CITY of PERTH

Point Fraser Monitoring and Evaluation Program

2014 Report and 5 Year Report

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Mine Water and Environment Research Centre

Centre for Ecosystem Management

Report No. 2015-04

1 MINE WATER AND ENVIRONMENT RESEARCH CENTRE

Founded at Edith Cowan University in 2008, the Mine Water and Environment Research (MiWER) Centre is headed by A/Prof Mark Lund. The research group has a focus on mine waters; particularly pit lakes formed from open-cut mining. The group's research also extends to the ecology and rehabilitation of all inland water bodies, natural and constructed. MiWER's aim is to further understanding of freshwater science using creative, cutting-edge technologies and innovative approaches for practically improving resource sustainability and environmental condition.

MiWER is also a member of Edith Cowan University's research centre, the Centre for Ecosystem Management.

More information on MiWER and our projects can be found at www.miwer.org

2 ACKNOWLEDGEMENTS

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2.1.1.1 FRONTISPIECE

Plate 1. Mark Lund collecting water samples at Site W2 (Point Fraser).

This report should be referenced as follows.

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3 CONTENTS

4 EXECUTIVE SUMMARY

Point Fraser was developed in 2004 to convert former lawn area to a recreation space, with environmental values. In addition, a wetland was constructed to intercept and treat a stormwater drain from East Perth (catchment 18.3 ha) that had previously discharged untreated into the Swan River. In 2010, the City of Perth (COP) contracted the Mine Water and Environment Research Centre at Edith Cowan University (ECU) to undertake a comprehensive monitoring program at the site. The aim was to determine how well the wetland and to a lesser extent other components of the development achieved the goals originally set for the site.

This report covers monthly monitoring of water quality in the wetland from January to December 2014 and reviews the 5 years of monitoring data from the site. Results suggest that water quality is generally within the normal ranges that might be expected in stormwater wetland on the Swan Coastal Plain. A major issue over the 5 years of the project has been salt intrusion into the wetland from influx of saline Swan River water during high tides, and incoming slightly salty water from stormwater and Lake Vasto. It appears that the 2013 installation of a valve on the outflow from W4 has substantially reduced salt levels within the system. The consequences of the high salinities experienced in 2012 and 2013 are reflected in changes in changes in wetland vegetation in terms of species distribution - encouraged a near monoculture of *Juncus kraussii*. Also the salinity has reduced the vitality of the plants resulting in release of nitrogen, that has caused potential net export of nitrogen from the wetland over 2013-14. The main loss of water from the wetland is evaporation which concentrates the salt up to undesirable levels over the summer months particularly in W3. Increased inflow and the outflow valve will however probably keep salinities in the wetland within acceptable levels in future years.

Solar powered monitoring stations were established at both inlet and outlets to the wetland. These were designed to allow for quantification of nutrient loads in and out of the system so that the overall removal efficiency could be determined. Overall, the monitoring system struggles to obtain very accurate data at the inflow. The inlet structure makes monitoring difficult and the acoustic Doppler instrument currently used to measure water velocity does not operate satisfactorily primarily due to nature of the inflow rather than a failure of the instrument itself. Through use of an ECU bubble flow meter, it has been possible to produce meaningful data. Flows into the wetland are well below predictions in the original design and are barely adequate to test the effectiveness of the system, it also results in the City having to top up the wetland excessively using water from Lake Vasto. Improved quantities of flow would improve the ability to accurately measure those flows. It is likely however that removal efficiencies of the wetland would decline with increased flows. Currently Shelley Smith of the City will be investigating inflows into the wetland which should provide guidance on why current inflows are below those expected.

Top-up water from Lake Vasto is required to maintain the plants within the wetland over the summer months. Ideally, only limited top-ups should be required however low inflows and low rainfall have contributed to requirements for over 7,000 m^3 of water to be required for the wetland. There is evidence that issues associated with the automated top-up system are responsible for the loss of top-up water back to the drainage network (backflow) or outflow. It is recommended that the City pays close attention to the operation of the top-up system to prevent wastage of the water being used (possibly 1,000-2,000 m^3).

The team has identified in previous years issues associated with the inlet structure that means that much of the water (46% of the total water inputs in 2012, 13% in 2014) that enters the wetland later drains back into the drainage network, and as such it is effectively lost from the wetland. The reasons are two-fold, firstly the shallow slope of all the drains relative to the wetland mean that it is particularly susceptible to the relative heights of water in the incoming drains compared to the wetland (i.e. if the wetland is higher, water drains out and vice versa), and secondarily as there is probably a leak in the drainage network which is continuously reducing the height of the drain water allowing backflow to occur. This issue is significantly impacting on wetland function, as it means that the wetland treats only a proportion of the actual drain flow. Further the lack of water remaining in the wetland costs the City with the additional expenses associated with using Lake Vasto waters to keep wetland wet.

In 2014, the wetland was potentially a net exporter of nitrogen with a removal efficiency of –45 to 11% (depending on water estimate used), but was effective at removing phosphorus (20-34%) and total suspended materials (38-73%). Total N on a number of occasions exceeded the target concentrations for discharge. Removal of P appeared successful in preventing exceedances of the target values for discharge. Generally performance of the wetland was good for the five years of the study, it should be noted that this was under very low flow conditions (significantly below design) and that during the only year (2013) with recorded moderate inflows that performance declined.

Wetland vegetation has survived a series of low rainfall years and high salinities in the wetlands over the project; however *Juncus kraussii* is out-competing the other species, with all the others on the decline. Although *Eleocharis acuta* appeared healthy, the degree of coverage has declined substantially with only a reasonable pocket remaining in W4. *Baumea articulata* and *Typha domingensis* has suffered a large dieback, possibly due to increasing salinity. The impact of the high salinities in the wetland in 2012/13 are only now being felt in low productivity in the plants, with excessive release of nitrogen (resulting in potential net exports of nitrogen from the wetland). This illustrates the role that plants play in nutrient uptake – they are a nutrient pool rather than store. Biofilms (not measured) on plants are generally consisted to be more important in uptake of nutrients from the water and conversion to the sediment as a sink. Excessive growth of the plants has created water flow

issues through the wetland (especially given the low gradient) that may assist with encouraging backflow and poor flow through.

Foreshore monitoring has revealed erosion and plant loss (including trees) along the foreshore particularly in area 1. Area 2 was largely inaccessible due to construction of the commercial development.

Biodiversity measured through bird and macroinvertebrate communities showed communities rich in cosmopolitan common taxa. A total of 37 bird species from 23 families have been recorded which is very encouraging given the scale of the wetland. The aquatic macroinvertebrate taxa richness increased from May to October in every year. October or spring is generally considered the time of highest species richness and abundance on the Swan Coastal Plain which was reflected in the Point Fraser wetlands particularly in taxa richness which increased by over 5 taxa, but not for abundance. The changes seen in total abundance reflect the impact of increasing salinities which substantially reduced abundance, only seeing it rise again in 2014 as the salinities dropped. The taxa richness declined sharply from 2010 as salinities increased in Zone 2, and did not decrease in Zone 1 until the salinity increased in 2012. Between 2012 and 2013 taxa were generally salt tolerant and Foraminifera and Polychaeta are primarily marine groups. The taxa collected were generally cosmopolitan and tolerant. Although salinity over the five year project negatively impacted on macroinvertebrate diversity, evidence of recovery with declining salinities in 2013/14 can be seen.

Social monitoring was undertaken to see how people use the site. Point Fraser does not appear to be a destination of choice but is used extensively as people pass through it primarily for exercise or park in the car parks to access the city. Most respondents viewed Point Fraser positively with 91% stating they would visit again. There was concern about the lack of facilities, although it was accepted that the commercial development may address these. A few respondents were not supportive of commercial developments at Point Fraser fearing their impact on the environment. The time taken for the commercial development to be completed was also identified as an issue by the majority of users. *About a Bike Hire* is a key driver for current recreational activities within the parkland.

Overall the wetland appears to performing its various functions successfully, although it is not operating at anywhere close to design levels. However, as inflows increase as the catchment is restored, performance appears likely to drop.

5 INTRODUCTION

Point Fraser is named after the colonial botanist Sir Charles Fraser who explored the Swan River in 1827 when he accompanied Captain Stirling's expedition. The site was originally named 'Boodjargabbeelup' by Noongar peoples, when it was still a peninsula and prior to river reclamation in the 1930s. Point Fraser is located between Riverside Drive and the Swan River, next to the Causeway. The land was reclaimed using spoil from the dredging of the river used to deepen the water around Heirisson Island and causeway (see Figure 1a). Prior to 2004, the site was a lawn area containing a car park, a helipad and a shipping container used for bike hire. A stormwater drain (Point Fraser Main Drain) discharged into the river at this point. The catchment of the drain was 18.3 Ha of East Perth located mainly west of the WACA Cricket Ground (Figure 1b).

a)

b)

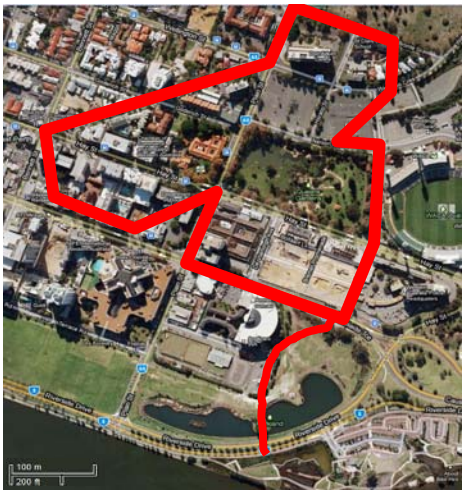


Figure 1. Aerial photographs of Point Fraser in a) 2000 and b) 2010 (showing catchment area for the wetland in red). Photographs taken from Google Earth, 2011.

After 2000, the City of Perth sort to improve the quality of stormwater discharge to the Swan River and improve aesthetic, recreational and environmental values of the area. This

culminated in the Point Fraser redevelopment; the first stage was the creation of a constructed wetland which was completed in 2004. The second stage saw the redevelopment of the remaining area and was completed in 2007. The redevelopment included construction of new car parks, a bicycle hire facility, grassed areas, BBQ facilities, a children's playground, a mixture of native bush areas and parkland and the constructed wetland.

In 2012, the construction of a commercial development in the Point Fraser reserve commenced. This will ultimately consist of shops and food outlets, a jetty and a foot bridge to Heirisson Island. An artist's impression is shown in Figure 2. By the end of 2014, the development had still not been completed.

Figure 2. Artists impression of the new commercial development (centre) being constructed at Point Fraser (Source: WA Business News - http://www.wabusinessnews.com.au/article/Point-Fraser-development-gets-go-ahead)

The objectives of the Point Fraser redevelopment project were to:

1. "Improve the quality of urban stormwater discharging to the Swan River through the Point Fraser wetland, including stormwater management run-off from the surrounding area;
2. Establish a wetland habitat and breeding place for native fauna which will be attractive to avifauna, in particular Black Swans;
3. Promote passive recreation and community education, including use of the wetland to demonstrate stormwater management techniques;
4. Enhance the landscape and visual aesthetic; and
5. Provide a recreational and educational environment and experience for the public." (quoted from Syrinx Environmental Pl, 2005)

The effectiveness of the wetland in removing nutrients from stormwater is an important consideration in the entire re-development and will provide value information for similar projects in the City. The City of Perth commissioned the authors to undertake a 5 year monitoring program to evaluate how the redevelopment was meeting its original objectives. Specifically to monitor, evaluate and report on the following, as taken from the Point Fraser Monitoring and Evaluation Plan (PFMEP; COP, 2010):

1. The quality of urban stormwater discharging to the Swan River long term, as a result of the redevelopment of Point Fraser by determining the amount of pollutant removal via the constructed wetland;
2. The quality of wetland habitat and the quantity and quality of breeding places for native avifauna presence, behaviours and habitat use;
3. The ongoing ecological health of the constructed wetland via its conformance with relevant water quality guidelines and legislation requirements.
4. The quality, quantity and type of recreational and educational use of Point Fraser by determining the diversity of visitor presence, behaviour, use, expectations and satisfaction and awareness of reports/information specific to Point Fraser performance; and
5. The long term integrity and quality of the restoration of the foreshore edge, as a result of the redevelopment of Point Fraser by determining vegetation health and structural reliability.

This is the final and fifth annual report of the PFMEP and covers the period January to December 2014 and reviews data from all five years of the project.

6 METHODS

6.1 STUDY SITE

The majority of the study was conducted in the constructed wetland in the Point Fraser reserve, however foreshore monitoring occurred in two areas (1 & 2) while avifauna and social monitoring were conducted across the entire reserve (Figure 3).

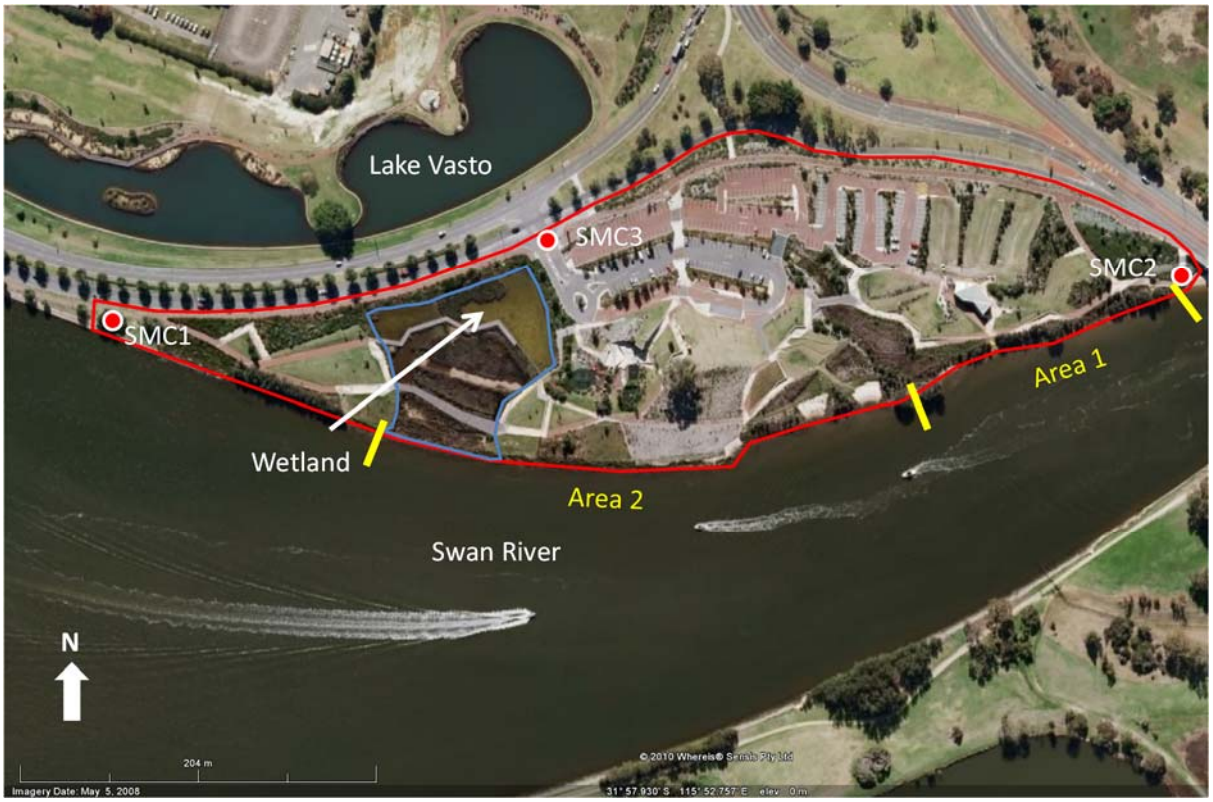


Figure 3. Aerial photograph of Point Fraser (bounded by the red line), showing the constructed wetland (bounded by the blue line), Lake Vasto, the social monitoring sites (red and white circles, SMC1-3) and the foreshore monitoring areas (yellow). Photograph adapted from Google Earth, 2010.

Water enters the wetland from the catchment via the East Perth drain; this arrives at the splitter box where low flows are directed via two pipes into a bubble-up grate (BUG) in W1 (Figure 4). High flows exceed the weir in the splitter box and part of the flow is directed via a pipe and another BUG into the Swan River. Bubble-up grates slow the flow rate reducing erosion and providing opportunities for particulates to settle. Water flows from W1 to W2 (Zone 1), and then when levels exceed those of the weir, water flows into W3 and then W4 (Zone 2) before exiting via a small pipe into the foreshore vegetation (Zone 3) and then into the Swan River. The boardwalk separating W1 and W2 from W3 contains a weir that is set higher than the control weir. The boardwalk weir is designed to overflow only in

exceptionally high flow conditions. A similar weir lies under the boardwalk separating the discharge area from W4. This contains a valve to prevent ingress of water from the Swan River at times of exceptionally high tides, while also permitting exceptional high water levels in W4 to discharge. W1 to W4 are lined to prevent interaction with underlying acid sulphate soils (Syrinx Environmental Pl, 2009). W1 and W2 are covered with a thin layer (approx. 20 mm) of Supersorb activated zeolite clay, while W3 and W4 have layer of soil (100-200 mm deep) to grow plants in. The cleared strip between W3 and W4 is actually a small mound that effectively prevents water moving directly from the weir to the discharge point. Excessive build-up of salt in the mound, resulted in removal of the surface layer (Syrinx Environmental Pl, 2008), which is why it is currently devoid of plants. As stormwater flows infrequently into the wetland, the ponds W1 and W2 (which must remain under 250-300 mm of water and W3 and W4 which must be under 50-100 mm of water must be topped up with water taken from Lake Vasto (Syrinx Environmental Pl, 2009).

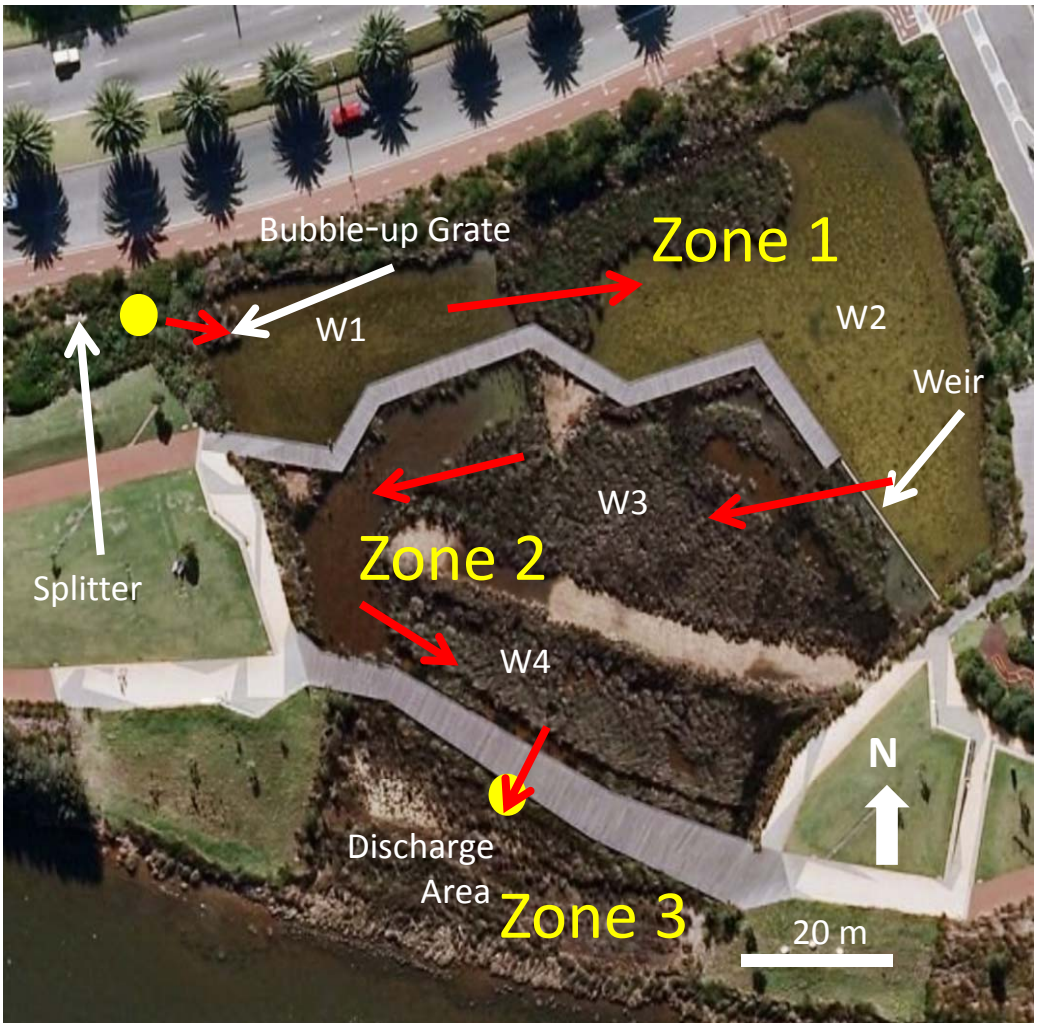


Figure 4. Aerial photograph showing the movement of water (red arrows) through the Point Fraser constructed wetland. Yellow circles mark the fixed inlet and outlet monitoring structures. Sampling sites are indicated as W1 to W4. Imagery adapted from Google Earth, 2010.

Photographs of all the sampling sites are shown in Figure 5.

a) W1

b) W2

c) W3

d) W4

e) Discharge area (Zone 3)

Figure 5. Photographs of the sampling sites in Point Fraser constructed wetland

6.2 SAMPLING

The sampling procedures used in this study are provided in condensed form below but are available in more detail in PFMEP (COP, 2010). The monitoring program commenced in April 2010, however this report covers the period January to December 2014.

6.2.1 WATER QUALITY (WSWQ)

Sampling for this study was conducted on the third week of every month. On each occasion, pH, oxidation reduction potential (ORP), conductivity, temperature and dissolved oxygen (% saturation and mg L^{-1}), turbidity and chlorophyll *a* were measured *in situ* in the water using a Hydrolab Datasonde (4a) multimeter at each site (and Ozone in April). At each site, a water sample was collected, an unfiltered aliquots (subsample) of this sample were bottled for determination of total nitrogen (total N[1]) and total phosphorus (total P). Another two aliquots were filtered in the field (through 0.5 µm Pall Metrigard filter paper) before bottling prior to determination of a) nitrate/nitrite (NO_x), filterable reactive phosphorus (FRP) and ammonia (NH_3), and b) dissolved organic carbon (DOC). At quarterly intervals (May, Aug, Nov), water was also collected for determination of Chlorophyll *a* and Phaeophytin, total hardness, metals (Al, Fe, Mn, As, Cd, Cr, Cu, Hg, Pb, Ni, Zn) and total suspended solids). Trip blanks of ultrapure water were used to test for procedural or collection contamination.

Samples were sent to SGS Australia Ltd for analysis. SGS Australia offers NATA accredited analyses and detailed QA/QC processes (except where noted). All samples were collected, stored and preserved as recommended by the company.

6.2.2 SEDIMENT QUALITY (WSQ)

In May 2011, eight sediment cores were randomly taken each from W2 and W3. The cores were clear acrylic tubes (50 mm dia.). Cores were pressed into the sediment to a maximum depth of 100 mm or touching the liner (whichever came first), the top was sealed, core extracted and bottom sealed. Water was carefully decanted from each core and the sediment transferred to a glass jar. Four jars were analysed for total Kjeldahl N (TKN), Total P, total organic carbon (TOC), total metals (Al, Fe, Mn, As, Cd, Cr, Cu, Hg, Pb, Ni, Zn), wet and dry weight and loss on ignition (LOI) at 500 ^{o}C and 1000 ^{o}C. All analysis was undertaken at

[1] All nutrients are reported as per their respective elements i.e. Total N-N, Total P-P, FRP-P, NOx-N and NH_3-N

SGS Australia Ltd, except for the LOI which was not NATA accredited and therefore was undertaken at Edith Cowan University.

Sediment depth in W2 was measured at 8 random sites using a ruler as the distance from the surface to the liner. It was not possible to distinguish between the zeolite layer and accumulated sediment.

6.2.3 QUANTIFICATION OF LOADS IN AND OUT OF THE WETLAND (WSFM & AWWQ)

At the inlet to W1, an ISCO 6712 Autosampler was installed, this was triggered by an ISCO Bubble Flow Module when water depth in the BUG reached a set limit. In addition an Acoustic Doppler Velocity (ADV) meter (Unidata) was used to measure flows in the pipes linking the splitter box and BUG. In 2010, this was located at the splitter box end of the pipe but was relocated to the BUG end on 2/7/11; this was to improve flow measurements which had been problematic in 2010. A solar panel is connected to the system to recharge the battery for the system. In addition, a tipping bucket rain gauge (Unidata) was installed. The rain gauge and ADV are both connected to a data logger with telemetry (Unidata Neon). The autosampler pulls samples from the BUG; samples are taken every 40-60 minutes whilst flows are occurring. In 2014 an additional depth sensor was installed in W1 to provide better estimates of backflow into the drain.

At the outlet to W4 (pipe), an ISCO 6712 Autosampler was installed, this was triggered by a ISCO Bubble Flow Module. The bubble flow tube was attached to a hydrostatic depth sensor (Unidata) mounted in W4. When water depth exceeds the height of the discharge pipe, water starts to discharge from the wetland triggering sample collection. Samples are subsequently collected every 24 hours. This system is connected to a data logger with telemetry (Unidata Neon) and is supported by a solar panel recharging the battery.

Samples from the autosamplers were collected within 2-3 days of collection and sent to SGS for determination of total N and total P, and total suspended solids.

6.2.4 WETLAND VEGETATION (WV)

In October and May, the wetland vegetation was mapped. Photographs are taken at fixed points (Table 1; Figure 6) to record vegetation health.

Table 1. The site codes, site names for wetland vegetation monitoring photo-points (GPS co-ordinates use UTM Zone 50 with datum GDA94)

Site Code	Site Name	Easting	Northing	Notes
WV1	Wetland #1 - Weir b/n Zone 1 and 2	393898	6462962	4 photos: NE, SE, E and S directions
WV2	Wetland #2 – Zone 2 middle	393869	6462969	3 photos: E, S and N directions
WV3	Wetland #3 – Zone 2 west side	393832	6462961	2 photos: E and S directions
WV4	Wetland #4 – Mound in Zone 2	393900	6462937	3 photos: NW, W and SW directions
WV5	Wetland #5 – Zone 1	393917	6462988	2 photos: SW and W directions

Figure 6. Location of vegetation monitoring photopoints (WV1-WV5)

Three quadrats (200 mm x 200 mm) were randomly taken from each major plant species (*Baumea articulata*, *Eleocharis acuta, Juncus kraussii, Typha domingensis*) where present in sufficient biomass from W1 and W2 (combined), W3, and W4. All the plant material (above and below ground) in the quadrat was removed. For each quadrat, the above ground material had each stem length measured, presence of flowers noted of leaves that mature, new or senescent determined and the number of flowers recorded. Dry weight of above and below ground material for each quadrat was measured, samples of dried material were sent to SGS Australia Ltd for analysis of TKN and Total P. Loss on ignition was then performed on composite biomass from each sample area (above and below ground) at 500 ^{o}C and then 1000 ^{o}C.

6.2.5 MACROINVERTEBRATES (MINVERT)

In May and October macroinvertebrate samples were collected from Zone 1 and Zone 2 using a 250 µm dip net over two 5 m transects per site. Samples were preserved in 70% ethanol and returned to the laboratory for sorting, identification (to Family) and counting.

6.2.6 SOCIAL MONITORING (SM)

In May and October visitor counts and visitor observations was undertaken. Social monitoring for each round was carried out between 7 am and 6:30 pm on a weekday and weekend day. Surveyors were based at each end of Point Fraser (see Figure 3) capturing walkers and cyclists moving through the park, a third person was based near the road entrance to capture people using the Point Fraser car-park for visiting the city. On the hour, for the first 15 minutes, the numbers of people and vehicles entering or leaving the park were recorded at the three sites on Observation Count data sheets. Between the hourly visitor counts, a surveyor walked from the east to west entrance ensuring all areas of the reserve were covered and recorded the behaviour of park users using the Observation Behaviour datasheet. An aerial photograph was used to mark the location of stationary park users. Copies of the datasheets are appended.

6.2.7 AVIFAUNA

In early June and early November, a survey of all birds seen within the park or flying above it were recorded. Surveys were conducted in the early morning and were timed to avoid adverse weather conditions. During surveys, the entire area of parks and garden were surveyed by walking at a steady pace and recording all birds encountered by both call and sightings. Particular attention was paid to the wetland areas to ensure that cryptic species and water birds were recorded.

6.2.8 FORESHORE MONITORING

In May, the foreshore of Point Fraser was monitored at 3 sites in each of the two areas shown in Figure 3. Photographs were taken at each site and condition assessed. The locations of the foreshore monitoring sites are shown in Figure 7.

Figure 7. Locations of the foreshore monitoring sites (F1A-C and F2A-C) (taken from Google Earth 2010)

7 RESULTS AND DISCUSSION

7.1 HOW WELL DOES THE WETLAND WORK?

The Point Fraser constructed wetland is a highly engineered wetland designed to perform a range of tasks, primarily stormwater treatment but aesthetics and biodiversity values are also important constraints on the design. As the wetland is isolated from groundwater (by a liner) to prevent oxidation of underlying acid sulphate soils, this simplifies the hydrology of the ponds but has constrained the design in terms of wetland depth. Constructed wetlands attempt to maximize the retention time for water entering the systems as the longer the water is retained generally the more treatment is possible. Peak stormwater flows can scour the wetland, reduce treatment times and the overall wetland efficiency. To reduce the potential for this, the wetland has a splitter box that allows high flows to be split with a part of the flow directed into the Swan River.

Perth had below average (850 mm) annual rainfall in four of the study years, 2014 (674.4 mm), 2013 (782.4 mm), 2012 (608.2 mm), 2010 (503.8 mm) with the exception of 2011 (860.8 mm) (Bureau of Meteorology, Perth Airport station). In Figure 8, daily rainfall measured at Point Fraser and by the Bureau of Meteorology (Perth airport) is shown for comparison. These sites are all within a 10 km radius of each other, showing local variability in rainfall, particularly apparent in May 2014. Further, rainfall at Point Fraser was recorded each day from 12 am to 12 pm, while Bureau of Meteorology data are recorded at 9 am for each day and reflects the previous 24 h. This explains the Point Fraser data appearing out of sync by a day on some occasions. Unfortunately the design of the rainfall gauge makes it attractive to predatory birds, who sit and eat their prey on the edge of the gauge. Unwanted food from the birds can then block the rain gauge as happened between July and August 2014.

The largest single rainfall day was 51.2 mm on the 30/8/14, followed by 50.6 mm on the 18/6/14 higher than any other similar events back until 56.8 mm in 24/6/11. Other significant events occurred on 23/5/14 (38.6 mm), 22/9/14 (35.8 mm) and 8/5/14 (47.2 mm). Rainfall was therefore more intense in 2014, but less common than in 2013.

The rain gauge provides useful local data for Point Fraser but is more problematic to operate (due to blocking). Overall data from the Bureau of Meteorology is adequate to access the performance of the wetland.

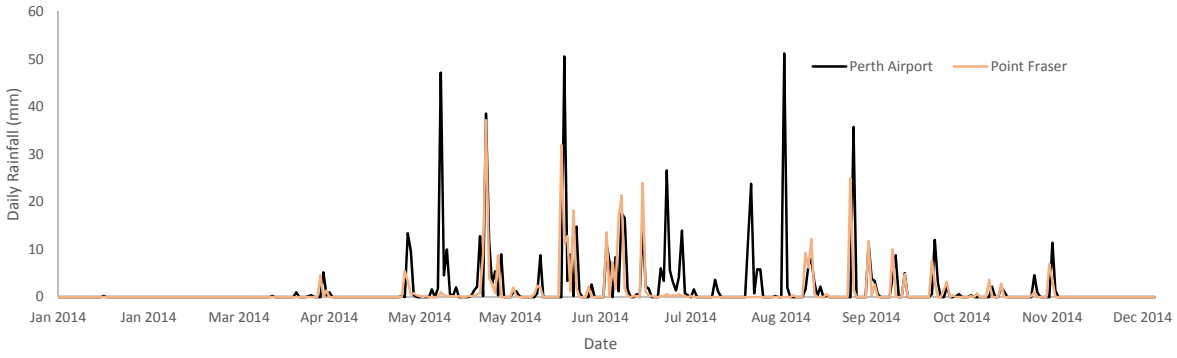


Figure 8. Daily rainfall measured at Point Fraser and Perth airport in 2014. Perth airport data from the Bureau of Meteorology and recorded 9 pm to 9 am, Point Fraser data recorded 12 am to 12 pm.

7.2 INFLOW AND OUTFLOW

The specific aims of measuring the inflow and outflow of the wetland were to:

1. Create a water budget for the wetland.

This will show how the water moves through the wetland (hydraulic residence times) as well as allowing quantification of nutrient loads.

2. Quantify nutrient loads in and out of the wetland

This will show how nutrient loads change during storm flows (the 'first flush' effect) and allows determination of wetland nutrient removal efficiency.

7.2.1 INFLOWS

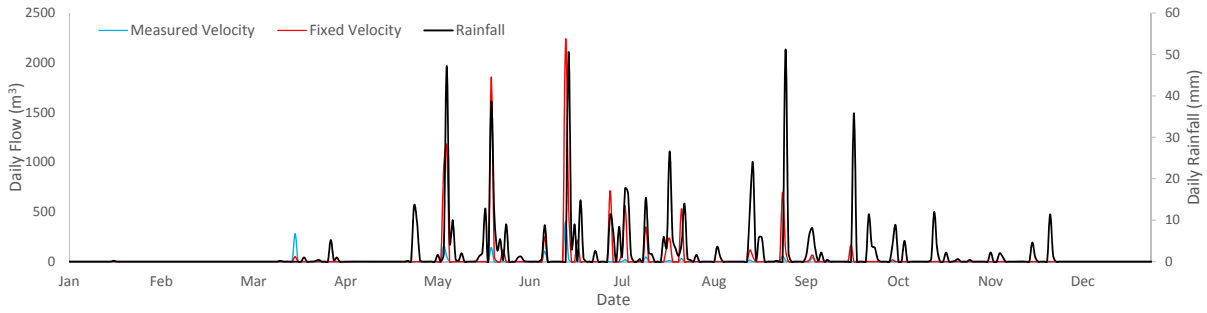
In 2014, inflow data was collected by ISCO for the most of the year and all year from the ADV. ISCO depth data was used to estimate inflows, although missing data was estimated using the depth measurements from the ADV (where y=0.001x+0.1559, where r= 0.98, x= ADV depth in mm and y = ISCO depth in m based on 2012 data). In 2014, the overall correlation between ADV depth measurements and the ISCO depth measurements was very poor (r<2), however between January and May correlations were similar to 2012 – as the ISCO depth data was manually checked throughout the year, this has been used to calculate inflows. Data were also collected by the new depth gauge for the entire year.

The catchment (assuming it was 18.3 ha) received a total of 123,415 m^3 compared to 143,180 m^3 in 2013 of rainwater. Typically for hard surfaces, a runoff coefficient of 0.6

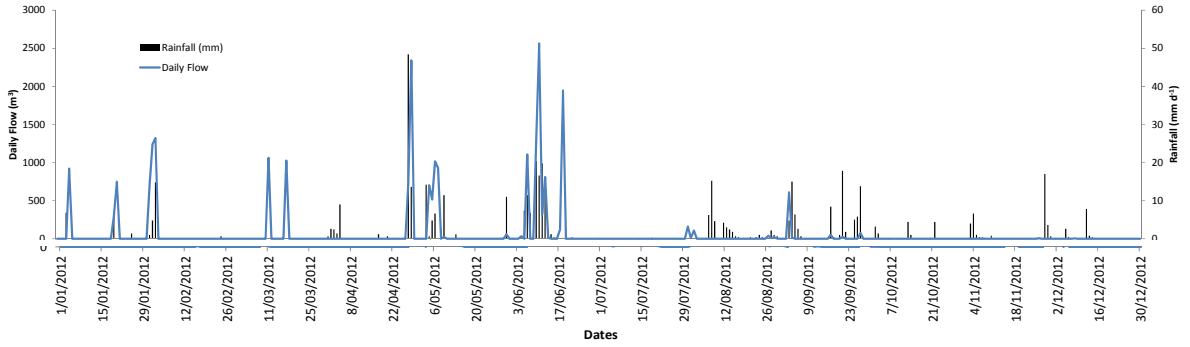
would be conservative suggesting that at least 74,049 m^3 of rainfall from the catchment should have reached the splitter box.

The scarcity of flows into the wetland make it very difficult to measure flow velocities into the system, however flow has been measured on two occasions at 0.13 and 0.25 m s^{-1}, these values correspond well with the Manning formula derived value of 0.13 m s^{-1}. This derived value does not take into account head at either end of the pipes. Velocities during periods of flow into W1 were measured directly using the ADV range from 0 (174/522) to 1.41 m s^{-1} (mean = 0.034±0.005 m s^{-1}; median = 0.015 m s^{-1}). Using the measured velocities, the inflow was 1,390 m^3, using a fixed velocity of 0.13 m s^{-1} gave an inflow of 5,884 m^3 and using 0.25 m s^{-1} gave a value of 11,315 m^3 (Figure 9). In 2012, the estimated flow using measured velocities was 22,938 m^3, whereas using 0.13 m s^{-1} it was 14,549 m^3 and 0.25 m s^{-1} gave 27,978 m^3. The 2012 flow data is substantially higher than in 2014 despite lower annual rainfall, suggesting that there are issues associated with the connectivity to the wetland of the designed catchment. Almost all inflow in 2014 was associated with >8 mm of rainfall with the exception of a small inflow on 18/5/14 during no rain and on 27-28/4/14 and 27-28/11/14 when 23 mm and 12.8 mm respectively of rainfall failed to produce any inflow. In 2012, daily rainfall >4 mm typically resulted in inflows, although there were several occasions when no rainfall was observed yet there were inflows and other occasions of high rainfall not resulting in inflows. Inflows occurring without rainfall might be associated with spills and deliberate releases within the catchment, however it is difficult to explain how significant rainfall events failed to generate inflows.

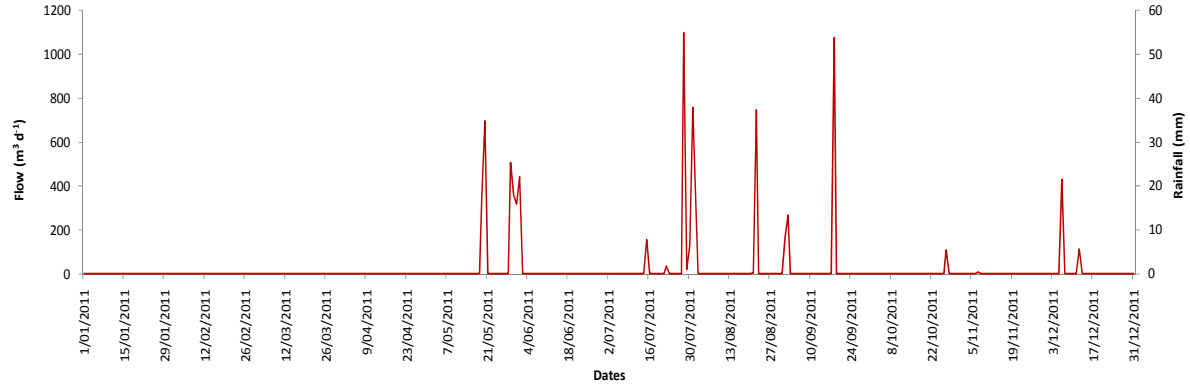
a) 2014



b) 2012



c) 2011



d) 2010

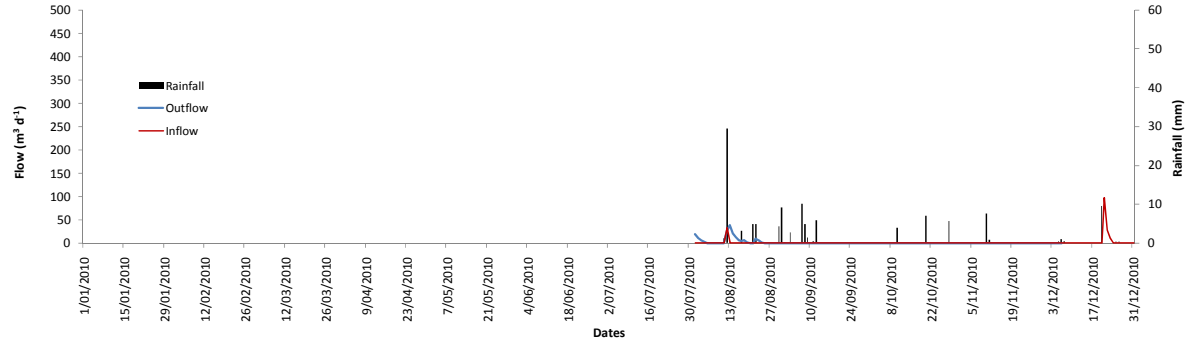


Figure 9. Inflows into Point Fraser in 2014 estimated using Acoustic Doppler (ADV) measured velocities and using a fixed velocity (0.25 m s^{-1}) and daily rainfall.

The wetland is topped up by water pumped automatically from Lake Vasto (Ozone Reserve) when water levels drop to heights that might impact on the vegetation. COP records the inflows from the pumps and in June, July and September no water was pumped, with 7,215

m^3 added throughout the rest of the year (2,320 m^3 in January). This was a substantial increase on 2013 (total of 6,242 m^3) and reflects an effort in January to ensure the wetland particularly Zone 2 would not dry out. Figure 10 shows the apart from 2010 which had the highest inputs from Lake Vasto, inputs have steadily increased each year, although the months of peak inflows have varied in response to different amounts of rainfall. Currently inputs are much higher than initially predicted in the wetland design. High levels of input of Lake Vasto waters are undesirable for the City as Lake Vasto is filled by groundwater abstraction and the more waters required by Point Fraser the more groundwater that is used.

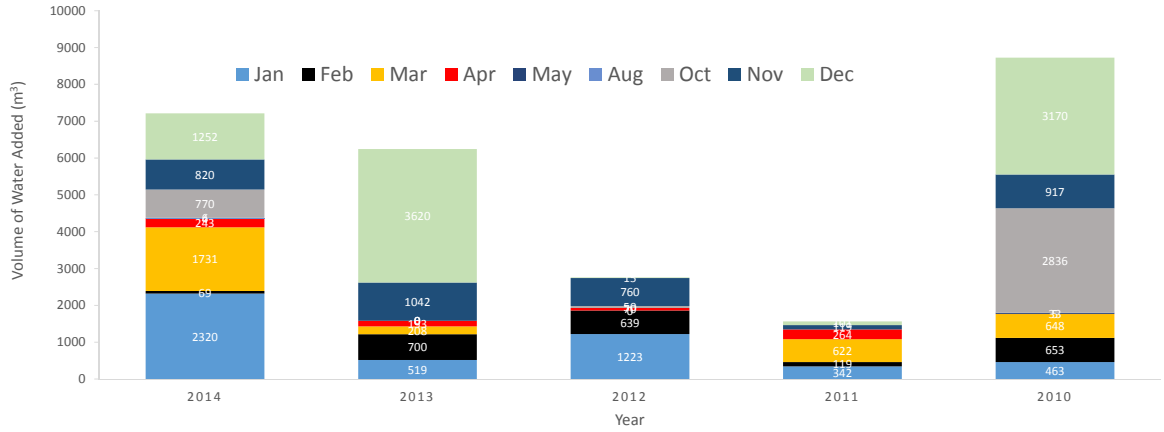


Figure 10. Volume of water added from Lake Vasto to Point Fraser wetland, over 2010 to 2014 per month.

In addition, the wetland received direct rainfall of 674.4 mm (using Perth Airport data) in 2014, which equates to 3606.2 m^3 (area is 5347.3 m^2).

The additional depth sensor installed in W1 for 2014, allows the likelihood of backflow to be determined. On 30 occasions (approximately 59 days) the water height in W1 was higher than the BUG and water levels in the BUG were less than the depth of the BUG (Figure 11). If it is assumed that all water (difference between BUG height and W1 height multiplied by the area of W1 & W2 – 1970.9 m^2) exits via the drain then approximately 2107.4 m^3 of water was probably lost down the drain. In winter, much of this loss down the drain is associated with inflow events, i.e. water flows into the wetland and then fills up W1 & W2 causing it to discharge back into the drain once inflows stop. At other times of the year most of this water is probably from top-up water or direct rainfall. The backflow estimated from the depth data is substantially less than the 15,390 m^3 estimated in 2012. The discrepancy highlights potential errors associated with the depth methodology but may also suggest than inflow estimates are too high.

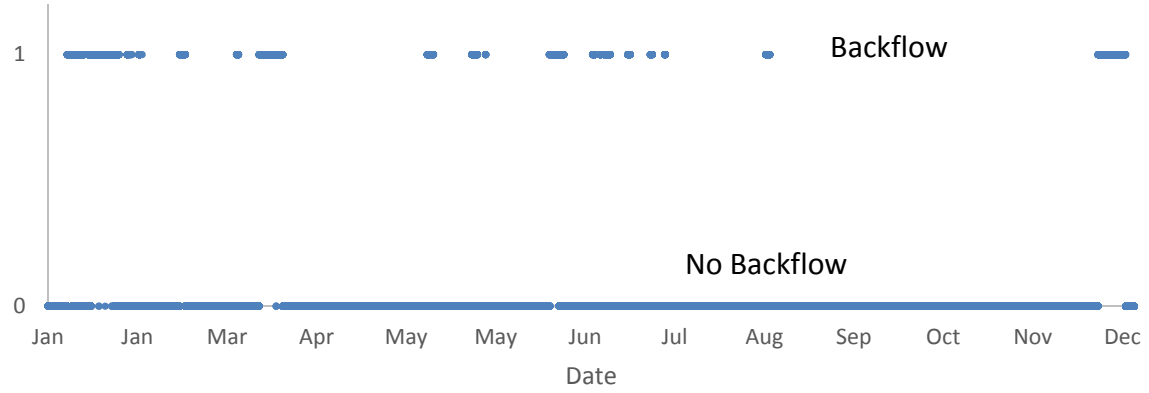


Figure 11. Periods of backflow into the drain at Point Fraser over 2014.

Monitoring of inflows has proven extremely difficult over the 5 year study period, with the shallow gradient limiting the effectiveness of the ADV in accurately measuring inflow velocities. The bubble flow module has proven to be the most reliable method for estimating when flows are occurring i.e. assuming that when the BUG is full than inflow is occurring. The bubble module needs accurate velocity measurements or a rating curve to produce reliable estimates of inflow – as inflow is infrequent and short-lived it is very difficult to produce a comprehensive rating curve, however there is relatively good agreement using the two values obtained to date with that theoretically expected. In 2014, the catchment situation appears to have significantly worsened with very low inflows recorded. The investigation to be undertaken by Shelley Smith (COP) in 2015/2016 of the Point Fraser catchment should resolve the obvious issue of the low levels of inflows that are reaching Point Fraser. The ongoing issue of backflow out of W1 back into the drain network still needs to be resolved although the research by Shelley Smith should address the cause. In 2014, the additional depth sensor in W1 allowed a better estimate of the backflow than in previous years and this saw the estimated backflow account for only 9.5 to 12.6% of total water inputs compared to 53% in 2012. The reduced backflow in 2014 could be through improved estimates, but also might reflect reduced inflows creating less opportunities for backflow.

7.2.2 OUTFLOWS

ISCO Bubble Flow module collected depth data for the entire year. The Unidata depth sensor was replaced with a salt tolerant version in November 2013. The depth sensor, despite adjustment by Unidata did not deliver reliable data and so was not used in determining the outflows – Unidata will be asked to recheck the sensor. In December 2013, a valve was added to the discharge pipe to prevent backflow from the river into the wetland, this does not appear to have substantially altered flows.

A rating curve was developed using a Marsh McBirney Flow meter, by measuring velocity at a range of depths. The velocity data were used with cross sectional areas to create flow rates at particular depths, these data were plotted and a polynomial function fitted. As more data are collected this curve will be further refined. The constants from this equation were used to calculate flows for all water heights greater than the outlet (115 mm). Depths greater than 195 mm were considered to have reached the maximum discharge rate (i.e. the pipe was full).

The total daily discharge in and out of the wetland and rainfall for 2014 are shown in Figure 12. Total outflow in 2014 was 7524.9 m^3 substantially lower than the 9,557.3 m^3 recorded in 2013. The discharge in January 2014 occurred when there was no rainfall and most likely represents discharge of top-up water. If this is the case, then approximately 997 m^3 of top water was wasted, this further ignores the quantity that was probably was lost by the drain via the BUG.

Calculating likely evaporation (ignoring transpiration, which can increase loss considerably depending on the species (Sanchez-Carrillo *et al.*, 2001)) using Bureau of Meteorology pan evaporations corrected with Black and Rosher (1980) values for the Peel Inlet (as cited in Congdon, 1985), then there was 1542.1 mm of evaporation which equates to a loss of 8246.1 m^3 over 2014. Therefore the total outflow of the wetland was 15,771 m^3, slightly higher than in 2012.

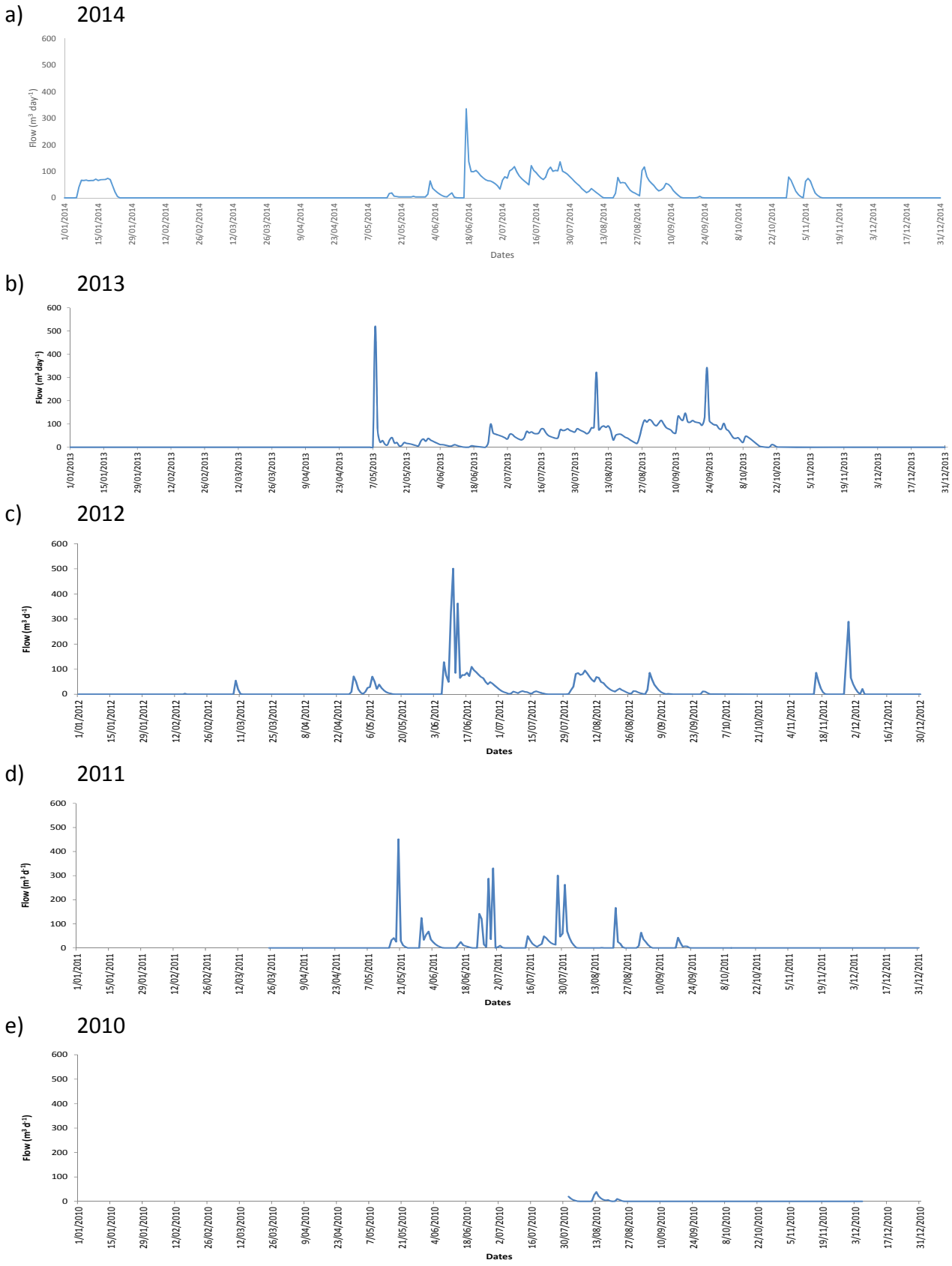
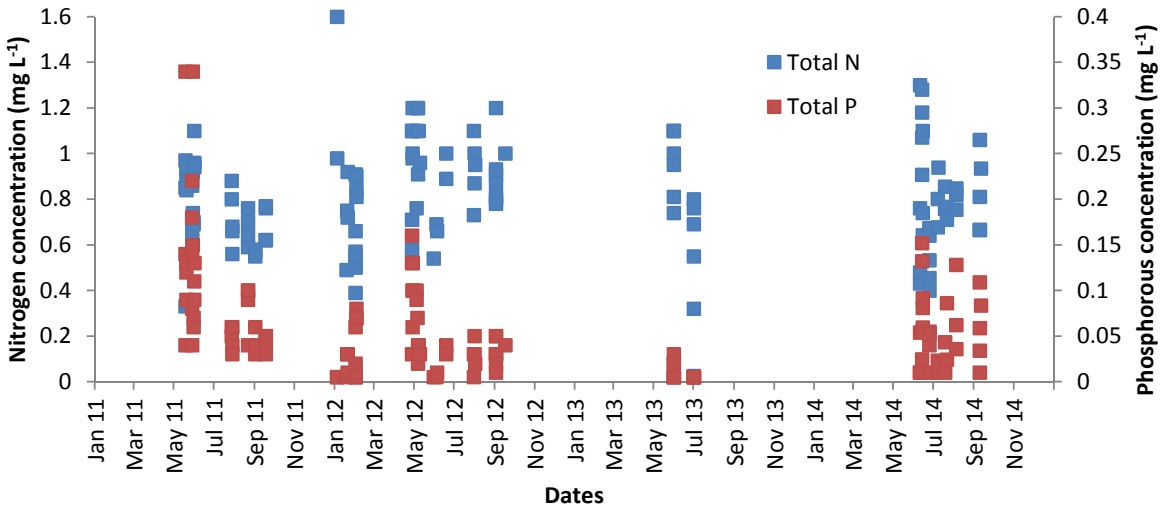


Figure 12. Daily total outflow for 2014 to 2010 for the Point Fraser wetland.

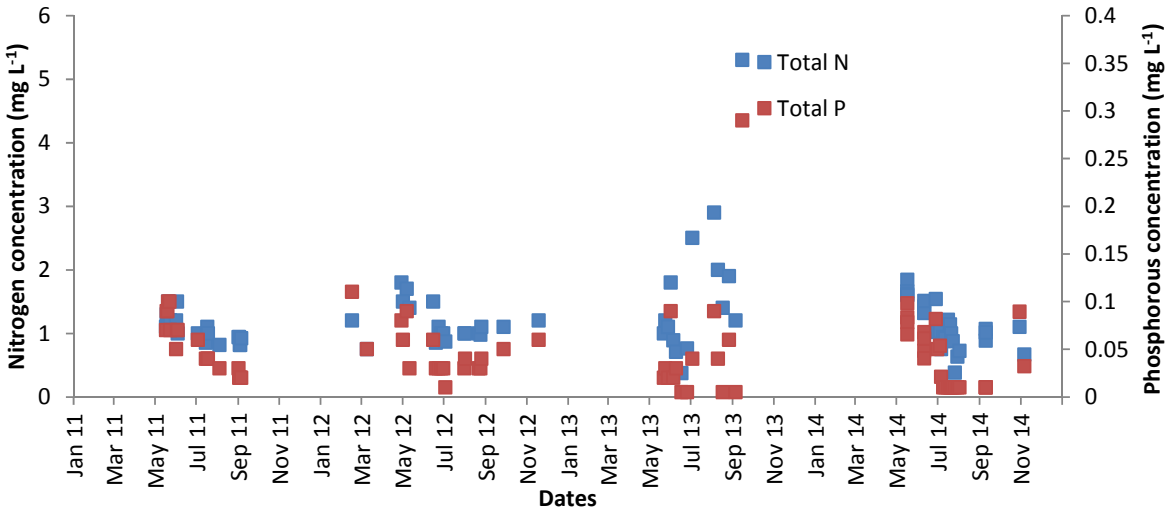
7.2.3 QUANTIFICATION OF NUTRIENT LOADS

Samples were collected during storm events for both the inlet and outlet. Inlet samples were taken at hourly (to 40 min) intervals and the outlet at daily intervals to capture flows based on their frequency and longevity. Concentrations of total N were generally higher in the outlet than inlet (mean of 1.67 ± 0.32 mg L^{-1} compared to 0.77 ± 0.09 mg L^{-1}), total P showed a similar trend (0.01 ± 0.002 mg L^{-1} vs 0.05 ± 0.02 mg L^{-1}). The first flush is a theory which suggests that the first heavy rain following a period of dry weather will effectively wash the catchment and so the stormwater will initially contain high concentrations of mainly particulate material, which decreases as the storm event progresses. Although this makes intuitive sense, there is little evidence to support it (see Hall, 2006; Khwanboonbumpen, 2006). Analysing the storm events entering Point Fraser for total P, total N and total suspended solids there appears to be little evidence supporting first flush. Particularly in the outlet, later in the year there is much higher variability in both nutrients. Total P concentrations in the inlet were lower than seen in previous years, although all other nutrient concentrations were very similar on average. It can be seen in Figure 13 that there was no consistent pattern as to when during the storm event that high or low concentrations occurred. Total suspended solids concentrations were generally lower in the outlet (12.7 ± 1.6 mg L^{-1}) compared to the inlet (43 ± 6.5 mg L^{-1}).

a) Inlet



b) Outlet



c) Total Suspended Solids (Inlet and Outlet)

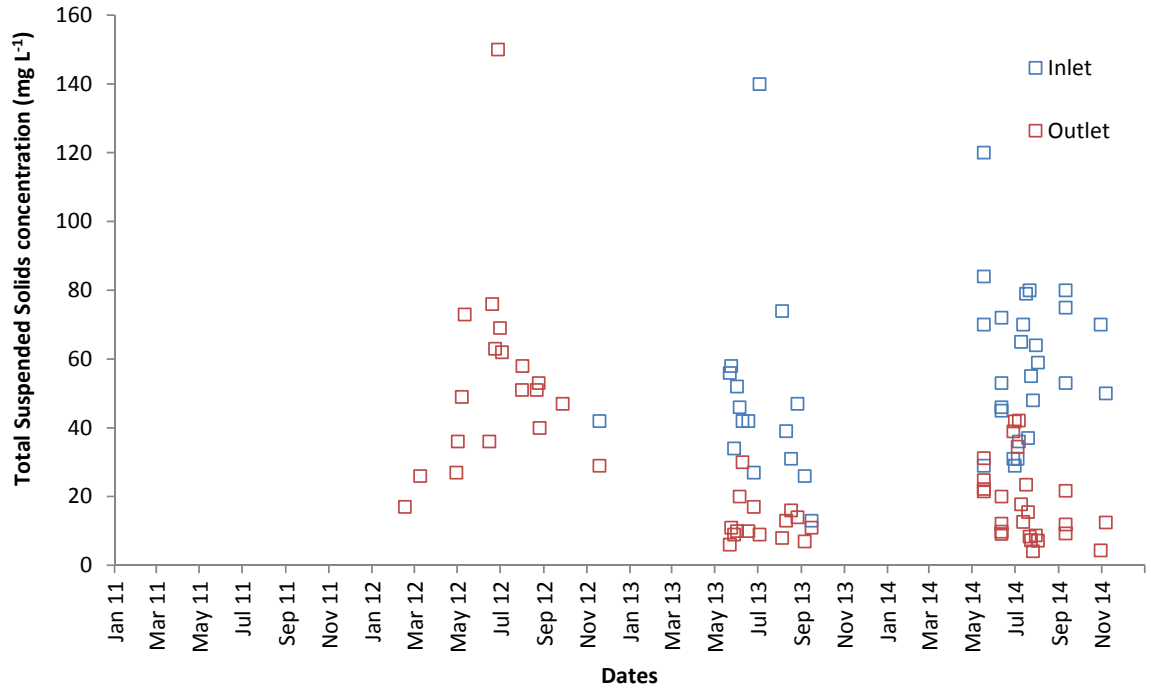


Figure 13. Concentrations of total P and total N recorded in the a) inlet, b) outlet, and c) total suspended solids for both inlet and outlet autosamplers over 2011-2014.

Loads of N and P entering and leaving Point Fraser were estimated by multiplying flows by the concentrations from the storm event sampling from 2012. It was assumed that concentrations remained unchanged between sampling events. Lake Vasto loads were estimated from monthly samples taken from Lake Vasto (where available) multiplied by the monthly quantity of water pumped. Rainfall loads were estimated using nutrient concentrations in rainfall taken from Khwanboonbumpen (2006) for Bannister Creek.

Approximately 9.0 kg of N and 0.8 kg of P were estimated to be exported to Zone 3, with potentially some further removal prior to reaching the Swan River. This is substantially higher than exports in 2012 (6.9 kg N and 0.24 kg P) and 2011 (3.8 kg N and 0.2 kg P) despite similar inflows in 2011 and substantially higher in 2012. There were exceptionally high removal efficiencies for N and P of 53% and 84% in 2011, however these dropped with the higher inflows of 2012 to 37% and 60% respectively. The low removal efficiency for N in 2014 is probably due to plant release, as they recover from high salt concentrations in 2012.

Table 2. Summary of water and nutrient budgets determined for Point Fraser wetland 2011 to 2014 (nutrient concentrations based on 2012 data), including removal efficiency. (? Estimates based on 2012 runoff to rainfall ratio's and average nutrient concentrations – Caution should be used when using these estimated values due to large potential errors). Numbers in brackets are total inputs without losses due to backflow. + indicates estimated flows (9/6/11 – 2/7/11). Removal efficiency determined from total input (excluding backflow) and total output.

	Water (m^3)				N (g)			
	2014	**2013**	**2012**	**2011**	**2014**	**2013**	**2012**	**2011**
	5,884 – 11,315	?29,588	22,938	8,111 +3,200	4269 – 8208	?	18,916	5,989 +3,040
Rainfall	3,606	4,150	3,226	5,765	967	1,112	865	1540
Top-up from Vasto	7,215	6,242	2,757	1,567	2,768	1,737	831	594
Backflow	-2,107	?-22,476	-15,390	-3,975	-1833	?	-9,644	-3,061
TOTAL INPUTS	14,598 – 20,029	?39,980	13,531 (28,921)	14,668 (18,643)	6,198 – 10,110	?	10,968 (20,612)	8,102 (11,163)
Outflow	7,525	9,557	5,582	3,551	9,029	26,821	6958	3773
Evaporation	8,246	7,946	7,949	11,117	NA	NA	NA	NA
TOTAL OUTPUTS	15,771	17,504	13,531	14,668	9,029	26,821	6958	3773
Removal Efficiency					-45 – 11%	?	37%	53%

Table 2. cont

	P (g)				TSS (kg)			
	2014	**2013**	**2012**	**2011**	**2014**	**2013**	**2012**	**2011**
Inflow	249 – 479	?	889	764 +416	297 - 571	?	889	
Rainfall	76	87	68	126	0	0	68	
Top-up from Vasto	812	157	190	171	0	0	190	
Backflow	-105	?	-537	-171	-90	?	-537	
TOTAL INPUTS	1,032 – 1,262	?	610 (1,147)	1,306 (1477)	207 – 481	?	610 (1,147)	
Outflow	828	1,027	241	308	128	114	241	
Evaporation	NA	NA	NA	NA	NA	NA	NA	
TOTAL OUTPUTS	828	1027	241	208	128	114	241	
Removal Efficiency	20 – 34%	?	60%	84%	38 – 73%	?	60%	

Total N concentrations should be <1000 µg L^{-1} to meet the Mounts Bay Water Quality improvement targets (Swan River Trust, 2009a), however in the Point Fraser 2010 to 2014 higher concentrations were seen in the outflow samples reaching a maximum value of 5300 µg L^{-1} on the 15/9/13. However, few values in the inlet exceeded the threshold for Total N. Phosphorus concentrations in the wetland were all below a target of <100 µg L^{-1} (Figure 15) recommended for the Mounts Bay Drain catchment by the Swan River Trust (Swan River Trust, 2009a), as part of the Swan-Canning Water Quality Improvement Plan (Swan River Trust, 2009b).

7.2.4 CONCLUSIONS & RECOMMENDATIONS

7.2.4.1 CONCLUSIONS

1. Create a water budget for the wetland.

Solar powered monitoring stations were established at both inlet and outlets to the wetland. These were designed to allow for quantification of nutrient loads in and out of the system so that the overall removal efficiency could be determined. Overall, the monitoring system struggles to obtain very accurate data at the inflow. The inlet structure makes monitoring difficult and the acoustic Doppler instrument currently used to measure water velocity does not operate satisfactorily primarily due to nature of the inflow rather than a failure of the instrument itself. Improved quantities of inflow would improve the ability to accurately measure those flows. Through use of an ECU bubble flow meter, it has been possible to produce meaningful data. Flows into the wetland are well below predictions in the original design and are barely adequate to test the effectiveness of the system. The low inflows contribute to the City having to top-up the wetland excessively using water from Lake Vasto.

The volume of water stored in the wetland when full is estimated to be approximately 2,000 m^3. For example, evaporation in January 2012 was approximately 1,000 m^3 (similar in February and March), with negligible other inputs, this means that substantial inputs will be required from Lake Vasto. Given the location, there are no real options to increase the storage of the wetland to allow it to carry water throughout the summer. Examination of the depth data from Zone 2, suggests that in the absence of inputs, water levels drop by up to 50 mm a day in January and 20 mm in May (where 10 mm equates to approximately 34 m^3 of water) based on 2012 data. As the rate of water level decline is relatively constant, this suggests that the majority of the water is being lost via evapotranspiration. Top-up water from Lake Vasto is required to maintain the plants within the wetland over the summer months. Ideally, only limited top-ups should be required however low inflows and low rainfall have contributed to requirements for over 7,000 m^3 of water to be required for the wetland in 2014. There is evidence that

issues associated with the automated top-up system are responsible for the loss of top-up water (possibly 1,000-2,000 m^3) back to the drainage network (backflow) or outflow.

The team has identified in previous years issues associated with the inlet structure that means that much of the water (46% of the total water inputs in 2012, 13% in 2014) that enters the wetland later drains back into the drainage network, and as such it is effectively lost from the wetland. The reasons are two-fold, firstly the shallow slope of all the drains relative to the wetland mean that it is particularly susceptible to the relative heights of water in the incoming drains compared to the wetland (i.e. if the wetland is higher, water drains out and vice versa), and secondarily as there is probably a leak in the drainage network which is continuously reducing the height of the drain water allowing backflow to occur. Backflow is not desirable simply as it would be more useful for the water to move through the wetland, adding to storage and dilution. Use of valves on the BUG is considered unlikely to be successful as the relative height difference is so slight that there is unlikely to be sufficient head to allow the valve to close and the installation could reduce inflows. Raising the height of the BUG is a possibility for reducing backflow; however this would also potentially reduce inflows. Another issue that has been noted is that excessive growth of plants has the effect of impeding flows through the wetland. Prevention of damming by plants could be achieved by selective removal of plants. Plants in the centre of Zone 1, sit in approximately 200 mm of soil over the liner. Removal of plants would need to be done carefully to prevent damage to the liner. Based on plant harvesting for the monitoring program it would be possible but difficult to remove the plants. Alternatively cutting the plants below the water line may be a viable solution – it may not prevent them growing back but would be quick and easy. The role the plants are designed to play is to still the water in W2 allowing particulates to settle. Removal of plants within 1 m of the boardwalk should be sufficient to allow flows to move unimpeded into Pond 2, whilst not losing the stilling function.

2. Quantify nutrient loads in and out of the wetland

The quantities of nutrients leaving the wetland have increased from 2011, 2012 to 2014, although removal efficiencies for P have remained very high. Export of N from plants impacted by high salt loads in 2012 reduced removal efficiencies for N in 2014. Although P concentrations are kept below the discharge guideline values, those for N frequently exceed them. Once the plants recover, it is likely that there will be fewer exceedances.

7.2.4.2 RECOMMENDATIONS

1. It is recommended that increasing the inflows is desirable to fully test system for nutrient removal – although it is likely that removal efficiency will decline (although

export nutrient concentrations should not exceed trigger values). The additional inflows due to the low storage capacity for water in the wetland will probably not substantially reduce the reliance on top-up water from Lake Vasto but should keep salinities at acceptable levels. The City is investigating why inflows are lower than designed.

2. It is recommended that the City purchase bubble flow modules for both ISCO autosamplers to replace those belonging to ECU, as these have proved very reliable. Monitoring inflows and outflows in the wetland remains a difficult task requiring specialist knowledge.
3. It is recommended that regular monitoring of water quality within the wetland continue. This should include quantification of inflows and outflows and within lake sampling (scheme presented in the Appendices). Monitoring is needed to determine whether the wetland meets target discharge concentrations and would be useful in evaluating the wetland system if inflows are increased.
4. The subtle gradient in the wetland ensures that small variations in the automated cut-offs for the top-up system can lead to water loss via backflow or through the outflow. It is recommended that the City regularly checks the automated system during the summer months to check correct operation of the system.
5. Backflow works against the aims of the wetland in treating water discharged to the Swan River, especially as where currently water is being discharged is not known. Reducing or eliminating backflow would also aid in maintaining water levels within the system reducing reliance on top-up. The issue of backflow is currently being investigated by the City.
6. It is also recommended that research be undertaken to reduce the damming effect of plants noted within the wetland to improve flow paths and ensure that all the wetland is being used for treatment.

7.3 WATER QUALITY IN THE WETLAND

The specific aims of measuring the water quality in the wetland were to:

1. Determine how physico-chemical variables and nutrient concentrations changed on a monthly timescale

This will show whether there are any management issues associated with water quality over the year. The data will allow the effectiveness of various processes responsible for nutrient uptake or release to be inferred.

2. Examine how key metals and other selected parameters change quarterly between all the ponds.

This will provide information on metal removal by the wetland but also highlight any metals of concern, which might require management actions.

7.3.1 MONTHLY DATA

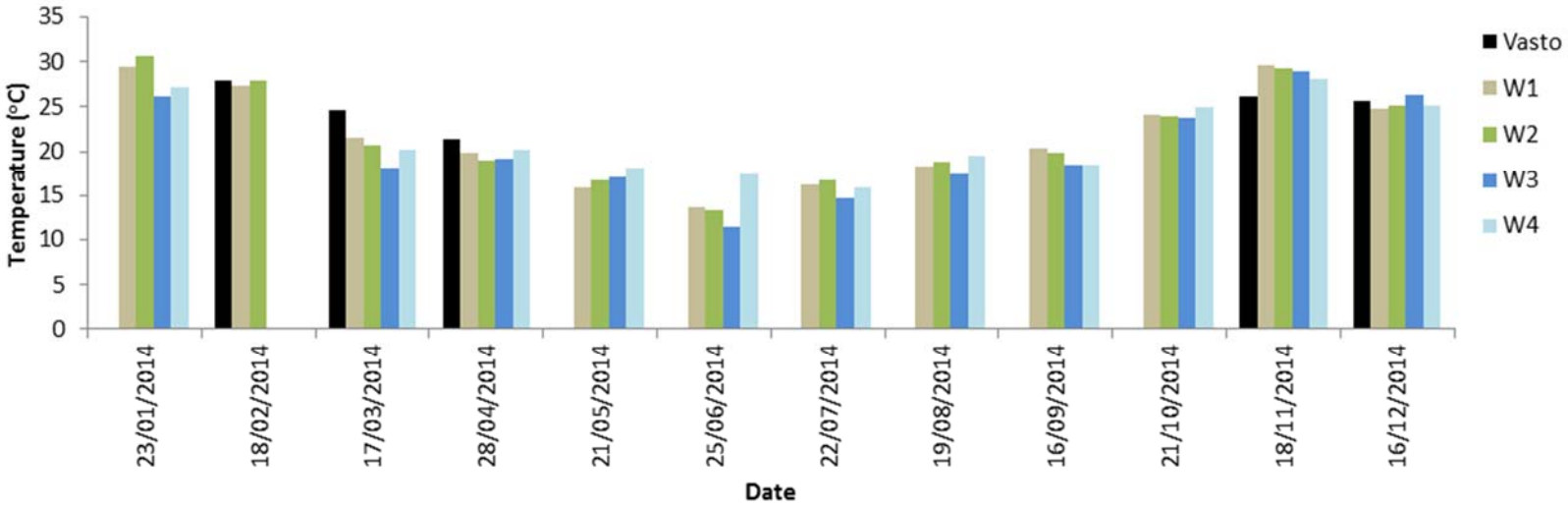
Monthly data for common physico-chemical parameters are shown in Figure 14. Water temperatures at the time of measurement (9-12 am) were >25 ^{o}C in January, February, and November.

Lake Vasto is much less saline (2.14 ± 0.03 mS cm^{-1}) than the Point Fraser wetland during the months where it is used as top-up water. It therefore is useful in diluting the high salinities encountered in the wetland during the summer months. In 2014, W1 (5.76 ± 0.98 mS cm^{-1}) had much lower conductivities than the other ponds including W2 (9.00 ± 1.10 mS cm^{-1}) despite the direct connection. The differences between W1 and W2, suggest that the stand of *Juncus kraussii* separating them is effective in preventing mixing between the two. In addition, the higher conductivity in W2 suggests that there is movement of more saline water from W3 across the weir. Conductivity was highest in W3 (15.77 ± 2.21 mS cm^{-1}) although in 2014 peak concentrations were lower than in previous years (reaching 29.3 mS cm^{-1} in April). Conductivity remained generally lower in W4 (11.5 ± 1.97 mS cm^{-1}) although the peak was similar to W3 but occurred in June (presumably washed in from W3 by winter rains). Salinities of >7 ppt (James & Hart, 1993) for the plants *Eleocharis acuta*, and >10 ppt for *Juncus kraussii* (Zedler *et al.*, 1990) and *Baumea articulata* (Chambers *et al.*, 1995) are known to impact on growth, this equates to an approximate conductivity of 12.5 and 18 mS cm^{-1} respectively. Conductivities in Point Fraser exceeded 12.5 mS cm^{-1} on 25% of occasions across all ponds, which is an improvement upon 2013 which exceeded on 50% of occasions. Therefore in 2014, despite a couple of extreme conductivities, conductivity was generally lower than in 2013.

Dissolved oxygen concentrations were recorded in excess of 100% saturation on a couple of occasions in all ponds and Lake Vasto primarily in January, February, November and December (Figure 14), indicating high algal growth in the water (high rates of photosynthesis can temporarily raise % saturation above 100%). At most other times of the year, dissolved oxygen concentrations were often below ANZECC & ARMCANZ (2000) recommended guidelines for protection of aquatic systems; occasionally reaching levels that would impact on many species of fish (<6 mg L^{-1}). This may indicate increasing biological oxygen demand from the sediments due to build-up of organic material. The only fish present, *Gambusia holbrooki*, an introduced fish would not be affected by low dissolved oxygen concentrations as it can air breath to supplement water oxygen levels.

pH was always circum-neutral to slightly alkaline, with only a single time when values occurred outside recommended guideline levels. Oxidation reduction potential values

greater than 100 mV pose no issue for wetland processes. However, under 100 mV, the process of denitrification can occur which is the conversion of nitrates to nitrogen gas by bacteria. This is a desirable process for constructed wetlands as it results in the permanent loss of nitrogen from the system. Although mainly occurring in all ponds between January and March, low ORP occurred on several other occasions particularly in W4.


Temperature (°C)
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18/02/2014
17/03/2014
28/04/2014
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25/06/2014
22/07/2014
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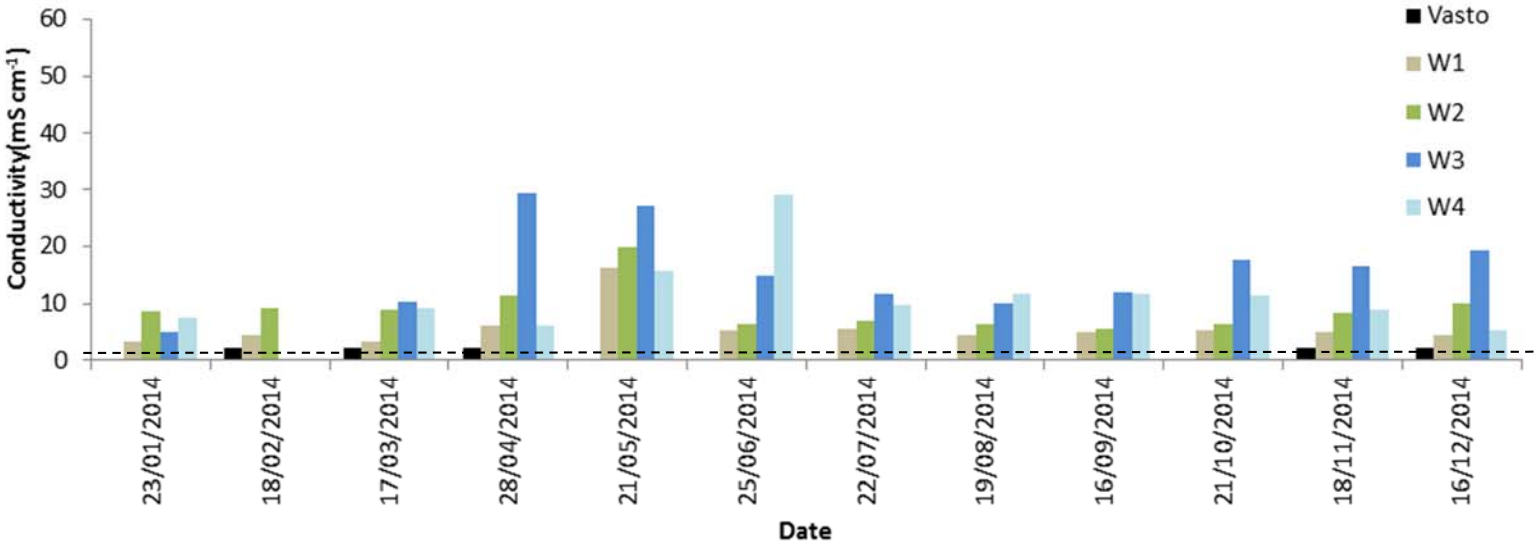
16/12/2014
Date
Vasto
W1
W2
W3
W4


Conductivity(mS cm-1)
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40
30
20
10
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
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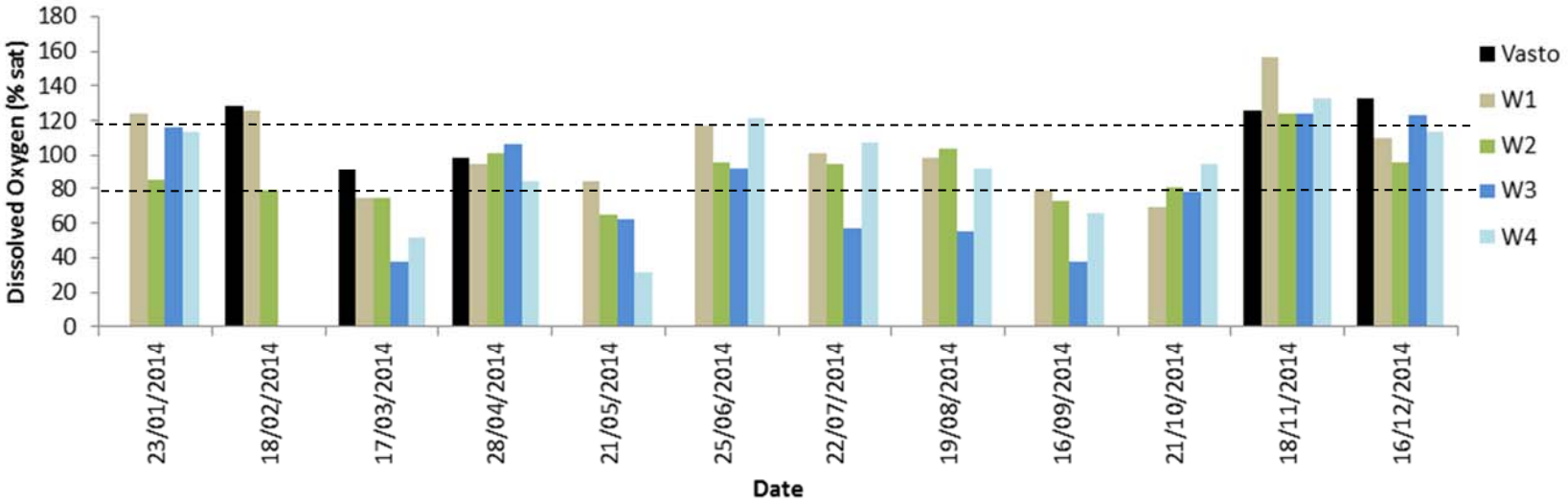
16/12/2014
Date
Vasto
W1
W2
W3
W4


Dissolved Oxygen (% sat)
180
160
140
120
100
80
60
40
20
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
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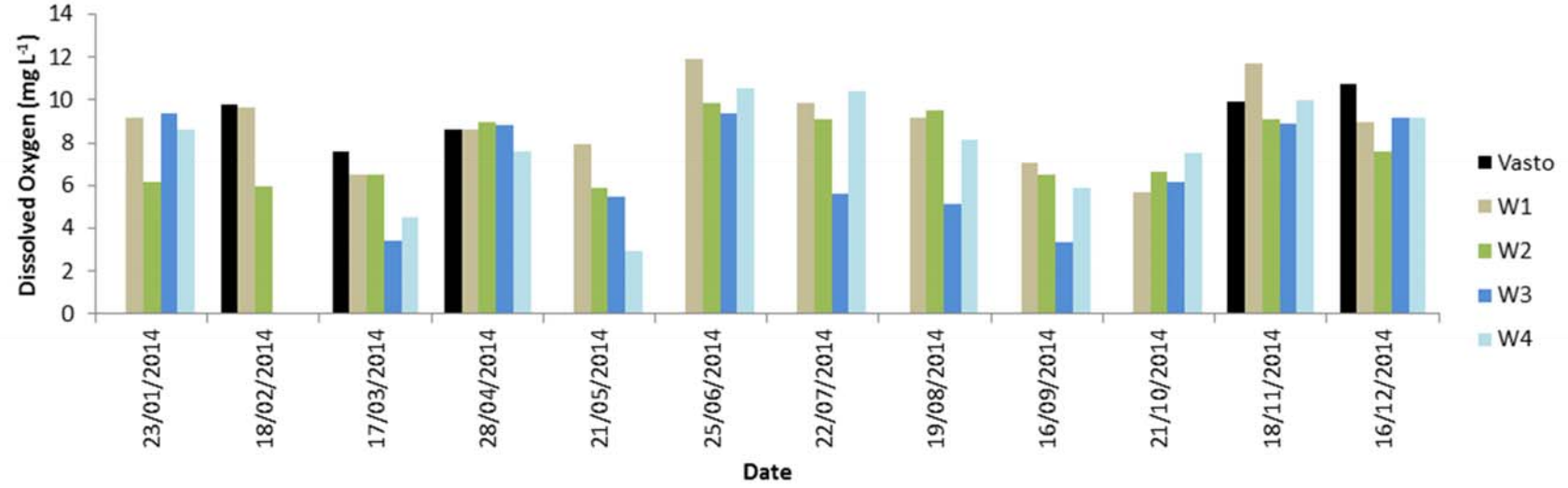
16/12/2014
Date
Vasto
W1
W2
W3
W4


Dissolved Oxygen (mg L-1)
14
12
10
8
6
4
2
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date
Vasto
W1
W2
W3
W4

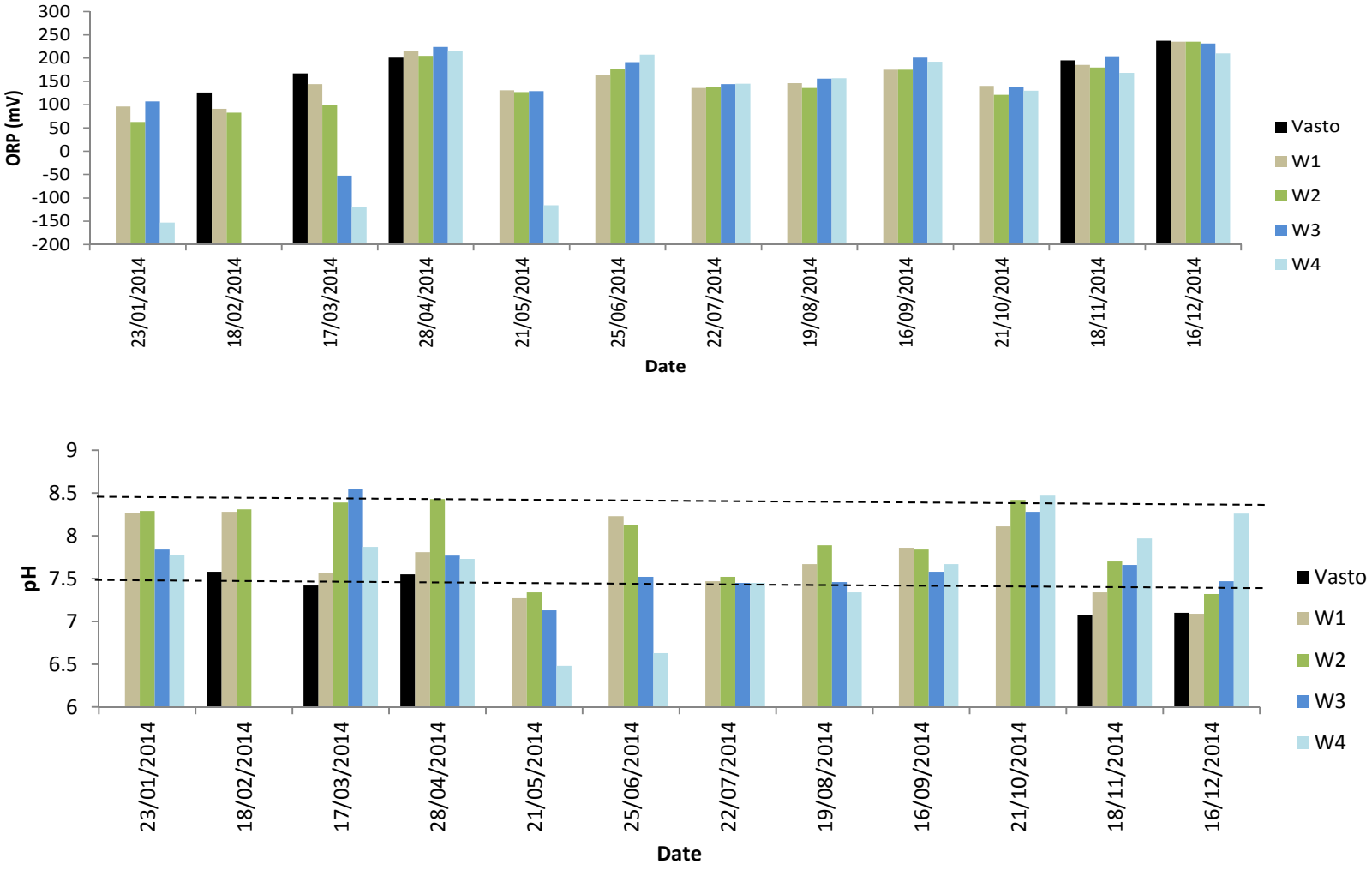
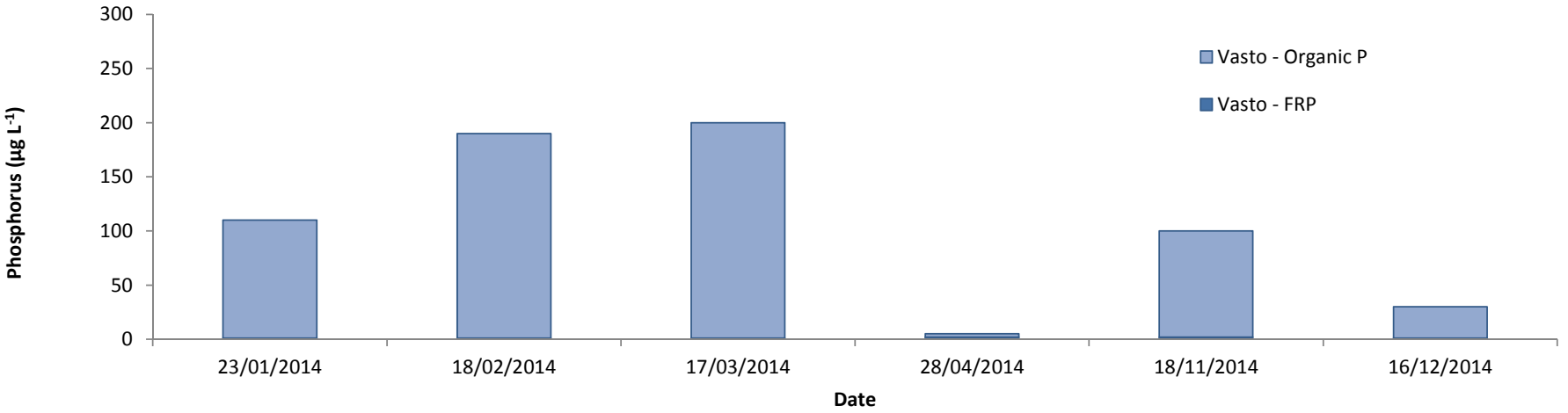


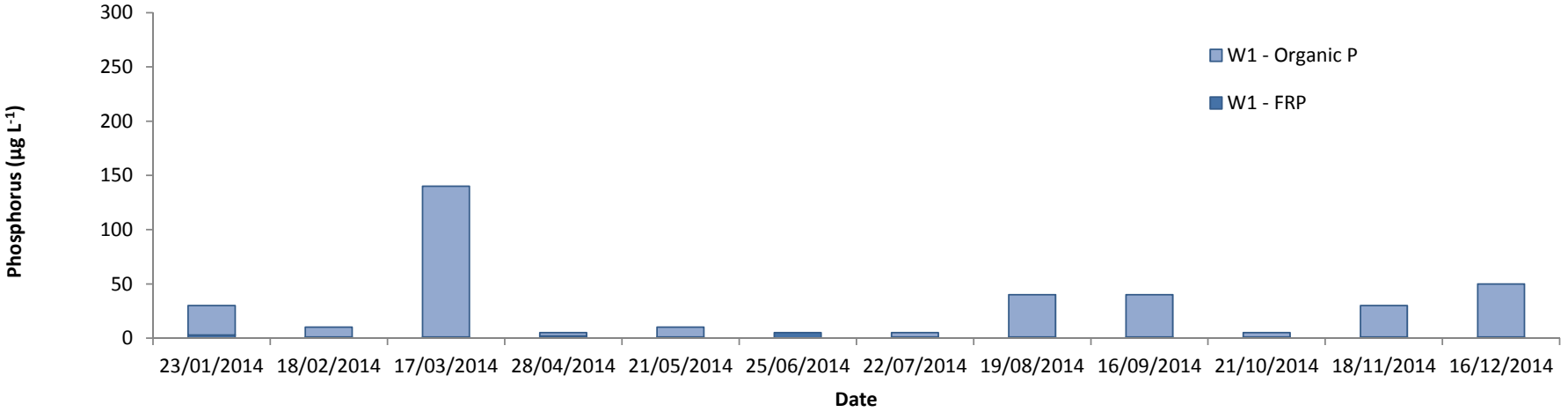
Figure 14. Physico-chemical parameters measured monthly at Point Fraser sites (W1-W4 and Lake Vasto. Dotted lines show relevant ANZECC & ARMCANZ (2000) guideline levels (see Table 3 for details).

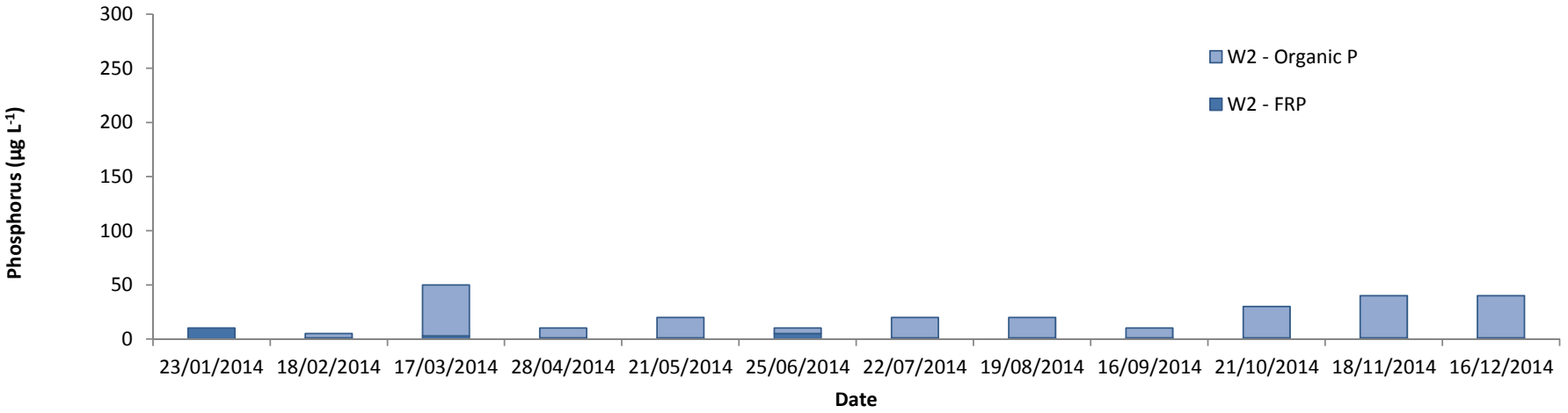
Phosphorus concentrations in W1 tend to follow those of Lake Vasto during the summer months when topping up of W1 occurred (Figure 15). The majority of the P was in the form of particulate (algae or otherwise) rather than dissolved FRP. Rains appeared to bring in comparatively low concentrations of P. Concentrations of P then generally dropped in W2 presumably due to settling of particulates and binding onto sediment. Concentrations picked up in W3 and declined again in W4. These increases are more likely due to the impact of evapo-concentration and water volumes rather than any releases of P from the sediments. Algal blooms also account for occasional spikes of total P across the wetland. Concentrations on a couple of occasions exceeded the targets of <100 µg L^{-1} (Figure 15) in W4 recommended for the Mounts Bay Drain catchment by the Swan River Trust (Swan River Trust, 2009a), as part of the Swan-Canning Water Quality Improvement Plan (Swan River Trust, 2009b). This appears to contradict the findings of the nutrient budget which showed that P was greatly reduced from inlet to outlet. However, at times of outflow, concentrations in W4 were all below the target level.

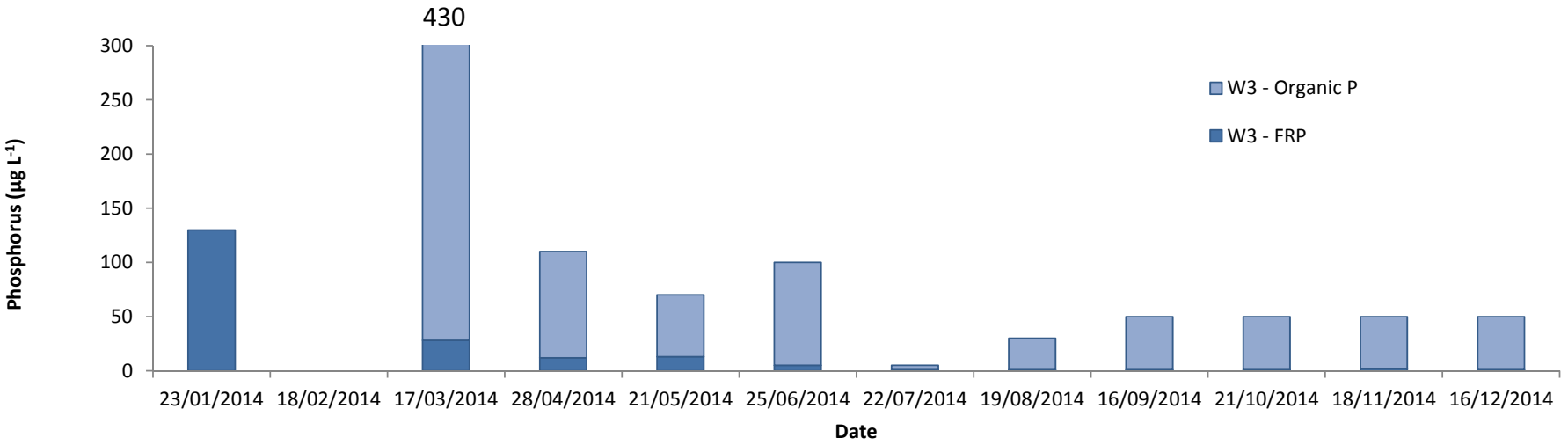
Lake Vasto contained relatively low total N (<600 µg L^{-1}) concentrations with NOx and NH_3 being low (<40 µg L^{-1}, Figure 16). Unlike for P, concentrations of N in W1 were not reflective of Vasto concentrations, but were higher, predominantly in organic/particulate forms. This suggests that algal growth in this pond might be responsible for the higher N concentrations. In W2 concentrations of NH_3 increased substantially, this is surprising as the Supersorb has in previous years been effective in reducing NH_3 concentrations. This may suggest that the Supersorb is either saturated or buried in W2. The source of the NH_3 is unknown, although it can be produced as organic matter breaks down. In all ponds, organic N (organic or particulate) accounted for the majority of the N present. The dry and salty conditions in W3 resulted in high N concentrations compared to other ponds and particularly in March with very high NH_3 concentrations. Concentrations of total N generally declined between W2 and W4, although concentrations were more variable in W4. Breakdown of organic matter associated with the plants is the most likely source of the high N concentrations in Zone 2.

The ANZECC/ARMCANZ (2000) guidelines for aquatic ecosystems in the south west of Australia for wetlands or lakes/reservoirs are presented in Table 3. These trigger values are designed for natural wetlands and are only indicative of possible issues. Constructed wetlands would be expected to exceed many of these trigger values as their role is treat water of poor quality, however it would be expected that as water passes through the wetland, the frequency of exceedances would decrease as the water is treated. In some cases such as FRP, Total P and Total N there are more exceedances in W4 than W1, suggesting the concentrations are worsening across the wetland. Salinities were higher than the guidelines, as the incoming water (at least from Lake Vasto) is already saltier than the guidelines. Dissolved oxygen was both higher and lower than the recommended value at different times. The trend was for low dissolved oxygen concentrations.


300
250
200
150
100
50
0
Phosphorus (µg L-1)
Vasto - Organic P
Vasto - FRP
23/01/2014
18/02/2014
17/03/2014
28/04/2014
18/11/2014
16/12/2014
Date


300
250
200
150
100
50
0
Phosphorus (µg L-1)
W1 - Organic P
W1 - FRP
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date


300
250
200
150
100
50
0
Phosphorus (µg L-1)
W2 - Organic P
W2 - FRP
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date


430
300
250
200
150
100
50
0
Phosphorus (µg L-1)
W3 - Organic P
W3 - FRP
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date

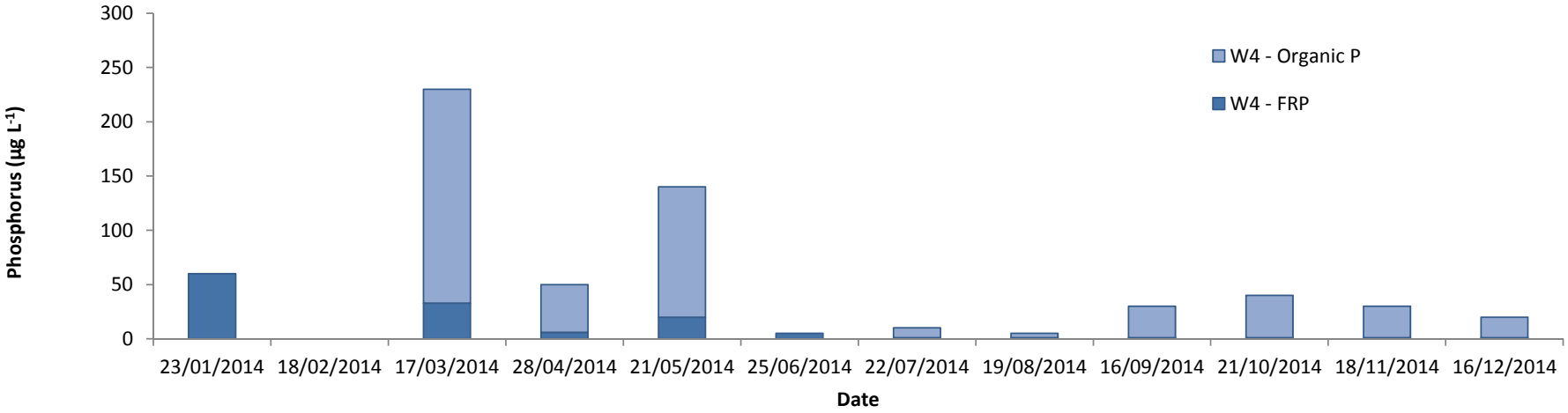
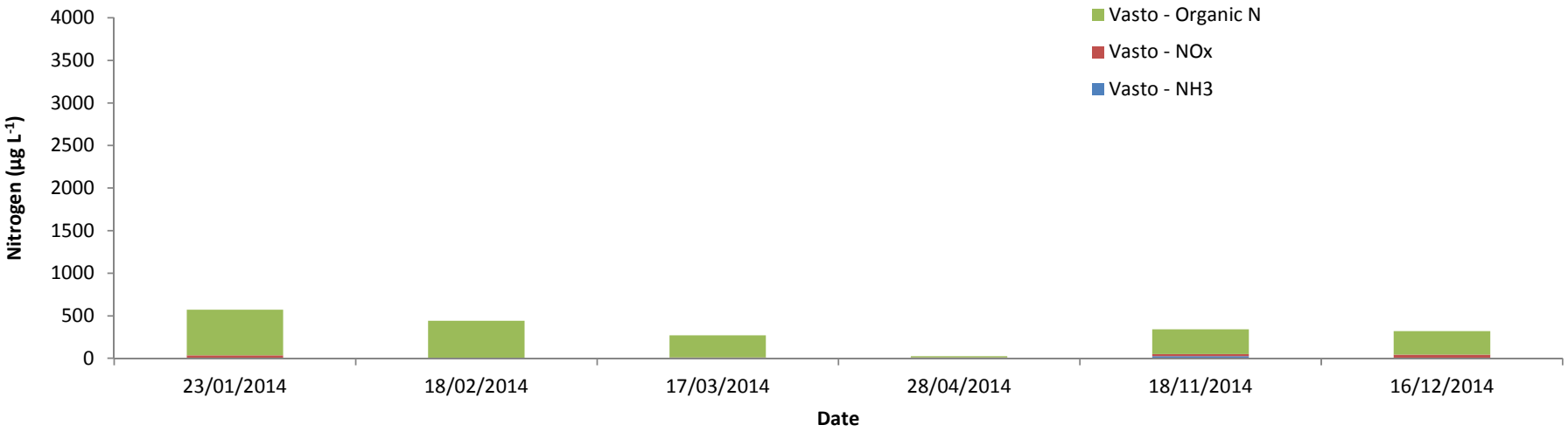
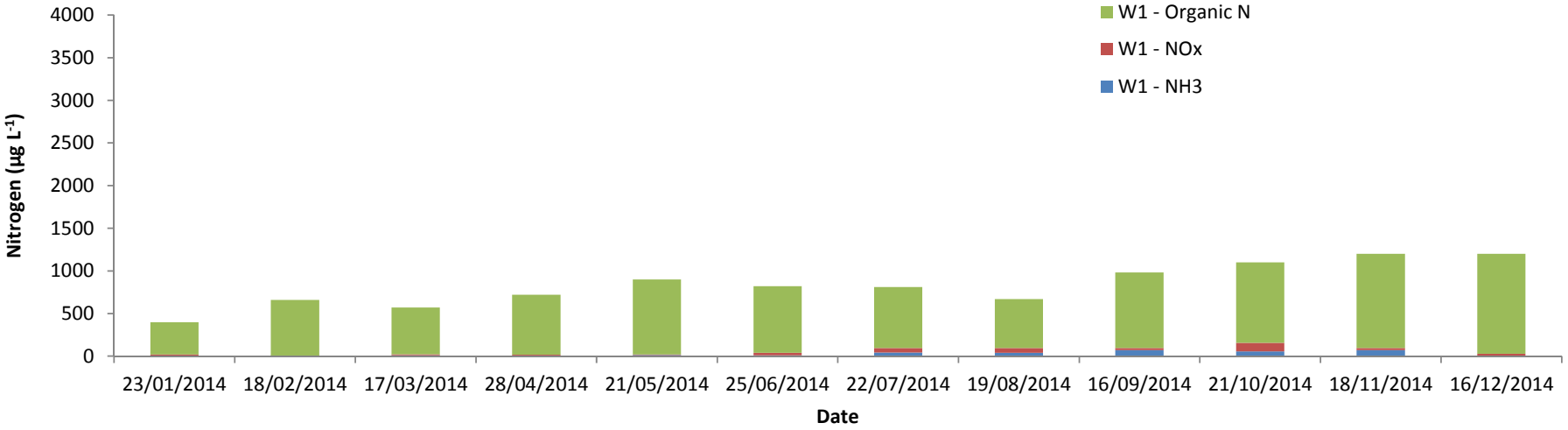
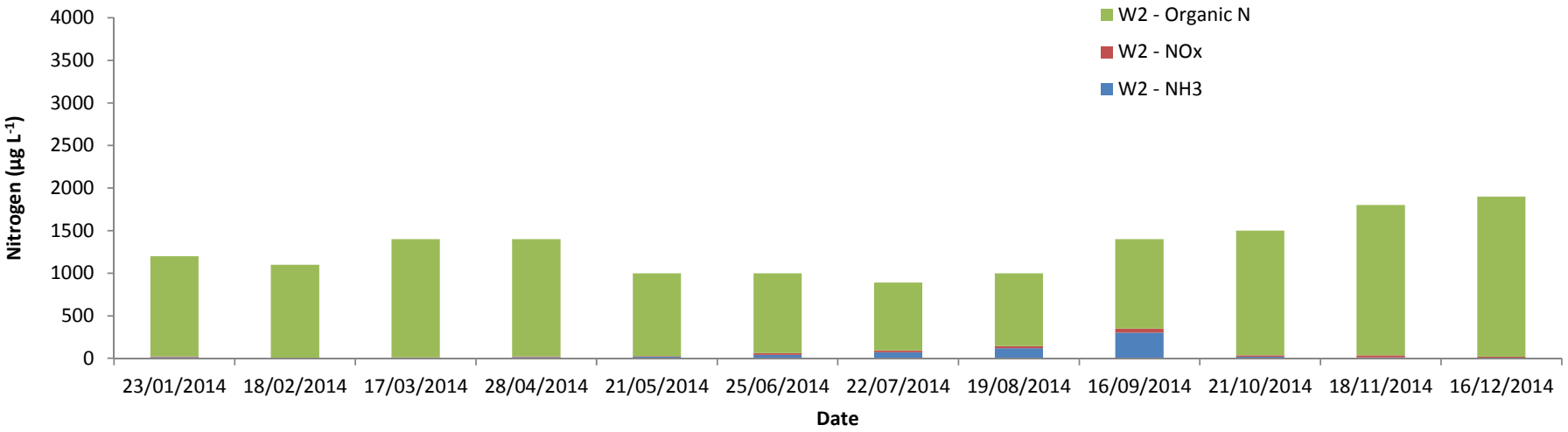
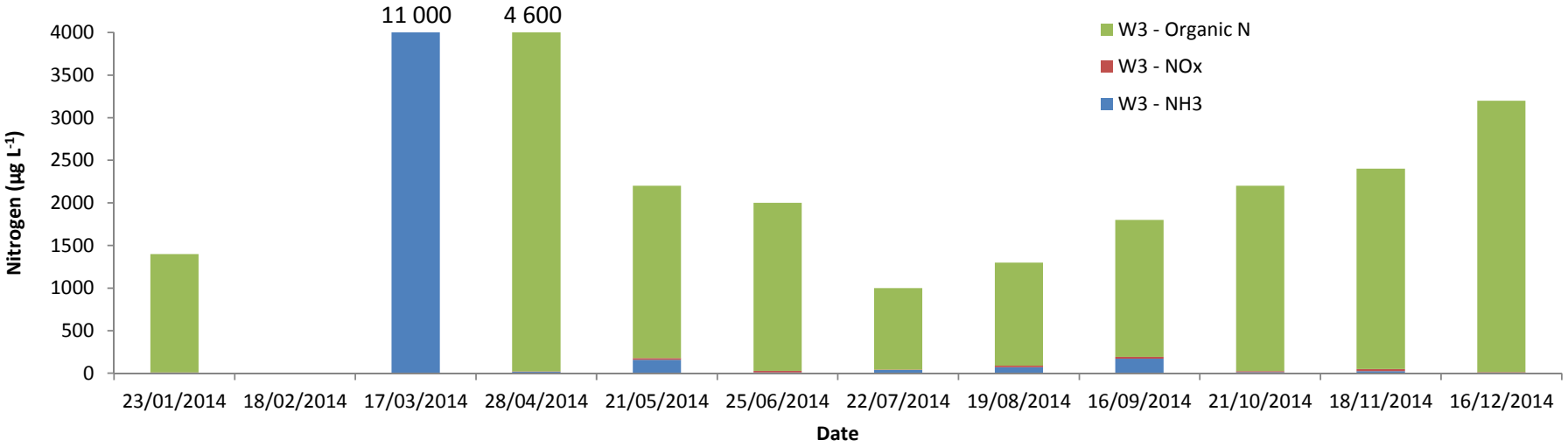


Figure 15. Phosphorus (Total P = Organic P + FRP) concentrations recorded at all sites in the wetland. Majority of FRP concentrations were below detection at 2 µg L^{-1}.


Vasto - Organic N
Vasto - NOx
Vasto - NH3
Nitrogen (µg L-1)
4000
3500
3000
2500
2000
1500
1000
500
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
18/11/2014
16/12/2014
Date


W1 - Organic N
W1 - NOx
W1 - NH3
Nitrogen (µg L-1)
4000
3500
3000
2500
2000
1500
1000
500
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date


W2 - Organic N
W2 - NOx
W2 - NH3
Nitrogen (µg L-1)
4000
3500
3000
2500
2000
1500
1000
500
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date


11 000
4 600
W3 - Organic N
W3 - NOx
W3 - NH3
Nitrogen (µg L-1)
4000
3500
3000
2500
2000
1500
1000
500
0
23/01/2014
18/02/2014
17/03/2014
28/04/2014
21/05/2014
25/06/2014
22/07/2014
19/08/2014
16/09/2014
21/10/2014
18/11/2014
16/12/2014
Date

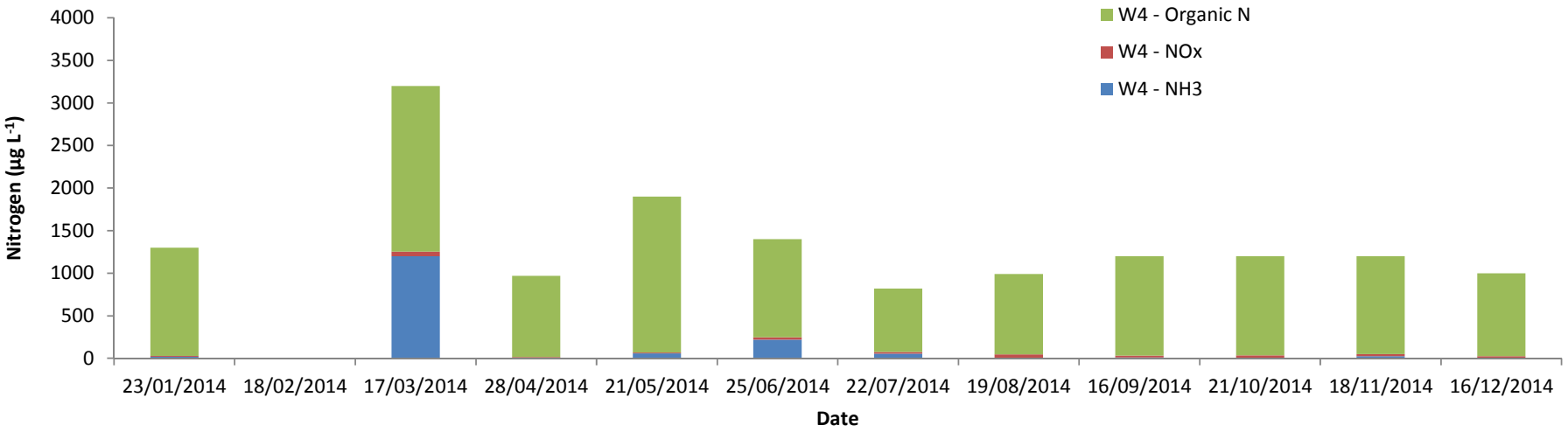


Figure 16. Nitrogen (Total N = Organic N + NH_3 + NOx) concentrations recorded at all sites in the wetland. On the 17/4/14 in W3, there was 5800 µg L^{-1} of NH_3, 20 µg L^{-1} of NOx and 5180 µg L^{-1} Organic N.

Table 3. ANZECC/ARMCANZ (2000) guideline for aquatic ecosystems in the south west of Australia for wetlands or lakes/reservoirs

Parameter	Acceptable range	Number of Exceedances (# samples)			
		W1	W2	W3	W4
Dissolved oxygen	90-120% saturation	7 (12)	7 (12)	8 (11)	6 (11)
pH	7.0-8.5	0 (12)	0 (12)	1 (11)	2 (11)
Conductivity	0.3-1.5 mS cm^{-1}	12 (12)	12 (12)	11 (11)	11 (11)
Total P	<60 µg L^{-1}	1 (12)	0 (12)	5 (11)	3 (11)
FRP	<30 µg L^{-1}	0 (12)	0 (12)	1 (11)	2 (11)
Total N	<1500 µg L^{-1}	0 (12)	3 (12)	8 (11)	2 (11)
NOx	<100 µg L^{-1}	1 (12)	0 (12)	0 (11)	0 (11)
Ammonia	<40 µg L^{-1}	4 (12)	4 (12)	4 (11)	4 (11)

7.3.2 QUARTERLY DATA

A broader range of parameters and metals were sampled from each pond at quarterly intervals (Table 4). Water hardness was 'extremely high' throughout the year, except in Lake Vasto where it was hard (Table 5). Chlorophyll *a* concentrations were low. Biological oxygen demand remained below detection on all occasions (<5 mg L^{-1}). Turbidity exceeded the guideline levels on all occasions as did chloride.

All the metals measured had concentrations (due to water hardness in some cases) that were below the ANZECC/ARMCANZ (2000) trigger values for the 95% protection of aquatic systems with the exception of Cu and Zn. Zinc exceeded trigger values in all ponds on all occasions reaching 110 µg L^{-1}. Zinc has been exceeded trigger values in previous years, although its appearance is variable and typically intermittent. Copper also exceeded the trigger values on all occasions across the entire wetland reaching a peak of 25 µg L^{-1}. Arsenic, Cd, Cr, Ni and Pb had detection limits that exceeded the trigger value which means that's exceedances may have occurred but the analytical technique used was unable to detect them.

Table 4. Quarterly concentrations of metals and selected other parameters recorded in February, May, August, November 2014. ANZECC/ARMCANZ (2000) trigger values for protection of 95% of species in aquatic ecosystems provided. (H= must be adjusted for hardness as in Table 5, C = does not necessarily protect against chronic effects, B= possible biomagnification needs to be considered). Values in blue have detection limits above the trigger value, while red values exceed the trigger value.

	ANZECC (2000)	18/02/2014					21/05/2014			
Analysis (mg L^{-1})	**Trigger Values**	**W1**	**W2**	**W3**	**W4**	**Vasto**	**W1**	**W2**	**W3**	**W4**
Total Suspended Solids		12	12			13	<5	<5	<5	<5
Total Hardness ($CaCO_3$)		340	700	Dry	Dry	150	460	550	1100	1300
Ca		33	58			15	49	54	120	130
Mg		63	130			28	82	100	210	230
Al (µg L^{-1})	55	<20	<20			<20	<20	<20	<20	<20
As (µg L-1)	13 As(V)	<20	<20			<20	<20	<20	<20	<20
Cd (µg L^{-1})	0.2^{H}	<1	<1			<1	<1	<1	<1	<1
Cr (µg L^{-1})	1 Cr^{C} (VI)	<5	<5			<5	<5	<5	<5	<5
Cu (µg L^{-1})	1.4^{H}	13	12			11	25	8	11	9
Ni (µg L^{-1})	11^{H}	6	6			<5	6	5	6	6
Pb (µg L^{-1})	3.4^{H}	<20	<20			<20	<20	<20	<20	<20
Zn (µg L^{-1})	8^{CH}	40	60			60	50	20	40	110
Mn (µg L^{-1})	1900^{C}	38	58			260	68	29	170	440
Fe (µg L^{-1})		30	30			<20	140	80	1100	1700
Hg (µg L^{-1})	0.6(Inorganic)^{B}	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05
DOC		7.9	15			2.1	15	18	36	34
Chlorophyll a (µg L^{-1})							8.6	3.7	5.9	13
Phaeophytin (µg L^{-1})							5.5	0.8	7.2	22
TKN (µg L^{-1})		0.65	1.1			0.4	0.89	1	2.2	1.9
BOD_5		<5	<5			<5	<5	<5	<5	<5
Turbidity (NTU)	0.1	1.9	2.3			27.00	2	1.6	3.8	15
Cl- (µg L^{-1})	200	1300	2700			610	1600	1800	3900	3800

Table 4 (cont)

Analysis (mg L^{-1})	ANZECC (2000) Trigger Values	19/08/2014 W1	W2	W3	W4	18/11/2014 W1	W2	W3	W4	Vasto
Total Suspended Solids		10	18	53	11	7	15	35	16	11
Total Hardness ($CaCO_3$)		410	600	1200	1300	460	800	1700	900	180
Ca		49	60	120	130	0.2	57	72	180	110
Mg		70	110	210	240	0.1	77	150	300	150
Al (µg L^{-1})	55	<20	<20	<20	<20	<20	<20	<20	<20	<20
As (µg L-1)	13 As(V)	<20	<20	<20	<20	<20	<20	<20	<20	<20
Cd (µg L^{-1})	0.2[H]	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cr (µg L^{-1})	1 Cr[C] (VI)	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cu (µg L^{-1})	1.4[H]	<5	<5	<5	<5	10	10	10	10	8
Ni (µg L^{-1})	11[H]	<5	6	8	<5	5	7	7	7	<5
Pb (µg L^{-1})	3.4[H]	<20	<20	<20	<20	<20	<20	<20	<20	<20
Zn (µg L^{-1})	8[CH]	20	<10	30	30	<10	<10	10	10	40
Mn (µg L^{-1})	1900[C]	130	54	87	69	29	42	81	58	170
Fe (µg L^{-1})		90	40	440	200	20	<20	130	150	110
Hg (µg L^{-1})	0.6 (Inorganic)[B]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
DOC		7.6	10	18	18	9.6	16	32	13	1.7
Chlorophyll a (µg L^{-1})		<0.5	1.3	0.7	1.1	4.4	2.4	33	2.5	10
Phaeophytin (µg L^{-1})		<0.5	<0.5	0.6	1.2	1.3	7.5	16	2.1	7.8
TKN (µg L-1)		0.6	1.0	1.2	1.0	1.2	1.8	2.4	1.2	0.33
BOD		<5	<5	<5	<5	<5	<5	<5	<5	<5
Turbidity (NTU)	0.1	4.7	4.3	7	1.7	2.8	2.4	12	2.1	40
Cl- (µg L^{-1})	200	1200	1800	3400	3800	140	2400	5200	2600	620

Table 5 Approximate factors to apply to soft water trigger values for selected metals in freshwaters of varying water hardness (taken from (ANZECC/ARMCANZ, 2000) (TV = Trigger value).

Hardness category (mg/L as $CaCO_3$)	**Cd**	**Cu**	**Pb**	**Ni**	**Zn**
Soft (0–59)	TV	TV	TV	TV	TV
Moderate (60–119)	X 2.7	X 2.5	X 4.0	X 2.5	X 2.5
Hard (120–179)	X 4.2	X 3.9	X 7.6	X 3.9	X 3.9
Very hard (180–240)	X 5.7	X 5.2	X 11.8	X 5.2	X 5.2
Extremely hard (400)	X 10.0	X 9.0	X 26.7	X 9.0	X 9.0

7.3.3 CONCLUSIONS

a) Determine how physico-chemical variables and nutrient concentrations changed on a monthly timescale
b) Examine how key metals and other selected parameters change quarterly between all the ponds

Results suggest that water quality is generally within the normal ranges that might be expected in stormwater wetland on the Swan Coastal Plain. A major issue over the 5 years of the project has been salt intrusion into the wetland from influx of saline Swan River water during high tides, and incoming slightly salty water from stormwater and Lake Vasto. It appears that the 2013 installation of a valve on the outflow from W4 has substantially reduced salt levels within the system. The consequences of the high salinities experienced in 2012 and 2013 are reflected in changes in changes in wetland vegetation in terms of species distribution - encouraged a near monoculture of *Juncus kraussii*. Also the salinity has reduced the vitality of the plants resulting in release of nitrogen, that has caused likely net export of nitrogen from the wetland over 2013-14. The main loss of water from the wetland is evaporation which further concentrates the salt up to undesirable levels over the summer months particularly in W3. Increased inflow and the outflow valve will however probably keep salinities in the wetland within acceptable levels in future years.

There were clear exceedances of ANZECC/ARMCANZ (2000) guidelines for metals concentration for both Cu, Zn and on one occasion for Ni. It is likely that the wetland would have discharged some of these concentrations into the Swan River. The wetland appeared to achieve its principal objective of discharging water meeting the requirements of the Swan-Canning Water Quality Improvement Plan (Swan River Trust, 2009a, b) for P but not for N. Close examination of physico-chemical parameters found a number of exceedances of

ANZECC/ARMCANZ (2000) guidelines however with the exception of salinity, these exceedances were unlikely to be of significant consequence to wetland function.

7.4 SEDIMENT

The specific aims of measuring the sediment quality in the wetland were to:

a) Determine how key metal and nutrients were accumulating in the sediment.

This will show whether there are any management issues associated with sediment quality. The data will allow the effectiveness of various processes responsible for nutrient uptake or release to be inferred.

b) To evaluate how the sediment is developing over time.

Comparison to previous years will allow the development of sediment to be measured.

Sediments were sampled in May 2014 for a range of metals and nutrients as shown in Table 6. The average depth of sediment to the liner in W2 was 102.3 ± 10.4 mm, a decrease of 70 mm over 2013. The depth in 2014 was very similar to 2012. In W3 the sediment depth dropped back to near 2012 levels at 116.7 ± 11.5 mm from 252.5 ± 12.7 mm in 2013. The discrepancy between 2013 and 2014 might be due to increased flows in 2014 that have scoured the sediment No metal concentrations exceeded any ANZECC & ARMCANZ (2000) guidelines for sediment. The organic (LOI_{500}) and carbonate content (LOI_{1000}) of the sediment has remained largely unchanged in W3 from 2010 to 2014 (2.3 ± 0.2% to 3.4 ± 1% respectively). In W2, LOI_{500} may have increased slightly between 2010 and 2014 in W2 (15.3 ± 1.9% to 18.5 ± 4.3% respectively) but was not consistent across all years indicating a reasonable degree of variability in the data. Carbonate content changed little in W3 and was very low at <2 % in any year, in W2 carbonate content was highly variable and peaked at 16%, but there was no consistent trend over time.

Table 6. Sediment concentrations of selected metals and nutrients in W2 and W3 in May 2014. (where some of the four replicate samples were below detection levels, the number of samples used in the mean is indicated by n=)

Variable (mg kg^{-1})	ANZECC & ARMCANZ (2000) Interim Guidelines (Low-High)	W2	W3
Moisture Content (%)		81 ± 6	38 ± 4
TKN		4375 ± 1347	1580 ± 384
TP		413 ± 125	81 ± 24
TOC		9 ± 3	2 ± 1
Al		11525 ± 3752	1150 ± 87
As	20-70	4 ± 1	1 (n=2)
Cd	1.5-10	0.4 (n=1)	<0.3
Cr	80-370	5 ± 2	4 ± 0
Cu	65-270	8 ± 3	3 ± 0
Fe		5625 ± 1599	2425 ± 293
Ni	21-52	3 ± 1	1 ± 0
Pb	50-220	11 ± 4	9 ± 2
Zn	200-410	50 ± 18	19 ± 5
Mn		210 ± 56	21 ± 8
Hg	0.15-1	<0.05	<0.05

In Figure 17, the sediment characteristics between sites W2 and W3 are clearly different in all years except 2012, although in 2014 and 2013 the differences are fairly small. The sediments of site W3 were very similar across all the years. This suggests only marginal changes in W3, while W2 has rapidly progressed from having different chemistries in 2010/2011 towards that of W3. Further, the presence of zeolite in W2 appears to be having minimal impact on the sediment metal and nutrient load as the sediment is increasingly similar to natural sediment in W3. In 2012, there appeared to be an analytical discrepancy between the sediment metal concentrations compared to 2011. However, when 2012 is compared in the PCA, it is similar to the other years, although W2 is much closer to W3 than in other years.

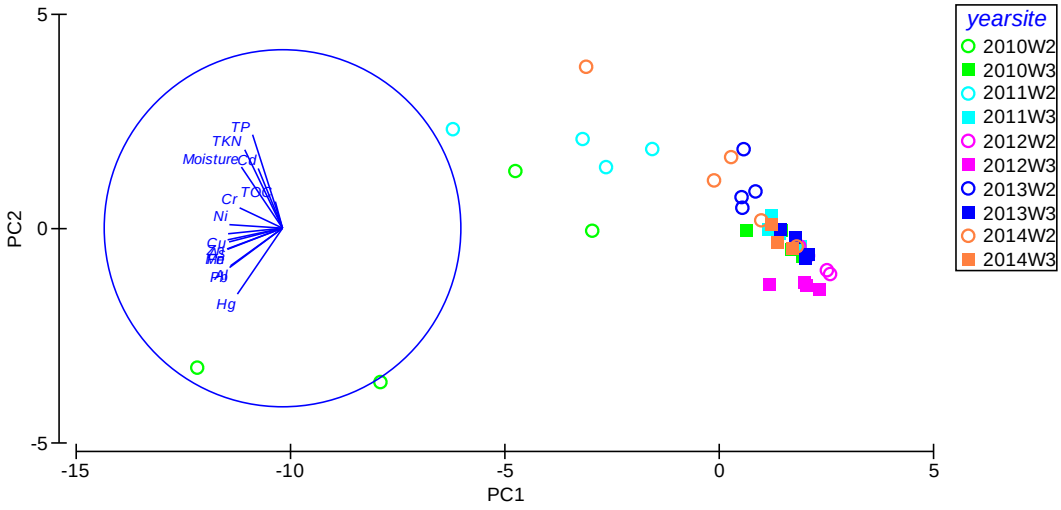


Figure 17. PCA of sediment metal and nutrient concentrations (excluding Hg and Cd where most values were below detection) over 2010 to 2014 and for sites W2 and W3.

W2 is designed to aid settling of particulates and with the addition of zeolite to bind cations (positively charged ions) such as metals and ammonium. Comparing metal and nutrient concentrations from 2010 to 2014, Only TOC and Total P increased in concentration up to double for TOC. All other metals and nutrients declined in concentration. A possible explanation is that accumulation of particulates has buried the zeolite and the deposited particulates are less effective at retaining nutrients and metals. In contrast, W3 was designed for plant removal of nutrients and metals, however the sediment has proved very effective at removing nutrients with TOC, Total P and TKN all increasing in concentration at least two fold over the time period, additionally Mn and Cr have also increased. All other metals have remained largely unchanged or possibly have declined. The area of W3 sampled is just after the weir where there have been no plants. The results suggest that the sediment used in W3 is superior for nutrient removal than the zeolite enhanced sediment, especially if the zeolite is continually being buried by particulates.

Figure 18. Photograph of a sediment cores taken at W2 (left) and W3 (right).

7.4.1 CONCLUSIONS & RECOMMENDATIONS

7.4.1.1 CONCLUSIONS

a) Determine how key metal and nutrients were accumulating in the sediment.
b) To evaluate how the sediment is developing over time.

There were no exceedances of ANZECC/ARMCANZ (2000) guidelines for metals concentration in sediments. Although there was no strong evidence for the build-up of sediments in either W2 or W3, changes in some metal concentrations such as Al suggests that the zeolite amendment in W2 is becoming buried/sinking to the bottom of the sediment. No strong evidence was fond to suggest that zeolite was effective for either metal or nutrient removal with better removal obtained by the more natural sediments found in W3.

7.4.1.2 RECOMMENDATIONS

7. It is not recommended to add more or replace the Supersorb clay in W1 and W2 as it appears to make little contribution to nutrient uptake within the wetland.
8. Ongoing annual sediment monitoring for metals and nutrients is not recommended. It is recommended that sediment monitoring every 2-3 years would be useful.
9. It is recommended that the sediment in W2 not be allowed to accumulate to be above the base of the weir between the two zones. The rate of accumulation of sediment is relatively low at present but may increase with larger inflows.

7.5 VEGETATION

The specific aims of sampling the vegetation were to:

1. Map the coverage of the aquatic plant species in the wetland.

This will show how the plant communities in the wetland are developing. It will also allow the area of each species to be determined and this information will be used in the nutrient load calculations.

2. Measure development of biomass of major plant species within the wetland (Zones 1 and 2).

This will show whether the plants are becoming larger and/or denser. It also provides a basis to determine nutrient loads in the vegetation.

3. Measure the concentration of nutrients (N & P) in live, dead and below ground parts of each species in each site.

This will allow the total load of nutrients stored in plant material to be determined. It will also indicate which species are best for nutrient uptake.

The specific aims of the foreshore monitoring were to:

4. Establish some regular sites where the condition of the foreshore can be monitored. Key items of interest are erosion, weed invasion and the effectiveness of armouring that may have been put in place.

This will allow issues on the foreshore that require management action to be identified and acted upon before substantial damage is done to the site.

7.5.1 VEGETATION COMMUNITIES

Wetland vegetation mapping and photo-point monitoring were conducted in May 2014 and late October 2014 (30/10/14) as part of biannual monitoring as outlined in the PFMEP (Year 5).

7.5.1.1 CHANGES IN VEGETATION DISTRIBUTION: 2013 TO 2014

Five main plant communities were determined and mapped during the initial monitoring in 2010 (Year 1; Figure 19). These communities were remapped in 2011, 2012, 2013 and 2014 with particular focus on detecting any change in the extent and condition of these main vegetation types, as well as any recruitment and colonisation by new plants. In general, the spatial distribution of plant communities has remained reasonably stable between 2013 and 2014. Indeed the majority of vegetation types have not changed dramatically since original mapping in 2010 (compare Figure 19 and Figure 20).

Specifically, the following changes between 2013 and 2014 were noted:

1) *Baumea articulata* – the original single patch of *Baumea articulata* sedgeland which expanded (to triple its size) from 2010 to 2011, and contracted in 2012, now covers <1 m^2 (Table 7, Figure 27). This remaining small patch now contains stressed plants and plants in poor health, suggesting this species and community type will soon disappear from the wetlands. The contraction of *B. articulata* in the wetland appears to have started during spring 2011 (see 2011 monitoring report) and has progressed since. Most deaths appear to be over summer periods suggesting the decline may be caused by drought and/or increased water salinity at this time of the year.
2) *Eleocharis acuta* – This community is dominated by *Eleocharis acuta* (Common Spikerush, Cyperaceae) but is mixed with varying amounts of *Juncus kraussii*. During 2014, there has been further contraction of this sedgeland community at its margins, so that it now only covers a small amount of its original distribution (Table 7 & Table 8), mainly at the expense of expanding *J. kraussii*-dominated vegetation (Figure 19 & Figure 20). The relative cover of *J. kraussii* has again increased in some patches of this community. This suggests that *J. kraussii* is slowly taking over this community.
3) *Ficinia nodosa* – this community is dominated by Knotted Club Rush (previously *Isolepis nodosa*) and tends to occur on surrounding slopes on non-inundated areas. Its distribution has been more or less stable over the past few years, although there have been slight reductions in area around its edges over 2013-14, and especially in Zone 3 (Table 8).
4) *Juncus kraussii* – this is the most widespread vegetation type of the wetland and dominates each wetland zone. It consists of dense stands of *Juncus kraussii* (Sea Rush, Juncaceae) of between 70 to 100% cover. It is expanding at its margins, particularly where it abuts *E. acuta* community (type 2 above; Figure 19). However this community is also contracting where it abuts open water, and this has been particularly so in zone 2 and 3 during 2013-14 (Figure 20). Overall, there has been a reduction in area occupied by this community during 2014

(Table 7). The density of *J. kraussii* plants and its dominance over other species is gradually increasing (now generally 80-100% cover).

5) Samphire and other halophytes – This community is dominated by *Tecticornia indica* and other *Tecticornia* spp. (commonly known as samphires and until recently in the genus *Halosarcia*). Such species are not on the original planting list and so are likely to have colonised raised mounds of the wetland and other areas which dry out in summer. These raised areas appear to accumulate salts during the drying phase and also support other halophytes such as *Frankenia pauciflora* (which has been increasing in cover). This community has slightly decreased in range in 2013-14 after expanding its ranges considerably in 2012-13 (Figure 20, Table 8).

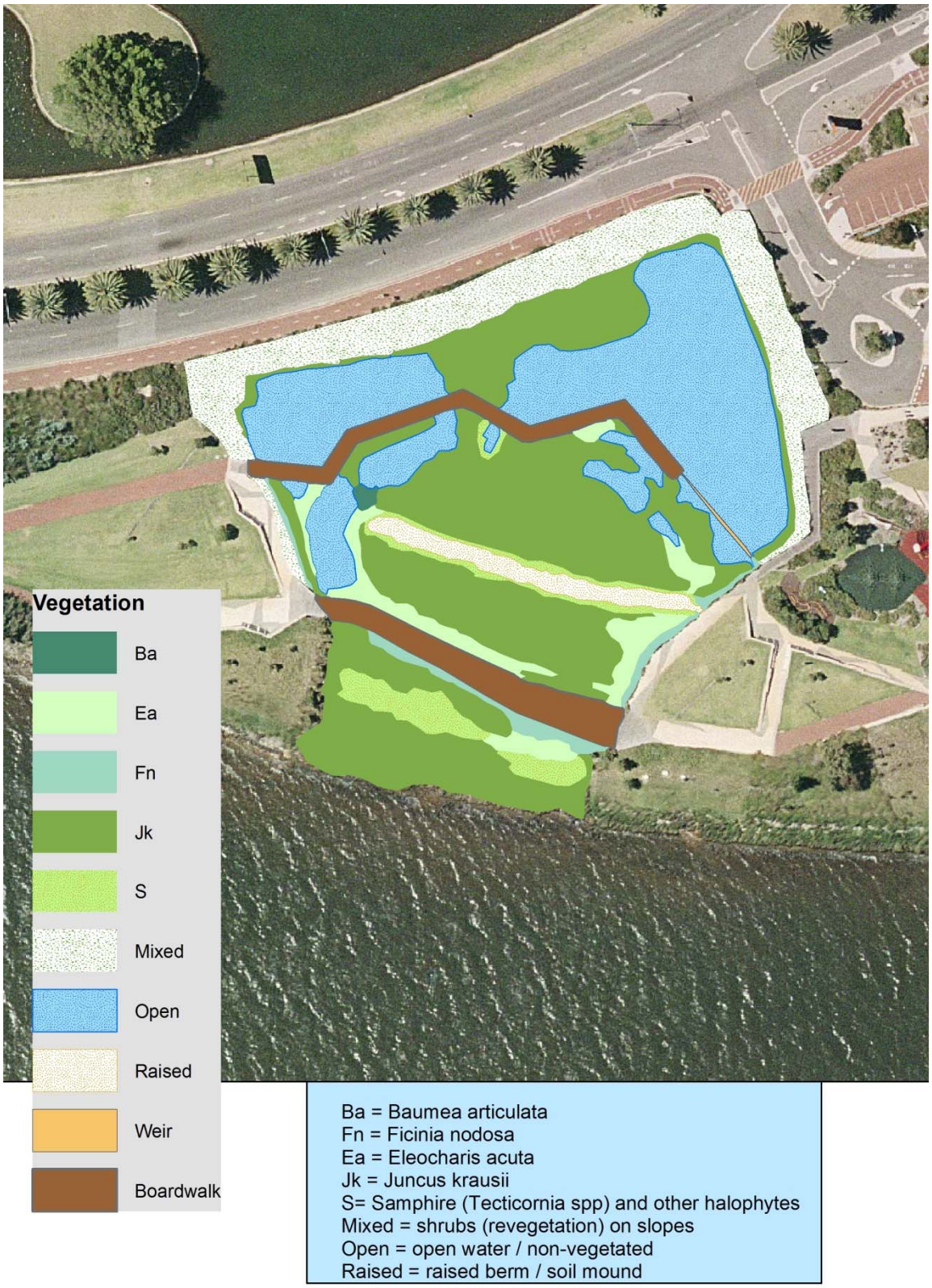


Figure 19. Map of vegetation types and other cover as of May 2010 (original mapping).

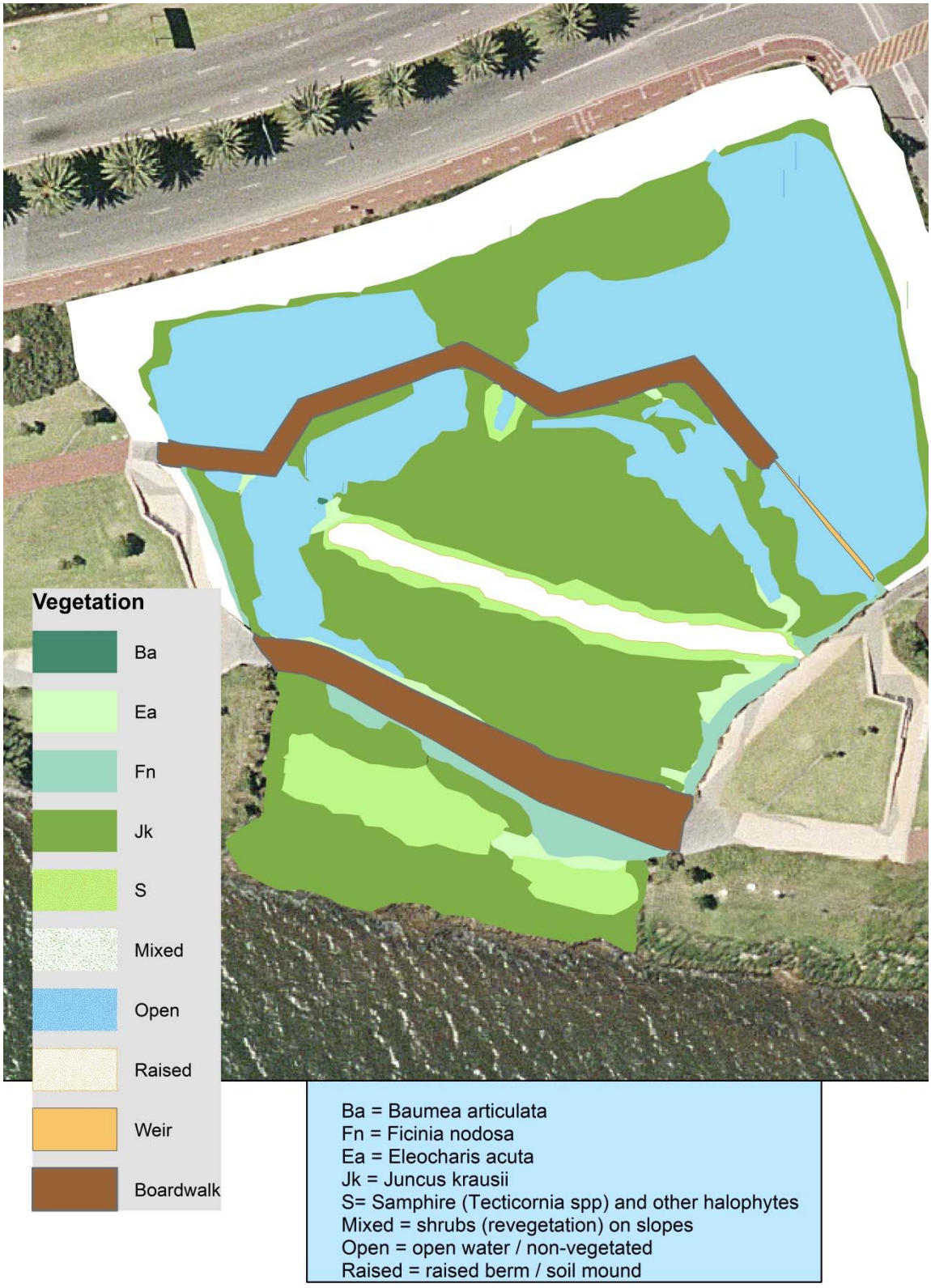


Figure 20. Map of vegetation and cover types as of 30th October 2014.

In addition to these plant communities, other habitats were found:

- Mixed shrubs on embankments – this community consists of a range of shrub species with medium to high cover. Dominant species include *Scaevola crassifolia, Kunzea ericifolia, Myoporum caprarioides, Ficinia nodosa* and *Atriplex cinerea*. Most of these species were planted around the edge of the wetland.
- Open Water – few aquatic plant species are typically found in these areas (with the exception of filamentous algae). However between and 2014 we noticed a further increase in aquatic grasses such as water couch (*Paspalum distichum*) in some areas. The area of open water has increased in Zones 1 and 2 over the last year, mainly due to contraction of *J. kraussii* and *E. acuta* vegetation (Figure 20, Table 7 & Table 8).
- A small patch of *Typha* or *Phragmites* colonised open water of Zone 2 between May and October 2012. However during 2013, this small patch died back considerably and has not been reported in 2014. The infestation may have been sprayed or otherwise controlled by council staff.

Tree & Shrub Species

Melaleuca cuticularis – two patches of young trees were observed on slightly raised mounds, both within Zone 2. These are most likely plants surviving from original planting in 2004. The trees are mostly found on the margin of *Juncus* community where it abuts samphire/halophyte community. One mound had 6 trees in 2010; one of these died during 2013. One tree was unhealthy in 2013 but appears to have recovered in 2014, suggesting that these trees are generally healthy (Figure 24). The other mound had 10 trees in 2010, and all these appear to be healthy in 2014 and are now approximately 2-2.5 m tall.

Melaleuca lateritia – this compact shrub was found interspersed throughout the *Juncus* community of Zone 2. Some 20 plants were observed in 2010, which had increased to 28 in 2011 and 31 individual plants in 2012. The increase from 2010 to 2012 was likely to be due to improved detectability (due to shrubs emerging above generally dense cover of *Juncus* in this area) rather than recruitment of new individuals. During 2014 monitoring, some 23 plants were counted, suggesting some loss of plants from 2013-14.

7.5.1.2 PLANT COMMUNITY CHANGES: 2010-2014

Each of the six main plant communities found in the original monitoring in 2010 were still present five years later (in 2014) and have remained relatively stable in terms of distribution (Table 7 & Table 8; Figure 21). The major changes in area have been the increase in open water areas (net increase of 373 m^2 or 16% of its original distribution) and the decrease in the *Juncus kraussii* community (net decrease of 220 m^2 or 7% of its original distribution). These are the two major plant communities occupying some 80% of the wetland in 2014 (compared to 78% of the wetland in 2010) (Figure 19 to Figure 21). These net changes in

area mask the true dynamic nature of the vegetation, especially in the *Juncus kraussii* community, as decline in some areas was at least partially offset by expansion elsewhere (Figure 19 & Figure 20).

The third most widespread community was the *Eleocharis acuta* community which covered some 406 m^2 or 5.7% of the wetland in 2010. By 2014 it had declined by 259.1 m^2 which represented a ~64% decline over its original distribution (Table 7 & Table 8; Figure 21). Most of the decline was due to the spread of *Juncus kraussii* vegetation into this community. It is entirely feasible that the *Eleocharis acuta* community will be completely overtaken by *Juncus kraussii* in coming years, which would decrease the overall heterogeneity and species composition of the wetland.

The decline of some other plant communities was much smaller in terms of absolute area but, as they were generally restricted in distribution, was generally much greater in terms of proportional change (Table 7 & Table 8; Figure 21). In particular, the *Baumea articulata* community declined by only 16 m^2 in period 2010-2014 but this reduction was 95% of its original distribution. This community would be expected to disappear in the near future. The decline in *Ficinia nodosa* community has been modest (only ~15 m^2). This community mainly occurs on higher ground around the edge of the wetland so is less likely to be affected by changes in water levels and quantity.

The area of the community dominated by samphires and other salt-tolerant species expanded its range by some 143 m^2 which represented a ~29% increase over its original distribution. Most of this increase occurred between 2012 and 2013 and represented an expansion of its range around its margins (Table 7; Figure 19 to Figure 21).

B. articulata was only found in Zone 2 and *J. kraussii* was the only species recorded in Zone 1 (Table 8). Zone 1 was predominantly open water as the design intended. *Juncus kraussii* was planted in Zone 1 in an area of deeper sediments and does not appear to have spread out from this area, although it has contracted substantially in Zone 2 in areas of deeper water. *Baumea articulata* is a species that prefers deeper and reliable inundation, the highly variable nature of the water levels in Zone 2 do not appear to have helped this species. Possibly the elevated salinity and/or drought conditions over summer periods have impacted this species, which suffered a severe decline of this species starting in spring 2011 and continuing to final monitoring in spring 2014. The deep water conditions of Zone 1 might suit this species and it can potentially recruit into this area. *Ficinia nodosa* is only found along the eastern edge of Zone 2 and northern edge of Zone 3. *Eleocharis acuta* occurred in patches and strips around the edge of *J. kraussii* and is contracting in area at expense of expanding *J. kraussii* (Table 7 & Table 8). It appears competition between species is at least partly responsible for changes in distribution of major plant communities. Increasing water salinities may also explain the apparent movement of *J. kraussii* into the *E. acuta* beds during across the 5 years of monitoring, as *E. acuta* is known to have lower salinity tolerance than *J. kraussii*. Samphires appear to have colonized Zone 2 and 3 from

areas outside the wetland, being common species along the Swan River. The high salt levels in the sediments resulting from the drying of the zones appear to favour these species; the samphires do not survive prolonged inundation.

A photographic record of each vegetation community was taken at fixed locations (Figure 22 to Figure 28).

Table 7. Area (m^2) of each cover type and its percentage of total study area and of wetland area (as of May 2010, May 2011, October 2012, early November 2013, and late October 2014).

Type	2010 Area (m^2)	2011 Area (m^2)	2012 Area (m^2)	2013 Area (m^2)	2014 Area (m^2)	% total 2010	% total 2014	% wetland 2010	% wetland 2014
Baumea articulata	16.9	64.3	24.2	5.6	0.9	0.2	0.01	0.2	0.01
Eleocharis acuta	405.6	352.4	287.3	173.2	146.5	4.7	1.7	5.7	2.1
Ficinia nodosa	154.3	154.3	154.3	152.2	139.1	1.8	1.6	2.2	2.0
Juncus kraussii	3234.3	3229.3	3179	3072.1	3014.7	37.7	35.1	45.6	42.5
Samphire / halophytes	355.1	383	387.7	524.8	498.3	4.1	5.8	5.0	7.0
Open Water	2305.0	2287.9	2438.9	2549.9	2677.8	26.9	31.2	32.5	37.7
Boardwalk, Weir etc	615.9	615.9	615.9	615.9	615.9	7.2	7.2	8.7	8.7
Total Wetland	7087.2	7087.1	7087.2	7093.7	7093.2	82.6	82.6	100	100.0
Mixed shrubs (slopes)	1285.6	1285.6	1285.6	1285.6	1285.6	15	15.0		
Raised Ground (~bare)	209.9	209.9	209.9	209.9	209.9	2.4	2.4		
Grand Total	8582.7	8582.6	8582.7	8589.2	8588.7	100	100		

Table 8. Area (m^2) of each plant community by wetland zone as of late October 2014 (area changes in m^2 from May 2010 are indicated in parenthesis).

Zone	*Baumea articulata*	*Eleocharis acuta*	*Ficinia nodosa*	*Juncus kraussii*	Open Water	Samphire/ Halophytes	TOTAL
1	0	0	0	588.5 (-18.3)	1382.4 (+18.3)	0	1970.9
2	0.9 (-16.0)	118.0 (-287.6)	65.1	1695.1 (-166.3)	1295.4 (+353.5)	201.9 (+63.9)	3376.4
3	0	28.5 (-25.4)	74.0 (-15.3)	731.1 (-16.6)	0.0	296.4 (+79.2)	1130.0
TOTAL	0.9	146.5	139.1	3014.7	2677.8	498.3	6477.3

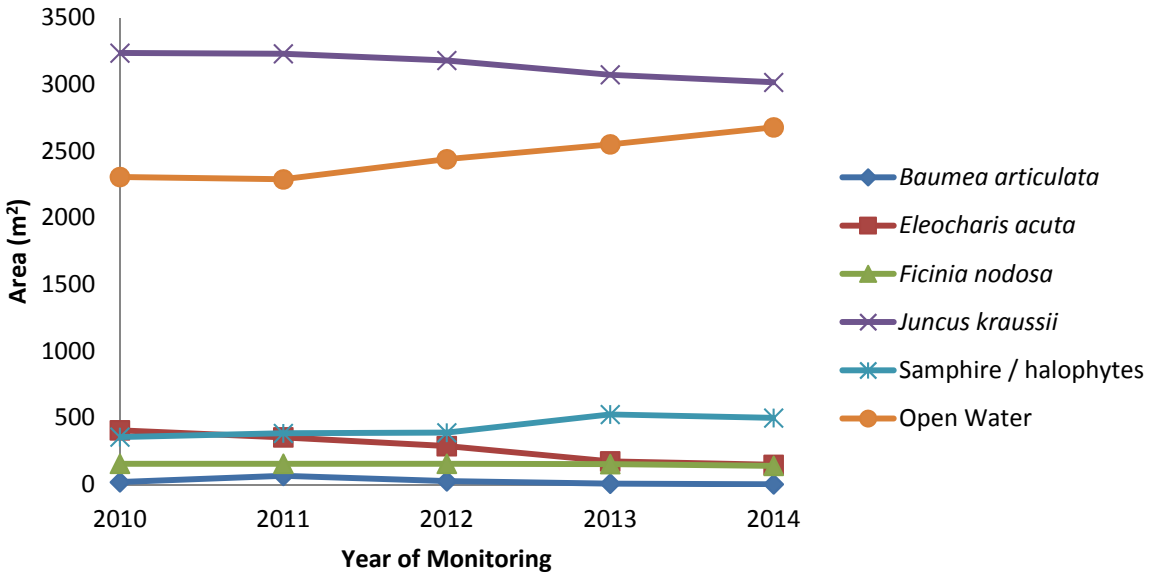


Figure 21. Change in the area of each plant community type over 2010-2014 monitoring period.

Figure 22. Photographs taken at photopoint WV1 looking south-east. Note the increase in open water areas on right hand size of weir.

May 2010

October 2010

October 2011

October 2012

Early November 2013

October 2014

Figure 23. Photograph taken at photopoint WV2 looking south. Vegetation here is dense *Juncus kraussii* and its extent and condition is generally stable, although open water is expanding in the foreground

May 2010

October 2010

May 2011

October 2011

Early November 2013

October 2014

Figure 24. Photographs taken at photopoint WV2 looking west towards patch of *Melaleuc*a trees. One tree has died (close to boardwalk), whereas the other appear to be healthy but growing only slowly.

May 2010

October 2010

October 2011

October 2012

Early November 2013

October 2014

Figure 25. Photograph taken at photopoint WV3 looking east (note expansion and subsequent death of *Baumea articulata* over the years). Photos have been taken in slightly different directions (top is due east, whilst others are ESE to focus more on the declining *Baumea*).

May 2010

October 2010

October 2011

October 2012

Early November 2013

October 2014

Figure 26. Photographs taken at photopoint WV4 looking west along drainage culvert. Note samphires and other halophtyes on the banks of the culvert, and increase levels of surface salt. October 2014 appear wetter than previous years.

May 2010

October 2010

October 2011

October 2012

Early November 2013

October 2014

Figure 27. Photograph taken at photopoint WV4 looking north towards city. NB: Direction and elevation of photograph has varied slightly each year, but generally show increase in open water.

May 2010

May 2011

October 2011

October 2012

Early November 2013

October 2014

Figure 28. Photographs taken at photopoint WV5 looking south-west

7.5.2 VEGETATION BIOMASS AND GROWTH

Stands of *Baumea articulata*, *Typha domingensis* and *Eleocharis acuta* (except in May at W4) were too small according to the PFMEP to be sampled. *Eleocharis acuta* had no flowers when sampled suggesting the plants were under stress in 2014. Likely competition from *Juncus kraussii* has slowly seen the contraction of the population of *E. acuta* within the wetlands. Similar flowering rates were seen in 2014 for *J. kraussii* in all ponds compared to previous years. The mean count of leaves per m^2 was similar for *J. kraussii* to previous years, however *E. acuta* had a substantially higher count possibly suggesting regrowth. As the mean leaf length for *E. acuta* was similar to previous years this suggests that it is due to regrowth in 2013 to allow the new leaves to mature. *Juncus kraussii* was similar in the number of leaves and their length to previous years.

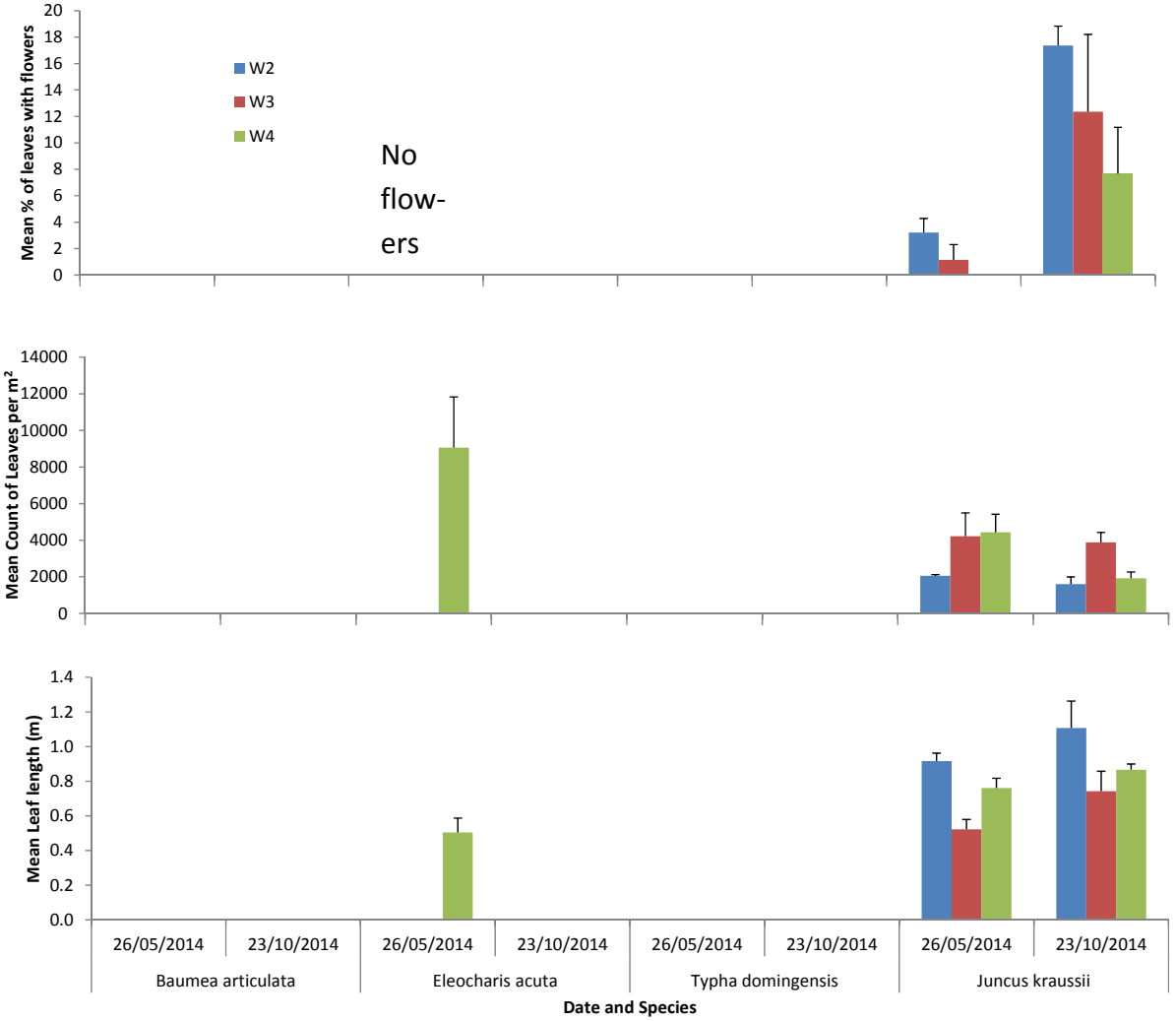
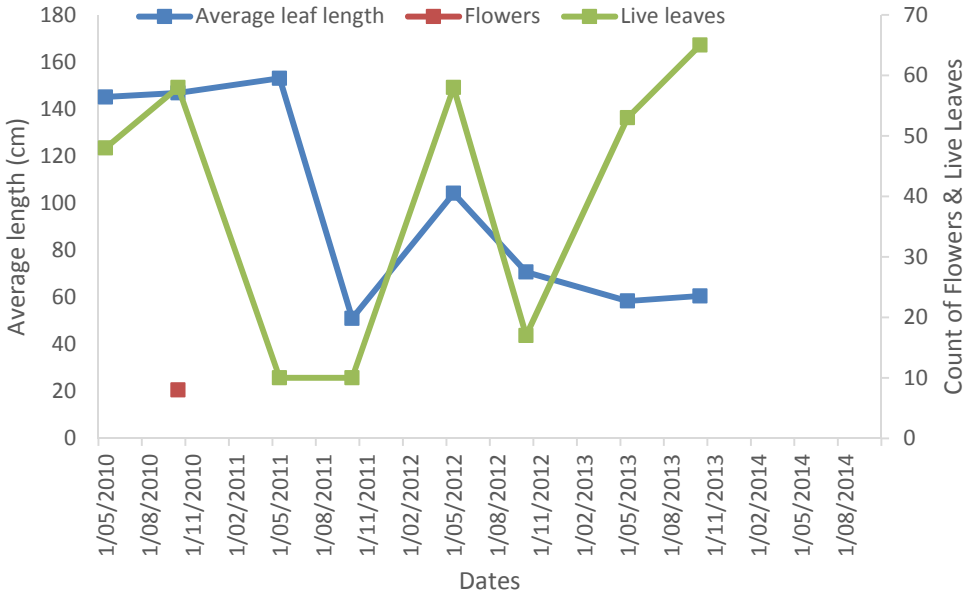


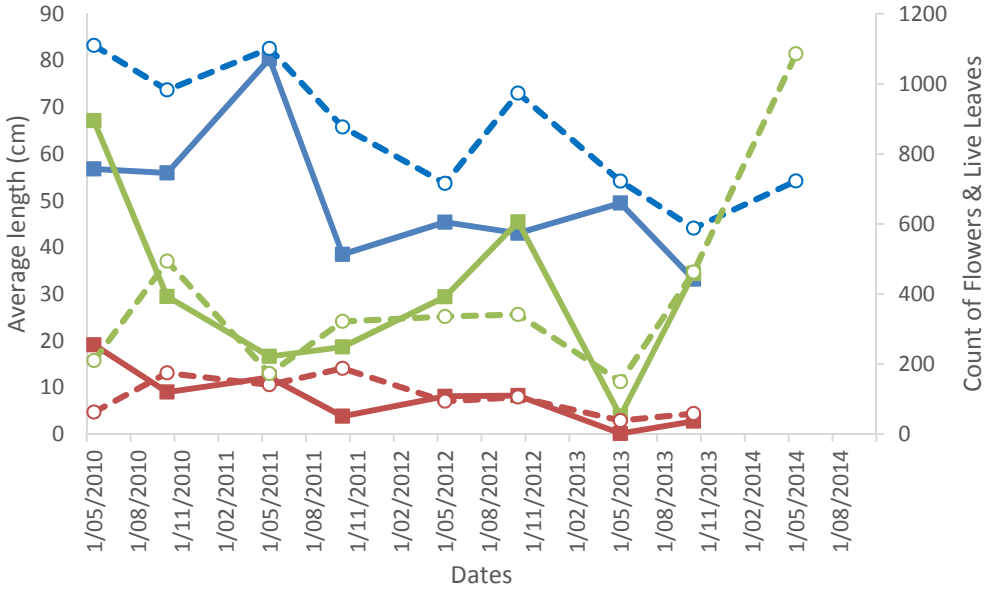
Figure 29. Mean (±SE) for percentage of leaves with flowers, count of leaves per m^2 and leaf length for each species on each sampling occasion for each wetland site. Note in 2014, insufficient stands of *B. articulata*, *T. domin*gensis and *E. acuta* prevented sampling.

Comparison of the number of live leaves, their average length and the number of leaves with flowers shows that between 2010 and 2014, all species have seen a general decline in average leaf length, with only *J. kraussii* returning to 2010 levels in 2014. The main decline in W3 in average leaf length occurred in October 2011, with a subsequent decline in May 2013 for *J. kraussii* (Figure 30). The number of live leaves generally declined for all species in 2011 and 2013, staging a brief recovery in 2012 before recovering in 2014. Flowers have generally declined for all species, although less so for J. kraussii. These results show the impact of increasing salinity within the wetland system. As salinity levels have now been controlled and are decreasing there is some recovery in plant biomass, although reproductive capacity has yet to return to 2010 levels.

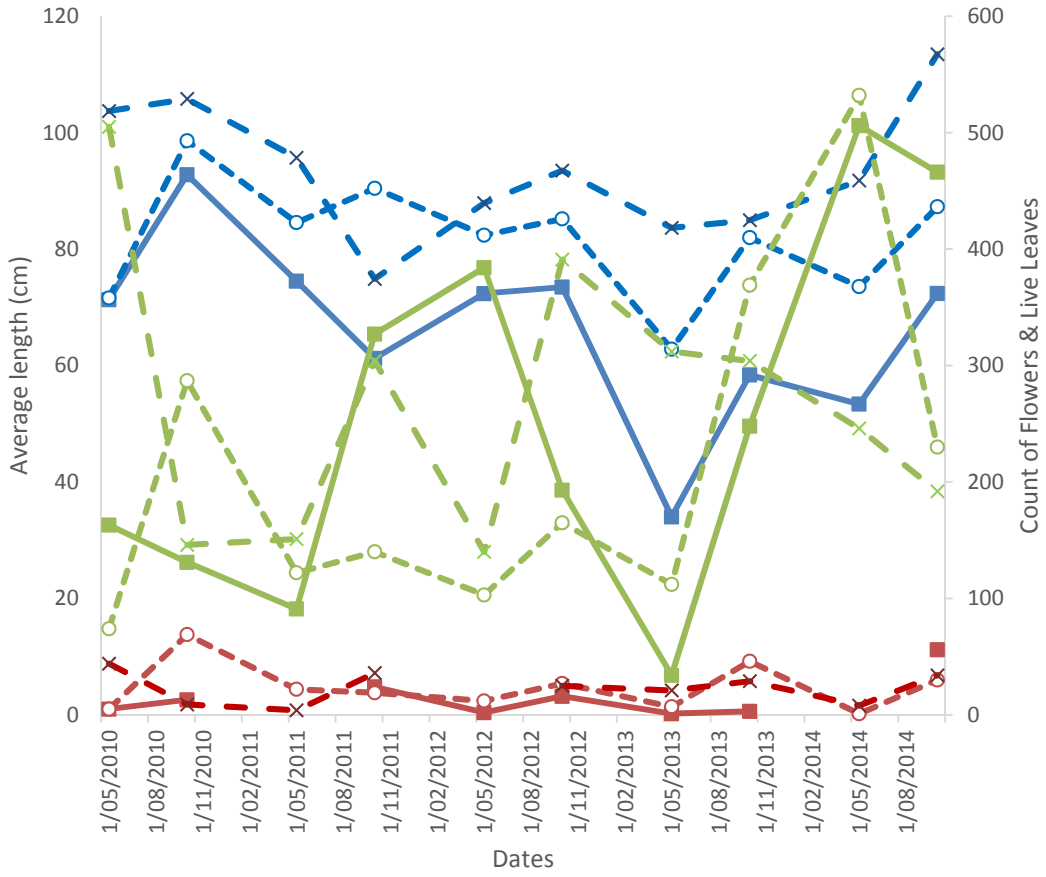
a) *Baumea articulata*



b) *Eleocharis acuta*



c) *Juncus kraussii*



d) *Typha domingensis*

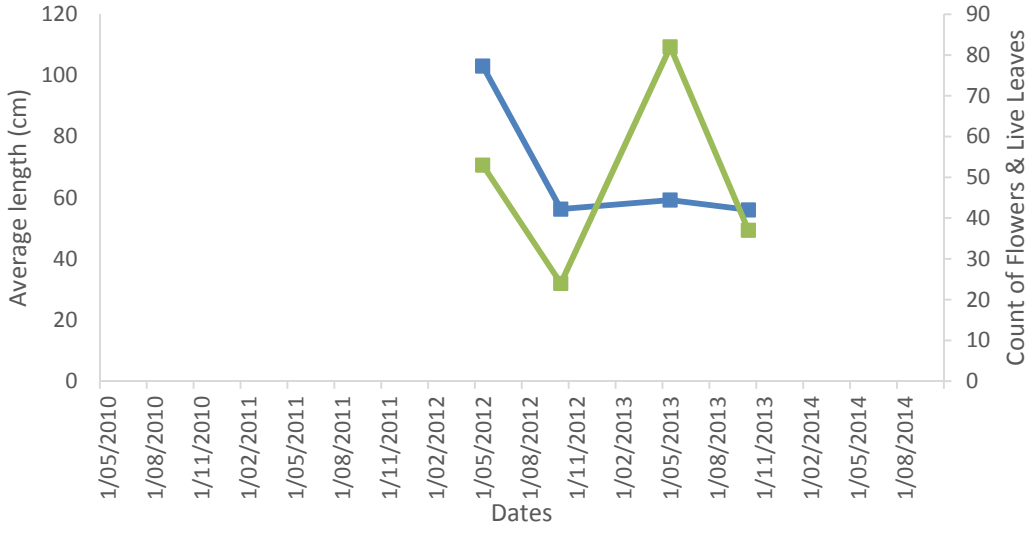


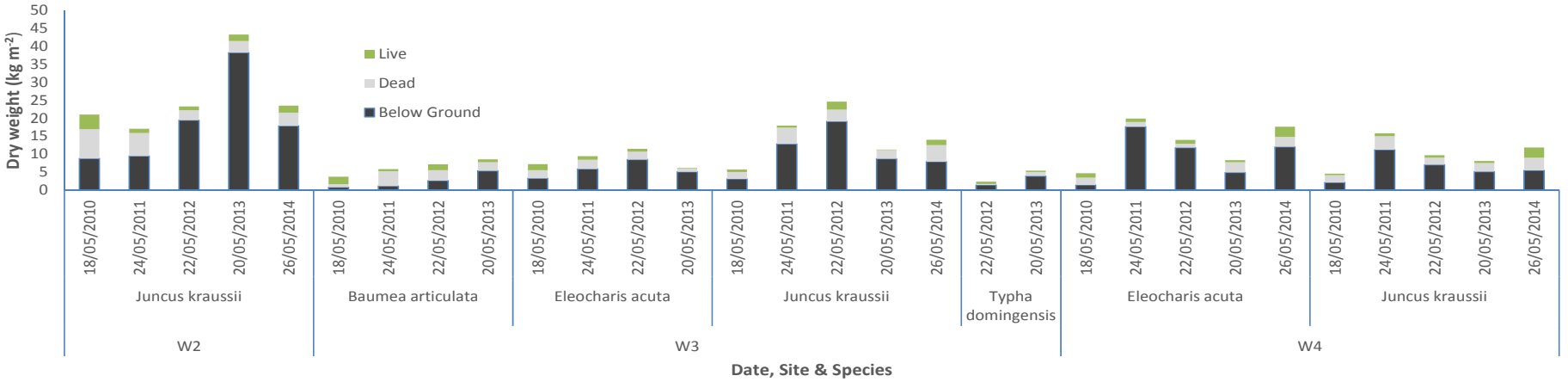
Figure 30. Average live leaf length and total counts of leaves with flowers and live leaves from three quadrats from the three ponds W2 – large dash, W3 – solid, and W4– small dash at Point Fraser between 2010 and 2014 for a) *Baumea articulata*, b) *Eleocharis acuta*, c) *Juncus kraussii* and) *Typha domingensis*.

Changes in biomass of vegetation throughout the ponds is shown in Figure 31. There is a high degree of variability in biomass between years, species and within years. Examination

of the replicate samples highlights that 1-2 kg m^{-2} variability in biomass were normal per location, time, species, for live material. More samples and consequential damage to the wetland would be necessary to reduce this variability. Live biomass was on average highest for *J. kraussii* in W2 at 2.09 kg m^{-2}, compared to 1.06 kg m^{-2} in W3 and 1.37 kg m^{-2} in W4. Live biomass for E. acuta was higher in W4 at 1.40 kg m^{-2} than W3 at 0.88 kg m^{-2}. *Typha domingensis* had the lowest average live biomass of all the species at 0.31 kg m^{-2} whilst *B. articulata* reached 1.3 kg m^{-2}. The amount of live biomass was highest in W2, W4 and W3 and probably reflects the salt concentrations seen in those ponds and to a lesser extent the more frequent drying seen in W3.

Loss on ignition (LOI) of plants collected from W2 to W4 is shown in Table 9. At 500 ^{o}C LOI shows the portion of the collected plant material that was carbon, while at 1000 ^{o}C this shows the proportion of carbonate materials. Below ground material generally has a lower percentage of carbon compared to both live and dead material due to the complex root structures holding sand that could not be washed off. There appears to be no consistent change in LOI 500 or 1000 ^{o}C over the five year period in W2. However in W3 there appears to be a reduction in LOI 500 ^{o}C from 2011 onwards, likely reflecting the rise in salinity levels and their negative impact on both below ground biomass and to a lesser extent dead material – live material was not impacted. In W4 the reductions in LOI 500 ^{o}C are only associated with the below ground material in 2011 with recovery back to 2010 levels in 2014.

a) May



b) October

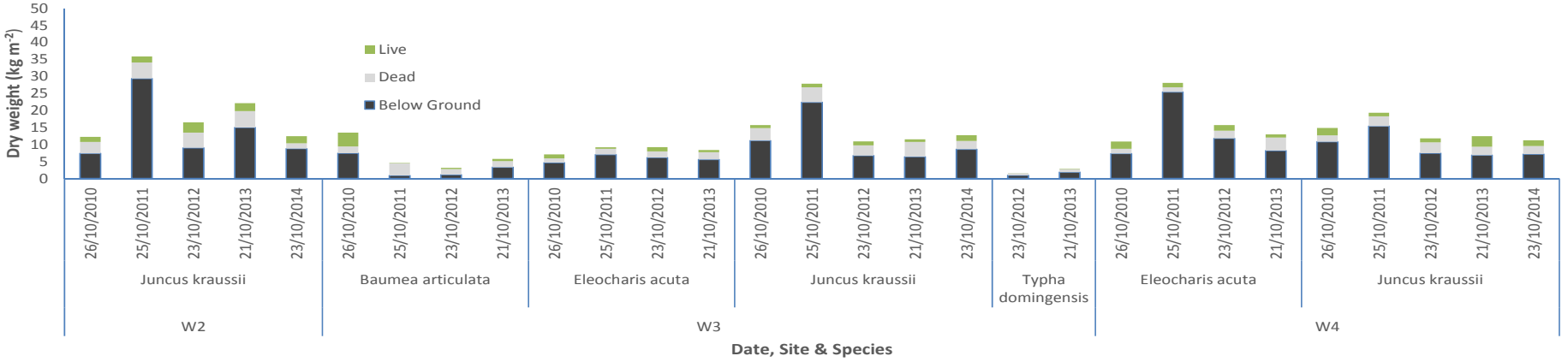


Figure 31. Mean vegetation biomass (live, dead and below ground material) for species sampled in a) May and b) October between 2010 and 2014 in each pond

Table 9. Loss on ignition (LOI; at 500 and 1000 °C) for rushes from ponds W2-W4 at Point Fraser between May and October 2010 to 2014.

Wetland	Species	Type of	18/05/2010		26/10/2010		24/05/2011		25/10/2011		22/05/2012		23/10/2012		20/05/2013		21/10/2013		26/05/2014		23/10/2014	
		Material	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000
W2	*Juncus kraussii*	Below Ground	60.7	1.0	48.9	0.7	32.9	1.6	17.0	0.8	24.0	1.6	44.2	1.5	16.3	0.8	29.5	0.8	26.8	1.0	20.6	1.3
		Dead	95.2	0.9	94.2	0.6	92.5	10.8	87.5	6.7	87.5	2.8	95.0	1.9	91.9	1.8	76.0	1.9	95.5	30.8	82.2	10.2
		Live	95.3	2.5	95.9	2.8	90.7	9.1	95.4	26.9	94.9	3.2	94.4	3.0	95.1	2.6	94.5	2.7	96.0	61.4	93.6	61.1
W3	*Baumea articulata*	Below Ground	72.8	1.3	65.5	1.6	72.4	6.3	75.8	7.1	42.0	1.3	65.2	2.1	50.4	1.3	62.3	1.2				
		Dead	93.6	0.7	86.5	3.9	89.4	10.9	81.9	7.0	92.2	1.7	89.4	5.8	82.1	1.8	62.7	2.5				
		Live	93.8	3.3	91.4	3.5	89.7	11.5			92.8	2.8	89.9	6.3	92.7	2.8						
	Eleocharis acuta	Below Ground	88.1	1.3	34.5	0.9	27.0	1.0	42.7	1.5	44.8	3.3	68.1	2.6	54.7	4.1	63.9	1.4				
		Dead	89.1	1.2	70.8	8.9	85.0	5.7	66.7	4.2	81.1	3.2	87.2	3.4	90.9	2.2	79.3	2.6				
		Live	94.8	1.7	93.8	2.2	90.9	5.8	91.6	9.2	92.9	1.4	91.6	2.9			92.3	1.8				
	Juncus kraussii	Below Ground	70.3	1.3	21.8	0.7	25.1	1.1	12.2	0.9	40.5	2.7	52.0	1.6	32.2	1.8	36.4	2.1	41.5	2.1	37.9	2.0
		Dead	93.8	1.3	70.0	7.2	89.4	7.3	91.4	1.0	89.2	4.2	86.5	6.5	81.8	3.2	69.6	2.5	87.9	26.7	71.0	15.3
		Live	96.3	2.7	91.5	4.7	94.2	18.4	94.6	28.7	94.5	3.3	94.2	3.7			84.7	4.0	94.7	70.0	94.6	61.1
	Typha domin-gensis	Below Ground									80.5	3.3	84.6	7.7	62.7	2.3	44.4	1.3				
		Dead									63.5	6.7	75.9	9.4	83.6	4.4	87.2	2.1				
		Live									89.1	7.5			84.5	7.3	92.9	3.0				
W4	*Eleocharis acuta*	Below Ground	56.6	1.0	78.4	1.2	16.6	1.0	21.5	0.9	34.3	1.1	54.5	1.0	54.1	0.9	41.9	0.8	61.4	2.9		
		Dead	88.7	1.3	88.4	2.6	86.1	10.0	89.8	6.7	82.3	2.6	86.4	3.3	89.2	1.4			85.2	9.3		
		Live	92.8	0.7	91.6	1.9	93.0	11.3	92.1	5.8	92.1	1.4	92.2	2.1	92.7	1.0			93.1	22.1		
	Juncus kraussii	Below Ground	72.4	1.8	39.1	1.2	19.6	0.9	15.9	0.9	33.7	2.1	59.3	0.6	42.1	1.5	50.7	1.0	62.4	3.9	27.1	1.3
		Dead	92.1	2.4	91.1	4.7	91.1	9.2	91.6	0.0	88.4	3.4	93.6	3.0	87.3	2.3	81.7	2.1	92.3	20.0	84.3	21.6
		Live	95.2	3.2	94.7	3.1	93.2	15.4	94.8	14.8	94.8	3.0	93.6	3.2	94.1	2.7	92.5	2.1	94.8	59.1	94.5	55.0

7.5.3 VEGETATION NUTRIENT LOADS

In Table 10 the mean concentrations across 2010 to 2014 for plant nutrient concentrations are shown. *Typha domingensis* generally outperforms all other species for nutrient uptake, followed by *B. articulata*, with *J. kraussii* and *E. acuta* similar with low means. *Typha domingensis* and to a lesser extent *B. articulata* are particularly interesting due to the high transfer of P to the below ground biomass, which may result in better storage and loss of P to the sediment. Both *J. kraussii* and *E. acuta* both have higher P concentrations in the leaves than found below ground or in dead material, suggesting that the nutrient is more easily released into the water column on leaf senescence. The P and N concentrations in below ground, dead and live biomass for *J. kraussii* was consistently higher in W3 and W4 compared to W2. Dead biomass for E. acuta concentrations of N and P differed little between W3 and W4, however W4 concentrations were consistently lower for below ground and live biomass. The higher nutrient concentrations seen in W3 suggest that increasing plant stress results in greater concentration of nutrients as the plants seek to sequester nutrients or produce less carbon increasing relative nutrient concentrations.

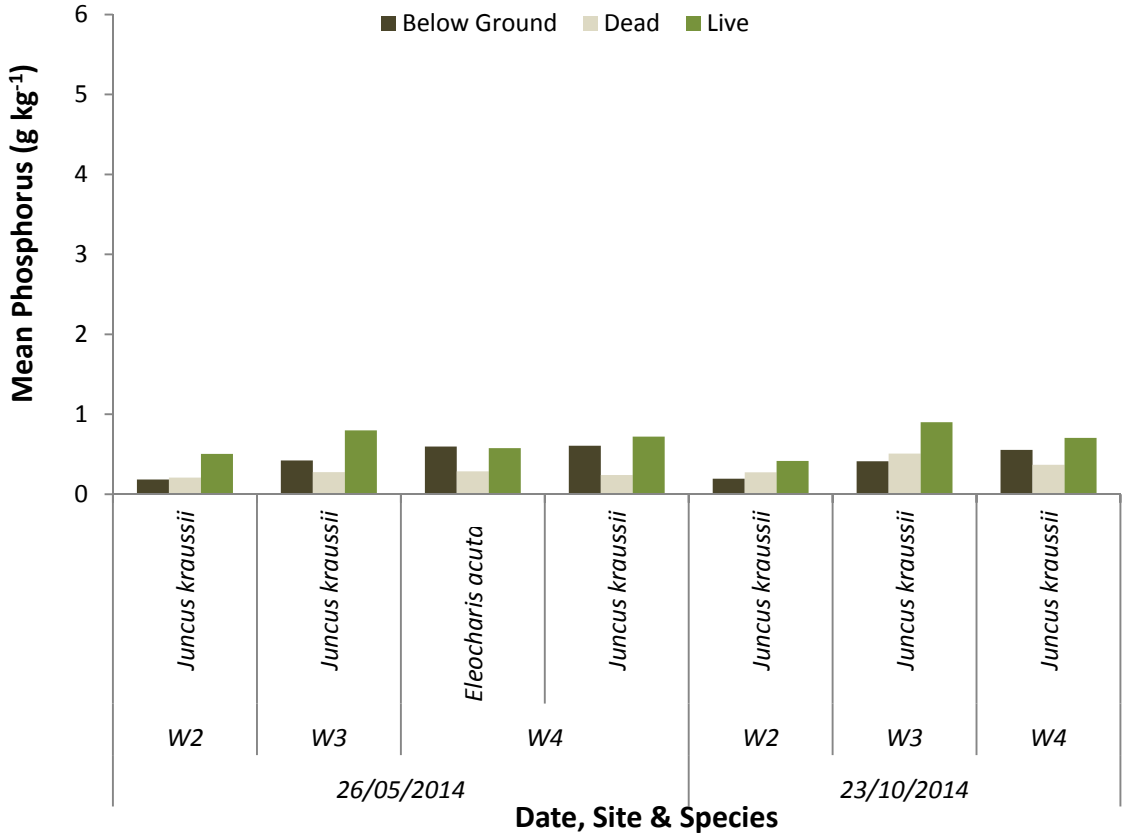
Table 10. Mean concentrations of P and N in plant components between 2010 and 2014

		Mean P concentrations (g kg^{-1})			Mean N concentrations (g kg^{-1})		
Species	Pond	Below Ground	Dead	Live	Below Ground	Dead	Live
Juncus kraussii	W2	0.9	0.7	1.7	16.9	24.0	27.0
	W3	2.2	1.6	3.2	26.7	31.7	36.2
	W4	2.2	0.7	3.4	24.5	32.8	34.0
Eleocharis acuta	W3	2.3	0.9	2.0	28.4	31.5	26.9
	W4	1.4	0.6	0.8	18.4	28.1	30.6
Typha domingensis	W3	6.1	1.6	3.7	34.4	36.7	55.2
Baumea articulata	W3	3.1	0.5	1.4	27.0	29.6	29.4

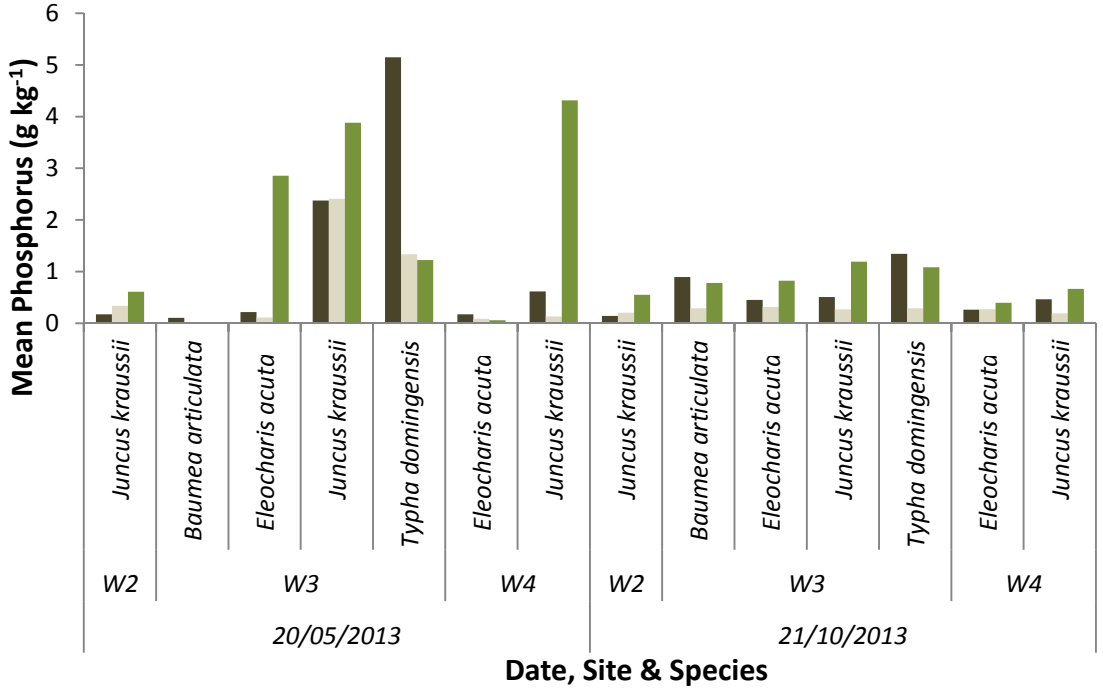
Mean P concentrations for each species, component, pond and sampling period are shown in Figure 32. In 2014, concentrations of P in *J. kraussii* in W2 were consistently lower than in W3 and W4. There was no difference between P concentrations in May and September. *Eleocharis acuta* P concentrations in all components was very similar to *J. kraussii* in W4. Concentrations of P were low in almost all locations (except W2), components and species in October 2013, but seemed to recover in May 2014. Coupled with slightly higher biomass in October 2013, these low concentrations might be associated with growth also seen in the number of leaves and leaf length.

Harvesting plants to remove P from the wetland is not recommended as for most seasons and species this would remove less than 1 g per kilogram of dry plant weight – considering most of this biomass is up to 70% water, this equates to 0.14 g P per kilogram of wet weight.

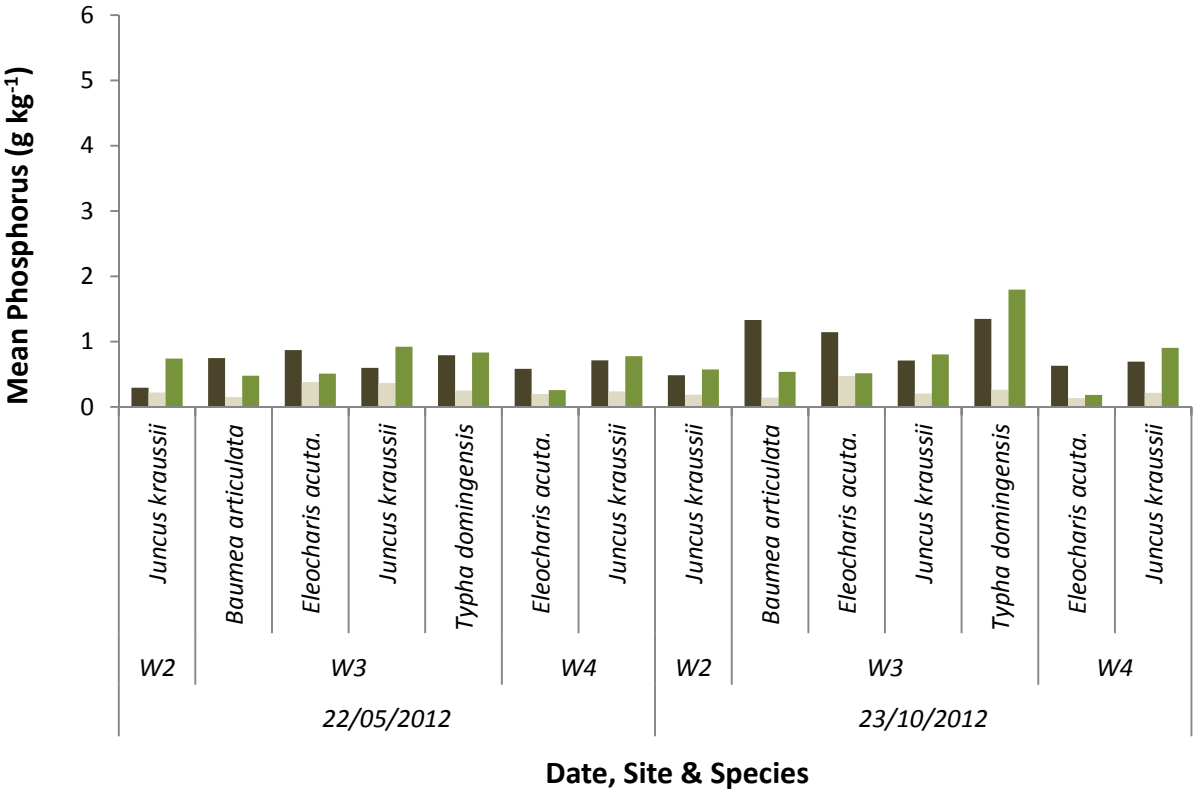
a) 2014



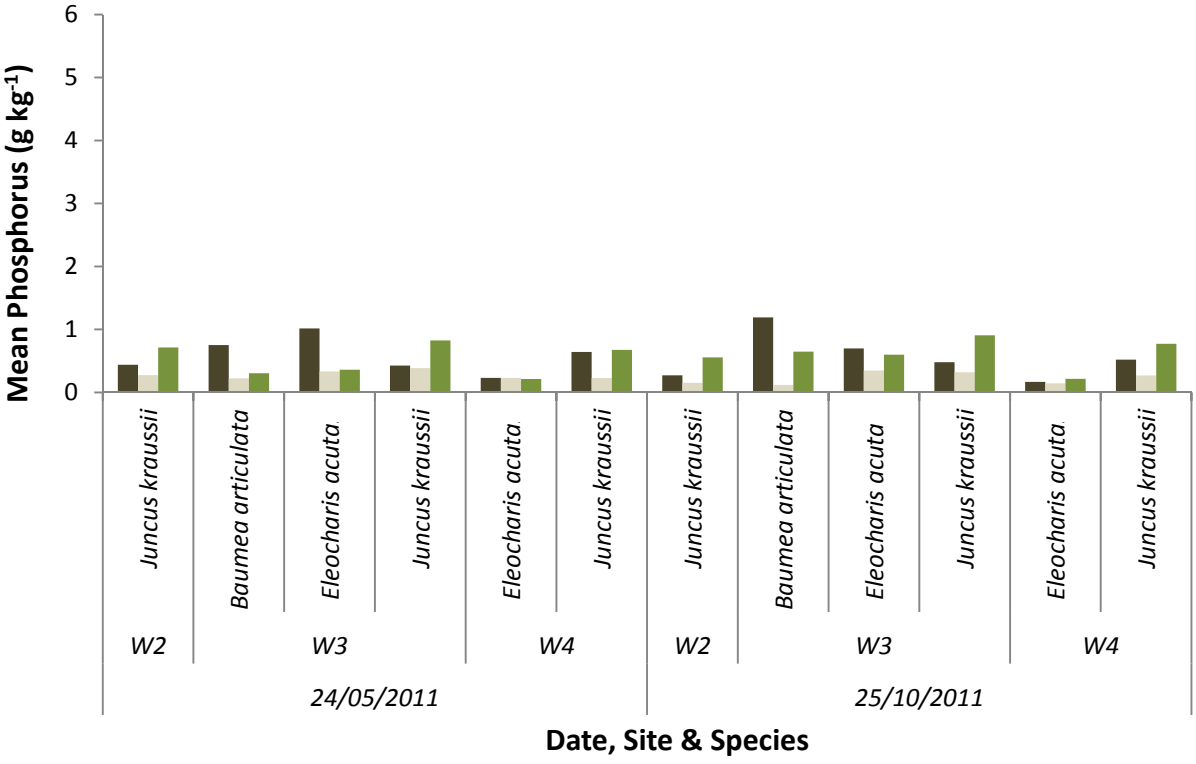
b) 2013



c) 2012


Mean Phosphorus (g kg-1)
6
5
4
3
2
1
0
Juncus kraussii
Baumea articulata
Eleocharis acuta.
Juncus kraussii
Typha domingensis
Eleocharis acuta.
Juncus kraussii
Juncus kraussii
Baumea articulata
Eleocharis acuta.
Juncus kraussii
Typha domingensis
Eleocharis acuta.
Juncus kraussii
W2
W3
W4
W2
W3
W4
22/05/2012
23/10/2012
Date, Site & Species

d) 2011


Mean Phosphorus (g kg-1)
6
5
4
3
2
1
0
Juncus kraussii
Baumea articulata
Eleocharis acuta
Juncus kraussii
Eleocharis acuta
Juncus kraussii
Juncus kraussii
Baumea articulata
Eleocharis acuta
Juncus kraussii
Eleocharis acuta
Juncus kraussii
W2
W3
W4
W2
W3
W4
24/05/2011
25/10/2011
Date, Site & Species

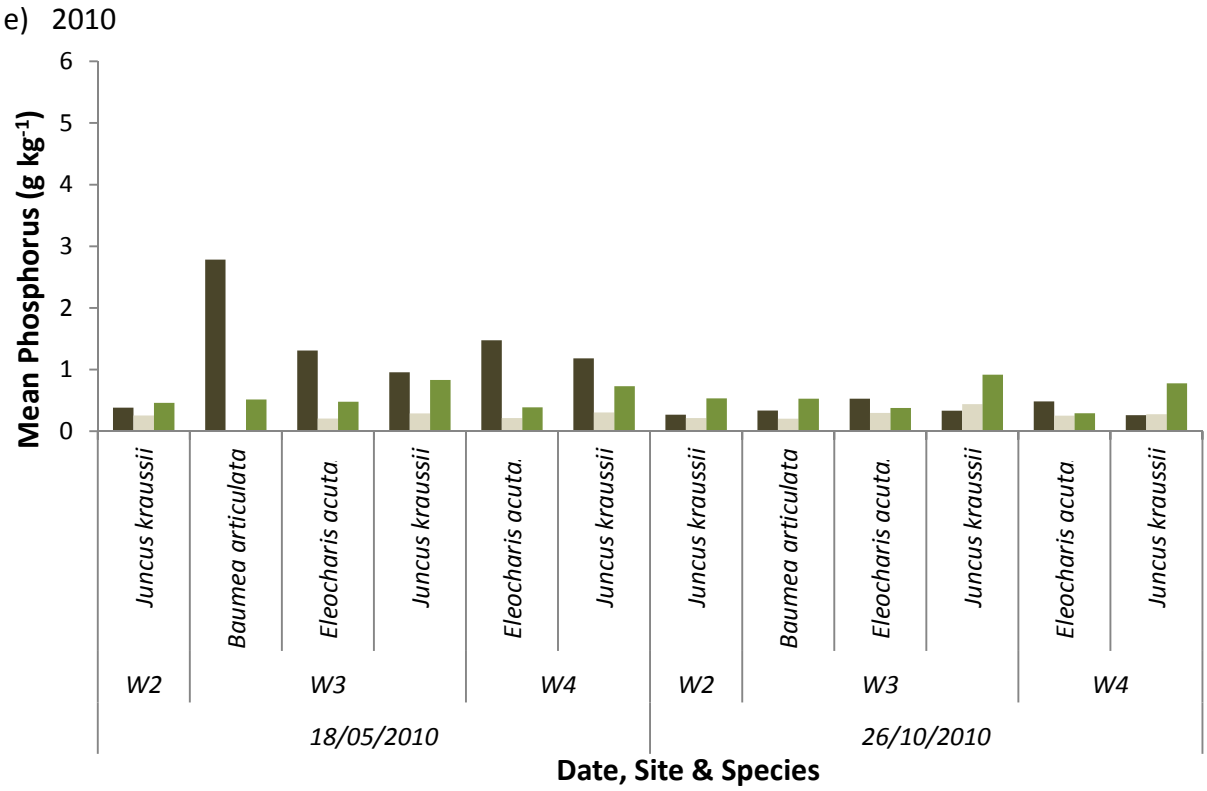
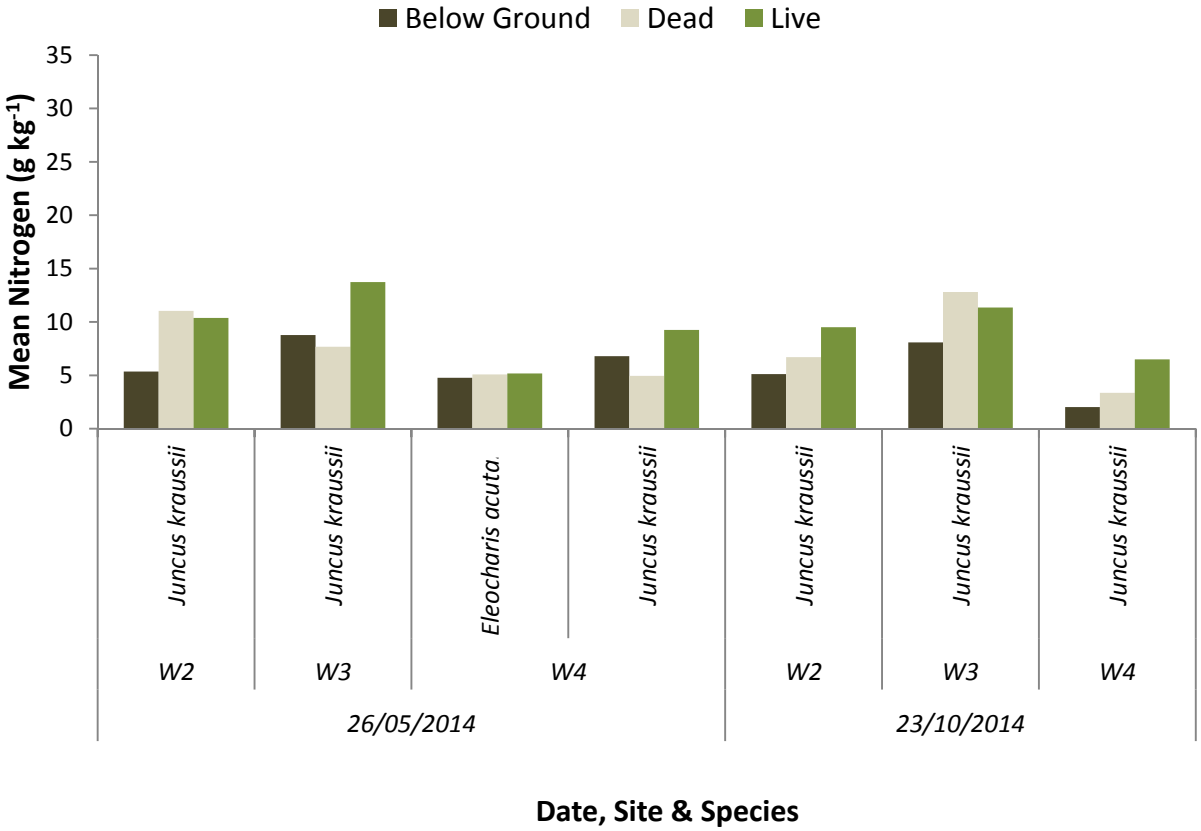


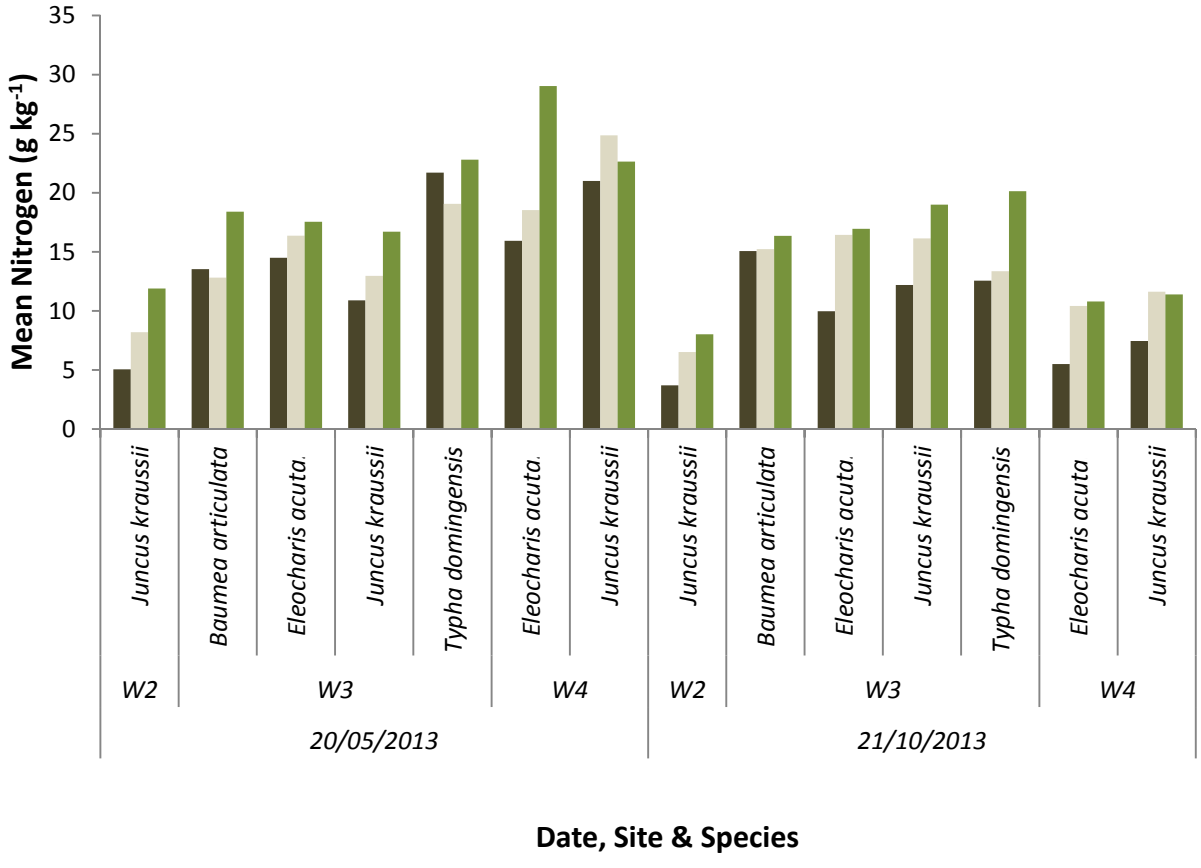
Figure 32. Mean quantities of phosphorus stored per kg of dry weight of live, dead and below ground parts of sampled species, over the seasons and between sites for a) 2014 to e) 2010.

Nitrogen concentrations in plant components over the seasons, between years and species are shown in Figure 33. Nitrogen concentrations were very similar between years in W2, however were highest in W3 and W4 in 2013, possibly due to increased growth in that year.

a) 2014


Below Ground
Dead
Live
Mean Nitrogen (g kg-1)
35
30
25
20
15
10
5
0
Juncus kraussii
Juncus kraussii
Eleocharis acuta.
Juncus kraussii
Juncus kraussii
Juncus kraussii
Juncus kraussii
W2
W3
W4
W2
W3
W4
26/05/2014
23/10/2014
Date, Site & Species

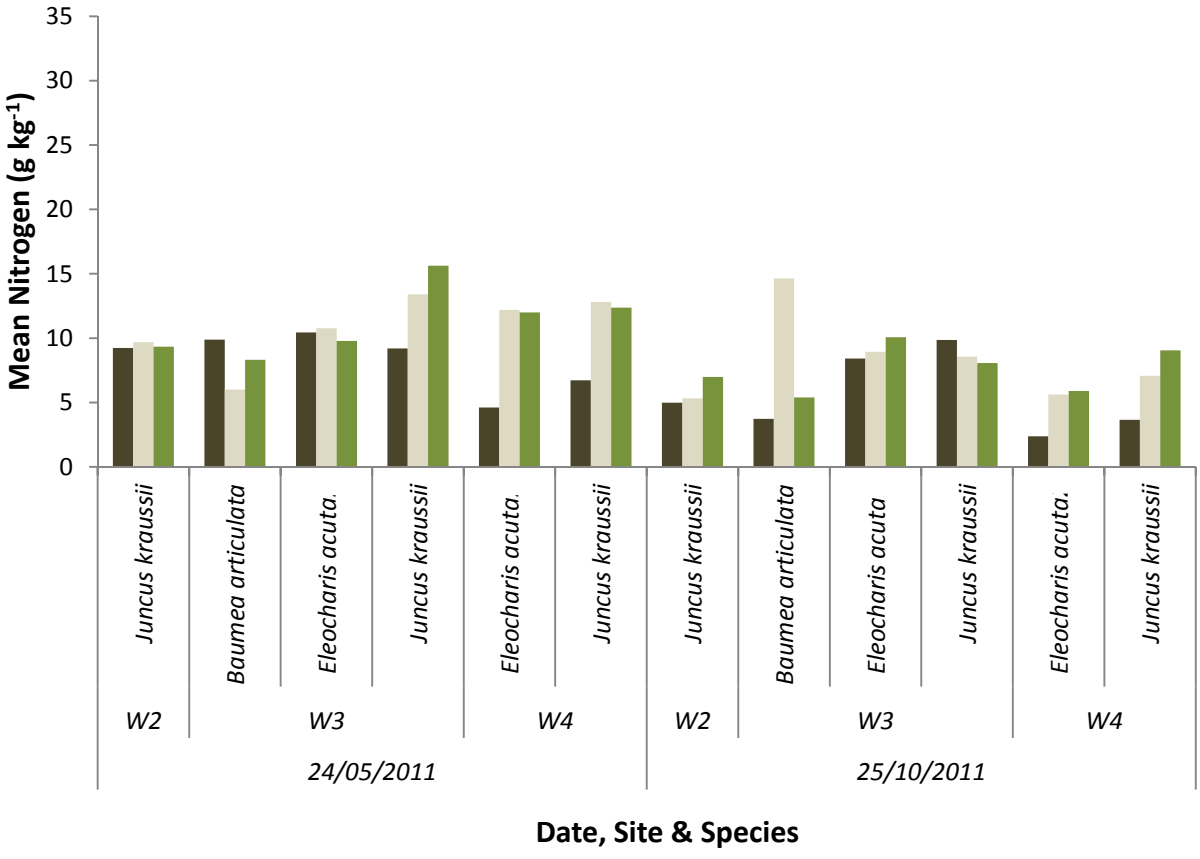
b) 2013


Mean Nitrogen (g kg-1)
35
30
25
20
15
10
5
0
Juncus kraussii
Baumea articulata
Eleocharis acuta.
Juncus kraussii
Typha domingensis
Eleocharis acuta.
Juncus kraussii
Juncus kraussii
Baumea articulata
Eleocharis acuta.
Juncus kraussii
Typha domingensis
Eleocharis acuta
Juncus kraussii
W2
W3
W4
W2
W3
W4
20/05/2013
21/10/2013
Date, Site & Species

c) 2012


Below Ground
Dead
Live
Mean Nitrogen (g kg-1)
35
30
25
20
15
10
5
0
Juncus kraussii
Baumea articulata
Eleocharis acuta
Juncus kraussii
Typha domingensis
Eleocharis acuta
Juncus kraussii
Juncus kraussii
Baumea articulata
Eleocharis acuta
Juncus kraussii
Typha domingensis
Eleocharis acuta.
Juncus kraussii
W2
W3
W4
W2
W3
W4
22/05/2012
23/10/2012
Date, Site & Species

d) 2011


Mean Nitrogen (g kg-1)
35
30
25
20
15
10
5
0
Juncus kraussii
Baumea articulata
Eleocharis acuta.
Juncus kraussii
Eleocharis acuta.
Juncus kraussii
Juncus kraussii
Baumea articulata
Eleocharis acuta
Juncus kraussii
Eleocharis acuta.
Juncus kraussii
W2
W3
W4
W2
W3
W4
24/05/2011
25/10/2011
Date, Site & Species

e) 2010

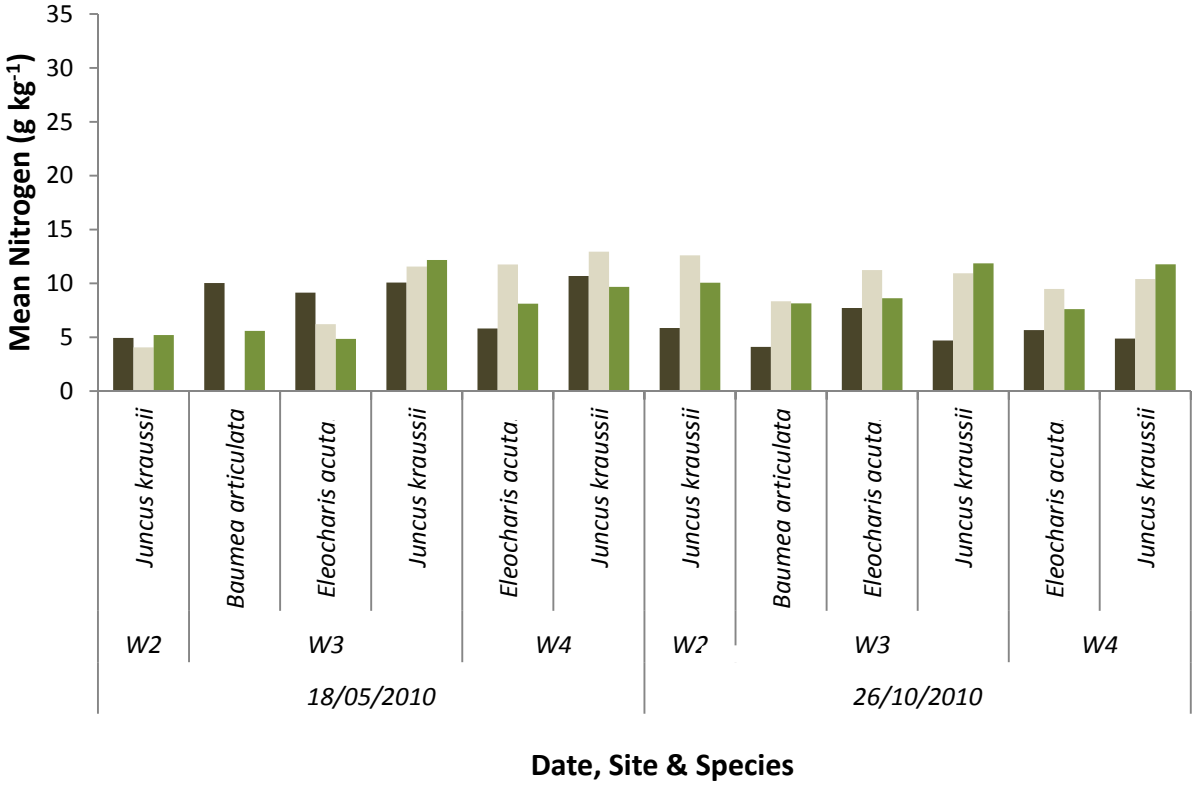


Figure 33. Mean quantities of nitrogen stored per kg of dry weight of live, dead and below ground parts of sampled species, over the seasons and between sites for a) 2014 to e) 2010.

Overall loads of P in living biomass decreased for *J. kraussii*, but increased for *E. acuta* despite the reduction in area, as concentrations increased. Lower concentrations of nutrients are often associated with growth, whilst increased concentrations can reflect sequestering or withdrawal from senescing leaves. All species except *E. acuta* saw substantial reductions in N, which supports the export noted from plant material noted in the water discharges. Phosphorus loads in dead plant material changed little from 2013 but generally decreased substantially for N. In 2012, loads of nutrients decreased substantially within the living and dead plant material, particularly for *J. kraussii*, following a significant drop in biomass and growth between May and October. The drop was probably associated with the high salinities noted prior to May in 2012 that manifested in poor growth in the main growing season of spring.

Wetland vegetation has survived a series of low rainfall years and high salinities in the ponds over the project; however *Juncus kraussii* is out-competing the other species, with all the others on the decline. Although *Eleocharis acuta* currently appeared healthy, the degree of coverage has declined substantially with only a reasonable pocket remaining in W4. *Baumea articulata* and *Typha domingensis* has suffered a large dieback, possibly due to the spike in salinity in 2012/13. The impact of the high salinities in the wetland in 2012/13 evident in low

productivity in 2012 and 2013, although there is now evidence of recovery. As the plants recover there has been substantial loss of N from all plant components which has resulted in release in elevated N concentrations from the wetland. This N release illustrates the role that plants play in nutrient uptake – they are a nutrient pool rather than store. Biofilms (not measured) on plants are generally considered to be more important in uptake of nutrients from the water and addition to the sediment sink.

Table 11. Total loads of N and P in living (above and below ground) and dead biomass per area of stands at each site. Note that the 2010 figures have been recalculated for *Eleocharis acuta* and *Juncus kraussii* for Zone 2.

			P Live (kg)					N Live (kg)				
Date	**Zone**	**Species**	**2010**	**2011**	**2012**	**2013**	**2014**	**2010**	**2011**	**2012**	**2013**	**2014**
May	1	*Juncus kraussii*	3.02	2.54	0.67	3.95	2.49	36.42	55.0	20.4	120.0	67.9
	2	*Baumea articulata*	0.04	0.07	0.05	0.03	-	0.37	1.03	8.71	5.60	-
		Eleocharis acuta	1.35	1.21	0.15	0.20	0.81	10.01	22.14	8.01	10.78	6.75
		Juncus kraussii	5.74	12.45	1.35	23.68	8.33	58.6	180.0	9.71	170.41	130.9
		Typha domingensis	-	-	2.97	0.03	-	-	-	11.30	3.30	-
Oct-ober	1	*Juncus kraussii*	1.66	4.67	0.34	2.00	1.39	34.33	83.22	7.38	43.4	36.3
	2	*Baumea articulata*	0.08	0.02	0.35	0.23	-	1.05	0.07	6.28	0.19	-
		Eleocharis acuta	1.18	1.69	0.29	0.39	-	17.33	23.29	6.09	8.20	-
		Juncus kraussii	8.13	11.13	0.44	7.74	8.15	122.25	140.49	8.58	150.6	94.6
		Typha domingensis	-	-	0.18	0.002	-	-	-	2.19	0.04	-

Table 11 cont.

			P Dead (kg)					N Dead (kg)				
Date	**Zone**	**Species**	**2010**	**2011**	**2012**	**2013**	**2014**	**2010**	**2011**	**2012**	**2013**	**2014**
May	1	*Juncus kraussii*	1.12	1.08	0.11	0.631	0.48	17.62	38.9	2.89	16.99	23.6
	2	*Baumea articulata*	<0.01	0.06	<0.01	<0.01	-	0.00	1.63	2.95	1.90	-
		Eleocharis acuta	0.20	0.27	0.02	0.027	0.12	6.51	6.60	3.42	4.60	1.73
		Juncus kraussii	1.06	1.91	0.20	3.568	1.79	43.61	101.2	4.78	83.9	46.4
		Typha domingensis	-	-	0.09	<0.01	-	-	-	1.83	0.02	-
Oct-ober	1	*Juncus kraussii*	0.49	0.50	0.10	0.592	0.23	27.00	15.65	3.11	18.31	6.24
	2	*Baumea articulata*	0.01	0.01	0.05	0.033	-	0.28	0.98	2.70	1.73	-
		Eleocharis acuta	0.13	0.14	0.09	0.121	-	4.87	3.90	3.75	5.05	-
		Juncus kraussii	1.95	2.03	0.08	1.447	1.70	54.73	54.6	4.94	86.8	31.6
		Typha domingensis	-	-	0.03	<0.01	-	-	-	1.11	0.01	-

7.5.4 FORESHORE MONITORING: CHANGES 2013-2014 (ONE YEAR)

The deterioration in foreshore condition at Monitoring Area 1 measured during previous year has continued in 2013, albeit at a generally slower rate than previous years of monitoring. Further erosion of the river bed has occurred and root systems of recently planted and older *Casuarina* trees on river banks are increasingly being exposed, jeopardising the health of these trees. There are now several dead *Casuarina* trees at the margin (see photographs below), with a few more tree dying at edge during 2013-2014. A slightly greater proportion of foreshore in Monitoring Area 1 is classified as having significant to severe erosion now mostly around 90%, up from average of 80% in 2013, and 20% in 2010; Table 12). Planted and naturally colonised areas of *Juncus* and other fringing wetland plants have all but disappeared along this section of foreshore and this appears to have made the sediment in this area more prone to erosion by waves, which are likely to be mainly driven by wind and the wake of large boats. PVC pipes, presumably buried in the sediment as part of an irrigation system to facilitate revegetation of foreshore, has now been exposed due to erosion, which demonstrates that a strip of sediment several metres wide and up to 30 cm deep has been lost to erosion in Monitoring Area 1. Further exposure of roots is likely which will result in more tree death.

Monitoring Area 2 remains relatively stable with dense *Juncus* and sedge cover protecting the foreshore from erosion (Table 12; Section 7.6). Access to Foreshore Monitoring sites 2A and 2B continued to be restricted in 2014 due to redevelopment in the area (i.e. fenced off) and therefore it was not possible to fully complete foreshore assessment and monitoring photographs during 2014 (although a nearby photo was taken for site 2A – see below)

7.5.5 FORESHORE MONITORING: CHANGE2010-2014 (5 YEARS)

Monitoring Area 1 (eastern side of Point Fraser) has experienced severe erosion over the monitoring period. At the start of the monitoring in 2010, most of this area had minimal or localised erosion only, with some patches having up to 50% significant erosion (by area). By 2014, most of this area was experiencing significant to severe erosion. A weighted erosion score was calculated for each monitoring site and period (Figure 34). On this scale, 1 represents a site having completely minimal erosion, whereas 4 means the whole site has severe erosion. Each monitoring site in Area 1 has dramatically increased its erosion score over the period 2010-2014, with the largest increases being the in period 2011-2012 (Figure 34). Sites F1A and F1C had generally localised erosion as of 2010 (erosion score less than 2), but by 2014 had mostly significant erosion (erosion score of 2.7 and 3.3 respectively). Site F1B had a relatively high erosion score at the start of monitoring in 2010, but by 2014 had almost complete coverage of severely eroded foreshore (erosion score of 3.6). With the erosion of the foreshore in Monitoring Area 1, tree roots have progressively been exposed, which ultimately lead to the death of these trees. As tree roots play a major role in binding

the sediment at the foreshore, loss of trees makes the area more vulnerable to further erosion.

Monitoring Area 2 (west side of Point Fraser) is relatively much more stable than Area 1. This is mainly due to the dense cover of sedges at the foreshore which has prevented erosion of the river bank. However, because of the restriction of access to much of this area from 2012 onwards, it is difficult to be certain of the more recent trends. The one monitoring site which has accessible each year (F2C) did however show increased erosion from 2010-2014 changing from a weighted erosion score of near 1 (i.e. mostly minimal erosion) to almost 2 in 2014 (which means generally localised erosion). This site however had generally less cover of sedges at the foreshore compared to sites F2A and F2B.

The headland area between Monitoring Areas 1 & 2 has been particularly affected by increased erosion. Since 2010, root systems of several large (and presumably old) *Casuarina* trees had been exposed through erosion of sediment despite various attempts to protect this stand of trees by rock re-enforcement and shells/pebbles. During 2011-12 one very large tree died and fell into the river. The health of several of the other trees (as evident from crown condition) appear to in decline with increasing amounts of erosion and root exposure during 2012-13, with some of these trees dying at the river edge in 2013-14.

It is recommended that Area 1 (including the headland between Areas 1 & 2) receive immediate remedial treatment in the form of sandbagging, further rock armoury or other re-enforcement, and then infill planting of fringing sedges/rushes to reduce erosion and help prevent further loss of trees. It is noted that some of this work has commenced in 2014.

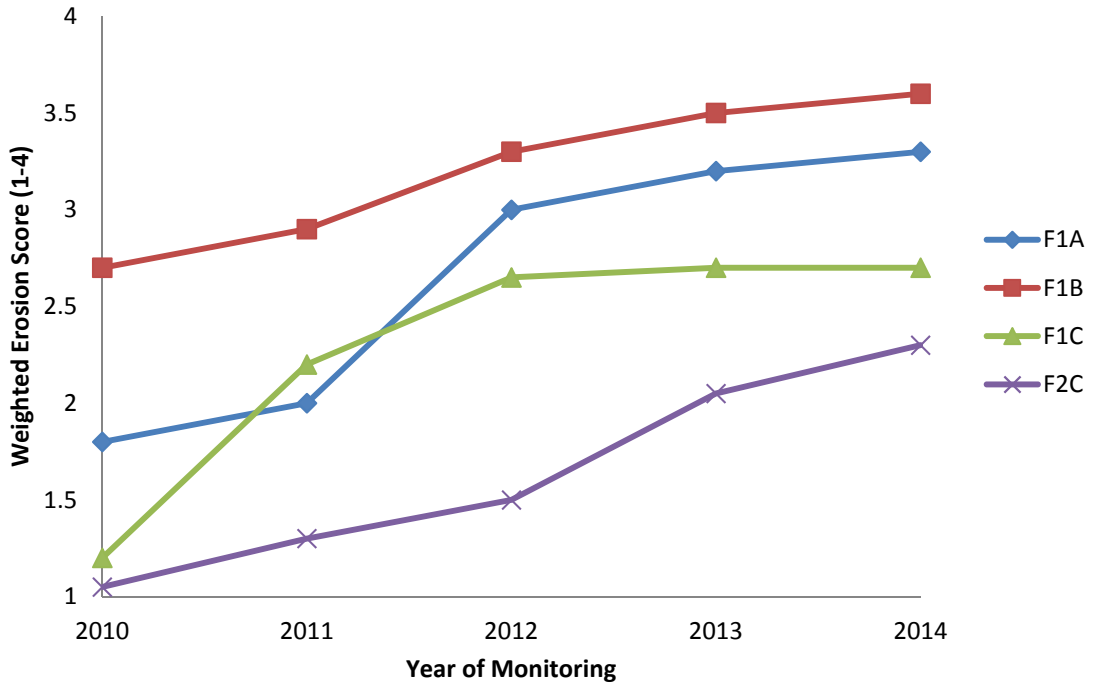


Figure 34. Change in weighted erosion score for four foreshore monitoring sites over period 2010 to 2014. Monitoring was conducted in late October or early November each year. Erosion score: 1= minimal, 2=localised; 3=significant; 4=severe. Weighted erosion score represents the average erosion score weighted by area.

.

Table 12. Condition Summary Table at each Study Site as of late October 2014. Data for 2010 and 2013 is included in parentheses (**in** red for 2010 and blue for 2013). Note F2A and F2B could not be monitored in 2012-13 (fenced off due to new foreshore development).

Site	Erosion	Slumping	Sedimentation	Vege-tation	Regen-eration	Weeds	Log/ Brush	Rock Work	Beach Areas	Fauna Use	Comments / Notes
F1A	0% Minimal (30%, 0%); 10% Localised (60%, 10%); 50%Significant (10%, 40%); 40% Severe (0%, 30%)	10% Minimal (40%, 20%); 20% Localised (50%,30%); 40% Significant (10%, 30%); 30% Severe (0, 20%)	70% Minimal (80%, 80%); 30% Localised (20%, 20%)	4 (2, 3)	3 (3, 4)	3 (3, 3)	N/A	Mostly consists of shell; Increased erosion of shells and underlying mud	Stable; but some erosion at high water mark	Nil	Needs new rock armoury at edge and infill planting to stop erosion. Rush/sedge cover is severely reduced from 2010 (cause for concern). Trees dying at edge.
F1B	0% Minimal (20%, 0%); 10% Localised (30%, 10%); 20%Significant (50%, 30%); 70% Severe (10%, 60%)	10% Minimal (40%, 20%); 20% Localised (50%, 30%); 30% Significant (10%, 20%); 40% Severe (0%, 30%)	80% Minimal (70%, 80%); 20% Localised (30%, 20%)	3 (2, 3)	3 (3, 4)	3 (3, 3)	N/A	Rock armoury around headland no longer effective. Wave action and high tides have eroded soil around trees exposing roots	Mostly stable; some erosion around edges near headlands	Nil	Erosion of headland either side of beach is significant exposing roots of trees; one tree has fallen into river and others are in decline; these areas need rock (or sandbag) armoury and infill planting.
F1C	80% Minimal (100%, 100%) 20% Localised (0%, 0%)	100% Minimal	70% Minimal (60%, 70%); 30% Localised (40%, 30%)	2	3	2 (3)	Stable	N/A	Loss of rushes and sedges at edge. Major increase in erosion in this area	Nil	Stability from dense rush/sedge cover has been lost since 2010. Increased erosion including roots of *Casuarina* trees
F2A	60% Minimal; 10% Localised (20%); 20% Significant; 10% Severe (0%)	70% Minimal; 10% Localised; 20% Significant	90% Minimal (70%); 10% Localised (30%)	2 (1)	4	3	Stable	Small amount of sedimentation	N/A	Trampling by water birds	Increase in amount of rubbish washed up from river (high tide). More couch grass invasion. Erosion between Juncus clumps in 2013-4
F2B	40% Minimal (95%, 50%); 10% Localised (5%, 10%); 30% Significant (0%, 25%); 20% Severe (0%, 15%)	90% Minimal; 10% Localised (*stable since 2011*)	75% Minimal (70%, 80%); 25% Localised (30%, 20%)	2 (1, 2)	3 (2, 3)	2 (3, 2)	Stable	Intact with minimal sedimentation	N/A	Trampling water birds	Some human trampling (to access river)
F2C								Minor sedimentation; rock work not effective	Erosion mostly on margins;	Nil	Stable embayment, but increased erosion of headland and flanks; vegetation

Site	Erosion	Slumping	Sedimentation	Vege-tation	Regen-eration	Weeds	Log/ Brush	Rock Work	Beach Areas	Fauna Use	Comments / Notes
								against high tides and storm surges – erosion of mud around tree roots	Reasonably stable		condition mostly finem but increasing erosion

Note 1: Erosion/Slumping/Sedimentation Classes: 0-5 % Minimal - Little evidence of erosion/slumping/sedimentation; 5-20 % Localized - Localized areas of erosion/slumping/ sedimentation; 20-50 % Significant - Active erosion/slumping/sedimentation is obvious along many parts of this section; >50% Severe - Significant erosion/slumping/sedimentation is more or less continuous along this section.

Note 2: Vegetation Condition: 1=Healthy- There is no observable damage or injury to the vegetation; 2=Some Sick - Some species show signs of insect/human damage above normal levels or a general decline in health such as defoliation or presence of dying branches; 3=Many sick or dying- Many plants show sign of severe decline in health with a number of dead and dying plants present; 4=Majority dead- Few of the native plants present are healthy

Note 3: Vegetation Regeneration: 1=Abundant- Seedlings occur in high numbers and are observable from any section of the area; 2=Frequent- Seedlings are common. Regeneration may occur in small stands of sporadically over large areas of the section; 3=Occasional: Seedlings are infrequent, occurring no more than once or twice with the area; 4=Rare: Seedlings occur very infrequently and may be observed only once or twice within the surveyed section.

Note 4: Weeds: 1=Abundant- Weeds are predominating. They can be seen from any section of the surveyed area; 2=Frequent- Weeds are common. They are patchy or occur in low numbers over a large percentage of the site; 3=Occasional- Weeds occur sporadically, more than once or twice within the area; 4=Rare- Weeds occur infrequently within the area. They may be observed only once or twice.

7.6 FORESHORE PHOTOGRAPHS

Photographs taken at Foreshore Monitoring Site 1A in an easterly direction. Note: loss of sedge/rush vegetation and increased erosion at the river edge with impacts on trees appearing in 2012-13.

May 2010

May 2011

October 2010

October 2012

Early November 2013

October 2014

Photographs taken at Foreshore Monitoring Site 1A showing severe erosion

October 2012

October 2012

Early November 2013

October 2014

Photographs taken at Foreshore Monitoring Site 1B in westerly direction. Note: *Casuarina* tree on headland has fallen into the river.

May 2010

May 2011

Early Nov 2013

October 2012

October 2014

Photographs taken at Foreshore Monitoring Site 2A in a Southerly direction. Note access to this site was restricted in 2012-14 due to redevelopment program

May 2010

May 2011

October 2012

Early November 2013

October 2014

Photographs taken at Foreshore Monitoring Site 2C in Southerly direction

May 2010

October 2011

October 2012

Early November 2013

October 2014

October 2014

Photographs taken at Foreshore Monitoring Site 2C in a Westerly direction

May 2010

October 2011

October 2012

Early November 2013

October 2014

October 2014

Photographs taken at Foreshore Monitoring Site 2C in Easterly direction

May 2010

May 2011

Early November 2013

October 2012

October 2014

Photographs taken of Casuarina Trees at Headland between Foreshore Monitoring Sites 2C and 1A

May 2010

October 2011

October 2012

October 2010

October 2011

October 2014

7.6.1 CONCLUSIONS AND RECOMMENDATIONS

7.6.1.1 CONCLUSIONS

1. Map the coverage of the aquatic plant species in the wetland.

Aquatic plant coverage was successfully mapped in 2014 with *Juncus kraussii* remaining as the dominant plant species and, followed by *Eleocharis acuta.* Areas dominated by *Juncus kraussii* were lost in 2013-14 and taken over by open water habitat; however this was more-or-less equal to spread of *J. kraussii* into patches of *E. acuta* vegetation. The small patch of *Baumea articulata* has continued to contract during 2014 and now occupies only ~1 m^2. A small patch of *Typha* or *Phragmites* colonised open water in Zone 2 during 2012 is no longer present. There is little evidence of weed invasion, although the wetland appears to have been colonised by species from the foreshore (possibly including *J. kraussii*). Overall, the extent of the various plant species and vegetation types has remained relatively stable from over 2014.

2. Measure development of biomass of major plant species within the wetland (Zones 1 and 2).

Biomass of major plant species has generally declined over the study from a peak in 2011, reflecting the impact of increased salinity in W3 and to a lesser extent W3. In W2 *J. kraussii* continued to grow until 2013 when salinity levels in W2 reached problematic levels.

3. Map the coverage of the aquatic plant species in the wetland.

Aquatic plant coverage was successfully mapped with *Juncus kraussii* remaining as the dominant plant species, followed by *Eleocharis acuta.* Areas dominated by *Juncus kraussii* were lost and taken over by open water habitat; however this was more-or-less equal to spread of *J. kraussii* into patches of *E. acuta* vegetation. The small patch of *Baumea articulata* has continued to contract during 2014. A small patch of *Typha* or *Phragmites* colonised open water in Zone 2 during 2012 but by the end of 2013, was almost dead. There is little evidence of weed invasion, although the wetland appears to have been colonised by species from the foreshore (possibly including *J. kraussii*). Overall, the extent of the various plant species and vegetation types has remained relatively stable from over 2014.

4. Measure the concentration of nutrients (N & P) in live, dead and below ground parts of each species in each site.

The salinity increase in 2012/13 noted in the wetland illustrated the limitations of relying on vegetation for nutrient removal. This limitation was that as the plants response to stress they can years later release large quantities of previously stored nutrients. In 2014, plants released N and this resulted in potentially a net export of the N from the wetland.

5. Establish some regular sites where the condition of the foreshore can be monitored. Key items of interest are erosion, weed invasion and the effectiveness of armouring that may have been put in place.

Sites have been established and monitored for the five years of the project. Significant erosion due to winter storms has caused considerable erosion and loss of vegetation over most of the foreshore.

7.6.1.2 RECOMMENDATIONS

10. Ongoing vegetation monitoring for nutrients and biomass is not considered necessary. It is recommended that annual assessments of the plant coverage are continued so that changes in coverage and possible die-back are detected allowing appropriate actions to be taken.
11. It is recommended that remediation activities be undertaken as soon as possible to protect the foreshore and existing vegetation along Area 1.
12. It is recommended that ongoing monitoring of the foreshore continue as detailed in the PFMEP. However, it is essential that action is taken by the City as soon as issues are reported to protect the foreshore.

7.7 AVIFAUNA

The specific aims of sampling the avifauna were to:

1. Determine the range of birds utilizing the park

Biodiversity is an important goal of the redevelopment of the Point Fraser reserve and avifauna are a good indicator of changes in biodiversity.

7.7.1 BACKGROUND AND METHODS

As part of the monitoring of biodiversity at Point Fraser, birds have been surveyed twice per year in autumn and spring at Point Fraser since 2010. Surveys consisted of a 60 minute area search of the entire Point Fraser site. All bird seen or heard were recorded. This included the gardens, lawns and shoreline, though birds in flight over the river were not included. Particular attention was paid to the created wetland areas of Point Fraser.

7.7.2 RESULTS AND DISCUSSION

Over the five years of monitoring, a total of 37 bird species from 23 families have been recorded from Point Fraser (Table 13). This is considered a good outcome for a small, very urban location. Waterbird numbers are fairly limited due to the small extent of open water on the reserve, though the nearby river provides ample habitat (though it was not surveyed). A number of interesting records have been noted from the site, including the Yellow-billed Spoonbills twice using the created wetlands and Little Grassbirds now nesting and permanently resident in the replanted reeds and rushes. The Pacific Black Duck is the most common waterbird and the other 4 species of duck recorded are all uncommon with only 2-3 occurrences (Table 13).

A number of predatory heron species are recorded from the site with the White-faced Heron present twice. Both the Eastern Reef Egret and Little Egret are rarely recorded in this area and are significant records for the site. Both of these species were recorded foraging along the shoreline of the river rather than in the created wetlands. These species are primary predators of frogs and fish. The Silver Gull was present in good numbers on all but two of the surveys and is a common generalist bird that has adapted strongly to suburbia.

The planted native gardens now support an abundant nectarivore community with the most commonly recorded bird in the surveys being the introduced Rainbow

Lorikeet. This species is usually recorded in flight or feeding on the planted nectar rich trees and shrubs. Unfortunately this declared pest species prefers palm trees for roosting and the prevalence of these along the foreshore serve to encourage this species. The Singing Honeyeater and Red Wattlebird have adapted well to suburban gardens (Davis et al., 2013) and were present in every survey. The Brown Honeyeater is also a common urban nectar feeder (Davis et al., 2013) and was present in all but one survey. An interesting and encouraging trend is the use of gardens by White-cheeked Honeyeaters. This species is less common than the New Holland Honeyeater in Perth gardens (Davis and Wilcox, 2013) but seems to be more common at Point Fraser where the dense, low gardens may emulate the heathland habitats that it prefers.

Aside from the ubiquitous Willie Wagtail and Magpie-lark which favour lawn areas (Davis et al., 2013), insectivorous birds are still uncommon at the site with a few records of the Black-faced Cuckoo-shrike, one record of the Western Gerygone (a foliage-gleaning insectivore reliant on native eucalypts) and the Striated Pardalote which is often present.

7.7.3 SAMPLING TIMING AND ADEQUACY

A species accumulation curve for the 5 years of sampling indicate that the number of species is still slowly accumulating but that the curve is starting to flatten off, indicating that sampling has been fairly representative (Figure 35). It can be seen that by the seventh sampling period (year 4) only a small number of species has been added.

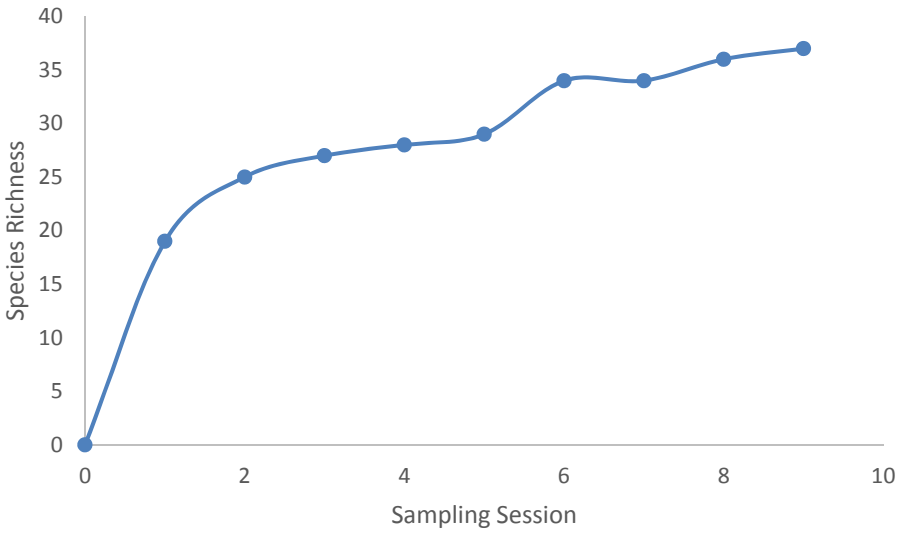


Figure 35. Species accumulation curve for bird surveys at Point Fraser.

7.7.4 CONCLUSIONS

Although the limited extent of the wetlands will never support a high number of waterbirds, the combination of different habitats including open lawns, planted native gardens, remnant trees, river shore and artificial wetlands with reed beds, host a diverse and abundant bird fauna. Ongoing monitoring will continue to add species and further understand the importance of the site to native birds.

Table 13. Birds recorded from the Point Fraser wetlands during surveys from 2010-2014 inclusive.

Species		21/5/10	3/11/10	1/6/11	9/11/11	1/6/12	21/5/13	15/10/13	29/5/14	14/10/14
Anatidae (ducks and swans)										
Australian Shelduck	*Tadorna tadornoides*						2			
Australian Wood Duck	*Chenonetta jubata*	4								
Grey Teal	*Anas gracilis*	2						2		1
Pacific Black Duck	*Anas superciliosa*	10	5	2	15	7	7	5	7	3
Hardhead	*Aythya australis*				2			2		
Columbidae (pigeons and doves)										
Laughing Dove	*Streptopeila senegalensis*		1		1		2			
Spotted Dove	*Streptopeila chinensis*	1				1	5	4	3	2
Anhingidae (darters)										
Australasian Darter	*Anhinga novaehollandiae*	1							1	
Phalacrocoracidae (cormorants)										
Little Pied Cormorant	*Microcarbo melanoleucos*	1	1			1				
Great Cormorant	*Phalacrocorax carbo*	1			2					
Little Black Cormorant	*Phalacrocorax sulcirostris*	4								3
Ardeidae (herons and egrets)										
Eastern Great Egret	*Ardea modesta*						1			
Little Egret	*Egretta garzetta*						1			
White-faced Heron	*Egretta novaehollandiae*						6			1
Threskiornithidae (ibis and spoonbills)										
Australian White Ibis	*Threskiornis molucca*			3						
Yellow-billed Spoonbill	*Platalea flavipes*	3								1
Accipitridae (kites, hawks and eagles)										
Black-shouldered Kite	*Elanus axillaris*		1							
Rallidae (rails and crakes)										
Buff-banded Rail	*Rallus phillipensis*									2

Species		21/5/10	3/11/10	1/6/11	9/11/11	1/6/12	21/5/13	15/10/13	29/5/14	14/10/14
Charadriidae (lapwings and plovers)										
Black-fronted Dotterel	*Elseyornis melanops*		1							
Laridae (gulls and terns)										
Caspian Tern	*Hydroprogne caspia*								1	
Crested Tern	*Thalasseus bergii*		1							
Silver Gull	*Chroicocephalus novaehollandiae*	8	1	2	4	1	2			3
Cacatuidae (cockatoos)										
Galah	*Eolophus roseicapillus*								4	2
Corella spp.	*Cacatua sp*	3								5
Psittacidae (lorikeets and parrots)										
Rainbow Lorikeet	*Trichoglossus haematodus*	36	26	54	2	9	10	21	9	16
Australian Ringneck	*Barnardius zonarius*									1
Acanthizidae (thornbills, scrubwrens and gerygones)										
Western Gerygone	*Gerygone fusca*						1			
Pardalotidae (pardalotes)										
Striated Pardalote	*Pardalotus striatus*	3	1		4	2	2		1	1
Meliphagidae (honeyeaters)										
Singing Honeyeater	*Lichenostomus virescens*	5	4	4	3	9	6	4	6	6
Western Wattlebird	*Anthochaera lunulata*				1				1	
Red Wattlebird	*Anthochaera carunculata*	7	1	2	6	11	12	6	7	5
Brown Honeyeater	*Lichmera indistincta*	2	10		11	7	1	11	3	9
New Holland Honeyeater	*Phylidonyris novaehollandiae*							2	7	
White-cheeked Honeyeater	*Phylidonyris niger*	4	2	4	5		8	1	3	1
Campephagidae (cuckoo-shrikes)										
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				5		2	1		
Artamidae (woodswallows)										
Australian Magpie	*Gymnorhina tibicen*			1					4	1
Rhipiduridae (flycatchers)										
Willie Wagtail	*Rhipidura leucophrys*	4	2	3	4	3	4	1	4	2

Species	21/5/10	3/11/10	1/6/11	9/11/11	1/6/12	21/5/13	15/10/13	29/5/14	14/10/14
Corvidae (ravens and crows)									
Australian Raven *Corvus coronoides*				3	1	2		3	4
Monarchidae (monarchs and flycatchers)									
Magpie-lark *Grallina cyanoleuca*		1		4	1	2		2	1
Megaluridae (Old World warblers)									
Little Grassbird *Cincloramphus mathewsi*				1		6	5	3	3
Timaliidae (White-eyes)									
Silvereye *Zosterops lateralis*		2	1			1	1	5	
Hirundinidae (swallows)									
Welcome Swallow *Hirundo neoxena*	4	2	14	4		2	6	3	1
Total:	103	62	90	72	57	86	72	77	74
Species Richness :	19	17	11	17	12	23	15	20	23
Species Richness to Date:	**42**								

7.8 MACROINVERTEBRATES

The specific aims of the macroinvertebrate monitoring program were to:

1. Determine what species were using different zones of the wetland

This will show the ability of the wetland to support biodiversity and provides a baseline for any development of biodiversity.

The taxa richness increased from May to October in every year (Figure 36a). October or spring is generally considered the time of highest species richness and abundance on the Swan Coastal Plain (Davis *et al.*, 1993). This was reflected in the Point Fraser wetlands particularly in taxa richness which increased by over 5 taxa, but not for abundance (Figure 36b). The changes seen in total abundance reflect the impact of increasing salinities which substantially reduced abundance, only seeing it rise again in 2014 as the salinities dropped. The taxa richness declined sharply from 2010 as salinities increased in Zone 2, and did not decrease in Zone 1 until the salinity increased in 2012. Between 2012 and 2013 taxa were generally salt tolerant and Foraminifera and Polychaeta are primarily marine groups. The taxa collected were generally cosmopolitan and tolerant. The most abundant taxa were the Ostracoda; the high numbers were partially due to the use of 250 µm net which ensures these taxa are collected.

The Primer 6 (Primer-E Ltd) software package was used to produce ordinations of the data (MDS), a technique for translating the similarities in communities in terms of richness and abundance into a physical distance and then plotting that distance to visually demonstrate those relationships. In Figure 36 c, it can be seen that there was a general trend for 2014 to move closer to 2010 than previous years. In 2014, for both zones and each month both 2010 and 2014 communities were similar. These trends support the reduction seen in salinity and the gradual move back to the communities that existed back in 2010.

The introduced fish *Gambusia holbrooki* was observed in all ponds in the summer months. They are known predators of a many surface dwelling macroinvertebrates and amphibians (Pyke, 2008). Removal and control of *G. holbrooki* populations is difficult and ultimately unlikely to be effective. Amphibians were not sampled during this study.

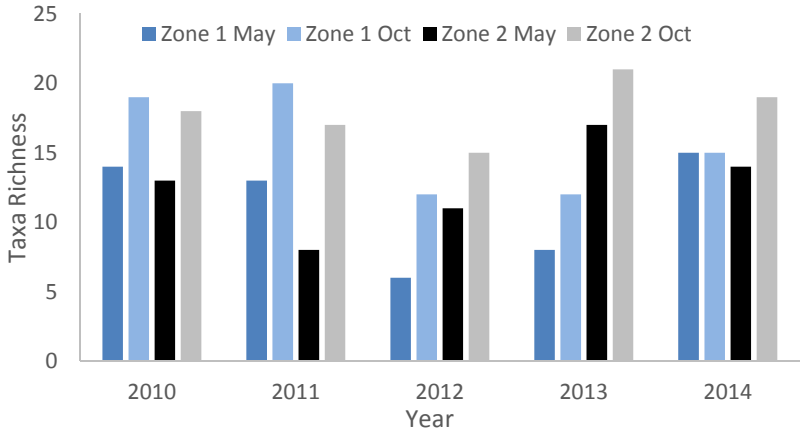
Table 14. Total abundance (from two 5 m transects) at Zone 1 and 2 of macroinvertebrates (>250 µm) in May and October 2010 to 2014; J=Juveniles (too small to identify), L= larvae, P = Pupa. (c=class, s=sub, sp=super, o=order, f=family, g=genera)

Collection date		2010				2011				2012				2013				2014			
		May		October		May		October		May		October		May		October		May		October	
Site		Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
ANNELIDA sc.Hirudinea		230	20	4		5	10	9	149	1	20	3	29	16	42	10	4	2		5	
ANNELIDA o.Oligochaeta									53						37		789				134
ANNELIDA o.Oligochaeta f.Tubificidae																	7				
ANNELIDA o.Polychaeta				4	7				7		2		29	2	66		2				
ARACHNIDA o.Acariformes f. Limnesidae																	1				
ARACHNIDA o.Acariformes f.Orbatidae				48		9		8	30		9				4		2			1	
CNIDARIA g.*Hydra*																		1			
FORAMNIFERA					9	4	5	8	304		176		171		2						
MOLLUSCA c.Bivalvia f.Sphaeriidae											1		3						56		
MOLLUSCA c.Gastropoda f.Ancylidae									1												
MOLLUSCA c.Gastropoda f.Physidae		25						2													
MOLLUSCA c.Gastropoda f.Pomatiopsidae						1	20	52	7	2	5	1	1					55	3	1	
MOLLUSCA c.Gastropoda f.Thiaridae																				22	
NEMATODA									1								2				
ARTHROPODA c.Insecta o.Coleoptera f.Dytiscidae	L	15	23	4	3	2		1													
ARTHROPODA c.Insecta o.Coleoptera f.Hydraenidae	L					1															
ARTHROPODA c.Insecta o.Coleoptera f.Hydrophilidae	L	5	1	4	2	1		2	2				1				1				4
ARTHROPODA c.Insecta o.Diptera f.Ceratopogonidae	P														2						
ARTHROPODA c.Insecta o.Diptera f.Ceratopogonidae	L							2							10				2		
ARTHROPODA c.Insecta o.Diptera f.Ceratopogonidae sf.Dasyheleinae	L		46	20	15								3		19	1	3				
ARTHROPODA c.Insecta o.Diptera f.Chironimidae	P		120		15							2				10	3		2		3
ARTHROPODA c.Insecta o.Diptera f.Chironimidae	J		120		15																
ARTHROPODA c.Insecta o.Diptera f.Chironimidae sf.Chironominae	L	200	1336	103	465	2	3	139	91	6	59	137	12	1	6	149	714	247	178	301	205
ARTHROPODA c.Insecta o.Diptera f.Chironomidae sf.Orthocladiinae	L	15	24					9						1	1		3	1	7		1

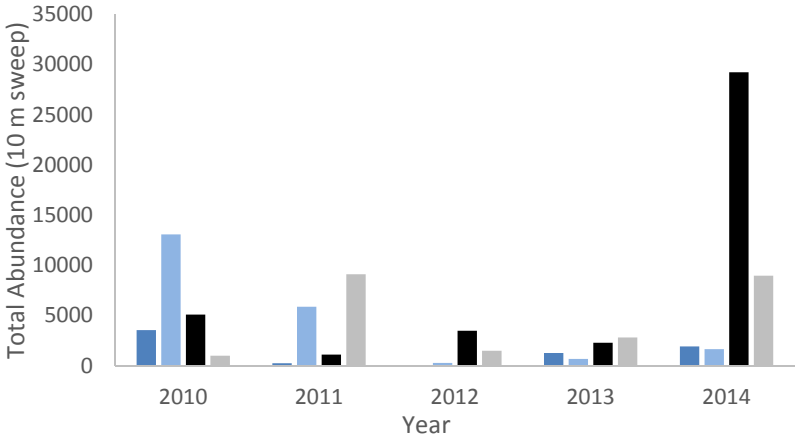
Collection date		2010				2011				2012				2013				2014			
		May		October		May		October		May		October		May		October		May		October	
Site		Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
ARTHROPODA c.Insecta o.Diptera f.Chironimidae sf.Tanypodinae	L			22	71		1	21	9			1				7	1	8	14	15	26
ARTHROPODA c.Insecta o.Diptera f.Chironimidae sf.Tanypodinae	P								1										3		
ARTHROPODA c.Insecta o.Diptera f.Culicidae g.*Culex*	L																				1
ARTHROPODA c.Insecta o.Diptera f.Lepidoptera																	1				
ARTHROPODA c.Insecta o.Diptera f.Tipulidae	L					2						1	1								
ARTHROPODA c.Insecta o.Diptera c.Trichoptera f.Leptoceridae	L	26			2				1			1						8	1	3	3
ARTHROPODA c.Insecta o.Diptera c.Trichoptera	P			1																	
ARTHROPODA c.Insecta o.Diptera c.Trichoptera f.Hydroptilidae	L			4																	
ARTHROPODA c.Insecta o.Hemiptera f.Coxidae *Agroptocorixa parvipunctata*																	2	6			
ARTHROPODA c.Insecta o.Hemiptera f.Corixidae		5	35	29	10			1		1					3	1		4	135	0	53
ARTHROPODA c.Insecta o.Hemiptera f.Notonectidae *Paranisops endymion*																			47		2
ARTHROPODA c.Insecta o.Hemiptera f.Veliidae						1		1	1								1				
ARTHROPODA c.Insecta o.Odonata so.Epiproctophora	J	5			1											1					6
ARTHROPODA c.Insecta o.Odonata so.Epiproctophora f.Aeshnidae	L																				1
ARTHROPODA c.Insecta o.Odonata so.Epiproctophora f.Telephlebiidae	L			3	1																
ARTHROPODA c.Insecta o.Odonata so.Zygoptera	J	5	42	1	1						1				2		1			2	33
ARTHROPODA c.Insecta o.Odonata so.Zygoptera f.Coenagrionidae	L			3	10					2			1					4	6		3
ARTHROPODA c.Insecta o.Odonata so.Zygoptera f.Chorismagrionidae	L		2																		
ARTHROPODA c.Insecta o.Odonata so.Zygoptera f.Lestidae	L		1					2													
ARTHROPODA c.Malacostraca o.Amphipoda f.Ceinidae												11		1	1	99	12	1			
ARTHROPODA c.Malacostraca o.Decapoda f.Palaemonidae							12		2							5				1	
ARTHROPODA c.Malacostraca o.Amphipoda f.Paramelitidae								85													
ARTHROPODA c.Malacostraca o.Isopoda f.Sphaeromatidae		5		88	56	19	132	12	49	5	22	4	258	16	25	5	83	5		14	
ARTHROPODA c.Ostracoda		2960	3400	1156	294	189	926	5505	8374	3	3184	34	936	918	2060	198	529	1472	28747	7060	1289
ARTHROPODA spo.Cladocera f.Chydoridae				52																	

Collection date	2010				2011				2012				2013				2014			
	May		October		May		October		May		October		May		October		May		October	
Site	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
ARTHROPODA sc.Copepoda o.Calanoida	20		1016	6						1	72	42	312	3	189	645	30	12	462	347
ARTHROPODA sc.Copepoda o.Cyclopoida	25	40	100	15	1		11	19				1		1		7	1	14	589	7
ARTHROPODA sc.Copepoda o.Harpacticoida							2							3			72		16	1
Taxa Richness	14	14	19	19	13	8	19	18	7	11	11	14	8	18	12	21	16	16	15	18
Total Abundance	3541	5210	13074	998	237	1109	5872	9101	20	3480	267	1488	1267	2287	675	2811	1913	29233	8492	2119

a) Taxa richness



b) Total abundance (10 m)



c) Ordination of community data

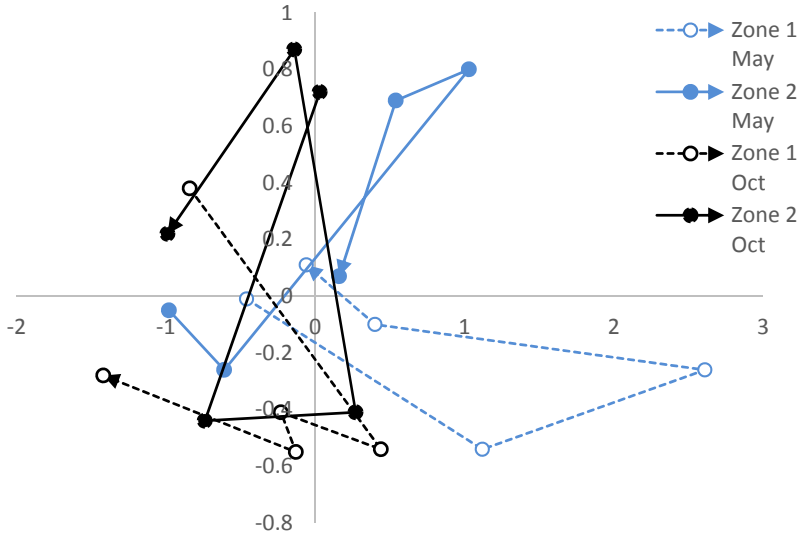


Figure 36. Macroinvertebrate a) taxa richness, b) total abundance (10 m sweep) and c) multi-dimensional scaling plot showing similarity of sites to each other in terms of community structure, data aggregated into zones (1 and 2) and months (May and October) at Point Fraser between 2010 to 2014 (arrows indicate direction of movement in that zone over time and point at 2014, rest of the years follow in consecutive order).

7.8.1 CONCLUSIONS AND RECOMMENDATIONS

7.8.1.1 CONCLUSIONS

1. Determine what species were using different zones of the wetland

Achieved, with 16-18 taxa collected which is similar to the high values recorded in 2010 prior to high salinities which saw taxa richness drop to 8-14 in 2012. Richness was always higher in spring and in W3 and W4 (presumably due to the high density of plants). The majority of taxa are cosmopolitan and typical for this type of wetland on the Swan Coastal Plain.

7.8.1.2 RECOMMENDATIONS

13. Although the avifauna and aquatic macroinvertebrate monitoring has shown there has been a slight increase in biodiversity within the wetland over the five years, it is not considered that ongoing monitoring is warranted. If further monitoring was to be considered then a frequency of every 2-3 years would be sufficient.

7.9 SOCIAL MONITORING

The five year social monitoring program has collected and analysed data to assess and report on the quality, quantity and type of recreational and educational use of the parkland by determining visitor presence, behaviour, use, expectations and satisfaction and awareness of reports/information specific to Point Fraser (COP, 2010). Social monitoring parameters enable the evaluation of the performance of the Point Fraser Reserve redevelopment. The specific aims of the social monitoring program are to:

(1) Determine visitor usage of Point Fraser: to document how people are utilising the reserve, including the mode of transport in and out.
(2) Observe usage of Point Fraser by the public: to document what people are doing once at the reserve.
(3) Interview park users for why they used the park: to provide a better understanding of why the park is being used by the public.

In order to achieve the aims, three assessment tools were applied in a biannual (May and October) sampling program: (1) visitor counts; (2) visitor surveys; and (3) visitor behaviour observations. Survey collection, visitor counts and observation of behaviour occurred for two days, during the week on a Wednesday and on the weekend on a Saturday, in May and October as outlined in Table 15. No visitor surveys were conducted in Round 4, 5 or 6 as per agreement with City of Perth due to issues of survey saturation identified during Round 3.

Visitor surveys were resumed in Year 4, Rounds 7 and 8. In the final year, Year 5, of the social monitoring, visitor counts, observations and surveys were all collected in both Round 9, May and Round 10, October 2014.

Table 15. Dates of Year 1 to 5 assessment events.

			Dates of Data Collection		Types of Data Collection	
Year		**Round**	**Weekday**	**Weekend**	**Visitor Observations & Behaviour Counts**	**Visitor Surveys**
YEAR 1 - 2010	May	1	Wed 19 May 2010	Sat 29 May 2010	Yes	Yes
	October	2	Wed 27 Oct 2010	Sat 30 Oct 2010	Yes	Yes
YEAR 2 - 2011	May	3	Wed 25 May 2011	Sat 28 May 2011	Yes	Yes
	October	4	Wed 26 Oct 2011	Sat 5 Nov 2011	Yes	No
YEAR 3 - 2012	May	5	Wed 23 May 2012	Sat 26 May 2012	Yes	No
	October	6	Wed 24 Oct 2012	Sat 27 Oct 2012	Yes	No
YEAR 4 - 2013	May	7	Wed 22 May 2013	Sat 25 May 2013	Yes	Yes
	October	8	Wed 23 Oct 2013	Sat 26 Oct 2013	Yes	Yes
YEAR 5 - 2014	May	9	Wed 28 May 2014	Sat 31 May 2014	Yes	Yes
	October	10	Wed 22 Oct 2014	Sat 25 Oct 2014	Yes	Yes

7.9.1 VISITOR COUNTS

Visitor observation counts were conducted during the weekday and the weekend monitoring event for each survey round, across three points at Point Fraser parkland in 2014, as per previous data collection rounds. SMC1 is the most western point of the parkland, in close proximity to both the river and Riverside Drive. Data collected at this point includes both observations inside the park and outside the park. The most eastern point of the park, adjacent to the river and to the Causeway is SMC2. The final observation point is SMC3, with the entrance to the commuter car park and the central most northern point of the park. The data is presented for May in Table 16, October in Table 17 at all three observation points, SMC1, SMC2 and SMC3. Table 18 displays the monitoring results SMC1 (outside the park) from the path that borders Point Fraser parkland and Riverside Drive. The data was recorded for a 15 minute period and extrapolated to hourly data from 7am to 6pm.

Overall in rounds 9 and 10 and consistent with previous data collected, the main entry points for both pedestrians and cyclists were the West (SMC1) and East (SMC2). The car park entrance (SMC3) was predominately used as an access point for a commuter car park by city workers during the week. Also as with previous years, on the weekend, car park use was lower as it appears that fewer people access Point Fraser by car specifically for recreational purposes. Point Fraser is busier in October than May as observed in Rounds 9

and 10. In general during the week the peak use is in the early morning and later in the afternoon, when people are commuting to and from the city or exercising. On the weekend, the majority of the park users were observed over the middle of the day, less so early morning or late afternoon.

During the week in the early morning and late afternoon, in both May and October there were extremely low, and at times no cyclists observed at SMC1 and SMC2. Early morning walkers were observed at SMC1 and SMC2 during the week in May, though considerably more in October. Over the middle of the day during the week there was a higher volume of walkers at both SMC1 and SMC2 recorded in October than in May. Use of SMC3 as access by commuters into the Point Fraser car park by vehicle and out by foot during the week is well established. It is evident that SMC3's main use is as a commuter car park during the week for city workers, with a clear correlation between vehicles going into the car park and pedestrians going out. The volume of vehicles entering the car park was higher in May than in October. In the middle of the day on a weekday, it is common in both May and October for Point Fraser to be used as a place to eat lunch or to walk for exercise, though this has also reduced in 2013 compared with previous years, possibly due to the ongoing construction.

Overall Point Fraser Parkland had a higher volume of visitors on the weekend in October than May. In October weekend visitors were more dispersed over the day, while in May, weekend visitors were limited to the middle of the day with the exception of a small number of early morning walkers, particularly at SMC2. In May, on the weekend there was a higher volume of walkers using SMC2 specifically compared to October. While at SMC1 there was a considerably larger volume of weekend walkers in October than May. On the weekend in both May and October there were lower numbers of cyclists compared to previous years. There is less use by cyclists and people on foot at SMC3, compared to SMC1 and SMC2.

SMC1 outside the park records the volume of people who travel either on foot or by bike along the path around Point Fraser. There are consistently high numbers of both pedestrians and cyclists that do not go into the park, compared to when the data was first collected, though fluctuations have been recorded during this time. During the week there are clear peak periods in the morning and afternoon for both walkers and cyclists using this path. On the weekend, in both May and October the majority of use is in the morning. It appears that people exercising on foot are more likely to use the park while cyclists, bypass the park. There is a higher volume of cyclists compared to walkers, particularly on the weekends with more than 70% of people counted using SMC1 outside the park were cycling, evident in both Rounds 9 and 10. It has been noted that the entrance for the car park is not ideal as the cycle path crosses the entrance.

In previous years there were higher volumes of both walkers and cyclists over all sites. Most notably there is a significant reduction in cyclists, predominately commuters in the early morning and late afternoon. The decline in visitor numbers can be attributed to the ongoing construction of the new commercial development at Point Fraser which affect visitor movement through the park. This has been confirmed in visitor survey comments.

Table 16. Extrapolated visitor counts data – Round 9, May 2014 survey round (All sites)

WEEKDAY - MAY 2014																				
Site	**SMC1**				**SMC2**				**SMC3**								**Total (SMC1 & SMC2)**			
Type	**Walking**		**Cycling**		**Walking**		**Cycling**		**Walking†**		**Cycling†**		**Vehicle†**		**Walking‡**		**Walking**		**Cycling**	
Time*	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**
7	12	0	0	0	12	20	0	0	0	20	0	0	28	4	0	16	24	20	0	0
8	4	8	0	0	24	0	0	0	12	20	0	0	68	4	8	44	28	8	0	0
9	0	4	12	0	8	4	0	4	0	0	0	0	76	4	0	36	8	8	12	4
10	12	0	4	4	8	12	8	24	0	12	0	4	16	12	4	4	20	12	12	28
11	4	4	16	0	8	8	4	12	8	4	0	8	32	8	0	0	12	12	20	12
12	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
13	16	16	0	0	4	0	8	16	0	0	0	0	4	4	4	0	20	16	8	16
14	8	0	0	0	4	4	0	16	0	0	0	0	4	4	0	0	12	4	0	16
15	0	0	8	0	0	8	8	4	8	0	4	0	20	24	8	0	0	8	16	4
16	32	16	0	0	16	12	4	4	4	8	4	8	4	52	64	0	48	28	4	4
17	20	0	0	0	4	12	4	0	0	0	0	0	0	0	0	0	24	12	4	0
18	0	0	8	0	4	0	0	0	0	28	0	0	28	68	8	12	4	0	8	0
Total	**108**	**48**	**48**	**4**	**100**	**80**	**36**	**80**	**32**	**92**	**8**	**20**	**280**	**184**	**96**	**112**	**208**	**128**	**84**	**84**
% by transport mode & park survey point	**75%**		**25%**		**61%**		**39%**		**15%**		**3%**		**56%**		**25%**		**67%**		**33%**	

* hourly data was extrapolated from hourly 15 minute counts commencing on the hour

† main road entrance

‡ pedestrian entrance

Table 15 (cont.)

WEEKEND - MAY 2014																				
Site	**SMC1**				**SMC2**				**SMC3**								**Total (SMC1 & SMC2)**			
Type	**Walking**		**Cycling**		**Walking**		**Cycling**		**Walking†**		**Cycling†**		**Vehicle†**		**Walking‡**		**Walking**		**Cycling**	
Time*	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**
7	12	12	0	0	24	4	4	4	0	16	0	4	4	12	0	0	36	16	4	4
8	8	8	0	0	12	8	0	0	12	0	0	0	0	12	0	0	20	16	0	0
9	0	8	0	0	8	16	0	0	0	4	0	0	16	4	0	0	8	24	0	0
10	8	12	0	0	20	0	4	4	12	4	0	20	4	16	4	0	28	12	4	4
11	12	4	4	0	4	8	8	0	0	4	8	8	4	20	0	0	16	12	12	0
12	28	12	0	0	12	12	8	0	12	0	0	0	8	0	0	0	40	24	8	0
13	0	12	20	0	36	16	0	28	0	0	0	0	8	4	0	0	36	28	20	28
14	8	0	4	8	20	12	32	8	0	12	4	8	4	12	4	0	28	12	36	16
15	12	8	4	0	4	40	8	4	0	0	4	8	20	20	16	0	16	48	12	4
16	8	4	24	0	12	12	12	0	4	0	0	32	12	8	4	8	20	16	36	0
17	0	4	8	8	16	4	0	0	16	0	0	0	24	4	0	4	16	8	8	8
18	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0
Total	**96**	**84**	**64**	**16**	**172**	**132**	**76**	**48**	**56**	**40**	**16**	**80**	**108**	**112**	**28**	**12**	**268**	**216**	**140**	**64**
% by transport mode & park survey point	**69%**		**31%**		**71%**		**29%**		**21%**		**21%**		**49%**		**9%**		**70%**		**30%**	

* hourly data was extrapolated from hourly 15 minute counts commencing on the hour

† main road entrance

‡ pedestrian entrance

Table 17. Extrapolated visitor counts data – Round 10, October 2014 survey round (All sites)

WEEKDAY - OCTOBER 2014																				
Site	**SMC1**				**SMC2**				**SMC3**								**Total (SMC1 & SMC2)**			
Type	**Walking**		**Cycling**		**Walking**		**Cycling**		**Walking†**		**Cycling†**		**Vehicle†**		**Walking‡**		**Walking**		**Cycling**	
Time*	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**
7	12	28	0	0	32	12	0	0	0	12	4	0	36	4	0	28	44	40	0	0
8	20	8	0	0	8	16	12	0	0	8	0	12	48	8	4	12	28	24	12	0
9	20	0	0	0	0	4	4	0	8	12	0	4	56	4	0	12	20	4	4	0
10	4	0	0	0	20	20	0	0	0	12	0	0	12	12	8	0	24	20	0	0
11	4	16	20	8	8	0	12	8	0	0	0	4	16	16	4	0	12	16	32	16
12	20	16	8	0	4	12	4	0	8	0	0	0	4	12	0	0	24	28	12	0
13	12	0	0	0	8	0	0	4	0	0	0	0	8	8	4	12	20	0	0	4
14	16	12	20	0	20	4	4	0	4	4	0	0	0	28	12	0	36	16	24	0
15	24	4	4	0	0	16	0	0	0	4	0	0	16	24	20	0	24	20	4	0
16	8	0	0	0	8	4	0	0	0	4	0	0	16	40	36	4	16	4	0	0
17	0	0	12	0	8	8	0	4	8	0	4	0	4	64	40	12	8	8	12	4
18	28	44	0	0	44	24	0	4	4	4	0	4	4	12	4	4	72	68	0	4
Total	**168**	**128**	**64**	**8**	**160**	**120**	**36**	**20**	**32**	**60**	**8**	**24**	**220**	**232**	**132**	**84**	**328**	**248**	**100**	**28**
% by transport mode & park survey point	**80%**		**20%**		**83%**		**17%**		**12%**		**5%**		**57%**		**27%**		**82%**		**18%**	

* hourly data was extrapolated from hourly 15 minute counts commencing on the hour

† main road entrance

‡ pedestrian entrance

Table 18 (cont)

WEEKEND - OCTOBER 2014																				
Site	**SMC1**				**SMC2**				**SMC3**								**Total (SMC1 & SMC2)**			
Type	**Walking**		**Cycling**		**Walking**		**Cycling**		**Walking†**		**Cycling†**		**Vehicle†**		**Walking‡**		**Walking**		**Cycling**	
Time*	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**	**In**	**Out**
7	12	0	4	0	4	4	8	4	4	4	0	4	8	0	0	0	16	4	12	4
8	4	4	4	0	4	4	16	0	8	0	0	24	8	0	0	8	8	8	20	0
9	12	40	12	0	16	8	8	4	4	8	0	20	24	16	0	12	28	48	20	4
10	16	20	0	12	16	20	4	0	4	56	0	0	24	8	0	4	32	40	4	12
11	12	12	0	8	0	8	8	16	4	4	0	0	8	16	0	8	12	20	8	24
12	24	0	4	8	4	16	8	8	0	4	0	8	8	4	0	4	28	16	12	16
13	24	8	4	4	0	16	12	0	0	12	0	24	8	24	0	0	24	24	16	4
14	4	28	8	0	24	12	8	8	4	4	8	0	16	20	0	0	28	40	16	8
15	4	20	0	4	16	12	12	16	4	0	0	0	12	12	0	0	20	32	12	20
16	32	4	16	4	12	12	12	0	0	12	8	8	0	4	0	12	44	16	28	4
17	16	16	4	4	0	0	0	4	0	0	4	0	0	0	0	0	16	16	4	8
18	16	4	0	0	0	8	0	4	4	4	0	0	8	0	0	4	16	12	0	4
Total	**176**	**156**	**56**	**44**	**96**	**120**	**96**	**64**	**36**	**108**	**20**	**88**	**124**	**104**	**0**	**52**	**272**	**276**	**152**	**108**
% by transport mode & park survey point	**77%**		**23%**		**57%**		**43%**		**27%**		**20%**		**43%**		**10%**		**68%**		**32%**	

* hourly data was extrapolated from hourly 15 minute counts commencing on the hour

† main road entrance

‡ pedestrian entrance

Table 18. Extrapolated visitor counts data – Round 9 and Round 10 survey rounds (SMC1 – Path along the outside of parkland)

SMC 1 - OUTSIDE PATH

MAY 2014								
	WEEKDAY				**WEEKEND**			
Type	**Walking/Running**		**Cycling**		**Walking/Running**		**Cycling**	
Time*	**To city**	**From city**	**To city**	**From city**	**To city**	**From city**	**To city**	**From city**
7	36	8	40	0	116	0	284	16
8	28	24	156	32	68	16	380	44
9	8	8	60	4	40	28	84	28
10	12	0	8	20	48	12	76	64
11	4	4	12	16	28	20	36	44
12	24	28	4	12	20	8	40	20
13	28	36	8	4	0	4	24	20
14	8	8	28	8	16	12	40	16
15	4	16	4	40	20	4	44	20
16	12	16	8	20	32	16	48	40
17	36	48	24	148	16	16	28	8
18	88	100	16	84	12	8	8	16
Total	**288**	**296**	**368**	**388**	**416**	**144**	**1092**	**336**
% by transport mode	**44%**		**56%**		**28%**		**72%**	
OCTOBER 2014								
7	24	32	72	12	72	20	604	44
8	36	12	120	8	56	20	204	44
9	28	12	20	20	60	32	152	40
10	20	12	220	20	64	32	36	48
11	0	12	12	0	32	32	20	36
12	28	20	12	24	24	12	28	44
13	12	16	20	8	16	8	48	32
14	4	4	12	8	28	16	16	36
15	12	4	0	52	0	16	20	32
16	16	16	12	28	8	8	12	28
17	16	40	44	160	4	4	4	36
18	40	72	20	80	24	8	4	0
Total	**236**	**252**	**564**	**420**	**388**	**208**	**1148**	**420**
% by transport mode	**33%**		**67%**		**28%**		**72%**	

*hourly data was extrapolated from hourly 15 minute count commencing on the hour.

7.9.2 VISITOR SURVEYS

During the 2014 survey rounds, a total of 302 surveys were collected (Table 19), with 108 surveys in Round 9 in May and 194 surveys in Round 10 in October. This is in addition to the 364 surveys completed during survey Rounds 1 and 2 in 2010, 204 surveys from Round 3 in May 2011, 372 surveys from Rounds 7 and 8. Over the five-year duration of the social monitoring, 1,242 surveys have been collected in total. A copy of the survey is attached, see Appendix A.

Table 19. Number of surveys collected

	Survey rounds							
	Round 1 May-10	**Round 2 Oct-10**	**Round 3 May-11**	**Round 7 May-13**	**Round 8 Oct-13**	**Round 9 May-14**	**Round 10 Oct-14**	**Total**
Weekday	69	73	89	48	84	43	82	488
Weekend	123	99	115	81	159	65	112	754
TOTAL	192	172	204	129	243	108	194	1242

100% of surveys collected onsite.

7.9.3 DEMOGRAPHICS

In 2014 survey rounds, there were more males surveyed than females. In Round 9, 56% of respondents were male and 44% were female. While in Round 10, 57% of respondents were male and 43% were females (Table 20 &

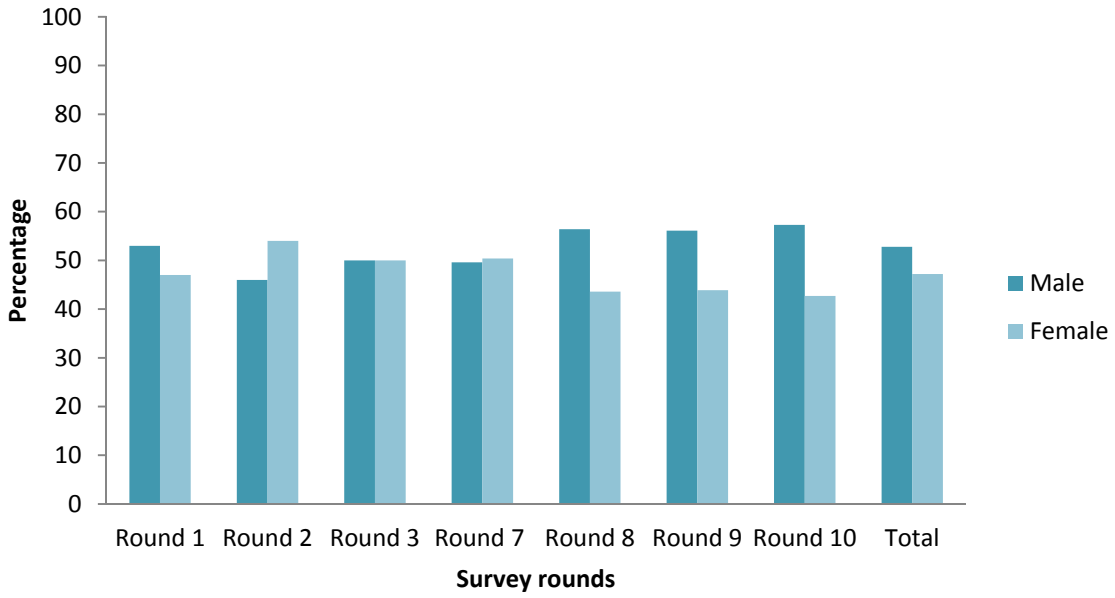


Figure 37). The higher representation of males being surveyed is reflected in the overall total of gender breakdown with 53% male and 47% female.

Table 20. Respondent gender (%) by survey round.

		Male	Female
Round 1	Weekday	59	41
	Weekend	49	51
	Total	53	47
Round 2	Weekday	47	53
	Weekend	45	55
	Total	46	54
Round 3	Weekday	57	43
	Weekend	45	55
	Total	50	50
Round 7	Weekday	55	45
	Weekend	46	54
	Total	50	50
Round 8	Weekday	55	45
	Weekend	57	43
	Total	56	44
Round 9	Weekday	61	40
	Weekend	53	47
	Total	56	44
Round 10	Weekday	58	42
	Weekend	57	43
	Total	57	43
Total		53	47

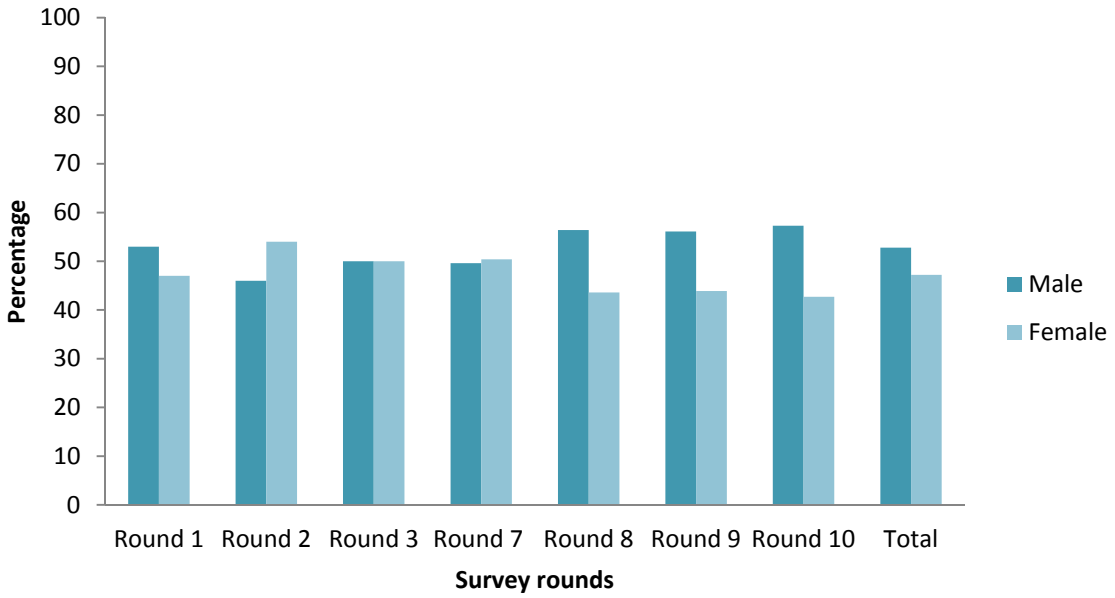


Figure 37. Respondent gender (%) by survey round.

In Round 9, the age group of users was more evenly dispersed than in previous years with 21-30 years (22%), 31-40 years (21%) and 41-50 years (20%) age groups as the most frequent users of Point Fraser parkland (Table 21 & Figure 38). Nineteen percent (19%) of respondents were aged >60 years and 15% were aged 51-60 years. There were minimal respondents under the age of 21 years (3%). The most frequent users in Round 10 were the 21-30 years age group (28%), followed by the 31-40 years age group (20%). Both 41-50 years and 51-60 years age groups were made up by 18% of users each. Eleven percent (11%) of respondents were aged >60 years. The most infrequent users were from the <21 years age group with 5% represented. Over the seven survey rounds, the 21-30 year age group is consistently the highest proportion of users and the <21 years age group the lowest.

Table 21. Respondent age (%) by survey round.

		< 21	21 – 30	31 – 40	41 – 50	51 – 60	> 60
Round 1	Weekday	4	23	12	22	20	19
	Weekend	4	28	20	14	21	14
	Total	4	26	17	17	21	16
Round 2	Weekday	1	25	18	17	18	21
	Weekend	8	20	19	16	16	20
	Total	5	22	19	16	17	21
Round 3	Weekday	6	27	13	22	17	15
	Weekend	3	29	15	17	20	17
	Total	4	28	14	20	19	16
Round 7	Weekday	6	17	15	13	27	23
	Weekend	2	27	14	16	17	23
	Total	4	23	14	15	21	23
Round 8	Weekday	6	25	20	15	21	12
	Weekend	3	32	19	13	16	17
	Total	4	30	20	14	18	15

Round 9	Weekday	2	26	23	21	16	12
	Weekend	3	20	20	20	14	23
	Total	3	22	21	20	15	19
Round 10	Weekday	4	21	21	17	23	15
	Weekend	5	33	20	19	14	9
	Total	5	28	20	18	18	11
Total		4	26	18	17	18	17

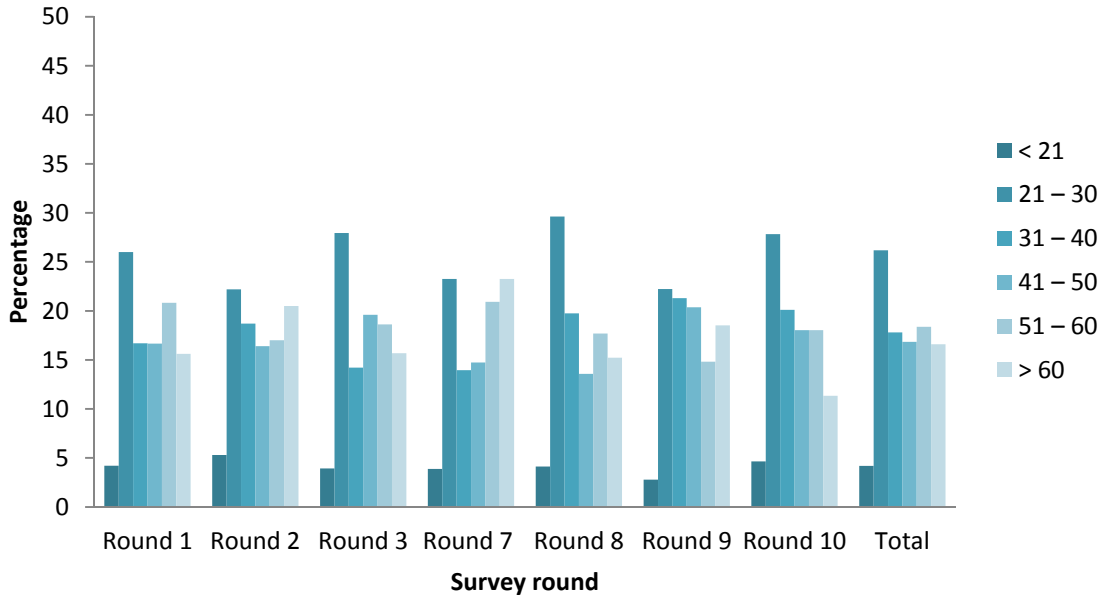


Figure 38. Respondent age (%) by survey round.

In Round 9, 76% of respondents were Australian residents and 24% of respondents were overseas visitors (Table 22 and

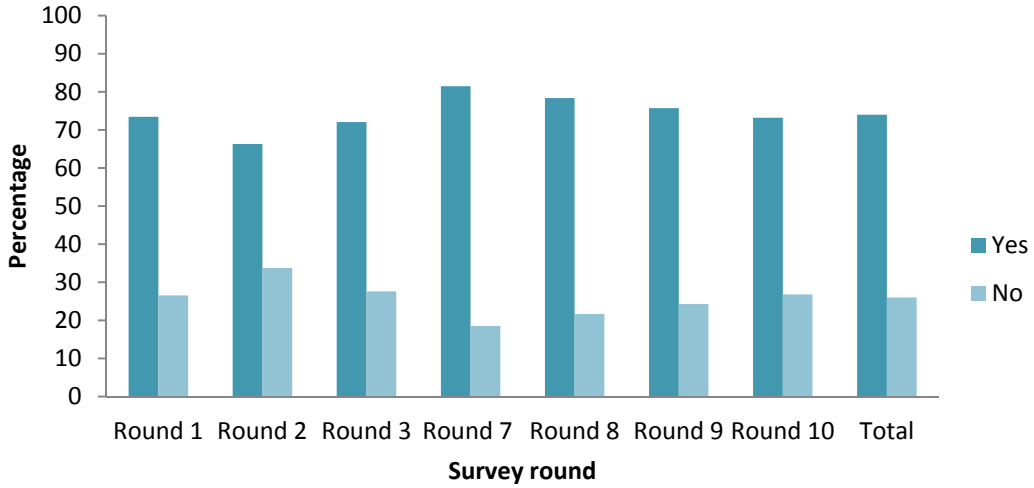


Figure 39). While in Round 10, 73% of respondents were Australian residents and 27% came from overseas. On average, over the seven survey rounds, 74% of respondents were Australian residents.

Table 22. Australian resident (%) by survey round.

		Yes	No
Round 1	Weekday	74	26
	Weekend	73	27
	Total	73	27
Round 2	Weekday	60	40
	Weekend	71	29
	Total	66	34
Round 3	Weekday	66	34
	Weekend	77	23
	Total	72	28
Round 7	Weekday	79	21
	Weekend	83	17
	Total	81	19
Round 8	Weekday	83	17
	Weekend	76	24
	Total	78	22
Round 9	Weekday	72	28
	Weekend	78	22
	Total	76	24
Round 10	Weekday	76	24
	Weekend	71	29
	Total	73	27
Total		74	26

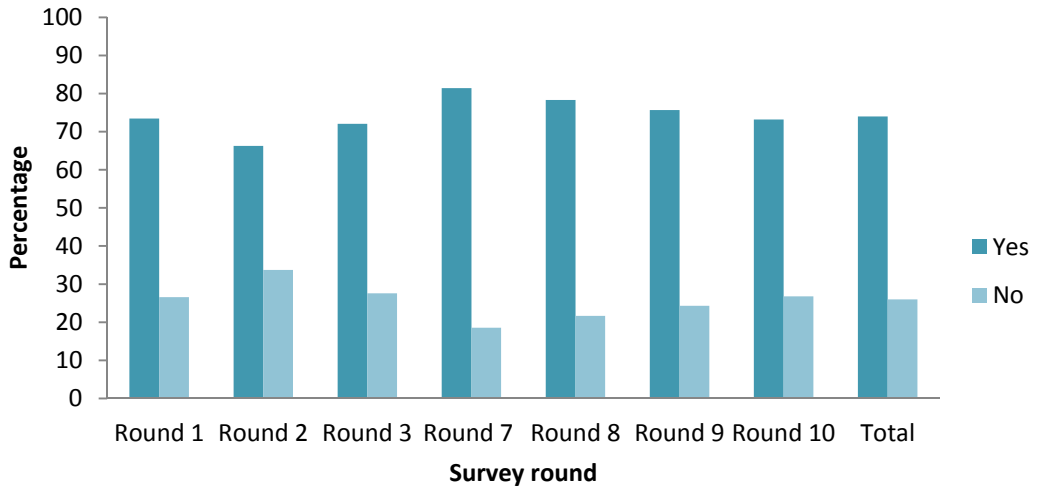


Figure 39. Australian resident (%) by survey round.

In both Rounds 9 and 10, the vast majority of respondents were from Western Australia, 93% and 87% respectively (Table 23 and Figure 40). Small percentages of respondents came from other states in Round 9, including New South Wales (4%), Northern Territory (1%), Queensland (1%) and Victoria (1%). Similarly in Round 10, respondents from other states had minimal representation with 5% from Queensland, 4% from New South Wales, 3% from Victoria, 1% from the South Australia and 1% from Tasmania. Over all the survey rounds, there is a clear trend for most respondents to be residents of Western Australia, almost 90% and in some cases more.

Table 23. Australian respondent state of origin (%) by survey round.

		Respondents' origin by state (%)							
		ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Round 1	Weekday	0	2	0	0	0	4	6	89
	Weekend	1	5	0	0	0	0	3	91
	Total	1	4	0	0	0	1	4	90
Round 2	Weekday	0	10	6	0	2	0	2	80
	Weekend	0	3	0	0	1	0	4	92
	Total	0	6	0	3	2	0	3	87
Round 3	Weekday	0	3	6	0	0	0	7	84
	Weekend	1	6	0	1	0	0	1	91
	Total	1	5	0	3	0	0	4	88
Round 7	Weekday	0	10	0	0	3	0	0	88
	Weekend	0	5	0	3	6	0	0	86
	Total	0	7	0	2	5	0	0	86
Round 8	Weekday	2	3	0	3	0	0	6	87
	Weekend	0	1	0	0	3	0	5	92
	Total	1	2	0	1	2	0	5	90

Round 9	Weekday	0	7	3	0	0	0	0	90
	Weekend	0	2	0	2	0	0	2	94
	Total	0	4	1	1	0	0	1	93
Round 10	Weekday	0	2	0	10	0	2	5	82
	Weekend	0	5	0	1	1	0	1	91
	Total	0	4	0	5	1	1	3	87
Total		0	4	0	2	1	0	3	89

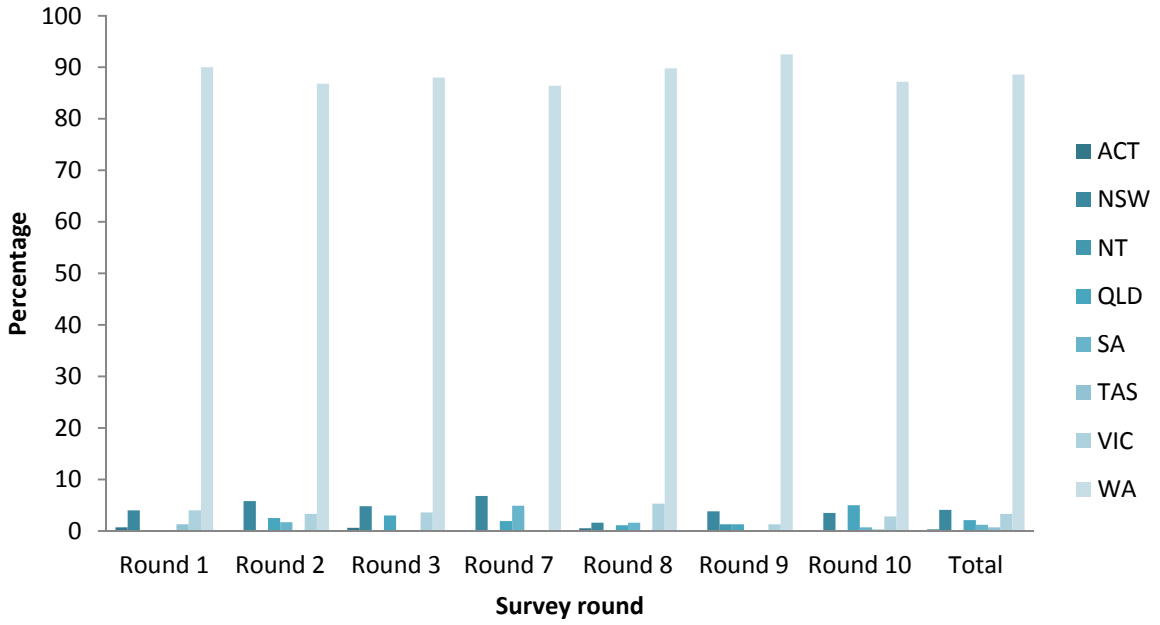


Figure 40. Australian respondent state of origin (%) by survey round.

In Round 9, the largest percentage of respondents from Perth residents came from the following postcode areas: 6004 (East Perth) (19.7%), 6000 (Perth) (12.7%), while 6008 (Daglish, Shenton Park, Subiaco), 6010 (Claremont, Karrakatta, Mount Claremont, Swanbourne), 6056 (Baskerville, Bellevue, Boya, Greenmount, Helena Valley), and 6151 (Kensington, South Perth) were all 4.2% each. While in Round 10, the most commonly represented postcode areas were 6000 (Perth) (13.2%), 6004 (East Perth) (11.6%), 6151 (Kensington, South Perth) (7.4%), 6100 (Burswood, Lathlain, Victoria Park) (5%), 6020 (Carine, Marmion, North Beach, Sorrento, Watermans Bay), while 6052 (Bedford, Inglewood), 6102 (Bentley, St James) were 3.3% each. Consistently, the most highly represented suburbs for local residents were Perth (6000) and East Perth (6004). These postcode areas are both within very close proximity to Point Fraser. However, it is important to note that there were respondents represented from all over Perth, both north and south of the river. This data reflects that Perth residents who use Point Fraser are not limited to a particular geographical region of the city; however, the largest user groups live within close proximity to the park.

Of the Round 9 respondents, 24% came from overseas and 27% in Round 10 (Table 8 &

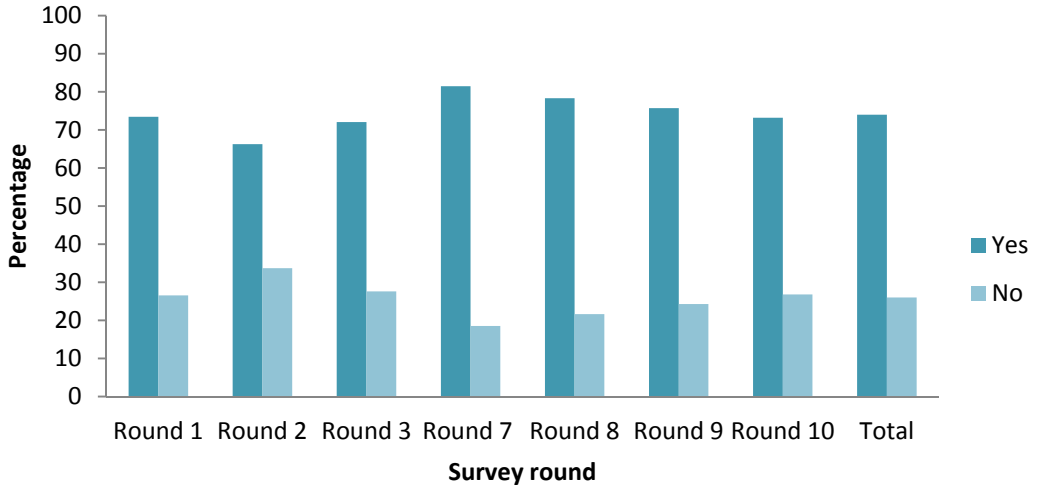


Figure 39). The largest group of overseas respondents were from the United Kingdom with 23% in Round 9. This was followed by France (12%), New Zealand (12%), Canada (8%) and the USA (8%). In Round 10 the most common nationality of an overseas visitor was from the United Kingdom (21%), followed by Germany (19%), Malaysia (12%), the USA (10%) and Italy (8%). Over the seven survey rounds, British (18%), American (11%), German (10%) and New Zealand (7%) visitors are the largest groups of non-Australian residents visiting Point Fraser. Considering all data collected to date, 44 different nationalities have visited Point Fraser during data collection periods, including: Argentina, Belgium, Brazil, Canada, China, Colombia, Czech Republic, Denmark, Egypt, Estonia, Ethiopia, Finland, France, Germany, Holland, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Kazakhstan, Korea, Malaysia, New Zealand, Norway, Philippines, Poland, Qatar, Russia, Serbia, Singapore, South Africa, Sweden, Switzerland, Taiwan, Ukraine, United Arab Emirates, United Kingdom, USA, and Vietnam.

7.9.4 PARK USE

In Round 9, the majority of respondents travelled by foot (65%) to Point Fraser (Table 24 and Figure 41). The second most popular mode of transport was by car (19%), followed by bicycle (9%). Four percent (4%) of respondents used a mixture of transport modes to get to Point Fraser and 2% used public transport. No respondents used a boat to get to Point Fraser. In Round 10, 68% of respondents walked to Point Fraser, followed by 17% who travelled by car. A lower proportion than all previous rounds travelled by bicycle (3%). Three percent (3%) travelled by public transport and 8% used a mixture of travel modes to get to Point Fraser. Over the seven survey periods, consistently, walking (64%) is the most common mode of transport, followed by car (17%) and bicycle (9%).

Table 24. Mode of travel (%) by survey round.

		On Foot	Car	Boat	Bicycle	Public Transport	Mixture of above	Other
Round 1	Weekday	49	15	0	23	1	12	0
	Weekend	48	22	0	17	9	4	0
	Total	48	19	0	19	6	7	0
Round 2	Weekday	59	29	0	3	4	6	0
	Weekend	69	12	0	8	2	8	0
	Total	65	19	0	6	3	7	0
Round 3	Weekday	71	14	0	8	3	3	1
	Weekend	68	18	0	5	1	7	1
	Total	69	16	0	6	2	5	1
Round 7	Weekday	73	13	0	6	6	2	0
	Weekend	70	17	0	5	0	7	0
	Total	71	16	0	5	2	5	0
Round 8	Weekday	71	14	0	10	0	5	0
	Weekend	58	17	1	16	1	6	1
	Total	63	16	0	14	1	6	0
Round 9	Weekday	72	14	0	12	0	0	2
	Weekend	60	22	0	8	3	6	2
	Total	65	19	0	9	2	4	2
Round 10	Weekday	68	17	0	2	4	6	2
	Weekend	68	16	0	4	3	9	0
	Total	68	17	1	3	3	8	1
Total		64	17	0	9	3	6	1

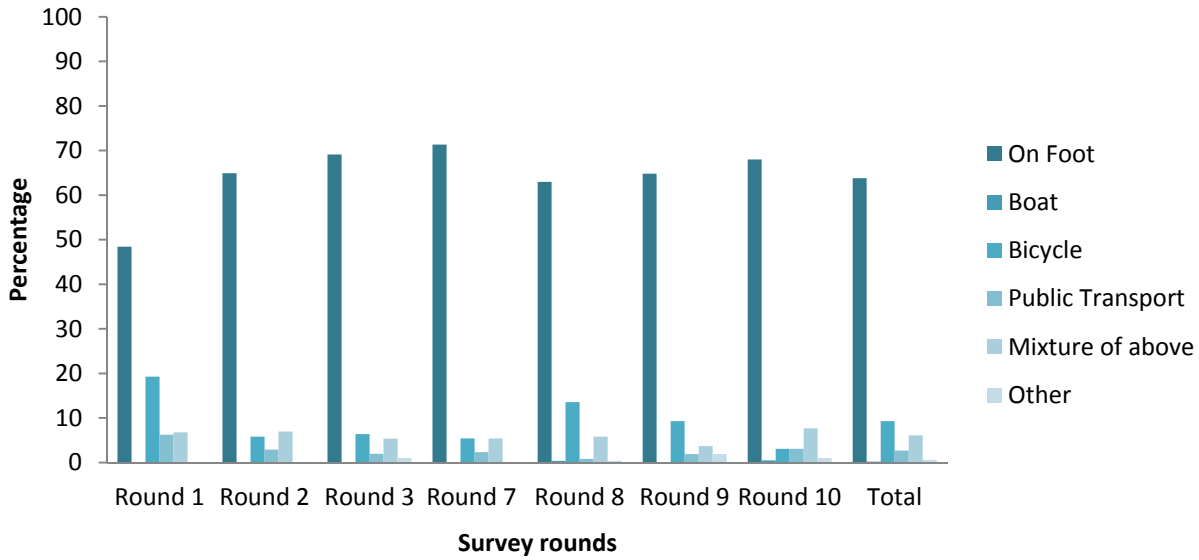


Figure 41. Mode of travel (%) by survey round.

Over Rounds 9 and 10, 4% and 8% respectively, utilised a mixture of modes to travel to Point Fraser (Table 25 and Figure 42). Of these, in Round 9, the most common mixture of

transport modes was car / walk (75%) and in Round 10, public transport / walk (25%). While in Round 10, other combinations of travel modes included bicycle / walk (33%), car / walk (33%) and public transport / walk (13%). Over all survey rounds, the most common travel combination is car / walk (42%).

Table 26. Mode of travel combinations (%) by survey round.

		Bicycle / walk	Car / bicycle	Car / walk	Car / walk / bicycle	Public transport / bicycle	Public transport / walk	Other
Round 1	Weekday	13	13	38	0	13	25	0
	Weekend	20	0	80	0	0	0	0
	Total	15	8	54	0	8	15	0
Round 2	Weekday	0	0	33	33	33	0	0
	Weekend	13	13	63	0	0	13	0
	Total	9	9	55	9	9	9	0
Round 3	Weekday	0	33	33	0	0	33	0
	Weekend	63	0	13	13	0	13	0
	Total	46	9	18	9	0	18	0
Round 7	Weekday	100	0	0	0	0	0	0
	Weekend	0	0	71	14	0	14	0
	Total	13	0	63	13	0	13	0
Round 8	Weekday	25	25	0	0	0	50	0
	Weekend	20	10	40	0	0	30	0
	Total	21	14	29	0	0	36	0
Round 9	Weekday	0	0	0	0	0	0	0
	Weekend	0	0	75	0	0	25	0
	Total	0	0	75	0	0	25	0
Round 10	Weekday	0	17	17	0	17	33	17
	Weekend	56	0	44	0	0	0	0
	Total	33	7	33	0	7	13	7
Total		22	8	42	4	4	18	1

In Round 9, almost three quarters of respondents had visited Point Fraser before, with 22% visiting weekly (Table 27 and Figure 43). Twenty-one percent (21%) visited monthly, followed by 15% of respondents who visited once or twice a year, 9% visited daily and 4% visited less than once per year. It was the first time to visit Point Fraser for 29% of survey respondents. In Round 10, 67% of respondents had visited the park previously. Thirty-two percent (32%) of respondents visited Point Fraser weekly and 15% visited once or twice a year. While 11% respondents indicating that they visit monthly, 7% visited daily and 4% less than once a year. Considering all the data gathered to date, the most common frequency of visitors was weekly (30%), followed closely by first time visitors (29%).

Table 27. Frequency of visiting point Fraser (%) by survey round.

		First time	Daily	Weekly	Monthly	Once or twice a year	Less than once a year
Round 1	Weekday	25	6	33	13	16	7
	Weekend	25	4	30	15	22	3
	Total	25	5	31	15	20	5
Round 2	Weekday	30	14	26	11	14	6
	Weekend	32	10	41	6	3	8
	Total	31	11	35	8	8	7
Round 3	Weekday	24	21	33	8	7	8
	Weekend	21	8	37	11	17	6
	Total	22	14	35	10	12	7
Round 7	Weekday	28	24	30	9	4	4
	Weekend	35	3	24	8	18	14
	Total	33	10	26	8	13	10
Round 8	Weekday	37	16	37	4	6	1
	Weekend	28	11	24	17	17	3
	Total	31	13	28	12	13	3
Round 9	Weekday	24	14	33	21	7	0
	Weekend	32	6	15	20	20	6
	Total	29	9	22	21	15	4
Round 10	Weekday	37	10	30	5	12	6
	Weekend	30	5	33	15	16	2
	Total	33	7	32	11	15	4
Total		29	10	30	12	14	5

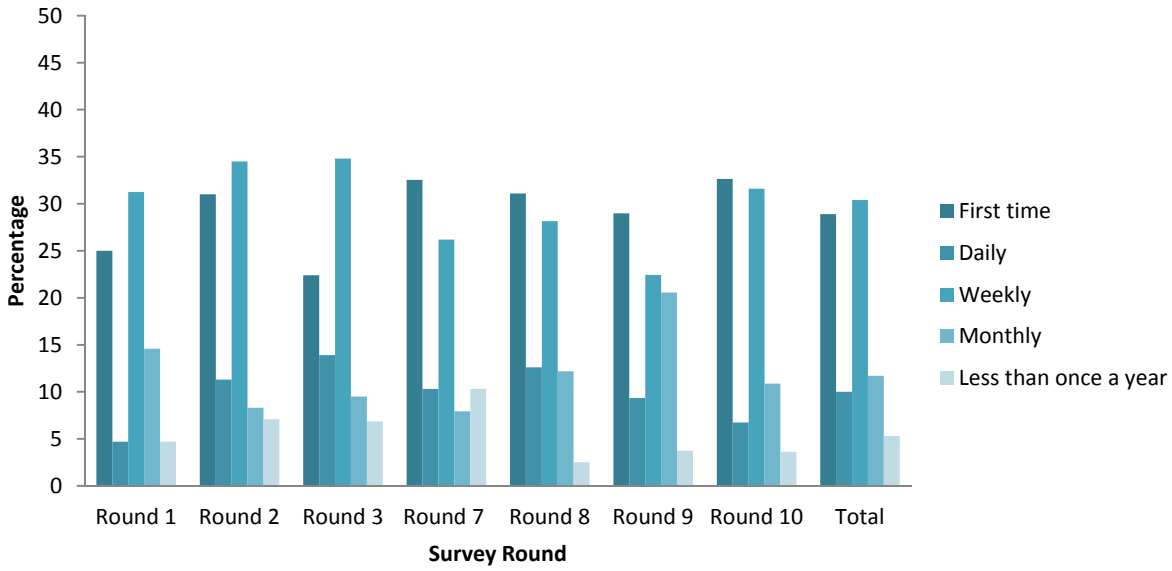


Figure 43. Frequency of visiting point Fraser (%) by survey round.

The majority of respondents (49%) in Round 9 were visiting Point Fraser on their own, while 31% were visiting with their partner and 12% with friends (Table 28 and Figure 44). Six percent (6%) of respondents visited with family and 2% with work associates. In Round 10, most respondents (31%) visited Point Fraser on their own. Following this, 30% visited Point Fraser with their friends and 26% with their partner. A small proportion, 6% visited with other family, 3% with work associates and 2% with community groups. In both Round 9 and 10, 1% and 2% of respondents respectively selected 'other', the most common response was dog and one respondent wrote, well wishers.

Table 28. Respondent visiting with (%) by survey round.

		On my own	Partner	Family	Friends	Work associates	Community groups	Other
Round 1	Weekday	40	2	28	22	2	0	7
	Weekend	27	3	28	37	1	0	4
	Total	31	3	28	32	1	0	5
Round 2	Weekday	43	11	11	24	7	0	4
	Weekend	38	16	13	31	1	0	2
	Total	40	14	12	28	4	0	3
Round 3	Weekday	53	7	5	29	5	0	2
	Weekend	30	37	14	17	0	0	2
	Total	40	23	10	22	2	0	2
Round 7	Weekday	45	26	9	9	13	0	0
	Weekend	20	44	15	19	0	0	1
	Total	29	37	13	15	5	0	1
Round 8	Weekday	45	17	2	27	5	1	2
	Weekend	25	31	2	41	1	0	0
	Total	32	26	2	36	2	0	1
Round 9	Weekday	61	21	2	14	2	0	0
	Weekend	42	37	8	11	2	0	2
	Total	49	31	6	12	2	0	1
Round 10	Weekday	39	26	10	18	5	2	0
	Weekend	25	26	4	39	2	1	4
	Total	31	26	6	30	3	2	2
Total		35	22	11	27	3	0	2

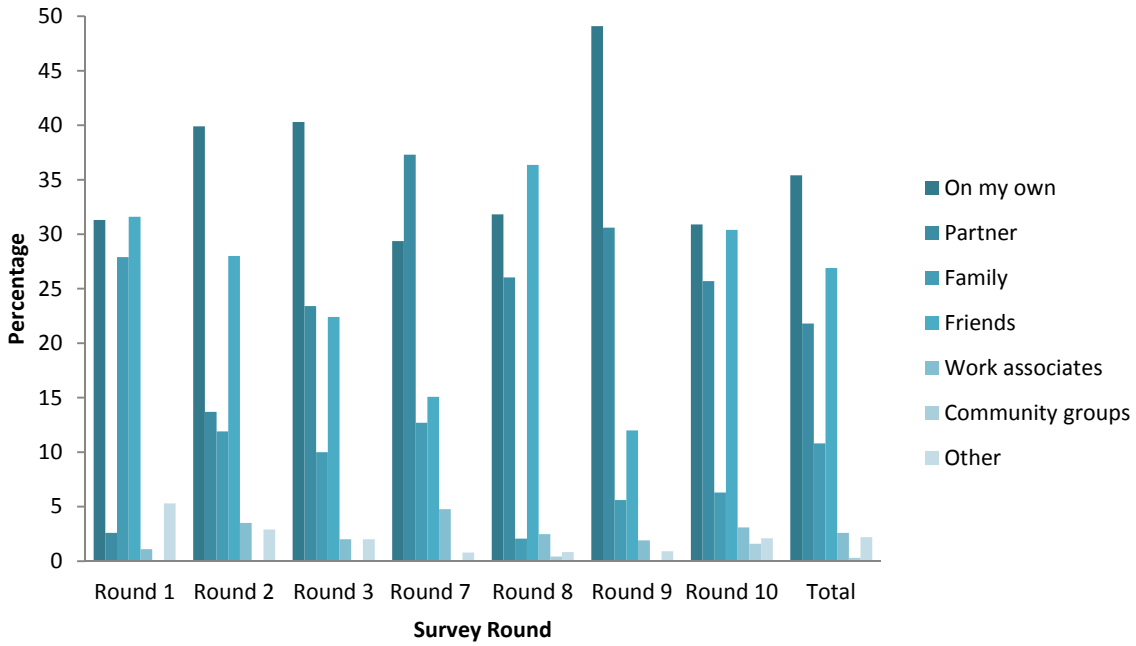


Figure 44. Respondent visiting with (%) by survey round.

In Round 9 there were two peak periods where the majority of visitors arrived between 11am and 1pm, accounting for 42% of arrivals and between 4-5pm with 12% arrivals. While in Round 10, the peak arrival times were between 7am to 10am, with 11% arriving at 7-8am, 10% at 8-9am and 13% at 9-10am. At 12-1pm, 13% of visitors arrived at Point Fraser and at 2-3pm 11% arrived. There were more lunch time visitors in May, especially on the weekend and a high frequency of arrivals early in the morning in October but also with some lunch time visitors. The peak visitor arrival periods fluctuates according to week day or weekend and time of year, autumn versus spring.

Table 29. Visitor arrivals over time (%) by survey round.

	Between	6-7am	7-8am	8-9am	9-10am	10-11am	11-12pm	12-1pm	1-2pm	2-3pm	3-4pm	4-5pm	5-6pm
	Weekday	4	0	4	22	16	12	9	9	9	6	7	3
Round 1	Weekend	0	11	6	11	20	12	5	7	15	10	3	2
	Total	2	7	5	15	18	12	6	8	13	8	5	2
	Weekday	1	14	7	11	14	14	7	12	7	7	4	3
Round 2	Weekend	3	10	16	9	9	5	4	9	10	8	5	10
	Total	2	12	12	10	11	9	5	11	9	8	5	7
	Weekday	1	13	7	6	8	8	14	8	12	9	10	5
Round 3	Weekend	2	15	12	8	9	13	10	5	8	10	8	1
	Total	2	14	10	7	9	11	12	6	10	10	9	2
	Weekday	2	4	7	11	11	15	11	11	7	11	9	2
Round 7	Weekend	1	6	11	15	18	8	15	9	3	5	6	4
	Total	2	6	10	13	15	10	13	10	4	7	7	3
	Weekday	5	7	4	8	7	4	14	11	10	4	8	19
Round 8	Weekend	3	17	7	6	14	11	4	9	9	7	4	8
	Total	4	14	6	7	12	9	8	10	9	6	6	12
	Weekday	2	2	0	7	7	14	14	14	17	2	12	7
Round 9	Weekend	0	3	3	9	9	16	9	17	8	11	13	2
	Total	1	3	2	8	8	15	11	16	11	8	12	4
	Weekday	2	7	4	12	4	12	20	6	6	7	5	14
Round 10	Weekend	4	14	15	13	9	7	9	7	14	4	3	0
	Total	3	11	10	13	7	9	13	7	11	6	4	6
Total		2	10	8	10	11	10	10	9	10	7	6	6

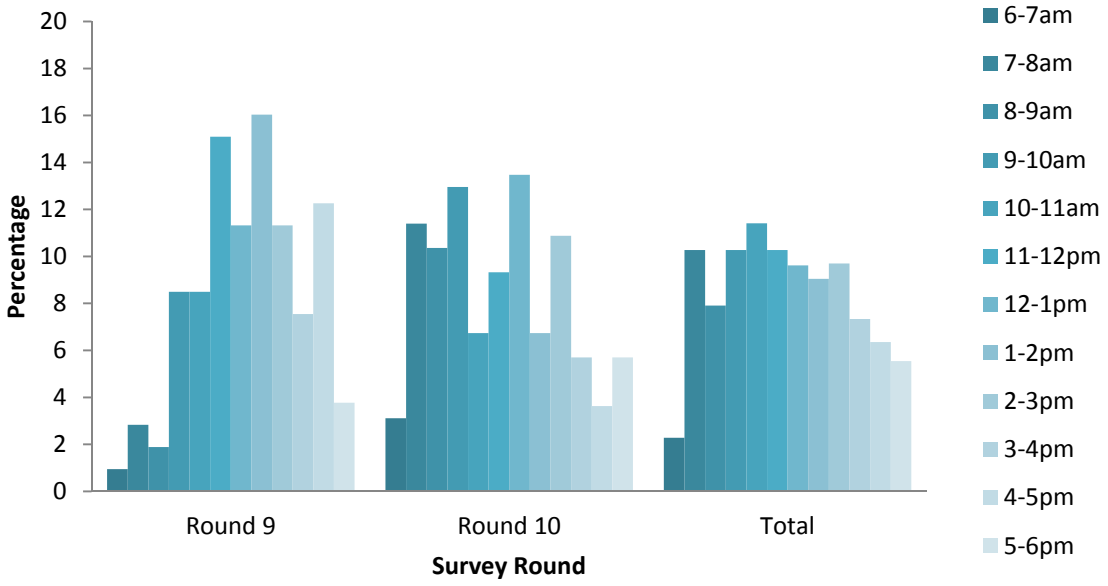


Figure 45. Visitor arrivals over time (%) by survey round.

As with previous survey rounds, the vast majority of respondents (62%) in Round 9, indicated that they were passing through Point Fraser when asked how long they were planning to stay at the parkland (Table 30 and Figure 46). Seventeen percent (17%) stayed for less than 1 hour and 17% stayed for 1-2 hours. A small proportion of respondents, 5% stayed for 2 – 4 hours. Just over half (51%) of survey respondents were passing through Point Fraser in Round 10. Twenty percent (20%) stayed for less than 1 hour and 17% stayed for 1 - 2 hours. Nine percent (9%) stayed for 2 – 4 hours and only 2% for more than 4 hours.

Table 30. Time stayed (%) by survey round.

		Passing through	< 1 hour	1 - 2 hours	2 - 4 hours	> 4 hours
Round 1	Weekday	55	13	17	10	4
	Weekend	40	22	26	9	2
	Total	45	19	23	9	3
Round 2	Weekday	46	18	21	6	10
	Weekend	62	14	16	5	3
	Total	55	16	18	5	6
Round 3	Weekday	62	21	11	3	2
	Weekend	52	21	23	4	1
	Total	56	21	18	3	1
Round 7	Weekday	65	15	20	0	0
	Weekend	63	12	22	2	0
	Total	64	13	21	2	0
Round 8	Weekday	58	19	18	4	1
	Weekend	57	14	23	5	1
	Total	58	16	21	5	1
Round 9	Weekday	60	16	19	5	0
	Weekend	63	17	15	5	0
	Total	62	17	17	5	0
Round 10	Weekday	54	23	19	3	3
	Weekend	49	18	16	15	2
	Total	51	20	17	9	2
Total		55	18	20	6	2

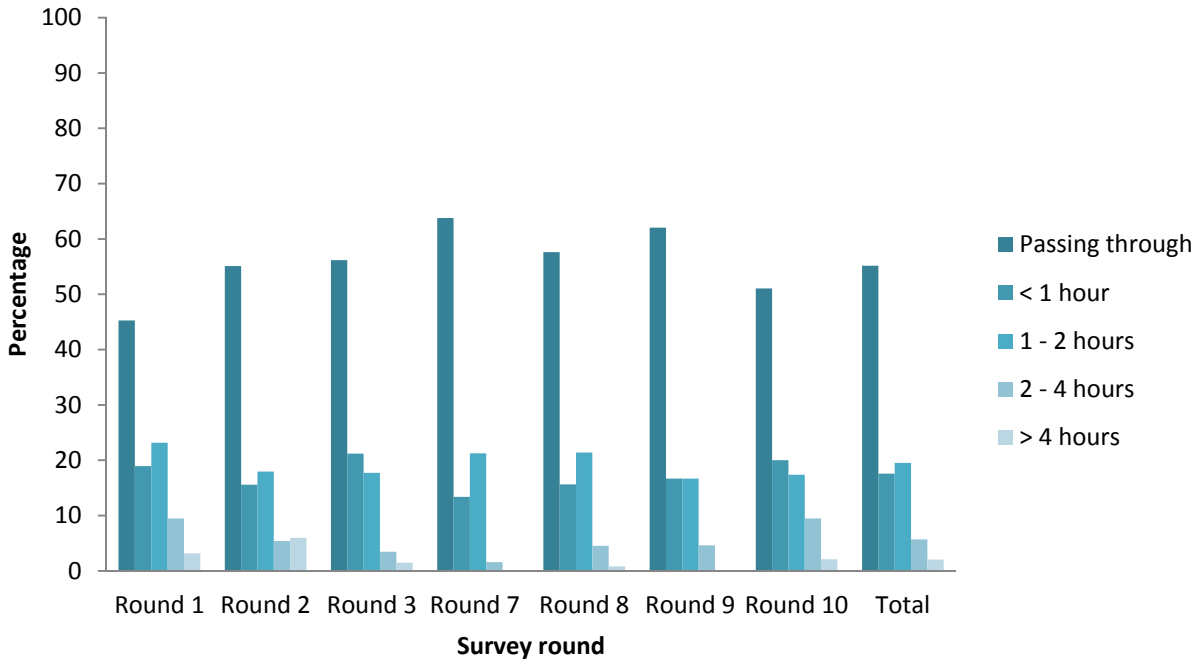


Figure 46. Time stayed (%) by survey round.

To explore park use, respondents were asked what activities they were doing at Point Fraser. There have been a number of changes to this survey question which reflect the fluctuations in the data. In the first survey round there was an option of 'passing through' which was selected at such high rates that it provided limited insight into what the respondents were actually doing. Therefore, in the second survey round, 'cycling, running / jogging and walking' were added as activity choices to the survey. This affected the results of Round 2, leading to a dramatic reduction in the percentage choosing 'passing through', though it was still an option which yielded little information about the actual activity the respondent was undertaking. In the third survey round, 'passing through' was removed completely to gain a clearer insight of the specific activities respondents were undertaking. For example rather than a survey respondent just indicating that they were 'passing through', they were now required to specify if they were 'walking' or 'cycling' or 'running'. This gives more clarity to the data.

Survey respondents were asked what activities they were doing at Point Fraser and were able to select multiple responses. In Round 9, as with previous rounds, by far the majority of respondents (72%) selected 'walking', 21% were at Point Fraser for 'general enjoyment', 15% for cycling and 12% selected photography (Table 31 and Figure 47). 'Running / jogging' was an activity selected by 10% of respondents and 7% were 'visiting playground'. Six percent (6%) were at the park 'exploring interpretative trails'. 'Using the services of About a Bike Hire' and 'BBQ/Picnic' was selected by 2% of respondents each and other was selected by 3%. This was compared to Round 10, where a similarly large number of respondents were 'walking' (73%). The second most common response was 'general enjoyment' selected

by 20%, followed by running (19%). ‘Cycling’ and ‘photography’ were selected by 12% of respondents each. While the remainder of activities selected included ‘exploring interpretative trails’ (10%), ‘other’ (6%), ‘using services of about bike hire’ (5%), ‘visiting playground’ (4%), and ‘BBQ/Picnic’ (3%). The ‘other’ activities specified by respondents in Round 9 and 10 included, chilling / relaxing, dancing, skateboarding, design and spatial inspiration, going to Heirisson Island, having lunch, kayaking, parking, to see a kangaroo, relaxing and trying to fish.

Table 31. Activities undertaken at (%) by survey round.

		Walking	Running / jogging	Cycling	BBQ / Picnic	General enjoyment	Interpretive trails	Photography	Playground	Using services of About Bike Hire	Other
Round 3	Weekday	65	21	19	3	5	0	8	1	3	3
	Weekend	82	13	18	4	17	6	10	5	4	4
	Total	75	17	19	3	11	3	9	3	4	3
Round 7	Weekday	67	13	17	0	10	2	4	6	4	2
	Weekend	79	9	12	7	24	5	7	1	4	1
	Total	74	10	14	5	19	4	6	3	4	2
Round 8	Weekday	66	18	16	5	13	2	14	2	10	4
	Weekend	67	16	22	4	13	3	6	2	5	5
	Total	66	17	20	4	13	3	9	9	7	5
Round 9	Weekday	65	12	19	2	14	5	19	5	2	2
	Weekend	77	9	12	2	26	6	8	8	3	3
	Total	72	10	15	2	21	6	12	7	2	3
Round 10	Weekday	70	13	9	2	20	9	12	4	2	11
	Weekend	76	23	14	3	20	11	12	4	6	2
	Total	73	19	12	3	20	10	12	4	5	6
Total		60	12	13	3	16	4	8	4	5	5

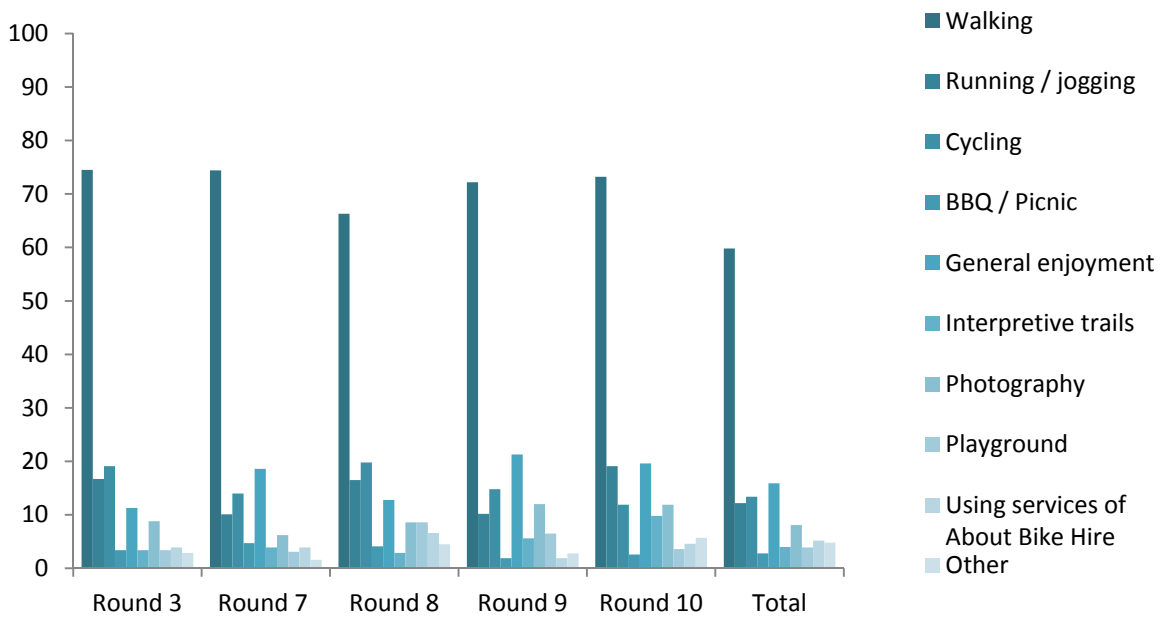


Figure 47. Activities undertaken (%) by survey rounds.

Respondents were asked what their main reason for visiting Point Fraser was. More than 49% indicated that they were visiting Point Fraser for 'exercise' in Round 9 (Table 32 and Figure 48). 'Spending time with family / friends' was selected by 16% of respondents. Less popular reasons for visiting Point Fraser included 'experiencing nature' (9%), 'rest and relax' (7%), 'scenery' (4%), 'other' (4%), 'seeing wildlife' (2%), 'something new and different' (2%), 'proximity to the city' (2%) and 'for solitude' (1%). In Round 10, 'exercise' was considered by the majority (62%) of respondents for visiting Point Fraser and was followed by 'spending time with family and friends' (11%). Other reasons for visiting Point Fraser included 'experiencing nature' (5%), 'rest and relax' (5%), 'something new and different' (5%), 'seeing wildlife' (4%), 'proximity to the city' (3%), 'for solitude' (2%), 'other' (2%), 'scenery' (1%) and 'proximity to the river' (1%). Of the respondents who selected other in both rounds 9 and 10, they specified, passing through, walking dog (x2), en-route from car park to office, just doing bridges loop and park run Heirisson Island.

Although stating quite clearly in the survey, 'what is your **main** reason for visiting Point Fraser today **(select only 1)?'**, this question has been the most misunderstood question in the survey. There were quite high rates of missing data due to the selection of multiple responses, with 25% in Round 9 and 32% in Round 10.

Table 32. Main reason for visiting (%) by survey round.

		Time with friends / family	Exercise	Experience nature	Learn about storm water	Seeing wildlife	Scenery	Something new and different	Proximity to the city	Rest and relax	Learn about the environ-ment	Proximity to the river	For solitude	Other
	Weekday	7	62	7	0	2	0	3	3	7	0	2	0	8
Round 1	Weekend	32	48	3	0	0	2	2	0	4	0	1	0	9
	Total	23	53	4	0	1	1	2	1	5	0	1	0	9
	Weekday	17	45	5	0	5	2	5	8	5	0	5	0	6
Round 2	Weekend	29	61	3	0	1	0	2	1	1	0	0	0	1
	Total	24	54	4	0	3	1	3	4	3	0	2	0	3
	Weekday	16	70	1	0	0	5	0	2	0	0	0	1	6
Round 3	Weekend	25	59	3	0	0	4	2	0	4	0	2	0	3
	Total	21	64	2	0	0	4	1	1	2	0	1	0	4
	Weekday	9	65	3	0	9	6	0	0	6	0	0	0	3
Round 7	Weekend	13	68	6	2	0	0	2	2	4	0	0	0	2
	Total	11	67	5	1	4	2	1	1	5	0	0	0	2
	Weekday	8	71	2	0	0	2	2	0	8	0	0	0	7
Round 8	Weekend	12	68	5	0	0	4	1	4	3	0	1	0	4
	Total	11	69	0	0	4	3	1	2	5	0	1	0	5
	Weekday	9	55	6	0	3	6	0	3	9	0	3	3	3
Round 9	Weekend	21	46	10	0	2	2	4	2	6	0	2	0	4
	Total	16	49	9	0	2	4	2	2	7	0	2	1	4
	Weekday	12	57	2	0	5	0	7	7	8	0	0	2	2
Round 10	Weekend	11	67	7	0	3	1	3	0	3	0	1	1	3
	Total	11	62	5	0	4	1	5	3	5	0	1	2	2
Total		17	60	3	0	2	2	2	2	4	0	1	0	4

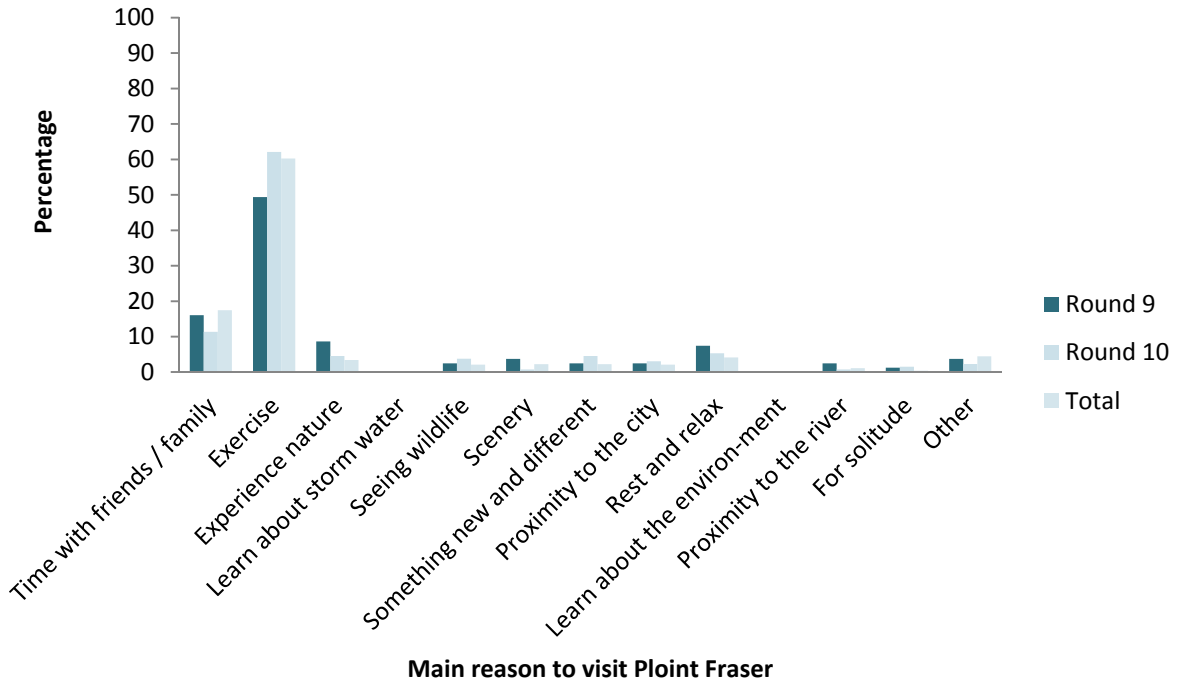


Figure 48. Main reason for visiting (%) by survey round.

7.9.5 PARK SATISFACTION

Respondents were asked about the quality of the features at Point Fraser using a 5-point scale (1=very poor; 2=poor; 3=satisfactory; 4=good; 5=excellent). Generally satisfaction was high, with limited negative ratings with the exception of the satisfaction of the toilet facilities.

In Round 9, the vast majority of respondents were satisfied with the cleanliness of Point Fraser parkland with only 3% selecting poor. Forty-six percent (46%) rated the cleanliness as excellent, 45% as good and 6% as satisfactory (Table 33 and Figure 49). One percent (1%) was dissatisfied in Round 10, selecting very poor while all of the remaining respondents considered cleanliness of the parkland to be either satisfactory (12%), good (34%) and excellent (52%).

Table 33. Quality of features – Cleanliness (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	2	0	5	30	64	0
	Weekend	0	0	3	39	58	0
	Total	1	0	4	36	60	0
Round 2	Weekday	0	1	12	26	59	1
	Weekend	1	0	3	42	52	1
	Total	1	1	7	35	55	1
Round 3	Weekday	0	1	0	39	58	1
	Weekend	0	1	5	49	45	0
	Total	0	1	3	45	51	1
Round 7	Weekday	0	0	6	40	53	0
	Weekend	0	0	8	55	37	0
	Total	0	0	7	50	43	0
Round 8	Weekday	1	0	8	42	46	2
	Weekend	0	2	9	41	48	0
	Total	0	1	9	41	47	1
Round 9	Weekday	0	2	2	44	51	0
	Weekend	0	3	8	46	43	0
	Total	0	3	6	45	46	0
Round 10	Weekday	0	0	8	35	58	0
	Weekend	1	0	15	33	49	2
	Total	1	0	12	34	52	1
Total		0	1	7	40	51	1

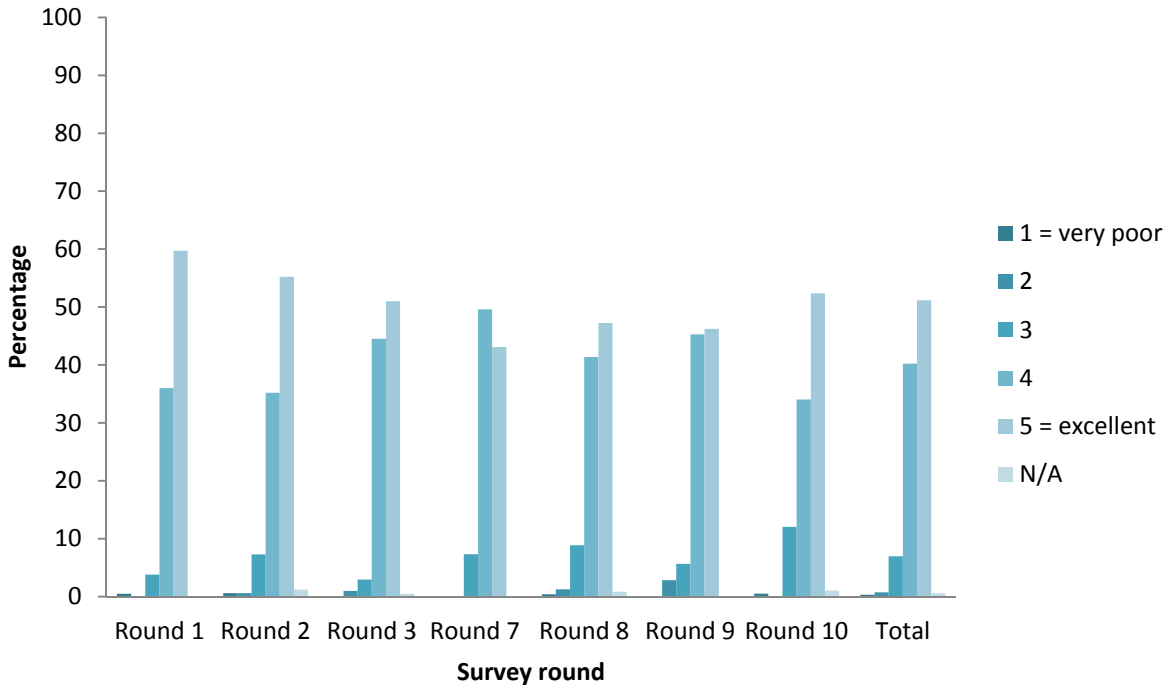


Figure 49. Quality of features – Cleanliness (%) by survey round

Access was predominately rated as good (44%) or excellent (40%) by the majority of respondents, with 10% rating it as satisfactory and 4% rating it as poor in Round 9 (Table 34 and Figure 50). In Round 10, 51% of respondents considered access to be excellent, 34% good, 11% satisfactory, 2% poor and 1% very poor.

Table 34. Quality of features – Access (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	2	0	5	28	65	2
	Weekend	0	1	7	37	53	2
	Total	1	1	6	34	57	2
Round 2	Weekday	0	1	12	26	55	6
	Weekend	0	0	7	41	50	2
	Total	0	1	9	34	52	4
Round 3	Weekday	0	2	2	33	62	1
	Weekend	0	1	7	44	48	0
	Total	0	2	5	39	54	1
Round 7	Weekday	0	2	6	46	46	0
	Weekend	0	1	15	43	41	0
	Total	0	2	11	44	43	0
Round 8	Weekday	1	1	12	32	49	4
	Weekend	0	2	15	38	45	1
	Total	0	2	14	36	46	2
Round 9	Weekday	0	7	14	42	37	0
	Weekend	0	2	8	45	42	3
	Total	0	4	10	44	40	2
Round 10	Weekday	0	1	6	42	49	1
	Weekend	1	2	15	28	53	2
	Total	1	2	11	34	51	2
Total		0	2	10	37	50	2

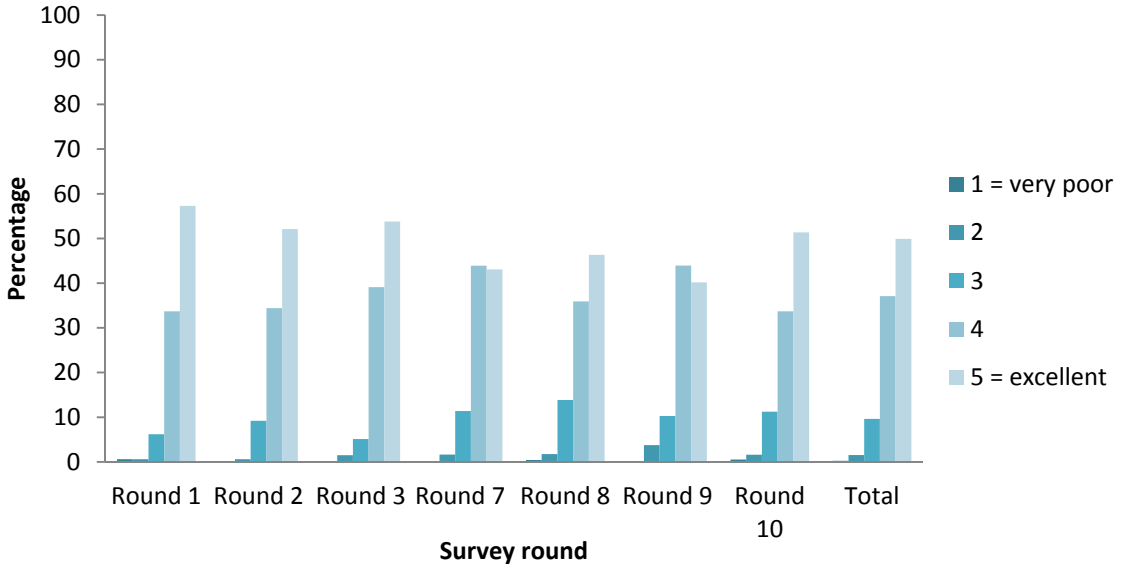


Figure 50. Quality of features – Access (%) by survey round

Playground facilities were generally rated positively in both survey rounds, though with an exception in Round 10 where 3% selected 'poor' and 1% 'very poor'. Although almost a quarter, 24% in Round 9 and 26% in Round 10, of respondents ticked 'not applicable', suggesting that they did not use or were not familiar with the playground facilities (Table 35 and Figure 51).

Table 35. Quality of features – Playground facilities (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	0	5	11	25	22	38
	Weekend	0	0	13	20	30	36
	Total	0	2	12	22	27	37
Round 2	Weekday	0	1	14	17	26	41
	Weekend	1	3	13	28	24	31
	Total	1	3	13	23	25	35
Round 3	Weekday	0	2	18	29	24	27
	Weekend	0	2	16	21	31	30
	Total	0	2	17	24	28	29
Round 7	Weekday	0	2	15	28	22	33
	Weekend	0	1	18	40	19	22
	Total	0	2	17	35	20	26
Round 8	Weekday	1	0	16	26	25	32
	Weekend	0	1	19	32	24	24
	Total	0	1	18	30	24	27
Round 9	Weekday	0	2	5	36	31	26
	Weekend	0	2	14	45	16	23
	Total	0	2	10	41	22	24
Round 10	Weekday	0	1	20	29	19	31
	Weekend	1	4	17	37	18	23
	Total	1	3	18	34	19	26
Total		0	2	15	29	24	30

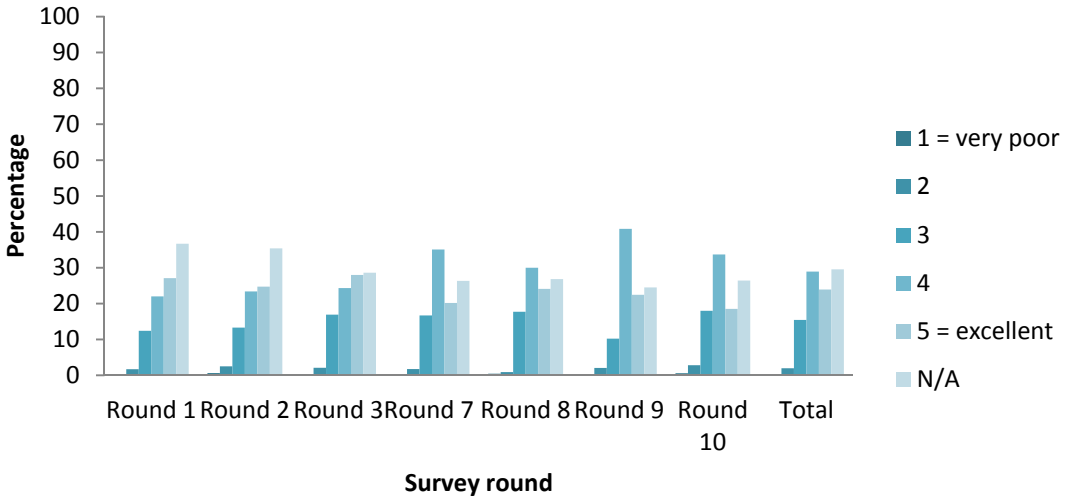


Figure 51. Quality of features – Playground facilities (%) by survey round.

In Round 9, Point Fraser parkland was rated highly for its scenic beauty with 84% rating the parkland as good (33%) or excellent (51%) (Table 36 and

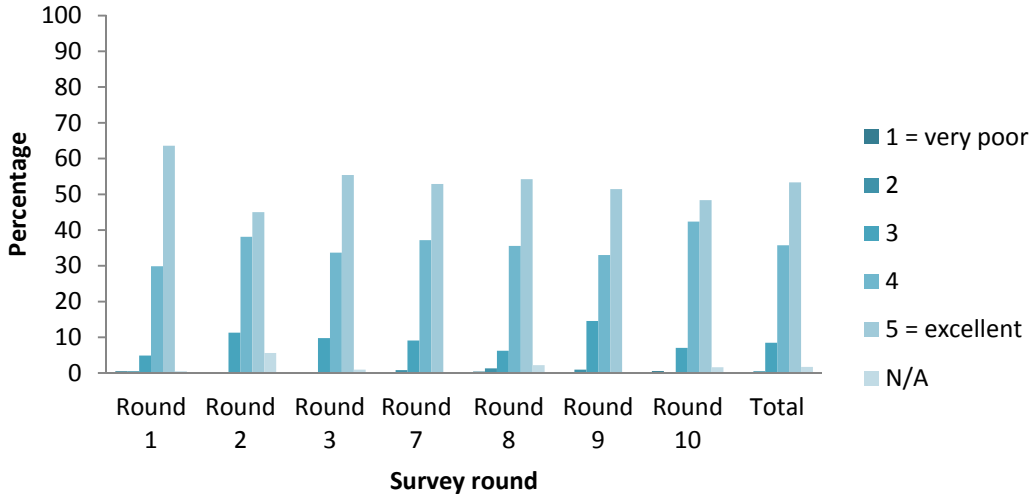


Figure 52). Fifteen percent (15%) of respondents were neutral about the scenery and 1% selected poor. Similarly in Round 10 the vast majority of respondents considered scenic beauty to be positive with 48% of respondents selecting excellent and 42% good, while 7% selected satisfactory and 1% very poor.

Table 36. Quality of features – Scenic beauty (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	2	0	5	27	67	0
	Weekend	0	1	5	31	62	1
	Total	1	1	5	30	64	1
Round 2	Weekday	0	0	15	35	45	6
	Weekend	0	0	9	41	45	6
	Total	0	0	11	38	45	6
Round 3	Weekday	0	0	17	28	53	2
	Weekend	0	0	5	38	57	0
	Total	0	0	10	34	55	1
Round 7	Weekday	0	0	7	35	59	0
	Weekend	0	1	11	39	49	0
	Total	0	1	9	37	53	0
Round 8	Weekday	0	1	4	33	56	5
	Weekend	1	1	7	37	53	1
	Total	0	1	6	36	54	2
Round 9	Weekday	0	0	9	35	56	0
	Weekend	0	2	18	32	48	0
	Total	0	1	15	33	51	0
Round 10	Weekday	0	0	4	49	47	0
	Weekend	1	0	9	38	49	3
	Total	1	0	7	42	48	2
Total		0	1	8	36	53	2

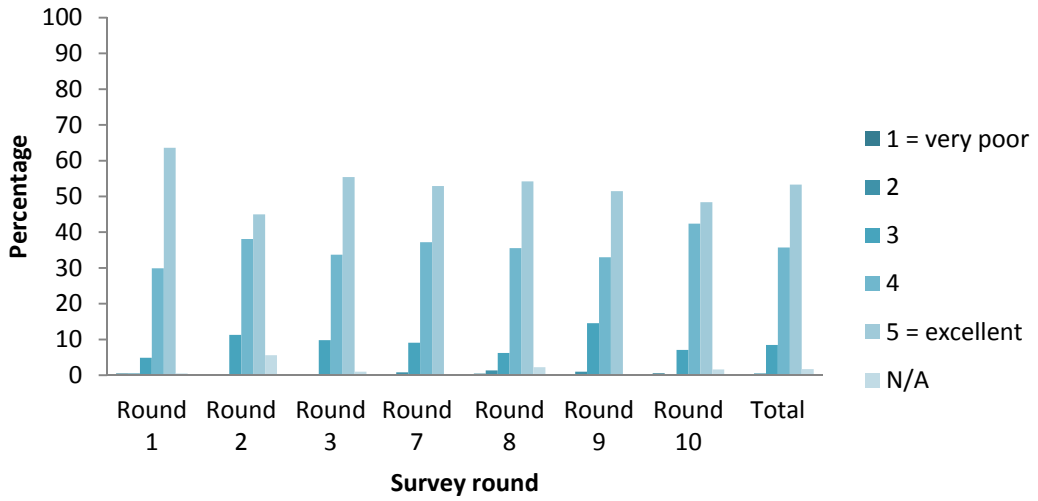


Figure 52. Quality of features – Scenic beauty (%) by survey round.

As with previous rounds, a high proportion of respondents (38% in Round 9 and 33% in Round 10) selected 'not applicable' with regards to the quality of barbeque facilities. This suggests a lack of awareness, familiarity with or use of the barbeque facilities at Point Fraser. Of the respondents who used or were familiar with barbeque facilities, 13% considered them to be excellent, 24% good, 13% satisfactory, 9% poor and 2% very poor in Round 9 (Table 37 and Figure 53). Respondents from Round 10 rated the barbeque facilities in a similar manner to round 9.

Table 37. Quality of features – BBQ facilities (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	0	6	6	16	13	59
	Weekend	0	1	19	16	17	48
	Total	0	3	14	16	15	52
Round 2	Weekday	0	9	9	16	19	46
	Weekend	1	0	16	25	11	47
	Total	1	4	13	21	15	47
Round 3	Weekday	1	6	25	23	14	30
	Weekend	0	7	18	25	14	37
	Total	1	7	21	24	14	34
Round 7	Weekday	2	7	25	23	14	30
	Weekend	0	6	18	28	8	40
	Total	1	6	21	26	10	36
Round 8	Weekday	1	3	17	21	9	49
	Weekend	3	5	26	22	15	29
	Total	2	4	23	22	13	36
Round 9	Weekday	2	2	12	24	12	46
	Weekend	2	14	14	23	14	32
	Total	2	9	13	24	13	38
Round 10	Weekday	4	9	20	18	12	36
	Weekend	5	8	21	25	10	31

	Total	5	9	21	22	11	33
Total		2	6	18	22	13	39

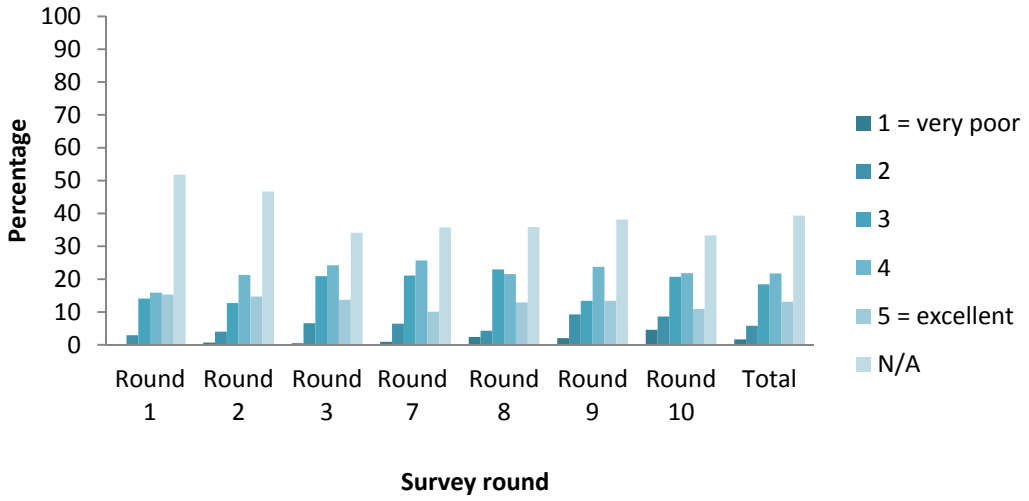


Figure 53. Quality of features – BBQ facilities (%) by survey round

Out of the surveyed features of Point Fraser parkland, the toilet facilities attracted the most criticism. In both Rounds 9 and 10, about a quarter of respondents selected 'non-applicable' (Table 38 and Figure 54). Despite the high selection of 'non-applicable', in Round 9, a total of 26% rated the toilet facilities as very poor or poor, compared to a 27% of positive responses and 21% rating them neither good nor bad. While in Round 10, a total of 24% rated the toilets as either very poor or poor. Twenty-nine percent (29%) selected satisfactory and a total of 24% rated them as either good or very good. Issues of quality, availability, placement, cleanliness and accessibility (i.e. disabled access) were highlighted by a substantial number of suggestions (see Section 1.2.5 Overall Satisfaction and Recommendations) by survey respondents, and have been raised consistently in previous years.

Table 38. Quality of features – Toilet facilities (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	10	8	16	25	12	30
	Weekend	6	13	17	22	11	31
	Total	7	11	17	23	11	30
Round 2	Weekday	7	12	21	13	13	34
	Weekend	6	8	23	26	7	32
	Total	6	10	22	20	10	33
Round 3	Weekday	12	11	24	21	11	21
	Weekend	10	18	19	24	12	17
	Total	11	15	21	23	11	19
Round 7	Weekday	15	15	19	19	11	21
	Weekend	7	18	21	22	6	26
	Total	10	17	20	21	8	24
Round 8	Weekday	13	10	22	18	8	29

	Weekend	5	15	34	17	8	22
	Total	8	13	29	17	8	25
Round 9	Weekday	5	14	17	12	12	40
	Weekend	16	16	24	24	5	16
	Total	11	15	21	19	8	26
Round 10	Weekday	6	22	22	10	12	27
	Weekend	9	12	34	17	9	20
	Total	8	16	29	14	10	23
Total		9	14	23	20	10	26

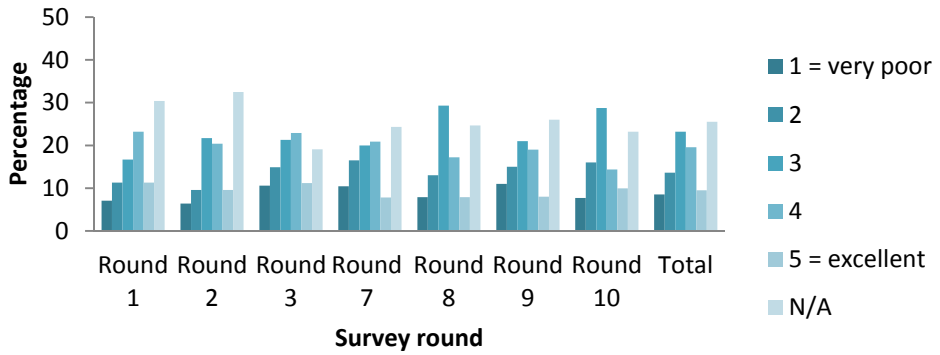


Figure 54. Quality of features – Toilet facilities (%) by survey round

Nine percent (9%) of Round 9 respondents rated the signage as poor or very poor, 31% were neutral and 50% were positive (Table 39 and
Figure 55). While in Round 10, 10% considered signage to be very poor or poor, 28% were neutral and 56% were positive. In previous rounds there have been comments by survey respondents highlighting the need for more signs and in particular directional signage and is reflected in the suggestions for improvements (see Section 1.2.5 Overall Satisfaction and Recommendations). The survey question does not make a distinction between directional, informational or interpretive signage. Use, perception, needs and effectiveness of different types of signage in the reserve are aspects that warrant further research.

Table 39. Quality of features – Signage (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	0	3	24	37	30	6
	Weekend	3	6	21	33	24	13
	Total	2	5	22	34	26	10
Round 2	Weekday	0	4	23	30	33	10
	Weekend	0	0	19	45	21	15
	Total	0	2	21	38	26	13
Round 3	Weekday	2	7	31	31	22	7
	Weekend	3	10	28	39	20	1
	Total	3	9	29	35	21	4
Round 7	Weekday	0	4	35	35	19	6
	Weekend	1	10	37	35	13	4
	Total	1	8	36	35	15	5
Round 8	Weekday	4	8	29	27	22	10

	Weekend	0	11	27	37	19	6
	Total	1	10	28	33	20	8
Round 9	Weekday	2	5	29	24	29	10
	Weekend	3	7	33	33	15	10
	Total	3	6	31	29	21	10
Round 10	Weekday	1	6	31	35	23	3
	Weekend	0	11	25	33	21	10
	Total	1	9	28	34	22	7
Total		1	7	27	34	22	8

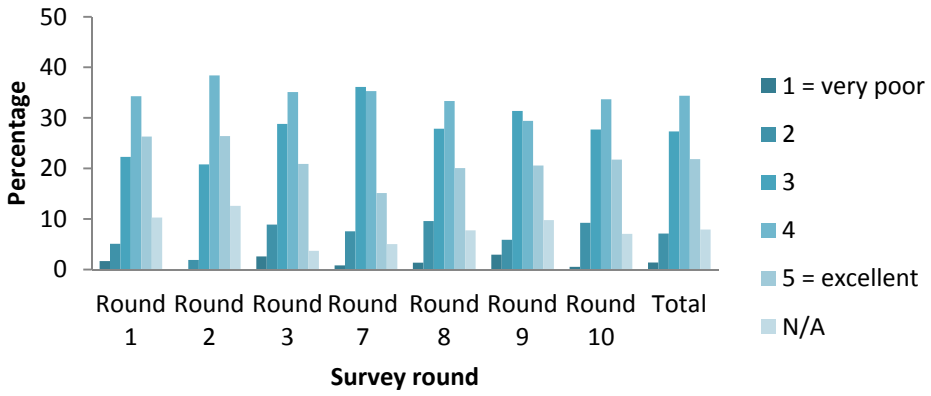


Figure 55. Quality of features – Signage (%) by survey round.

In Rounds 1 and 2, seating and tables had been combined (Table 40). However, since there are no tables in the Point Fraser parkland, it was considered that seating and tables should in fact be separated to present a more accurate picture.

Table 40. Quality of features – Seating and Tables (%) by survey Rounds 1 and 2.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	0	0	17	40	33	10
	Weekend	1	3	18	39	22	17
	Total	1	2	18	39	26	14
Round 2	Weekday	1	9	14	25	19	32
	Weekend	0	5	16	39	20	20
	Total	1	6	15	32	20	25
Total		1	4	17	36	23	20

In Round 9 almost 70% of respondents were positive about the quality of the seating, either selecting good (47%) or excellent (22%) (Table 41 and Figure 56). While 19% considered the seating to be neither good or bad and 5% were dissatisfied. Similarly in Round 10 the majority of respondents were positive about the seating at Point Fraser with 68% selecting either good or excellent. Nineteen percent (19%) were neutral about seating and 6% were dissatisfied.

Table 41. Quality of features – Seating (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 3	Weekday	1	4	18	38	27	12
	Weekend	0	5	15	49	24	7
	Total	1	4	16	44	26	9
Round 7	Weekday	0	2	27	41	23	7
	Weekend	1	7	17	40	33	1
	Total	1	5	21	40	29	4
Round 8	Weekday	4	1	18	36	28	13
	Weekend	0	4	21	41	26	8
	Total	1	3	20	39	27	9
Round 9	Weekday	0	2	12	49	29	7
	Weekend	2	5	24	45	18	6
	Total	1	4	19	47	22	7
Round 10	Weekday	1	4	19	42	25	9
	Weekend	0	6	16	41	28	9
	Total	1	5	17	41	27	9
Total		1	4	19	42	26	8

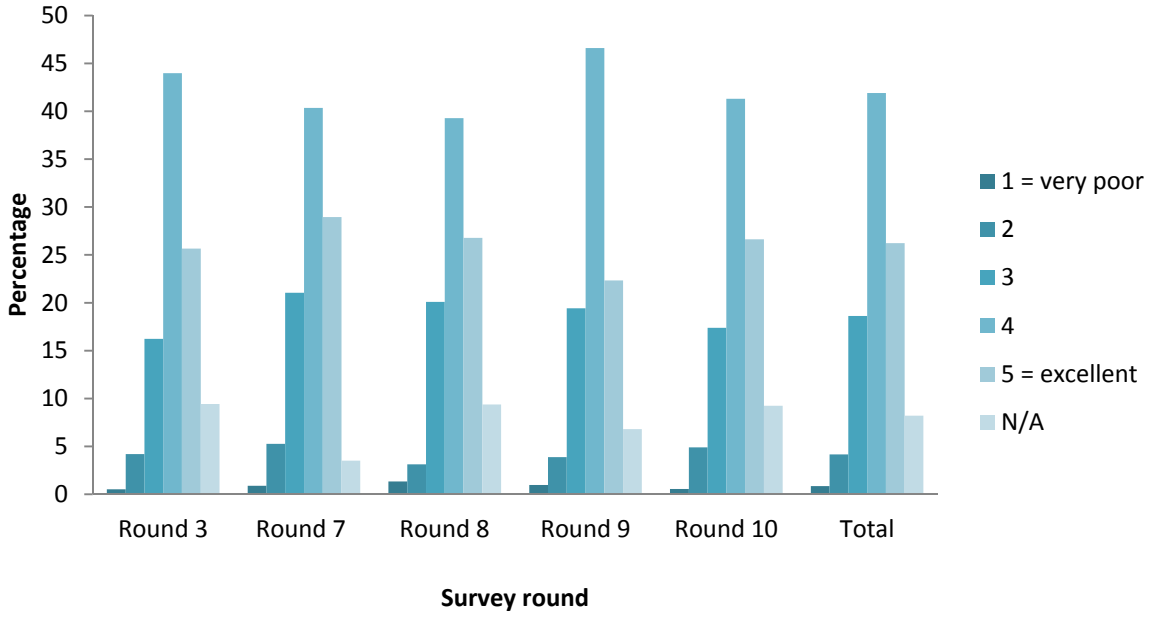


Figure 56. Quality of features – Seating (%) by survey round.

As with previous rounds, there is about a quarter of respondents who indicated that the issue of tables at Point Fraser is not applicable (Table 42 and Figure 57). In Round 9, 16% of respondents considered the quality of tables negatively, 21% neutral and 34% were positive. Similarly in Round 10, 14% of respondents rated the quality of the tables negatively, 28% were neutral and 34% were positive. As there are no tables at Point Fraser it is interesting that tables which don't exist can be rated positively by respondents. This potentially highlights a lack of awareness on the part of the survey respondents in regard to absence of tables or the length of the survey.

Table 42. Quality of features – Tables (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 3	Weekday	2	10	30	22	11	25
	Weekend	9	9	26	25	10	20
	Total	6	10	28	24	11	22
Round 7	Weekday	7	9	27	27	7	24
	Weekend	3	13	28	28	6	22
	Total	5	11	28	28	6	23
Round 8	Weekday	5	13	20	24	9	29
	Weekend	3	8	29	28	9	23
	Total	4	10	26	27	9	25
Round 9	Weekday	10	2	17	27	12	32
	Weekend	5	15	24	22	9	25
	Total	7	9	21	24	10	28
Round 10	Weekday	7	13	21	23	7	29
	Weekend	4	7	33	27	11	19
	Total	5	9	28	25	9	23
Total		5	10	26	25	9	24

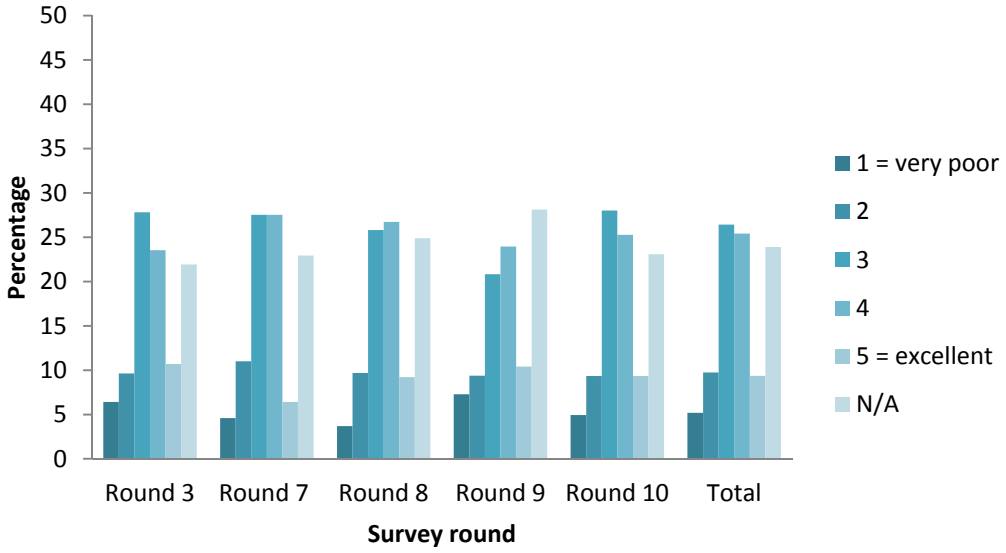


Figure 57. Quality of features – Tables (%) by survey round.

In both Rounds 9 and 10, almost a quarter of respondents rated education as not applicable. Forty percent (40%) rated education as good or excellent, 23% neither good nor bad, and 11% as poor or very poor (Table 43 and Figure 58). While in Round 10, 37% considered education positively, 31% as neutral and 8% negatively. There was no definition of 'education' presented in the survey and as such it was up to the respondents to identify what they considered to be education. As no guided tours were offered during the survey period, it is considered that this response relates predominately to the signage or visitor interpretation.

Table 43. Quality of features – Education (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	2	3	20	16	15	44
	Weekend	2	6	19	29	15	30
	Total	2	5	19	24	15	35
Round 2	Weekday	3	3	20	24	19	31
	Weekend	2	5	17	15	14	47
	Total	3	4	18	19	16	40
Round 3	Weekday	1	8	25	26	15	25
	Weekend	0	7	25	30	17	21
	Total	1	7	25	28	16	23
Round 7	Weekday	2	2	15	35	22	24
	Weekend	0	13	24	26	13	24
	Total	1	9	21	29	16	24
Round 8	Weekday	4	8	23	17	10	38
	Weekend	2	10	23	25	15	25
	Total	3	9	23	22	13	30
Round 9	Weekday	0	8	25	23	18	28
	Weekend	2	14	22	31	9	22
	Total	1	11	23	28	12	24
Round 10	Weekday	3	6	33	21	14	24
	Weekend	0	8	29	27	11	24
	Total	1	7	31	25	12	24
Total		2	7	23	25	14	29

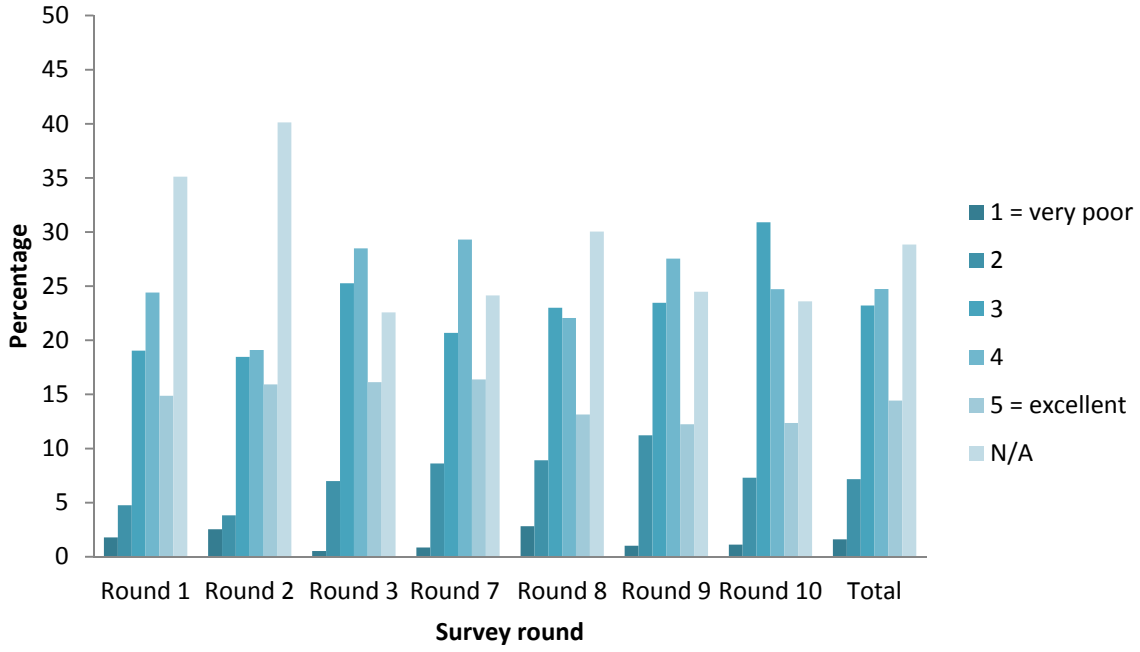


Figure 58. Quality of features – Education (%) by survey round.

As with some other features at Point Fraser and consistent with previous survey rounds, the quality of About a Bike Hire was rated as not applicable by a high proportion of respondents, both in Round 9 (36%) and Round 10 (34%) (Table 44 and Figure 59). This indicates that the respondents had not used the services of About Bike Hire, had no need to use the service or were unaware of it. These figures were also reflected in the question on staff interaction. This data require cautious interpretation as it appears that there is limited awareness of the name and presence of About a Bike hire amongst respondents. Of the respondents who were aware of the bike hire business, in Round 9, 48% of respondents were positive about About a Bike Hire, 11% were neutral and 6% negative. Thirty-nine (39%) percent of respondents ranked 'About a Bike Hire' as excellent or good, 20% as neither bad nor good and 7% as either poor or very poor.

Table 44. Quality of features – About a Bike Hire (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	2	2	2	19	21	55
	Weekend	0	4	6	21	21	48
	Total	1	3	4	21	21	50
Round 2	Weekday	1	5	10	14	10	59
	Weekend	1	5	10	14	10	59
	Total	1	3	8	14	17	57
Round 3	Weekday	5	4	14	22	21	35
	Weekend	2	4	12	19	24	40
	Total	3	4	13	20	22	38
Round 7	Weekday	0	2	11	22	22	42
	Weekend	4	3	18	21	18	37
	Total	3	3	15	21	19	39
Round 8	Weekday	3	1	12	22	18	44
	Weekend	3	5	15	27	25	25
	Total	3	4	14	25	22	32
Round 9	Weekday	0	2	7	21	29	40
	Weekend	2	7	14	29	17	32
	Total	1	5	11	26	22	36
Round 10	Weekday	3	7	14	15	17	44
	Weekend	2	3	24	31	12	28
	Total	2	5	20	25	14	34
Total		2	4	12	22	20	41

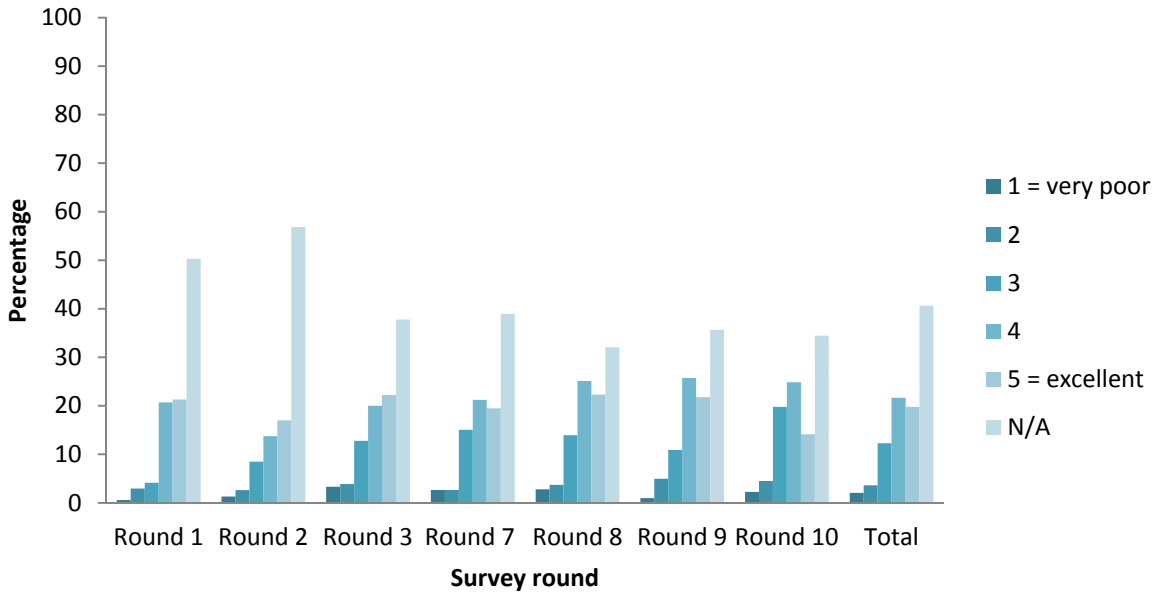


Figure 59. Quality of features – About a Bike Hire (%) by survey round.

In Round 9, 46% of respondents ranked 'staff interaction' as excellent or good, 13% as neither bad nor good and 6% as either poor or very poor (Table 45 and Figure 60). While in Round 10, 35% rated staff interaction positively, 17% neutral and 9% negatively. There were high percentages of respondents who selected not applicable, in Round 9, 35% and in Round 10, 39%. This indicated the respondents either didn't have any interaction with About Bike Hire staff while visiting Point Fraser and/or didn't have any awareness of the service and therefore did not use it. In some cases respondents thought staff interaction referred to City of Perth staff, while others reported on interactions with ECU survey teams. Thus as per comments regarding the previous item, caution is required with the interpretation of these results.

Table 45. Quality of features – Staff interaction (%) by survey round.

		1 = very poor	2	3	4	5 = excellent	N/A
Round 1	Weekday	0	5	10	15	16	55
	Weekend	3	5	14	11	18	50
	Total	2	5	12	12	18	51
Round 2	Weekday	0	5	8	16	27	44
	Weekend	0	5	11	12	17	55
	Total	2	3	10	14	21	51
Round 3	Weekday	8	11	9	16	26	30
	Weekend	4	7	14	15	20	39
	Total	6	9	12	16	23	35
Round 7	Weekday	2	4	13	17	24	39
	Weekend	5	0	14	17	14	51
	Total	4	2	14	17	18	46
Round 8	Weekday	4	5	12	12	27	41
	Weekend	6	3	15	23	23	30
	Total	5	4	13	19	25	34
Round 9	Weekday	2	2	5	22	29	39
	Weekend	5	2	19	22	20	32
	Total	4	2	13	22	24	35
Round 10	Weekday	3	7	10	10	23	48
	Weekend	2	7	22	24	14	32
	Total	2	7	17	18	18	39
Total		4	5	13	17	21	41

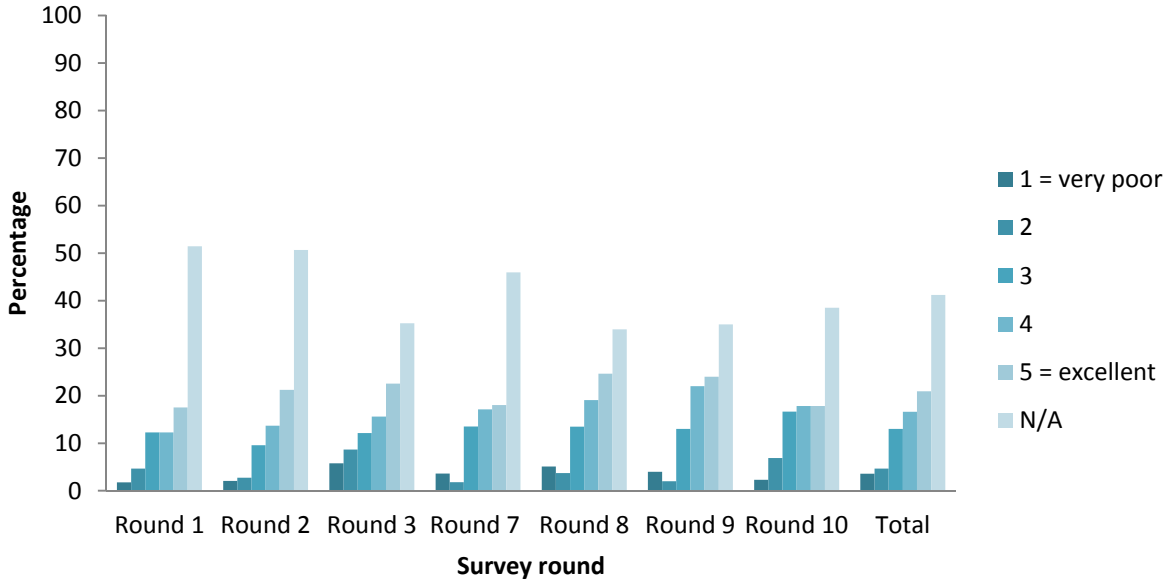


Figure 60. Quality of features – Staff interaction (%) by survey round.

In addition to the listed features, there was also the option for 'other' features not listed. In Round 9, respondents listed the following as 'other' features of quality, including: canoe hire and 'they need to let people know about Heirisson – very underrated'. While in Round 10, the only feature listed as 'other' was 'bike service important'.

To further explore the analysis of visitor park satisfaction, 'importance' of park features were added in Round 3, using a 5-point scale (1=low importance; 2= not important; 3=neutral; 4=important; 5=high importance). Overall respondents considered cleanliness of the park to be important, with 72% selecting high importance and 23% selecting important in Round 9 (Table 46 and Figure 61). In Round 10, 81% rated cleanliness as of high importance and 18% as important.

Table 46. Importance of features – Cleanliness (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	0	1	1	21	76	0
	Weekend	0	0	3	15	82	0
	Total	0	1	2	18	79	0
Round 7	Weekday	0	0	0	26	74	0
	Weekend	0	0	3	14	83	0
	Total	0	0	2	18	80	0
Round 8	Weekday	0	0	1	15	82	1
	Weekend	0	0	2	15	83	0
	Total	0	0	1	15	83	0
Round 9	Weekday	0	0	8	24	68	0
	Weekend	0	2	0	23	75	0
	Total	0	1	3	23	72	0
Round 10	Weekday	1	0	0	16	82	0
	Weekend	0	0	2	18	80	0
	Total	1	0	1	17	81	0
Total		0	0	2	18	80	0

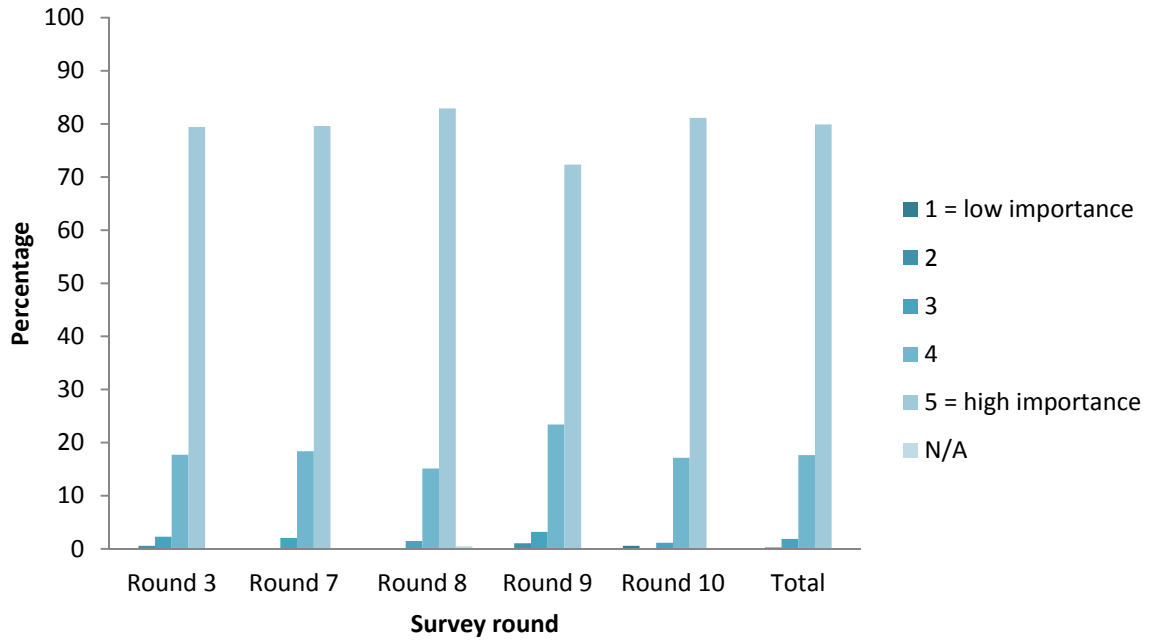


Figure 61. Importance of features – Cleanliness (%) by survey round.

'Access' was considered to be an important feature with 92% either selecting important or high importance, 6% were neutral and 1% considered it not to be important in Round 9 (Table 47 and Figure 62). Consistent with the previous round, in Round 10, 96% rated access to a feature of high importance, with 3% neutral and 1% considering it to be of low importance.

Table 47. Importance of features – Access (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	0	1	4	36	57	1
	Weekend	1	1	6	24	67	0
	Total	1	1	5	30	63	1
Round 7	Weekday	0	0	6	29	65	0
	Weekend	2	0	8	21	69	0
	Total	1	0	7	24	68	0
Round 8	Weekday	0	1	1	27	69	1
	Weekend	0	2	6	26	65	1
	Total	0	2	5	26	67	1
Round 9	Weekday	0	3	11	14	72	0
	Weekend	0	0	4	19	77	0
	Total	0	1	6	17	75	0
Round 10	Weekday	3	0	3	23	70	1
	Weekend	0	0	3	28	69	0
	Total	1	0	3	26	70	0
Total		1	1	5	26	68	1

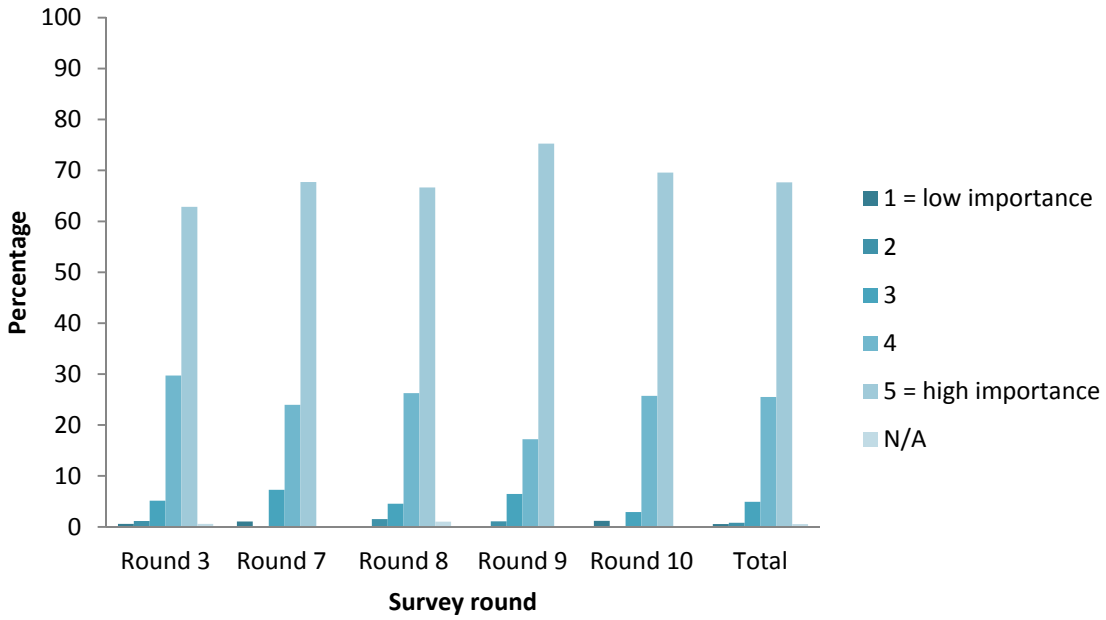


Figure 62. Importance of features – Access (%) by survey round.

Predominately in Round 9, the importance of 'playground facilities' was considered to be important (30%) or of high importance (34%) Table 48 and Figure 63). Fifteen percent (15%) were neutral and 7% considered playground facilities to be of low importance. Similarly in Round 10, playgrounds were considered to be of high importance by 36% of respondents and important to 25%. Seventeen percent (17%) were neutral and 9% did not consider to playground facilities to be important. In both Round 9 and 10 more than 10% indicated that the importance of playgrounds was not applicable to them.

Table 48. Importance of features – Playground facilities (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	5	11	19	30	22	12
	Weekend	13	8	16	18	32	13
	Total	10	9	18	24	27	13
Round 7	Weekday	10	7	17	30	23	13
	Weekend	5	10	13	30	33	10
	Total	7	9	14	30	30	11
Round 8	Weekday	9	6	21	19	39	7
	Weekend	11	5	16	23	37	8
	Total	10	5	18	21	38	8
Round 9	Weekday	6	9	20	29	29	9
	Weekend	4	0	11	31	37	17
	Total	4	3	15	30	34	13
Round 10	Weekday	9	3	15	18	37	19
	Weekend	6	2	19	31	36	5
	Total	7	2	17	25	36	11
Total		8	6	17	25	33	11

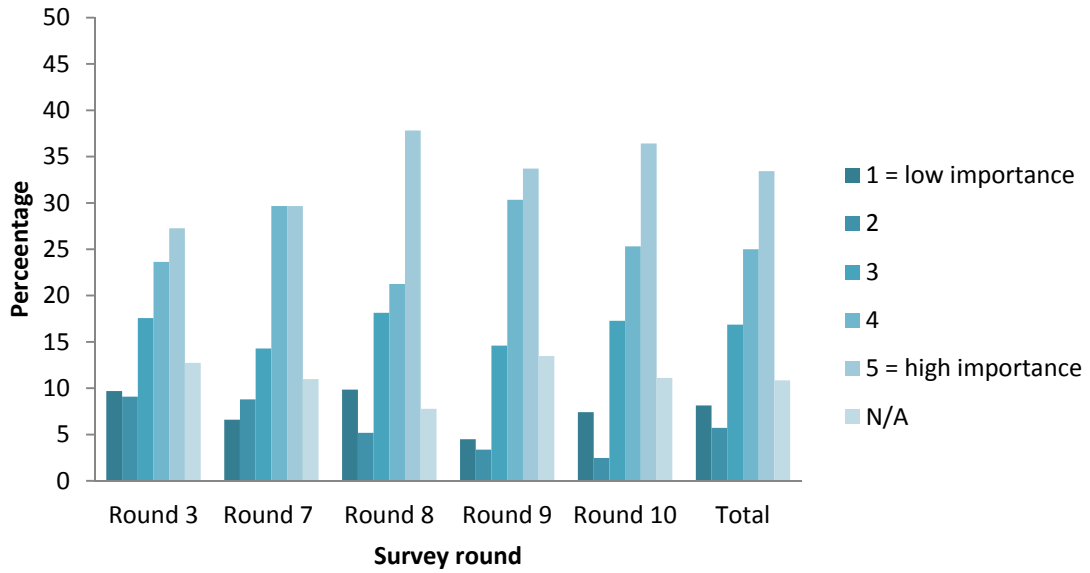


Figure 63. Importance of features – Playground facilities (%) by survey round.

The vast majority of Round 9 respondents considered 'scenic beauty' to be of high importance (71%) or important (18%) to them (Table 49 and

Figure 64). Nine percent (9%) were neutral and 2% selected scenic beauty to be not important or of low importance. There were similar trends in Round 10 with 71% indicating that scenic beauty at Point Fraser was of high importance to them, and 23% selecting important. Four percent (4%) were neutral on the importance of scenic beauty. Two percent of respondents considered it to be of low importance (1%) and not important (1%).

Table 49. Importance of features – Scenic beauty (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	0	3	8	32	57	0
	Weekend	1	0	2	26	71	0
	Total	1	0	1	5	29	65
Round 7	Weekday	0	3	3	28	66	0
	Weekend	0	0	7	26	67	0
	Total	0	1	5	27	67	0
Round 8	Weekday	0	1	4	21	72	1
	Weekend	2	0	5	27	66	2
	Total	1	1	5	25	68	2
Round 9	Weekday	0	0	8	28	64	0
	Weekend	2	2	9	12	75	0
	Total	1	1	9	18	71	0
Round 10	Weekday	1	1	4	25	67	1
	Weekend	0	1	4	22	73	0
	Total	1	1	4	23	71	1
Total		1	1	5	25	68	1

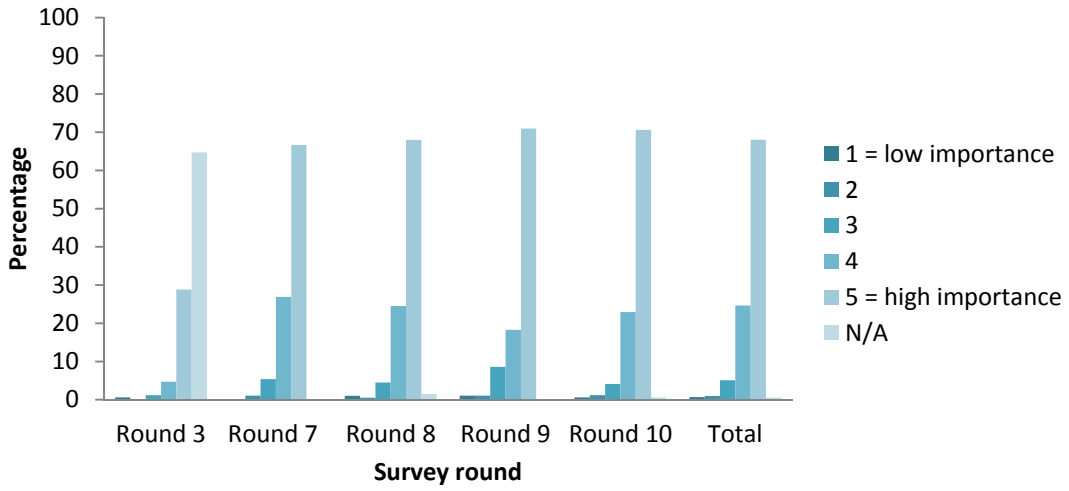


Figure 64. Importance of features – Scenic beauty (%) by survey round.

The importance of 'barbeque (BBQ) facilities' varied in survey Rounds 9 and 10. In Round 9, the majority of respondents rated barbeque facilities to be either important (33%) or of high importance (31%) (Table 50 and Figure 65). Ten (10%) percent of respondents were neutral, while 13% considered barbeque facilities to either be not important or of low importance and 13% not applicable. Thirty-three percent (33%) of respondents in Round 10, considered barbeque facilities to be of high importance and 24% to be important. While, 20% were neutral, 7% considered barbeque facilities not to be important, 7% of low importance and 9% not applicable.

Table 50. Importance of features – BBQ facilities (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	4	8	24	28	27	8
	Weekend	5	9	21	29	21	15
	Total	5	9	22	29	23	12
Round 7	Weekday	6	13	22	22	22	16
	Weekend	5	5	26	34	23	7
	Total	5	8	25	30	23	10
Round 8	Weekday	1	6	25	38	23	7
	Weekend	11	7	17	25	33	7
	Total	8	6	20	30	29	7
Round 9	Weekday	8	8	17	33	19	14
	Weekend	4	6	6	33	39	13
	Total	6	7	10	33	31	13
Round 10	Weekday	12	9	23	17	26	13
	Weekend	3	6	18	29	37	6
	Total	7	7	20	24	33	9
Total		6	7	20	29	28	10

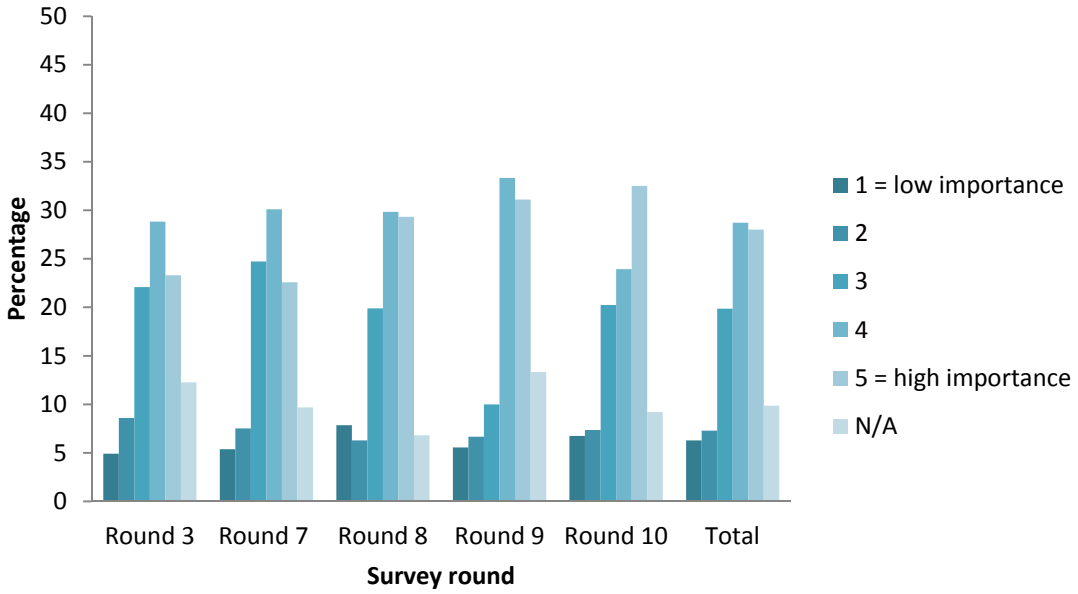


Figure 65. Importance of features – BBQ facilities (%) by survey round.

'Toilet facilities' were considered to be of high importance to 63% of respondents and important to 23% in Round 9 (Table 51 and Figure 66). A smaller proportion of respondents considered toilet facilities to be either neutral (5%) and or not applicable (2%). While in Round 10, 56% of respondents considered toilets to be of high importance and 29% important. Eight percent (8%) were neutral, 1% rated toilets to be not important and 1% of low importance.

Table 51. Importance of features – Toilet facilities (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	2	1	4	32	58	3
	Weekend	1	4	9	27	53	5
	Total	2	2	7	30	56	4
Round 7	Weekday	0	6	36	42	15	0
	Weekend	0	2	10	30	57	2
	Total	0	3	6	32	52	6
Round 8	Weekday	1	3	13	27	50	6
	Weekend	2	3	8	23	62	3
	Total	2	3	10	24	58	4
Round 9	Weekday	3	0	11	25	56	6
	Weekend	2	0	2	21	68	7
	Total	2	0	5	23	63	6
Round 10	Weekday	1	3	10	28	52	6
	Weekend	1	0	7	30	59	3
	Total	1	1	8	29	56	4
Total		1	2	8	27	57	5

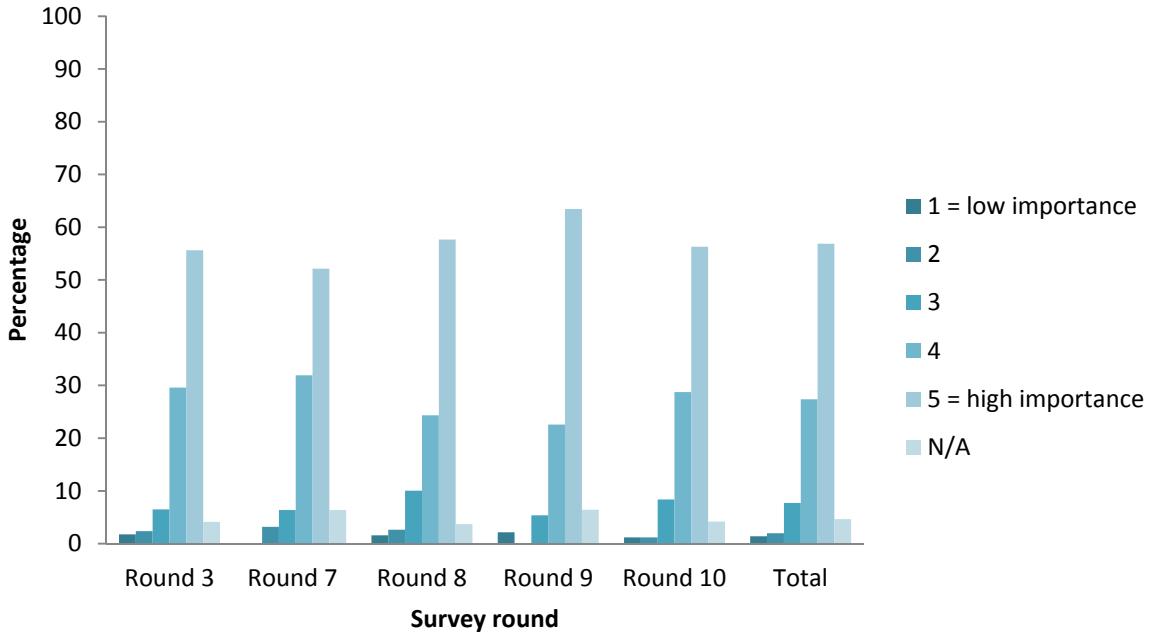


Figure 66. Importance of features – Toilet facilities (%) by survey round.

'Signage', in Round 9, was considered to be a feature in the park of importance, with 44% indicating high importance and 30% important (Table 52 and

Figure 67). Of the respondents, 16% were neutral, 4% considered signage to be less importance and 5% low importance. Again there was a strong correlation with Round 10 data, 45% rating signage to be of high importance and 30% important. Neutral was selected by 19%, while 2% considered signage to be less important and 1% of low importance.

Table 52. Importance of features - Signage (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	1	7	14	43	32	3
	Weekend	3	2	14	36	45	0
	Total	2	4	14	39	40	1
Round 7	Weekday	3	6	15	27	42	6
	Weekend	2	5	15	33	43	2
	Total	2	5	15	31	43	3
Round 8	Weekday	1	6	20	28	39	6
	Weekend	2	3	18	31	44	2
	Total	2	4	19	30	42	4
Round 9	Weekday	9	9	24	24	35	0
	Weekend	4	2	12	33	49	0
	Total	5	4	16	30	44	0
Round 10	Weekday	1	3	17	36	39	4

	Weekend	1	1	20	25	51	2
	Total	1	2	19	30	45	3
Total		2	4	17	32	43	2

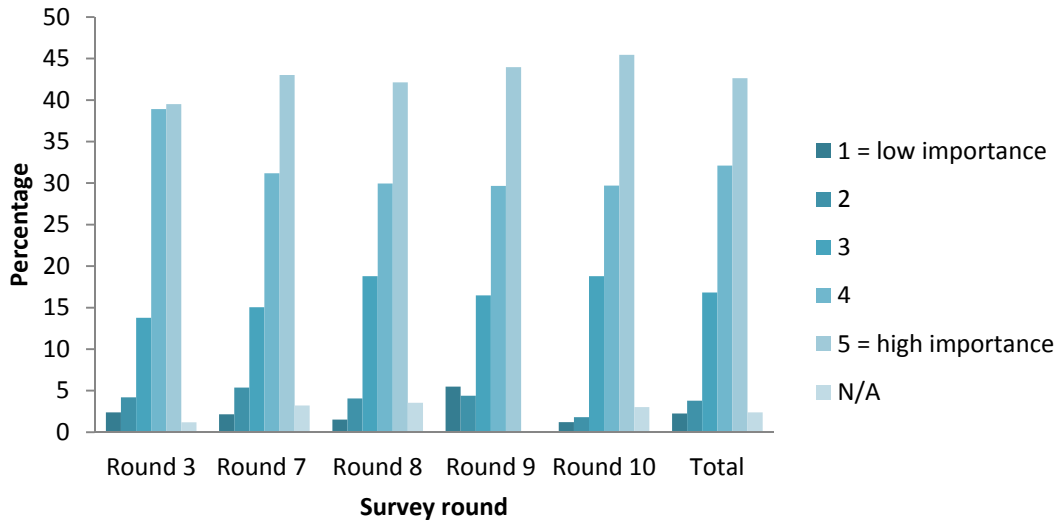


Figure 67. Importance of features – Signage (%) by survey round.

In Round 9, the importance of 'seating' was rated highly among respondents, with 45% high importance and 34% important (Table 53 and Figure 68). Sixteen (16%) percent of respondents considered seating to be neither important nor not important and 3% less or low importance. While in Round 10, 39% of respondents considered seating to be of high importance and 35% to be important. Of the remaining respondents, 17% were neutral on the importance of seating, 4% considered it not to be important and 2% of low importance.

Table 53. Importance of features – Seating (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	0	5	11	47	32	4
	Weekend	4	2	10	40	40	3
	Total	2	4	10	43	37	4
Round 7	Weekday	3	9	9	48	24	6
	Weekend	0	2	12	45	40	2
	Total	1	4	11	46	34	3
Round 8	Weekday	0	3	17	38	39	3
	Weekend	3	2	16	36	40	4
	Total	2	2	16	36	39	4
Round 9	Weekday	3	0	26	29	41	0
	Weekend	4	0	11	37	47	2
	Total	3	0	16	34	45	1
Round 10	Weekday	4	7	7	41	36	4
	Weekend	0	1	23	31	41	4
	Total	2	4	17	35	39	4

Total		2	3	14	39	39	3

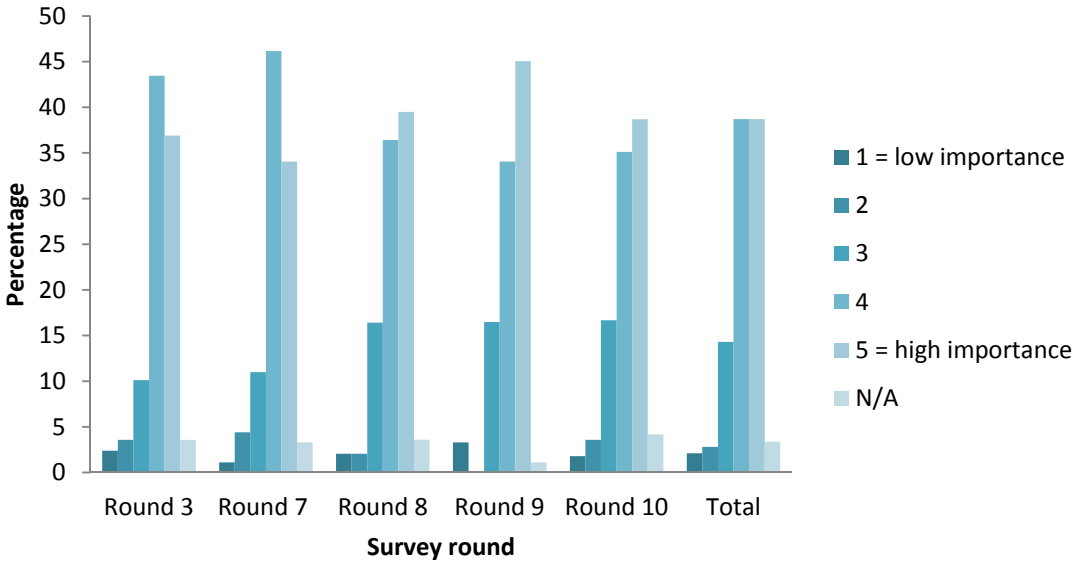


Figure 68. Importance of features – Seating (%) by survey round.

The importance of 'tables' as a feature, in Round 9, was considered to be of high importance, with 34%, while 26% selected important (Table 54 and Figure 69). Eighteen (18%) percent were neutral about the importance of tables and 13% considered tables not to be important or of low importance. Tables were not applicable for 10% of respondents. While in Round 10, 29% rated tables to be of high importance and 32% important. Twenty-four percent (24%) of respondents were neutral about the importance of tables, while 8% were considered them to be either less important or of low important.

Table 54. Importance of features - Tables (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	1	10	16	50	18	4
	Weekend	5	3	16	34	32	9
	Total	4	6	16	41	26	7
Round 7	Weekday	3	16	13	34	25	9
	Weekend	0	2	24	41	29	5
	Total	1	7	20	38	27	7
Round 8	Weekday	1	7	19	35	28	10
	Weekend	5	5	25	29	28	8
	Total	4	6	23	31	28	9
Round 9	Weekday	6	15	26	15	29	9
	Weekend	7	0	13	33	36	11
	Total	7	6	18	26	34	10
Round 10	Weekday	6	9	26	23	26	10

	Weekend	0	4	22	38	31	5
	Total	2	6	24	32	29	7
Total		3	6	20	34	28	8

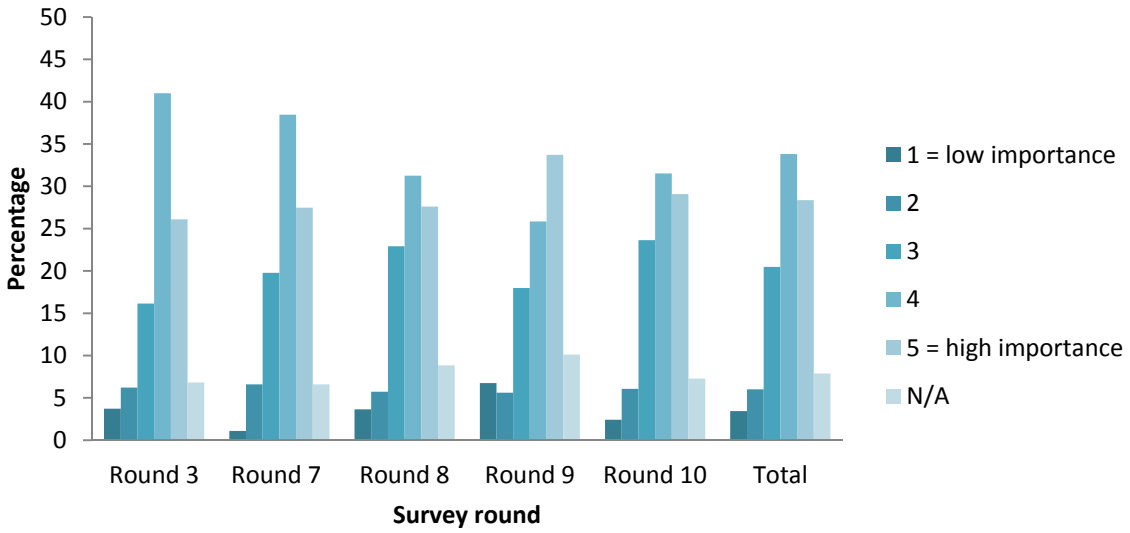


Figure 69. Importance of features – Tables (%) by survey round.

In Round 9, 'education' was considered to be of importance or high importance by a total of 66% of respondents, 23% were neutral and 5% less or low importance (Table 55 and

Figure 70). Six percent (6%) considered education to be not applicable. There were similar trends in the Round 10 data with 62% rating education to be of high importance or to be important. Twenty-two percent (22%) rated education as neutral and 8% not important or of low importance. Education was considered to be not applicable to 9% of respondents.

Table 55. Importance of features - Education (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	3	9	27	30	20	11
	Weekend	4	3	17	35	28	13
	Total	4	5	21	33	24	12
Round 7	Weekday	3	10	10	33	33	10
	Weekend	2	7	27	36	22	7
	Total	2	8	21	35	26	8
Round 8	Weekday	3	9	22	29	26	12
	Weekend	5	7	17	28	35	8
	Total	4	7	19	28	32	9
Round 9	Weekday	6	3	35	26	24	6
	Weekend	0	4	15	19	57	6
	Total	2	3	23	22	44	6
Round 10	Weekday	1	9	19	32	28	10
	Weekend	2	3	24	33	30	7
	Total	2	6	22	33	29	9

Total		3	6	21	30	30	9

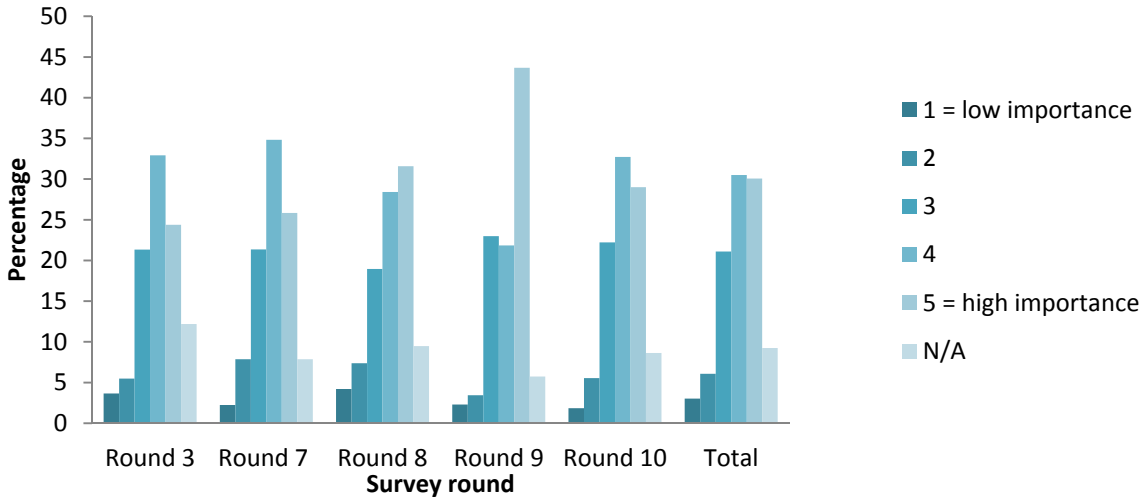


Figure 70. Importance of features – Education (%) by survey round.

Of the Round 9 survey respondents, 18% considered the importance of 'About a Bike Hire' to be not applicable to them (Table 56 and Figure 71). Thirty-four percent (34%) viewed About a Bike Hire as a very important feature and 27% considered it to be an important feature. While 12% were neutral about the importance of About a Bike Hire and 8% considered it to be not important or of low importance. In Round 10, 16% of survey respondents considered About a Bike Hire to be not applicable. The service was rated as important by almost half (49%) of respondents, with 27% neutral and 9% considering it to be of low importance.

Table 56. Importance of features – About a Bike Hire (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	5	8	18	36	18	15
	Weekend	11	3	19	26	22	19
	Total	8	5	19	30	21	17
Round 7	Weekday	10	13	13	32	19	13
	Weekend	5	8	33	30	13	10
	Total	7	10	26	31	15	11
Round 8	Weekday	6	9	16	25	22	23
	Weekend	7	7	18	30	29	10
	Total	6	7	17	28	26	15
Round 9	Weekday	6	8	14	31	22	19
	Weekend	4	2	11	24	43	17
	Total	4	4	12	27	34	18
Round 10	Weekday	6	6	27	16	25	19
	Weekend	2	4	26	26	27	14
	Total	4	5	27	22	27	16

Total		6	6	20	27	25	16

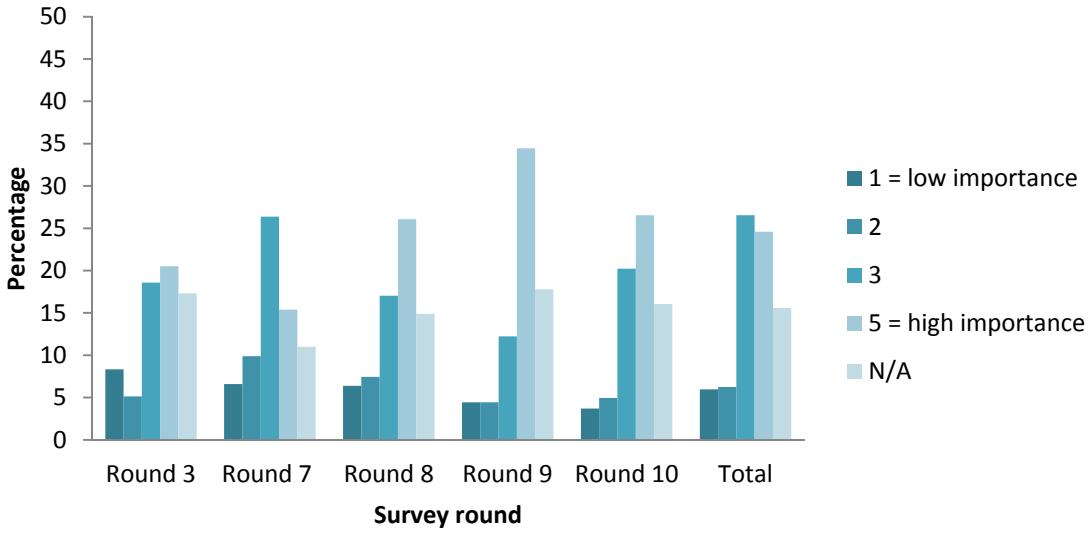


Figure 71. Importance of features – About a Bike Hire (%) by survey round.

'Staff interaction' at About a Bike Hire was considered to be of high importance to more than 30% of respondents and 23% rated it as important in Round 9 (Table 57 and Figure 72). While 18% of respondents were neutral about staff interaction and 11% considered it not to be important or of low importance. Sixteen percent (16%) felt this feature was not applicable to them. The data in Round 10 was not dissimilar with 50% rating staff interaction to be of importance (important or high importance) to them. Neutral was selected by 20% of respondents and 7% rated this feature as not important and 5% of low importance. Staff interaction was considered by 19% as not applicable.

Table 57. Importance of features – Staff interaction (%) by survey round.

		1 = low importance	2	3	4	5 = high importance	N/A
Round 3	Weekday	14	6	22	27	19	13
	Weekend	11	2	19	22	24	21
	Total	12	4	20	24	22	18
Round 7	Weekday	10	10	26	23	19	13
	Weekend	7	7	31	20	20	15
	Total	8	8	29	21	20	14
Round 8	Weekday	6	9	14	20	26	25
	Weekend	4	6	16	28	29	16
	Total	5	7	16	25	28	19
Round 9	Weekday	3	12	21	18	24	21
	Weekend	4	5	16	25	36	13
	Total	3	8	18	23	32	16
Round 10	Weekday	9	6	12	18	28	27
	Weekend	0	9	26	27	27	13
	Total	4	7	20	23	27	19
Total		6	7	20	24	26	18

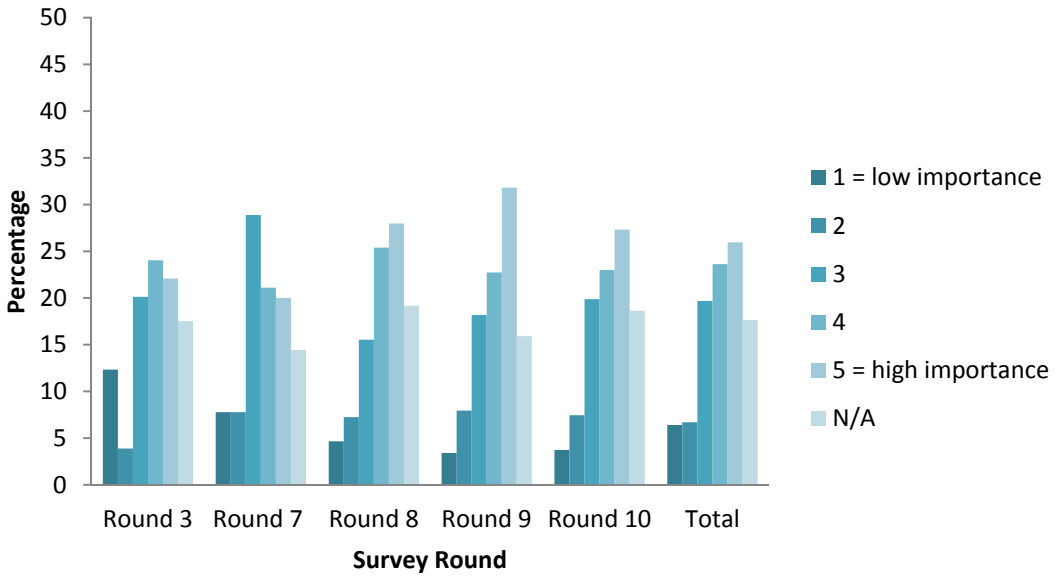


Figure 72. Importance of features – Staff interaction (%) by survey round.

Respondents were given the opportunity to indicate if there were 'other' features of importance to them not listed within the survey question. In Round 9 one respondent specified that 'canoe hire' was another feature considered to be important.

7.9.6 AVAILABILITY OF FEATURES

Respondents were asked about the availability of certain features at Point Fraser, including toilets, barbeques, seating, tables, signage and the number of other people, using a 4-point scale (1=too few; 2=about right; 3=too many; 4=didn't matter). Generally, respondents indicated that the availability of the facilities was 'about right', with the exception of the availability rating for toilet facilities. A high proportion of respondents noted that the availability of park features 'didn't matter' which reflects either that they were passing through the park and didn't have a need for such facilities or a lack of awareness of facilities.

In Round 9, 44% of respondents indicated that there were 'too few' toilets, consistent with the issues about toilet facilities outlined in quality of features and comments provided by respondents (Table 58 and Figure 73). While 39% considered the availability of toilets 'about right' and 17% 'didn't matter'. The proportion of respondents who said that the availability of toilets didn't matter is potentially a reflection of the significant number of people passing through the parkland. Data from Round 10 had very similar trends to the previous round, with 43% indicating that there were 'too few' toilets, while 38% of respondents said the number of toilets was 'about right', and for 19% the availability of toilets didn't matter. In both Rounds 9 and 10, no respondents indicated that there were 'too many' toilets.

Table 58. Availability of features – Toilets (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 1	Weekday	18	42	2	39
	Weekend	30	45	0	25
	Total	26	44	1	30
Round 2	Weekday	25	46	3	26
	Weekend	23	51	0	26
	Total	24	49	1	26
Round 3	Weekday	39	46	0	16
	Weekend	38	45	2	15
	Total	38	45	1	15
Round 7	Weekday	33	42	0	26
	Weekend	37	38	0	25
	Total	35	40	0	25
Round 8	Weekday	28	40	0	32
	Weekend	36	42	1	21
	Total	33	41	1	25
Round 9	Weekday	29	46	0	24
	Weekend	54	34	0	11
	Total	44	39	0	17
Round 10	Weekday	45	32	0	23
	Weekend	42	41	0	16
	Total	43	38	0	19
Total		34	42	1	23

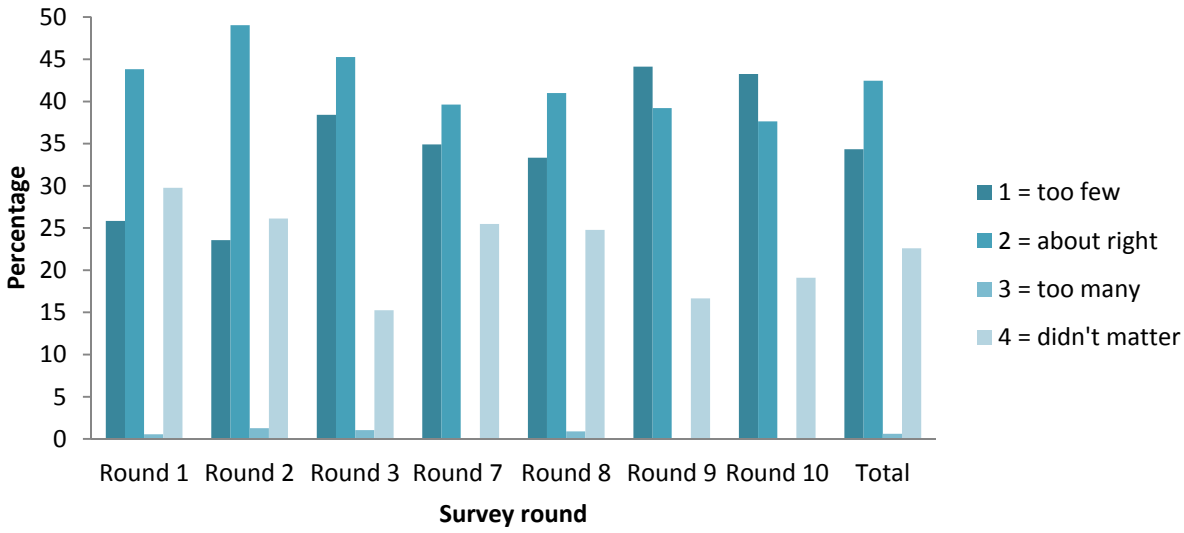


Figure 73. Availability of feature – Toilets (%) by survey round.

Of Round 9 respondents, 23% considered that there were 'too few' barbeque facilities (Table 59 and Figure 74). While 46% indicated that the number of barbeque facilities was 'about right', 30% said that it 'didn't matter' and 1% of respondents said there were 'too many' barbeques. Twenty-three percent (23%) of Round 10 respondents indicated that there were 'too few' barbeque facilities, 45% 'about right' and 32% 'didn't matter'. The

number and availability of barbeque facilities is limited and impacts the opportunities for recreational use of the park, also exacerbated by the lack of tables and seating. The significant number of people passing through the park reflects the high proportion of respondents indicating that the availability of barbeques 'didn't matter'.

Table 59. Availability of features – BBQs (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 1	Weekday	5	37	0	58
	Weekend	15	45	0	40
	Total	12	42	0	47
Round 2	Weekday	12	47	1	40
	Weekend	11	47	1	41
	Total	11	47	1	40
Round 3	Weekday	15	52	1	32
	Weekend	16	47	2	35
	Total	16	49	2	34
Round 7	Weekday	14	47	2	37
	Weekend	16	38	5	41
	Total	15	42	4	40
Round 8	Weekday	11	49	0	41
	Weekend	14	52	2	32
	Total	13	51	1	35
Round 9	Weekday	7	54	2	37
	Weekend	34	41	0	25
	Total	23	46	1	30
Round 10	Weekday	23	36	0	41
	Weekend	23	51	0	26
	Total	23	45	0	32
Total		16	46	1	37

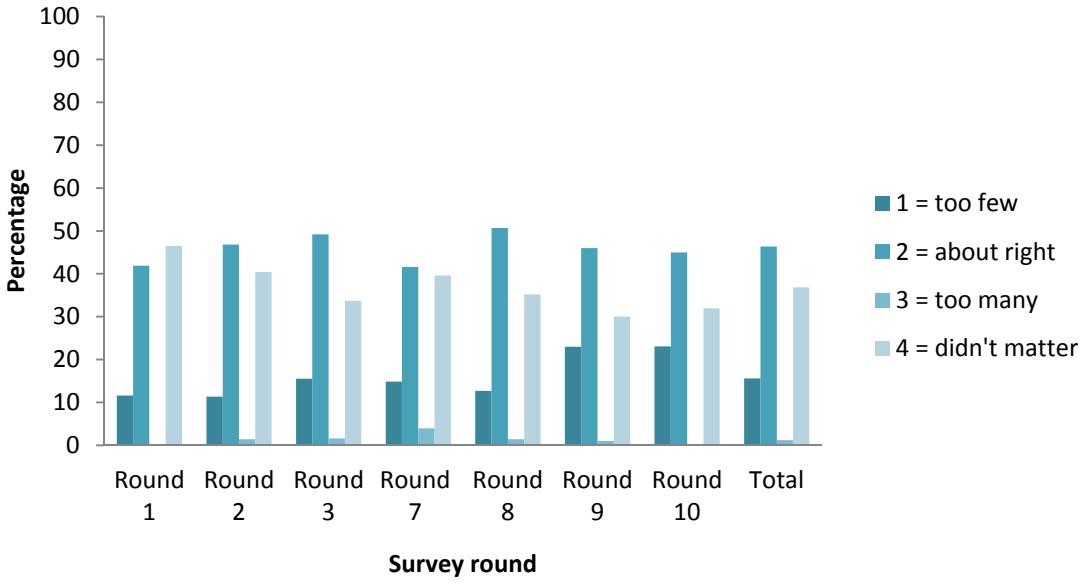


Figure 74. Availability of feature – BBQ facilities (%) by survey round.

Initially in Rounds 1 and 2, the respondent was asked about availability of both seating and tables as one feature, however, given that there are no tables in the park the data could be presented more clearly with it being differentiated. In Round 3 survey, the question regarding the availability of seating and tables was separated. In Round 9, 16% of respondents indicated that the availability of seating was 'too few' (Table 60 and Figure 75). A large proportion of respondents, 70%, indicated that the availability of seating was 'about right' and 14% said it 'didn't matter' suggesting either not needing to use these facilities or a lack of awareness that these facilities exist within the park. Similarly in Round 10, just over a quarter (16%) of respondents considered there to be 'too few' seats available at Point Fraser. While the majority of respondents, 65% considered that the availability of seats was 'about right', 2% said there were 'too many' and 16% said it 'didn't matter'.

Table 60. Availability of features – Seating (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 3	Weekday	13	63	1	22
	Weekend	10	65	3	22
	Total	12	64	2	22
Round 7	Weekday	12	60	0	29
	Weekend	12	67	0	22
	Total	12	64	0	25
Round 8	Weekday	8	67	1	24
	Weekend	8	65	5	22
	Total	8	66	4	22
Round 9	Weekday	8	69	0	23
	Weekend	21	70	0	8
	Total	16	70	0	14
Round 10	Weekday	15	62	1	22
	Weekend	17	67	3	13
	Total	16	65	2	16
Total		12	66	2	20

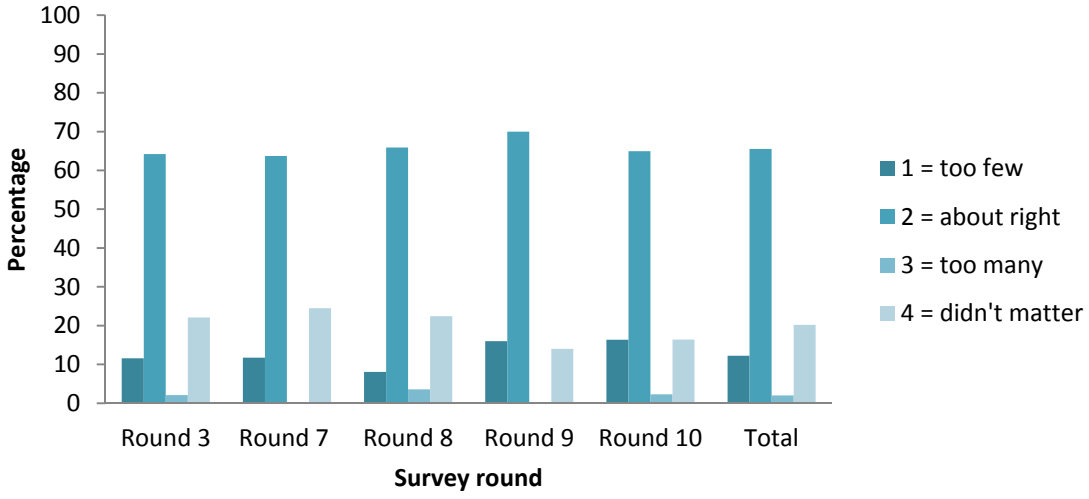


Figure 75. Availability of feature – Seating (%) by survey round.

Given that there are no tables at Point Fraser parkland, the high percentage of responses selecting 'about right' to the question of availability of tables is interesting. This potentially reflecting a lack of awareness of the facilities and / or that the survey is too long for respondents. Fifty-three percent (53%) of respondents suggested that the number of tables was 'about right' in Round 9 (Table 61 and Figure 76). While 24% indicated that there were 'too few' tables at Point Fraser and for 22% it 'didn't matter'. Only 1% said that there were 'too many'. Similarly in Round 10, 50% of respondents considered the number of tables to be 'about right', 25% 'too few' and for 24% the number of tables didn't matter. There was also 1% who said there were 'too many' tables. The majority of respondents were not undertaking activities which would require a seat and table such as walking, running, cycling, therefore tables are not relevant to them. This explains the considerable percentage of respondents who stated they 'didn't matter'.

Table 61. Availability of features - Tables (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 3	Weekday	21	56	0	23
	Weekend	25	47	1	27
	Total	23	51	1	26
Round 7	Weekday	20	46	2	32
	Weekend	16	52	3	29
	Total	17	49	3	30
Round 8	Weekday	22	46	1	30
	Weekend	18	52	4	26
	Total	19	50	3	28
Round 9	Weekday	28	45	3	25
	Weekend	22	58	0	20
	Total	24	53	1	22
Round 10	Weekday	28	43	0	29
	Weekend	24	55	1	20
	Total	25	50	1	24
Total		22	51	2	26

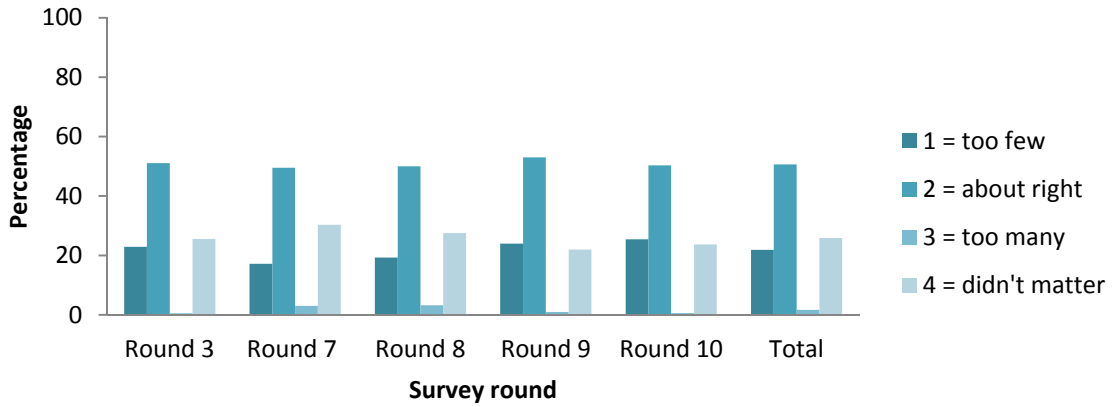


Figure 76. Availability of feature – Tables (%) by survey round.

The majority (67%) of respondents in Round 9 considered that the availability of signage at Point Fraser is 'about right' (Table 62 and Figure 77). Nineteen percent (19%) felt that there were 'too few' signs and for 12% it 'didn't matter'. Only 2% of respondents said that there were 'too many' signs. In Round 10, 67% of respondents indicated that there availability of signage was 'about right'. While 18% felt there were 'too few' signs, for 10% it 'didn't matter' and 5% indicated that there were 'too many' signs at Point Fraser. As outlined above in quality of features – signage, issues of signage vary from expectations of further interpretation of natural features and park history, to a perceived lack of directional, information and/or instructional signs as highlighted by respondents' comments.

Table 62. Availability of features – Signage (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 1	Weekday	6	68	2	24
	Weekend	12	72	1	15
	Total	10	70	1	18
Round 2	Weekday	12	61	7	20
	Weekend	9	66	5	20
	Total	10	64	6	20
Round 3	Weekday	16	66	3	15
	Weekend	21	64	1	14
	Total	19	65	2	14
Round 7	Weekday	16	60	0	23
	Weekend	18	64	2	16
	Total	17	63	1	19
Round 8	Weekday	20	61	0	19
	Weekend	13	65	6	17
	Total	15	63	4	18
Round 9	Weekday	20	61	0	19
	Weekend	13	65	6	17
	Total	19	67	2	12
Round 10	Weekday	15	63	2	20
	Weekend	22	70	2	7
	Total	18	67	5	10
Total		15	66	3	16

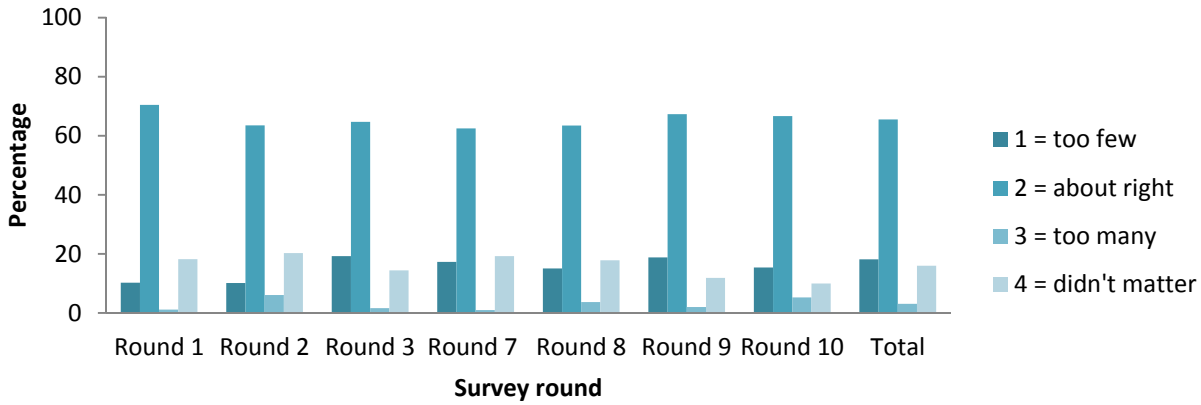


Figure 77. Availability of feature – Signage (%) by survey round.

The majority of respondents (59%) in Round 9 indicated that the number of other people at Point Fraser was 'about right'. Nineteen percent (19%) felt that there were 'too few' other people, while 1% thought there were 'too many'. For 22% it 'didn't matter' about the number of other people at the parkland. In Round 10, 62% of respondents said that the number of other people was 'about right', while 18% indicated that there were 'too few' other people. As per the previous round, one percent (1%) considered that there were 'too many' other people and for 19%, it 'didn't matter' how many people there were at Point Fraser.

Table 63. Availability of features – Number of other people (%) by survey round.

		1 = too few	2 = about right	3 = too many	4 = didn't matter
Round 1	Weekday	13	63	3	22
	Weekend	19	60	3	18
	Total	17	61	3	20
Round 2	Weekday	8	53	5	35
	Weekend	14	58	5	23
	Total	11	56	5	29
Round 3	Weekday	11	66	1	21
	Weekend	11	65	4	20
	Total	11	65	3	21
Round 7	Weekday	5	71	5	20
	Weekend	5	68	6	21
	Total	5	69	6	20
Round 8	Weekday	18	61	0	21
	Weekend	6	62	6	26
	Total	10	62	4	24
Round 9	Weekday	23	46	0	31
	Weekend	16	67	2	16
	Total	19	59	1	22
Round 10	Weekday	11	68	1	20
	Weekend	23	58	0	19
	Total	18	62	1	19
Total		13	62	3	22

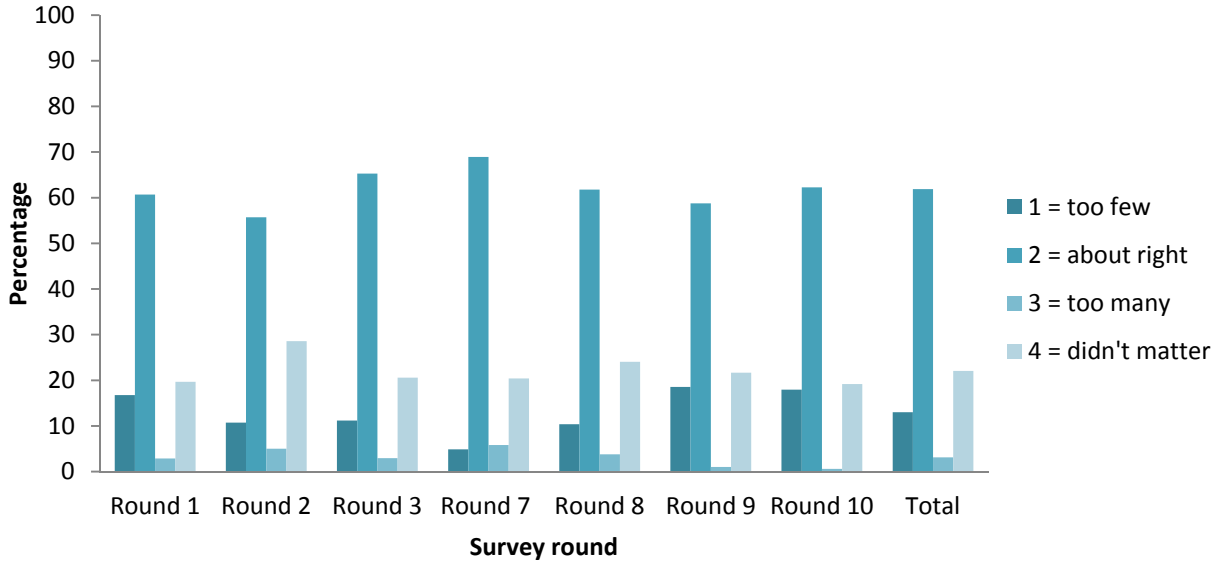


Figure 78. Availability of feature – Number of other people (%) by survey round.

In addition to the features which respondents rated availability, there was also the option for 'other' features not listed. In Rounds 9 and 10, no respondents selected 'other'.

7.9.7 OVERALL SATISFACTION AND RECOMMENDATIONS

Respondents were asked about their overall satisfaction with their Point Fraser experience. Of the Round 9 survey respondents, 35% were very satisfied with their experience and 40% were satisfied (Table 64 and Figure 79). Twenty-one percent (21%) indicated that they were neither satisfied nor dissatisfied and 4% were dissatisfied. Results from the Round 10 were slightly different with, 31% very satisfied, 54% satisfied, 13% were neither satisfied nor dissatisfied and 2% were dissatisfied with their visit to Point Fraser.

Table 64. Overall satisfaction (%) by survey round.

		1 = very dissatisfied	2	3	4	5 = very satisfied
Round 1	Weekday	0	0	5	42	54
	Weekend	1	1	8	48	42
	Total	1	1	7	46	46
Round 2	Weekday	0	3	21	36	40
	Weekend	2	2	7	59	30
	Total	1	2	13	49	34
Round 3	Weekday	1	1	11	51	36
	Weekend	0	1	12	47	40
	Total	1	1	11	49	38
Round 7	Weekday	0	0	7	50	43
	Weekend	0	0	16	54	30
	Total	0	0	13	53	35
Round 8	Weekday	0	0	12	42	46
	Weekend	0	1	10	56	33
	Total	0	0	11	51	37
Round 9	Weekday	0	2	14	43	40
	Weekend	0	5	26	38	31
	Total	0	4	21	40	35
Round 10	Weekday	0	1	9	58	33
	Weekend	0	3	16	52	29
	Total	0	2	13	54	31
Total		0	1	12	49	37

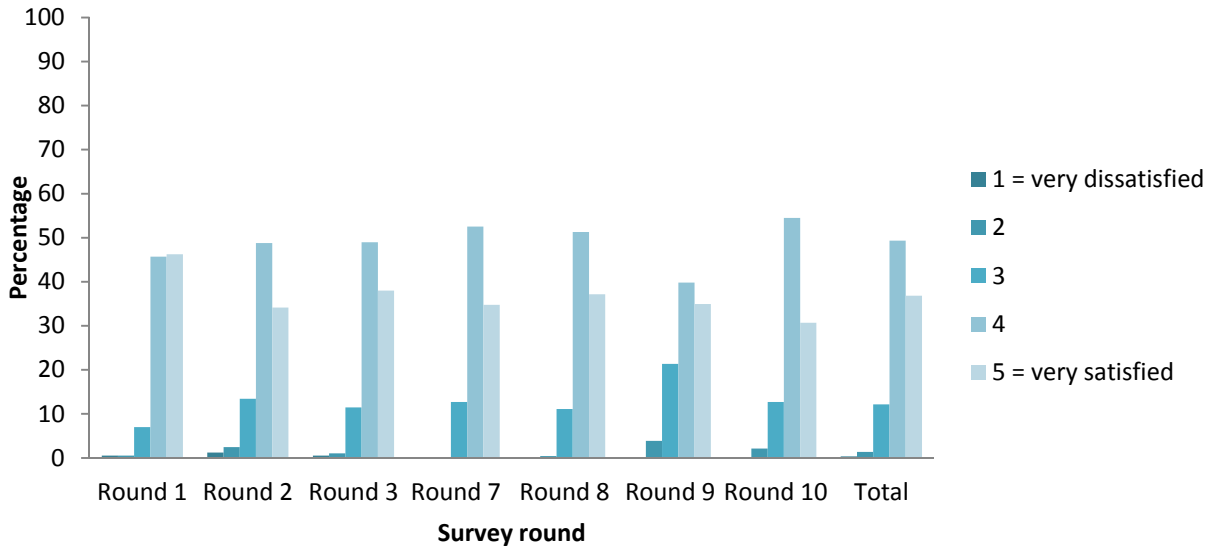


Figure 79. Overall satisfaction (%) by survey round.

Following the question on overall satisfaction, respondents were asked to provide suggestions on how to improve Point Fraser. The issue of quality, quantity and access to public toilets was most commonly commented on in both Rounds 9 and 10. Respondents asked for 'better', 'more' and 'permanent' toilet facilities at Point Fraser. Following toilets, the issue of other types of facilities was raised considerably, particularly in Round 10.

Respondents suggested a range of improvements regarding facilities including; more barbeques, lighting, shade / shelter, seats and tables, as well as the addition of exercise equipment / machines and dog bays. Of the comments regarding facilities, 'more and better' quality water fountains were frequently suggested. A variety of issues regarding access were raised including better access into and around Point Fraser, both on Riverside Drive and along the river. In addition a foot bridge to Heirisson Island was suggested several times.

In Round 10, signage was raised a number of times with respondents calling for more and updated general directions around the park, storm water education, and how to navigate around the construction site. One respondent commented positively that the education and historical signage was very good. As per previous survey rounds, a large proportion of respondents have consistently asked for cafe facilities. Other less common suggestions included cleanliness, parking and signage. It was suggested that the cleanliness of Point Fraser could be improved, both within the park, and in and along the river. As per previous survey rounds, respondents suggested that free parking be provided and it was commented that parking fees put off general public use.

A lack of awareness was commented on including the need to do advertising to attract more visitors and that more facilities will also attract more visitors. A large number of respondents suggested that the construction should be finished. One respondent asked for feedback on the progress of the construction. In regard to the development of the area, a number of respondents suggested that the development should not be continued and that there were environmental implications such as erosion of the river. Comments included, 'please don't improve things', 'keep it natural', 'get rid of commercial operations', and 'more habitat'. One respondent was supportive of the development and wanted 'more people and more facilities'. A small number of respondents commented on environmental aspects of the park, including more natural habitat and trees to attract birds and other small native animals. 'less bugs' and 'more dolphins' were also suggested.

Respondents were asked if they would visit Point Fraser again. Ninety-one percent (91%) in Round 9 said that they would visit again (Table 65 and Figure 80). While 2% said no and 7% said maybe they would visit Point Fraser again. In Round 10, 86% would visit again, 3% would not visit again and 12% might visit Point Fraser again.

Table 65. Repeat visitation (%) by survey round.

		Yes	No	Maybe
Round 1	Weekday	91	0	9
	Weekend	96	0	4
	Total	94	0	6
Round 2	Weekday	81	4	15
	Weekend	86	1	13
	Total	84	2	14
Round 3	Weekday	90	1	9
	Weekend	97	3	0
	Total	94	1	6
Round 7	Weekday	88	0	13
	Weekend	91	3	6
	Total	90	2	9
Round 8	Weekday	87	2	11
	Weekend	94	1	6
	Total	91	1	8
Round 9	Weekday	93	2	5
	Weekend	89	2	9
	Total	91	2	7
Round 10	Weekday	83	4	14
	Weekend	88	2	10
	Total	86	3	12
Total		90	1	9

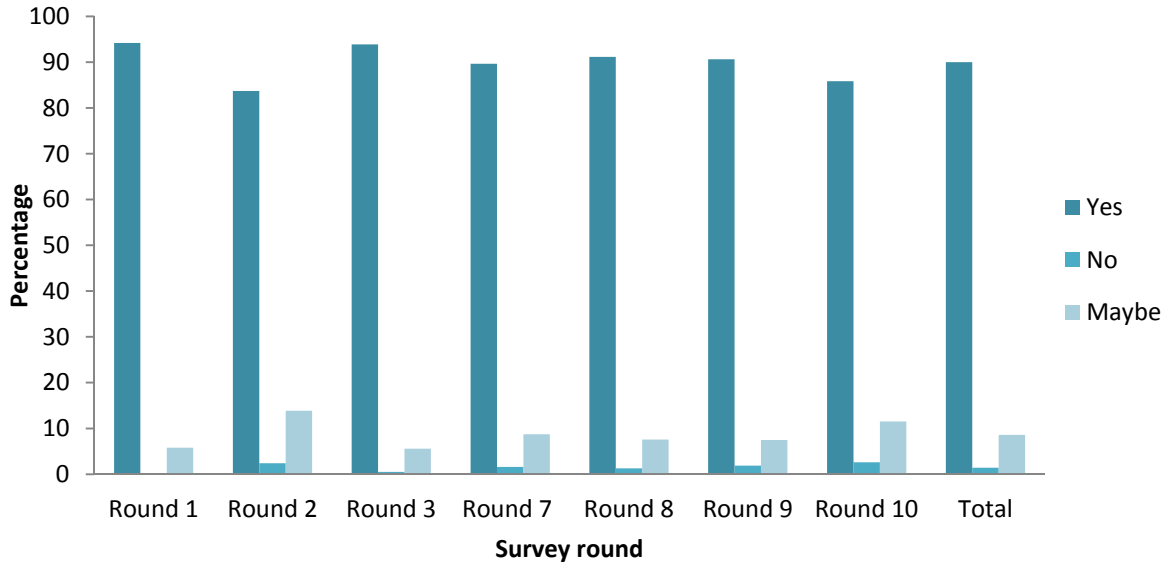


Figure 80. Repeat visitation (%) by survey round.

Following on from the question about repeat visitation, respondents were asked why or why not they would visit Point Fraser again. Respondents most commonly reported that exercise opportunities were the reason why they would visit Point Fraser again, with a number indicating that Point Fraser was a part of their regular exercise regime. Also

considerable responses indicated that aesthetics and general enjoyment were reasons why respondents would be a repeat visitor. There were many comments about the beautiful scenery and the relaxing place that Point Fraser is. Proximity was another reason respondents would visit again, particularly those who lived close by and/or who worked in Perth city and pass through the parkland regularly. There is also a proportion of respondents who work in the city and use the parkland during their lunch break. A number of respondents indicated that they would be repeat visitors because of the access to a natural area and wildlife, for example, 'because it is amazing to be so close to the city and nature' and 'Just love it. So important to have such a 'wild' place close to the city'. Two respondents indicated that they would return to Point Fraser to undertake recreational activities such as canoeing and fishing. Another respondent indicated that they would be a repeat visitor to Point Fraser because it was free, 'I also enjoy that it's free. I think it's important to have these area's for people to enjoy'. Of those respondents who said that they would not visit Point Fraser again, almost all were because they did not live in Perth or were just visiting. One respondent indicated that they would not visit again because the disability parking bay was not easily accessible.

Respondents were asked if they would recommend Point Fraser parkland to other people. In Round 9, 86% of respondents said that they would recommend Point Fraser to others and 13% maybe would (Table 66 and Figure 81). One percent (1%) said that they would not recommend Point Fraser to other people. In Round 10, 90% of respondents indicated that they would recommend Point Fraser to others, 9% maybe would and 1% would not recommend the parkland to others.

Table 66. Recommend visitation (%) by survey round.

		Yes	No	Maybe
Round 1	Weekday	93	0	8
	Weekend	95	2	3
	Total	94	1	5
Round 2	Weekday	89	0	11
	Weekend	86	2	12
	Total	87	1	12
Round 3	Weekday	94	0	6
	Weekend	95	1	4
	Total	95	1	5
Round 7	Weekday	89	2	9
	Weekend	88	3	10
	Total	88	3	9
Round 8	Weekday	91	0	9
	Weekend	88	2	10
	Total	89	1	10
Round 9	Weekday	86	2	12
	Weekend	87	0	13
	Total	86	1	13
Round 10	Weekday	90	1	9
	Weekend	91	0	9
	Total	90	1	9
Total		90	1	8

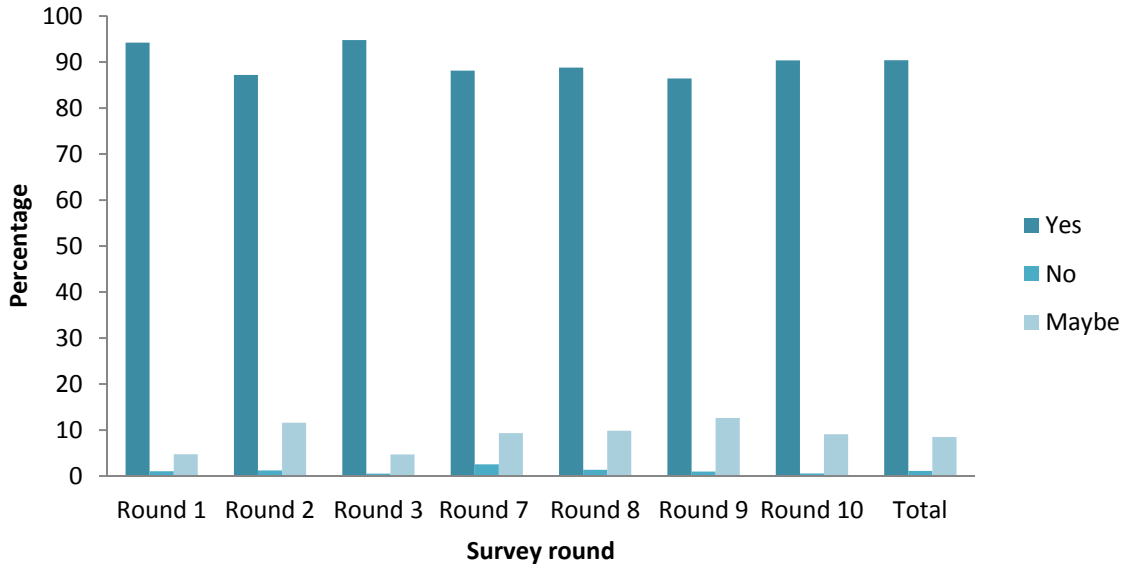


Figure 81. Recommend visitation (%) by survey round.

Construction of a new development has been underway at Point Fraser since 2013. The development will contain three single story buildings with a boutique brewery, cafes and restaurants, tourist retail outlets, function entre, sky garden, waterfront alfresco dining, take away facilities and late night supper club. Since Round 7 in 2013, respondents were

asked how they thought the new facilities would affect their experience of the Point Fraser Parkland. In Round 9, 71% considered that the development would have a positive impact on their experience, while 31% considered the impact to be negative and 11% selected no change (Table 67 and Figure 82). Later in 2014 in Round 10, only 54% considered that the development would be positive. There was a marked increase with 31% indicating that there would be a negative impact and 15% selected no change.

Table 67. Experience affected by new facilities (%) by survey round.

		Positive	Negative	No change
Round 7	Weekday	60	29	11
	Weekend	63	29	8
	Total	62	29	9
Round 8	Weekday	59	29	12
	Weekend	54	29	17
	Total	56	29	15
Round 9	Weekday	65	20	15
	Weekend	75	17	8
	Total	71	18	11
Round 10	Weekday	53	35	12
	Weekend	54	29	17
	Total	54	31	15
Total		59	28	13

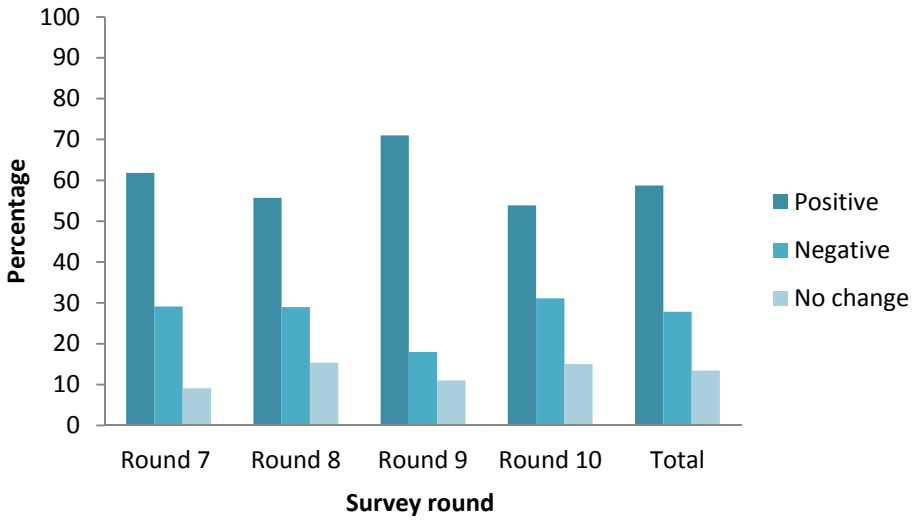


Figure 82. Experience affected by new facilities (%) by survey round.

Respondents were asked to comment how the new facilities will affect their experience at Point Fraser parkland. Respondent's comments fell into two main groups, those which supported the development and considered that the new facilities would positively affect their experience at Point Fraser and those did not support the development and felt there would be a negative impact on the parkland. The respondents which supported the

development wanted more people / tourists attracted the area, loved progress, considered more employment opportunities and more money would be generated. One respondent considered Point Fraser to be a 'dead area'. Several respondents drew the link that with more visitors, there is an increased opportunity for them to learn about storm water and the environment.

In Round 10, there were a very large number of negative comments. Respondents who did not support the development were concerned about the increase in the number of people and associated issues, such as more traffic, litter, pollution and noise. Concerns were raised about the impact on the environment, including wildlife and water quality. They were also concerned that the scenery, beauty, serenity /calmness and natural feel of Point Fraser would be destroyed and would change the sense of place. Several respondents commented that there are already enough 'dining out' facilities, especially with the Elizabeth Quay development, along the river. One respondent commented, 'the pressure of the development will change the experience into one of consumerism and general homogenising of recreational activities. Being here on the Swan you end up feeling like you could be anywhere.' Another respondent said, 'it should remain nature and cultural reserve rather than be used for commercial activities.'

To a lesser extent there was a small group of respondents who conveyed mixed feelings about how the development would affect their experience at Point Fraser, more in Round 10. Of those respondents who expressed mixed views regarding the development, they generally had conditions on the support of the new facilities, for example, 'if there is no impact to the environment', 'if they preserve the wetlands and scenery', or 'if there are no big buildings or too much cement'. There was a very small group of respondents who were uncertain about the development and the impact on their experience at Point Fraser.

Another question relating to the new development was included in the visitor survey in Round 7. Respondents were asked if in their view, does the type of development fit with the place and space of Point Fraser. In Round 9, 70% considered that the development was consistent with the place and space of Point Fraser, while 30% said no (Table 68 and Figure 83). Less respondents in Round 10 (64%) considered that there was a fit with the place and space of Point Fraser and the new development, while 36% said no.

Table 68. Development fit with the place and space (%) by survey round.

		Yes	No
Round 7	Weekday	72	28
	Weekend	68	32
	Total	70	30
Round 8	Weekday	64	36
	Weekend	61	39
	Total	62	38
Round 9	Weekday	65	35
	Weekend	73	27
	Total	70	30
Round 10	Weekday	60	40
	Weekend	67	33
	Total	64	36
Total		65	35

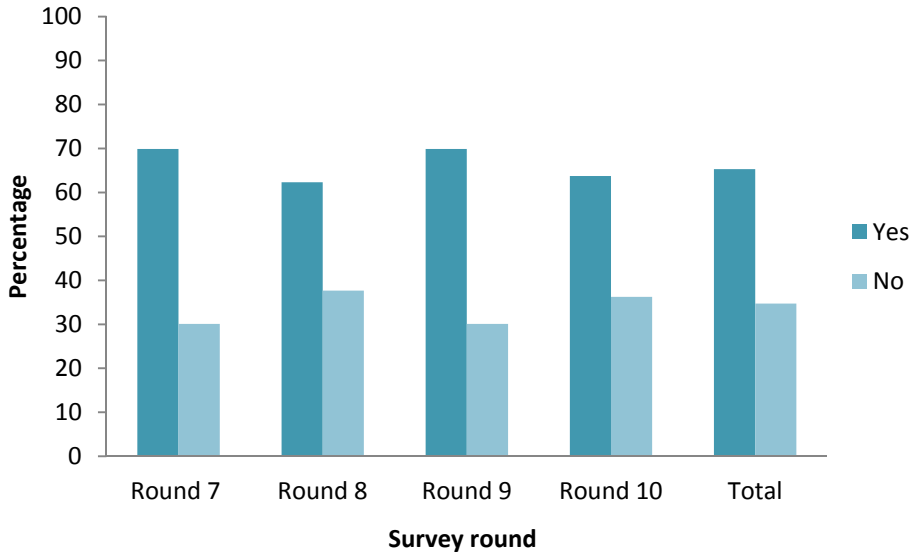


Figure 83. Development fit with the place and space (%) by survey round.

Respondents were asked to provide comments on whether the type of development fits with the place and space of Point Fraser. Again, respondent's comments were largely grouped into those who support the development and those that did not. Of those respondents who felt that the development did fit well with the place and space of Point Fraser, commented that they love development, facilities are needed, will create a tourist attraction and that the area will be revitalised. Multiple respondents commented that cafes and restaurants are always good. One respondent commented, 'People would spend more time here if these facilities were here.'

Particularly in Round 10, there was a very large number of comments which did not agree that the development fitted with the place and space of Point Fraser. These respondents

raised that Point Fraser should be left as a natural area and parkland. Concerns were raised about the impact of the development on the natural environment, wildlife and that there would be too many people, bringing an increase in noise, litter and pollution. Respondents indicated that the qualities which attract people to Point Fraser would no longer exist with the development, such as beautiful calm natural area. It was raised that there are already similar facilities along the river and that the development does not provide anything for families (a water playground would be preferred). One respondent said 'Point Fraser is more of an area of natural features, the cultural aspect strongly depends from the relaxation and the serenity of the area.' It was commented that, '[a] late night supper club [is] definitely not good for habitat.' Another respondent commented, 'this park was intended to show the original vegetation/marshland of the river bank. Should not be turned into yet another eating and drinking venue with 70% of mature Australians obese or overweight. We should be changing out lifestyles, not just more of the same.'

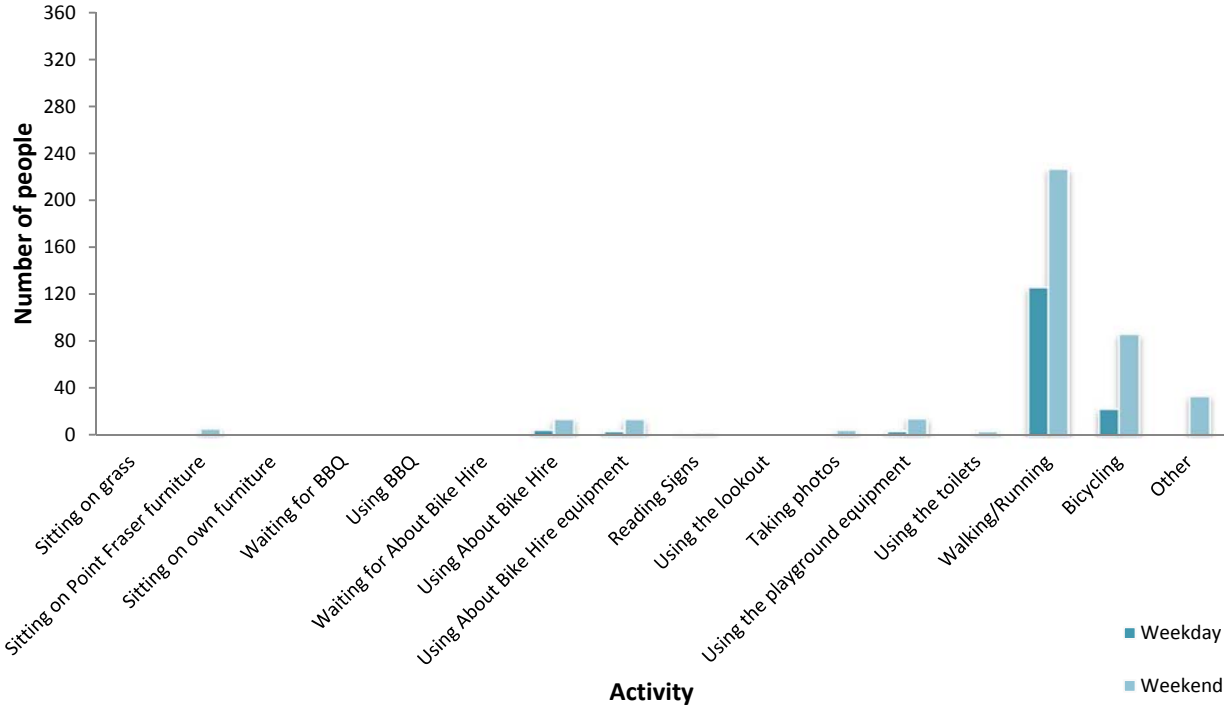
There was also a smaller group of respondents whose views were mixed with regard to the development fitting into the place and space of Point Fraser. Again, there were conditions provided for support for the development, such as, 'as long as low key and low impact', or 'if done in a careful and considered way'. Of those respondents with mixed views, a number commented that the development should be 'classy' and that the retail outlets were not needed. There was a small proportion of respondents who expressed uncertainty whether there was a fit with the place and space and the new development at Point Fraser parkland.

7.9.8 VISITOR OBSERVATIONS – BEHAVIOUR

In order to document how the Point Fraser parkland is used, observations of visitor behaviour were recorded. Between the hourly visitor counts, a surveyor walked from the east to west entrance ensuring all areas of the reserve were covered and recorded the behaviour of park users using the Observation Behaviour datasheet. As per previous rounds, visitor behaviour observations highlights that the vast majority of visitors use the parkland as an area to pass through during their regular exercise activity such as walking, running or cycling (

Figure 84) or travelling to another location. The activities undertaken are similar across May and October and between weekday and weekend, with similar numbers of visitors over both survey rounds despite the difference in weather. The volume of visitors was consistently higher on the weekend. Recreational facilities, such as About a Bike Hire was more commonly used on the weekends. On the weekend in May there was more use of the playground equipment.

a) Round 9 – May 2014



b) Round 10 – October 2014

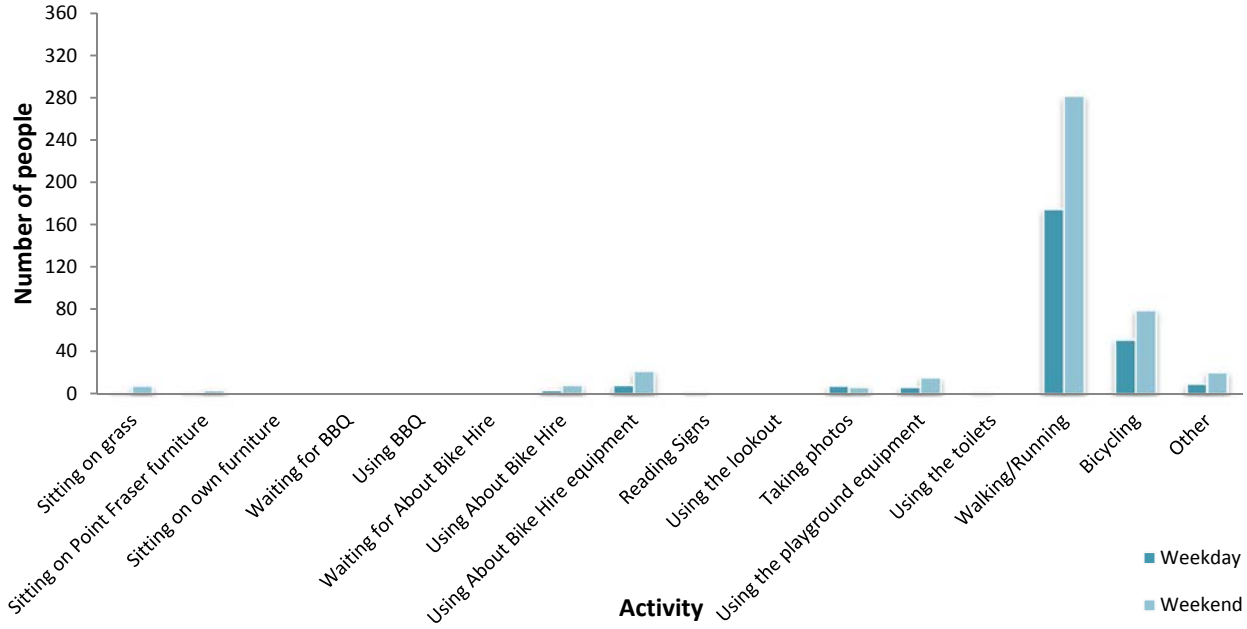


Figure 84. Number of people observed to engage in specific activities during hourly single-pass behaviour observations.

7.9.9 CONCLUSION

The aims of the Social Monitoring component of the PFMEP were to: (1) Determine visitor usage of Point Fraser; (2) Observe usage of Point Fraser by the public, and (3) Interview park users for why they used the park.

Point Fraser is well visited by the public, however, a large proportion of visitors are passing through as part of an exercise regime (walking, jogging or cycling) or travelling to another destination, such as workplace in the city or along the riverside. The car park is heavily used by city workers during the week. The cost of parking appears to be a deterrent for recreational users, though not for city commuters. Thus to encourage car-based access for recreational users while limiting commuter use, free parking with a maximum limit of 4 hours is suggested. Improvements to signage and the construction of a café are likely to see the park become more of a destination in its own right. Improved public transport access could also increase recreational use.

Point Fraser parkland is used by the vast majority of visitors for exercise, specifically walking, followed by running/jogging, cycling and general enjoyment. There is limited use of Point Fraser for barbeque / picnicking, interpretative trails, photography, playground and bike hire. Awareness of 'Destination Point Fraser' and its features, particularly relating to its ecological function, seems very limited amongst respondents. Accordingly, few people surveyed indicated that they had come to Point Fraser specifically, but most are simply using it as a thoroughfare. The limitations in a number of key features of the parkland, including poor toilets, no tables and appropriate seating, number of barbeques, and shelter, has an impact on the opportunities for recreational use of the park.

Overall park satisfaction is positive with the majority of respondents selecting 'good' and 'very good' when asked about the quality, importance and availability of key features. However, consistently and as per previous survey rounds, toilets were raised as a significant negative feature of the Point Fraser parkland, to a lesser extent, signage. Considering the nature of the visitation to Point Fraser parkland, with the majority of visitors passing through the park, this appears to have influenced the visitor survey results around park satisfaction. As the vast majority of visitors are passing through, they either don't need facilities the park has offer such as barbeques, seats, toilets, playground, bike hire or there is little or no awareness of these features. Therefore some of the visitor results need to be interpreted with caution.

Point Fraser parkland is predominately used by locals living nearby. There are some international visitors and a very small number of Australian interstate visitors. Consistent with activities observed and documented in visitor surveys, the reason why the vast majority of Point Fraser visitors are using the Point Fraser parkland is for exercise. To a

much lesser extent, the parkland is used mainly by visitors to spend time with friends / family, to experience nature and for rest and relaxation. The attraction of visitors to Point Fraser is for predominately exercise opportunities but also for the aesthetics of the park, general enjoyment, proximity and access to a natural area.

Visitors are frustrated with the length of time and inconvenience the construction has caused. The majority of visitors felt that the construction of the new development would positively affect their experience of Point Fraser and that it did fit with the 'place and space' of Point Fraser. However, there was a proportion of visitors who were adamant that Point Fraser is best as a natural space and that this is a unique asset to the city. Opponents of the development consider any large commercial developments are a duplication of other facilities on offer along the river and are unnecessary at Point Fraser. There appears to be an incongruity with the positive perception of the new construction given the high value, particularly by locals, of the ability to access a natural area in an urban environment. There is a strong sense of place amongst locals towards Point Fraser.

7.10 POINT FRASER SOCIAL MONITORING 5 YEAR PROGRAM REVIEW

7.10.1INTRODUCTION

The overall goal of the Point Fraser Redevelopment was to "to improve the quality of stormwater discharge to the Swan River and improve aesthetic, recreational and environmental values of the area" (Lund et. al. 2010, pg 12). Completed in 2007, the Point Fraser Redevelopment now known as the Point Fraser Parkland, involved construction of new car parks, a bicycle hire facility, grassed areas, barbeque facilities, a children's playground, a mixture of native bush areas and parkland and the constructed wetland (Lund et. al. 2010). The Point Fraser Monitoring and Evaluation Program (PFMEP), including the social component, sought to monitor whether the Point Fraser Redevelopment was meeting its original objectives. As part of this program, social monitoring data has been gathered biannually over the past five years to assess the quality, quantity and type of recreational and educational use of Point Fraser parkland by visitors.

This review at the end of the five year monitoring and evaluation program seeks to ascertain future needs for monitoring of the Point Fraser parkland. To review whether the social component of the PFMEP has met its objectives and how future monitoring needs can be met, the following steps have been undertaken:

(1) An analysis of the objectives relevant to the social monitoring, including the Point Fraser Redevelopment Objectives, PFMEP Objectives and social monitoring research aims.
(2) Evaluation of how the social monitoring aims have been met by the data collected and analysed.
(3) Evaluation of data collection methods, including the suitability of monitoring locations, parameters and frequency.
(4) Lessons learnt regarding the social monitoring component.

7.10.2 ANALYSIS OF OBJECTIVES

The purpose for the construction of Point Fraser wetland and parkland is outlined in the seven objectives of the Point Fraser Redevelopment (Figure 85). Of the seven Point Fraser Redevelopment objectives, five are related to the human interface or social aspects of the Point Fraser parkland, including promoting recreational and educational opportunities, creating a visually appealing place, promoting historical, cultural and environmental appreciation, providing explorative interpretative opportunities and facilitating a range of activities and events (CoP, 2010).

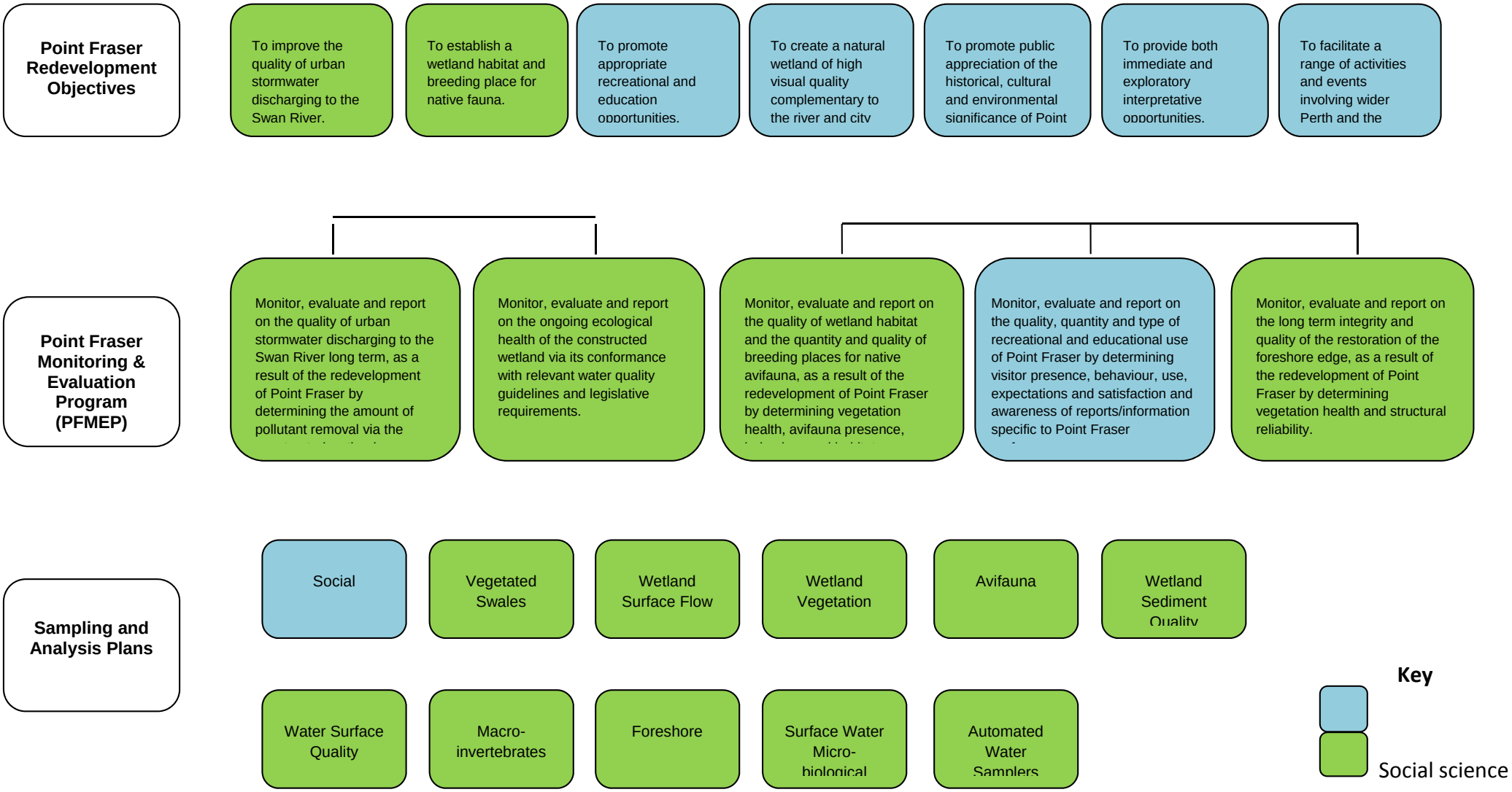


Figure 85. : Relationship of Point Fraser Development Objectives to PFMEPS Objectives to SAPs (adapted from Appendix B: CoP, 2010)

The PFMEP was established to monitor whether the Point Fraser wetland and parkland has been effective in achieving its redevelopment objectives. The PFMEP identified two primary objectives and three secondary objectives to outline the goals of the monitoring program. The two primary objectives of the PFMEP are to "monitor, evaluate and report on" how the Point Fraser Redevelopment impacts the quality of urban stormwater entering the Swan River and the ongoing ecological health of the constructed wetland (CoP, 2010 - Appendix B). The secondary objectives of the program include firstly, assessing the quality of the wetland habitat and implications for wildlife breeding, specifically avifauna and secondly, long term integrity and quality of the foreshore restoration (CoP, 2010 - Appendix B). A third objective addresses social aspects of Point Fraser parkland, by the following, "Monitor and evaluate and report on the quality, quantity and type of recreational and education use of Point Fraser by determining visitor presence, behaviour, use, expectations and satisfaction and awareness of reports/information specific to Point Fraser performance" (CoP, 2010 - Appendix B).

In order to review the social monitoring component of PFMEP, the hierarchy of social monitoring objectives will be explored (Table 69). Of the seven Point Fraser Redevelopment objectives, five objectives have a social focus, while the remaining two are science related. Of the five PFMEP objectives, just one is related to the social monitoring component of the program, while the other four objectives have a science focus. The PFMEP objective for social monitoring seeks to explore the human interface of the parkland by comprehensively assessing the detail of how Point Fraser is actually being used, by whom, their expectations and satisfaction. This overall social monitoring objective is then broken up into three aims to direct the data collection of the social monitoring component. The social monitoring component aims include, determining visitor usage of Point Fraser; observe usage of Point Fraser by the public; and, interviewing park users for why they used the park. The PFMEP Sampling and Analysis Plans outline the data collection methods for the implementation of the monitoring program. Four data collection methods were proposed at the outset of the program for the social monitoring component: visitor surveys, observation counts, observation behaviours and feedback forms, of which only the first three were implemented.

From analysis of objectives relating to Point Fraser, including the Redevelopment and the PFMEP objectives, there seems to be an absence of a solid explicit matrix of links between the different levels of objectives, aims and data collection parameters. The PFMEP social monitoring objective only addresses the Point Fraser Redevelopment social objectives in a limited capacity and does not consider the scope of social implications intended for Point Fraser, as outlined in the Point Fraser Redevelopment Objectives. Similarly there are limitations with how the aims of the social monitoring component reflect the PFMEP social monitoring objective.

Table 69. Social Monitoring Hierarchy of Objectives

Social Monitoring Hierarchy of Objectives	
Point Fraser Redevelopment Objectives (objectives with a social focus selected)	(1) To promote appropriate recreational and education opportunities. (2) To create a natural wetland of high visual quality complementary to the river and city setting. (3) To promote public appreciation of the historical, cultural and environmental significance of Point Fraser. (4) To provide immediate and exploratory interpretative opportunities. (5) To facilitate a range of activities and events involving wider Perth and international community
Point Fraser Monitoring and Evaluation Program Objectives (objective with a social focus selected)	Monitor, evaluate and report on the quality, quantity and type of recreational and educational use of Point Fraser by determining visitor presence, behaviour, use, expectations and satisfaction and awareness of reports/information specific to Point Fraser performance.
Social Monitoring Aims	(4) Determine visitor usage of Point Fraser: to document how people are utilising the reserve, including the mode of transport in and out. (5) Observe usage of Point Fraser by the public: to document what people are doing once at the reserve. (6) Interview park users for why they used the park: to provide a better understanding of why the park is being used by the public.
Social Monitoring Sampling and Analysis Plans	(1) Visitor surveys (2) Observation counts (3) Observation behaviours (4) Feedback forms

Despite these limitations in the objectives and social aims of PFMEP, the monitoring program has been reasonably effective in assessing the human interface and use of Point Fraser. The social monitoring program has demonstrated the underutilisation of the parkland and a lack of awareness, difficulty of access and lack of basic facilities for people who want to spend time at the site. As raised following the first year of monitoring data collection, and each subsequent year, Point Fraser is underutilised and has not being used by public as intended in the original objectives. It appears that no changes or improvements have been made in response to the feedback from the annual monitoring reports throughout the course of the five year monitoring program. The purpose of such a monitoring program is questionable if it is not coupled with an implementation program for continuous improvement based on feedback results – to close the monitoring and evaluation cycle (Figure 86).

Figure 86. The monitoring and evaluation cycle

7.10.3EVALUATION OF SOCIAL MONITORING DATA AND RESULTS

The specific aims of the social monitoring program were to:

(1) Determine visitor usage of Point Fraser: to document how people are utilising the reserve, including the mode of transport in and out.
(2) Observe usage of Point Fraser by the public: to document what people are doing once at the reserve.
(3) Interview park users for why they used the park: to provide a better understanding of why the park is being used by the public.

The social monitoring data was collected using three data collection tools, including: observation counts, visitor surveys, and observation behaviours. Within each annual PFMEP report, the social monitoring data was presented in the following format: Visitor Observation Counts, with the Visitor Survey including sections on Demographics, Park Use, Park Satisfaction, Overall Satisfaction and Visitor Observation Behaviours were also recorded.

There was little variation in the monitoring results between data collection rounds, hence for the purpose of this review, key data has been combined. However, there are several monitoring parameters in which the data has been presented broken down to assist with interpretation, for example the differences between weekday and weekend use or May or October use. The summary of the five rounds of data collection also serves to document general observations of use, as well as ensuring that the social monitoring component of PFMEP has met its aims.

7.10.3.1 VISITOR OBSERVATION COUNTS

Visitor Observation Counts recorded the number of people undertaking a particular activity (limited to walking or cycling) by a staff member located at three sites, SMC1, SMC2 and SMC3 (Figure 3) across Point Fraser.

For the purposes of this review, SMC1 in-flow counts of walkers and cyclists were collated from the five years of data collection as this is a significant entry point into Point Fraser. The most common activities undertaken at Point Fraser were walking/running and cycling and were recorded through the Observation Counts. During the week for walkers in both May and October, the use of Point Fraser for city workers during lunch time is clear and consistent (Figure 87). The peak use of this entrance otherwise varies according to the time of the year, with use during late afternoon in May as it would get darker earlier and later in October when day light hours are extending. Walkers use on the weekend of Point Fraser has peaks related to avoiding the heat of the day (Figure 88). In October, walkers peaked earlier and later in the day than in May when the temperature would be cooler and days shorter.

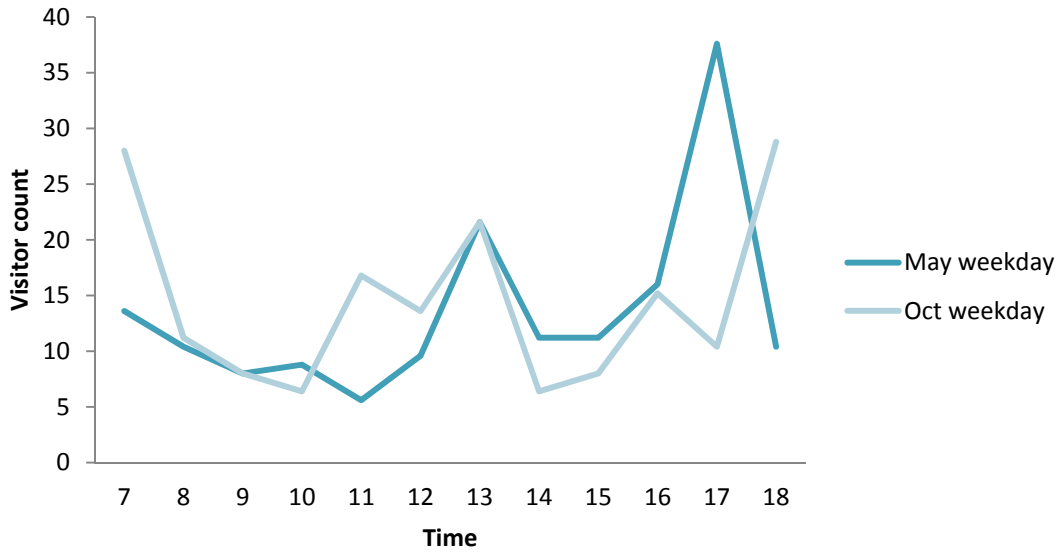


Figure 87. Visitor Observation Count: Cycling Weekday Average by survey periods (SMC1 site, direction into parkland).

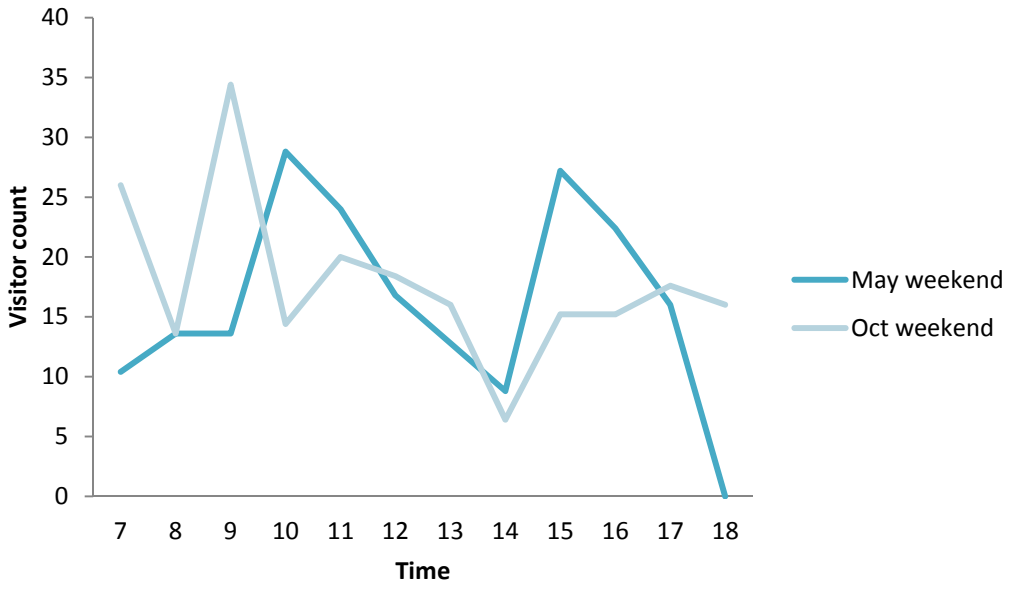


Figure 88. Visitor Observation Count: Walking Weekend Average by survey periods (SMC1 site, direction into parkland).

Cyclists' use of SMC1 suggests limited use of Point Fraser during the week (Figure 89). On the weekend there was higher usage by cyclists in the park (some of this associated with bike rentals from *About a Bike Hire*) and some avoidance of the certain times of the day depending on the time of year (Figure 89 and Figure 90). It is noted that the number of cyclists is comparatively low compared to walkers, as in general cyclists tended to bypass the park.

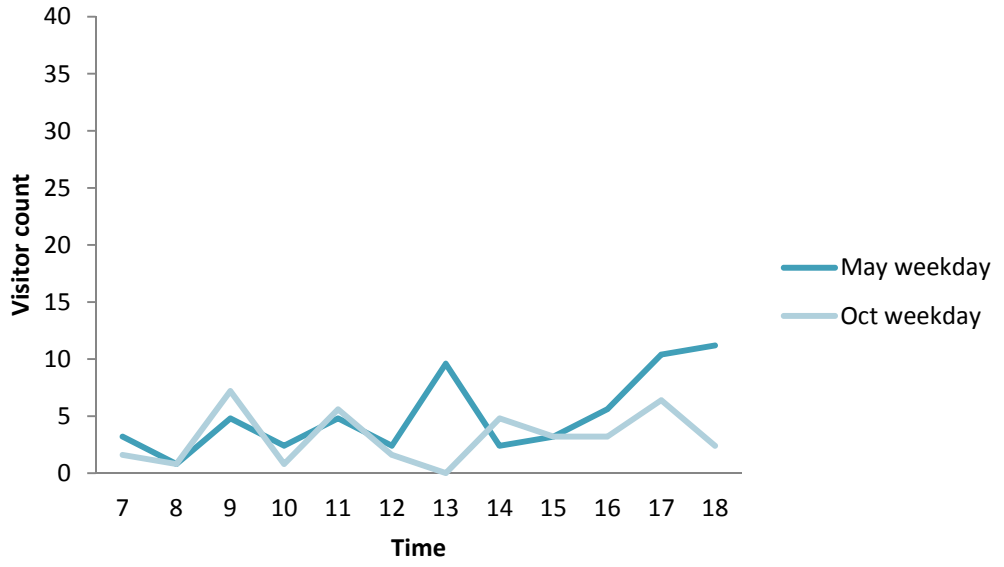


Figure 89. Visitor Observation Count: Cycling Weekday Average by survey periods (SMC1 site, direction into parkland).

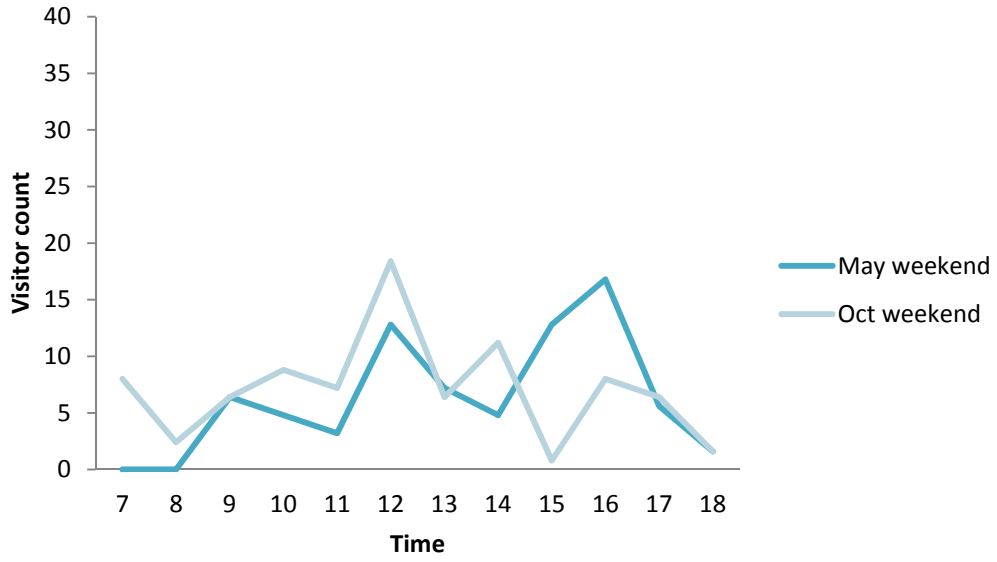


Figure 90. Visitor Observation Count: Cycling Weekend Average by survey periods (SMC1 site, direction into parkland).

7.10.3.2 VISITOR SURVEY: DEMOGRAPHICS

From data collected in the visitor surveys, in general there was a reasonably even distribution of males and females and across aged groups, with the exception of under 21 year olds, visiting Point Fraser (Table 70). The majority of visitors were locals living in close proximity to Point Fraser and more broadly from Western Australia, than other locations in Australia or overseas. The most common visitors of Point Fraser were males, aged between 21-30 years living in close proximity to Point Fraser.

Table 70. Summary of visitor demographics (2010-2014)

Gender (n=1229)	**Frequency**	**Percentage**
Male	649	53
Female	580	47
Age (n=1241)		
<21 years	52	4
21-30 years	325	26
31-40 years	221	18
41-50 years	209	17
51-60 years	228	18
>60 years	206	17
Place of residence (n=1233)		
Overseas resident	320	26
Australian resident	913	74
Australian state of origin (n=948)		
Australian Capital Territory	3	0
New South Wales	39	4
Northern Territory	1	0
Queensland	20	2
South Australia	11	1
Tasmania	3	0
Victoria	31	3
Western Australia	840	89

7.10.3.3 VISITOR SURVEY: PARK USE

The vast majority of visitors arrived at Point Fraser by walking (Table 71). This supports the high representation of locals living in close proximity to the site. Visitors who used the park weekly were only slightly more than first time visitors. Most commonly, visitors came to Point Fraser on their own and to a lesser extent with friends. The peak periods to arrive at Point Fraser were in the morning (likely commuters to work), the middle of the day and late afternoon (Figure 91). Most visitors were passing through Point Fraser by walking. The main reason for use of Point Fraser was for exercise.

Table 71. Summary of park use (2010-2014)

Mode of travel (n=1241)	Frequency	Percentage
On foot	792	64
Car	214	17
Boat	2	0
Bicycle	116	9
Public transport	34	3
Mixture of above	76	6
Other	7	1
Frequency of visiting (n=1225)		
First time	354	29
Daily	122	10
Weekly	373	30
Monthly	143	12
Once or twice a year	168	14
Less than once a year	65	5
Respondent visiting with (n=1226)		
On my own	434	35
Partner (spouse, defacto, girl/boyfriend)	267	22
Other Family	132	11
Community group	4	0
Friends	330	27
Work associates	32	3
Other (please specify)	27	2
Time arrived (n=1227)		
between 6 and 7 am	28	2
between 7 and 8 am	126	10
between 8 and 9 am	97	8
between 9 and 10 am	126	10
between 10 and 11am	140	11
between 11 and 12 am	126	10
between 12 and 1 pm	118	10
between 1 and 2 pm	111	9
between 2 and 3 pm	119	10
between 3 and 4 pm	90	7
between 4 and 5 pm	78	6
between 5 and 6 pm	68	6
Time stayed (n=1229)		
passing through	678	55
< 1 hour	216	18
1-2 hours	240	20
2-4 hours	70	6
Over 4 hours	25	2
Activities undertaken (multiple response Q)		
Walking	743	60
Running/ jogging	152	12
Cycling	167	13
Passing through	212	17
BBQ/Picnic	35	3
Visit for general enjoyment	197	16
Exploring interpretive trails	50	4
Photography	101	8

Visiting playground	48	4
Using services of About Bike Hire	65	5
Other	60	5
Main reason for visit (n=991)		
Spending time with friends & family	173	17
Exercising	597	60
Experiencing nature	34	3
Learn about storm water	1	0
Seeing wildlife	21	2
Scenery	22	2
Something new and different	22	2
Proximity to the city	21	2
Rest and relax	41	4
Proximity to the river	11	1
For solitude	4	0
Other (please specify)	44	4

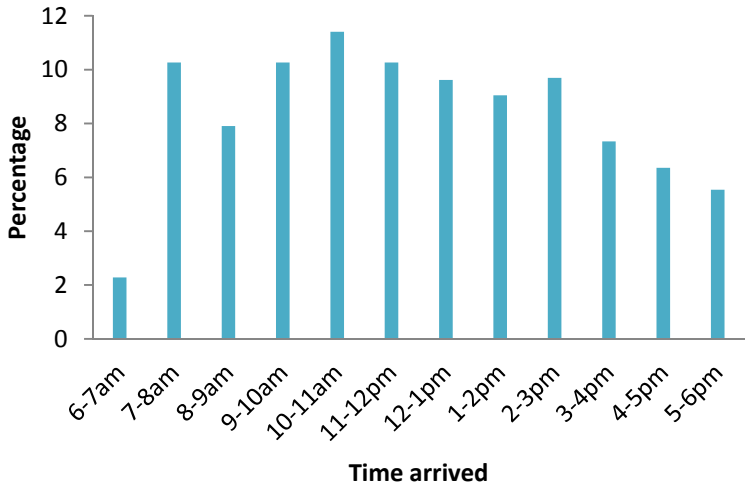


Figure 91. Visitor arrivals over time (%).

7.10.3.4 VISITOR SURVEY: PARK SATISFACTION

Over the monitoring program, survey respondents consistently considered the quality of toilet facilities to be low, this was followed by tables, education, and barbeque facilities (Table 72). The park features considered to be of highest quality were scenic beauty, overall cleanliness and access.

Table 72. Quality of park feature ranked by mean.

Rank	Quality of park feature	Mean	Very Poor <-> Excellent
1	Toilet facilities	3.10	
2	Tables	3.31	
3	Education	3.60	
4	BBQ facilities	3.64	
5	Signage	3.74	
6	Staff interaction	3.79	
7	Bike hire	3.89	
8	Seating	3.96	
9	Playground facilities	4.05	
10	Access	4.37	
11	Overall cleanliness	4.41	
12	Scenic beauty	4.43	

The most important park features were considered to be overall cleanliness, access and scenic beauty, followed by toilet facilities (Table 73).

Table 73. Importance of park feature ranked by mean.

Rank	Importance of park feature	Mean	Very Poor <-> Excellent
1	Overall cleanliness	4.77	
2	Access	4.59	
3	Scenic beauty	4.59	
4	Toilet facilities	4.43	
5	Seating	4.12	
6	Signage	4.11	
7	Education	3.86	
8	Tables	3.84	
9	Playground facilities	3.78	
10	BBQ facilities	3.71	
11	About Bike Hire	3.69	
12	Staff interaction	3.67	

Park satisfaction was further explored by the availability of key park features, where respondents could select too few, about right, too many or didn't matter. Toilet facilities and tables achieved the poorest results. Despite this it is important to note that there are high levels of respondents which selected didn't matter for these questions, either indicating no need to use facilities as just passing through or a lack of awareness of the facilities at Point Fraser.

Table 74. Availability of park feature ranked by mean.

Rank	Availability of park feature	Mean	Too few <-> Too many	Didn't matter (%)
1	Toilet facilities	1.56		23
2	Tables	1.72		26
3	BBQ facilities	1.77		37
4	Signage	1.85		16
5	Seating	1.87		20
6	Number of other people	1.87		22

7.10.3.5 VISITOR SURVEY: OVERALL SATISFACTION

Overall satisfaction with Point Fraser was high fairly consistently over all survey rounds (Figure 92). This is confirmed by the high rates of respondents who are repeat visitors and who would recommend Point Fraser to others (Table 7).

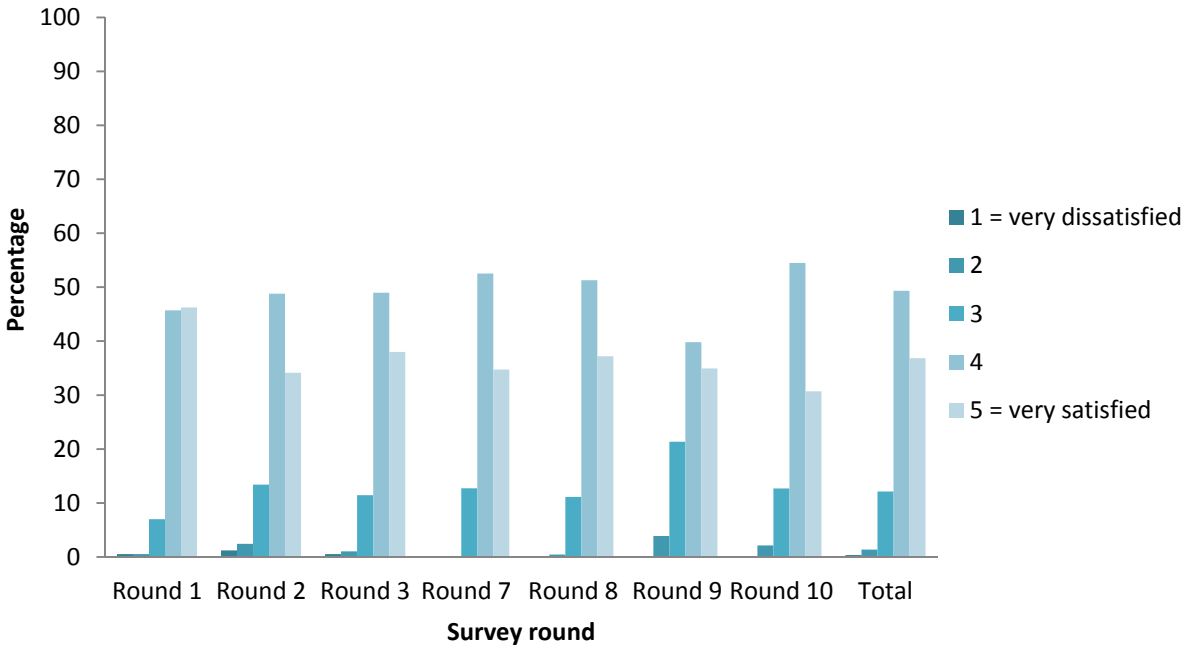


Figure 92. Overall satisfaction (%) by survey round.

Table 75. Repeat visitation and recommend to others.

Repeat visitation (n=1214)	Frequency	Percentage
Yes	1093	90
No	17	1
Maybe	104	9
Recommend to others (n=1165)	**Frequency**	**Percentage**
Yes	1053	90
No	13	1
Maybe	99	8

7.10.3.6 VISITOR SURVEY: MIXED USE HOSPITALITY DEVELOPMENT

Construction of a new mixed use hospitality development has been underway at Point Fraser since 2013. Since Round 7 in 2013, respondents were asked how they thought the new facilities would affect their experience of the Point Fraser Parkland and whether the development fit with the place and space of the site (Table 76). In general the development was considered to be positive, although, this fluctuated over the survey rounds, potentially a reflection of frustration with the presence of the ongoing construction site.

Table 76. Impact of Mixed Use Hospitality Development on Point Fraser experience.

Experience affected by new facilities (n=618)	Frequency	Percentage
Positive	363	59
Negative	172	28
No change	83	13
Development fit with place and space (n=582)	Frequency	Percentage
Yes	380	65
No	202	35

Following these additional survey questions, respondents were asked to comment how the new facilities will affect their experience at Point Fraser parkland and also whether the type of development fits with the place and space of Point Fraser. With both questions, there were two main groups with those supported the development and those who did not. Those supportive of the mixed use hospitality development felt that Point Fraser needed the facilities and more tourists / people to be positive. Those who felt there would be a negative impact with the development expressed significant concern about the impact on the environment and that the development would change the 'wild', 'natural' space that Point Fraser was into yet another commercial one. In both questions, there was a small group which had mixed feelings about the development. This cohort of respondents generally provided conditional support for the development, for example, "if there is no impact to the environment" or "if there are no big buildings or too much cement". In the quantitative questions there was more support for the commercial facilities, while in the qualitative

questions, more concern was raised about the implications environmentally and the sense of place.

7.10.3.7 VISITOR OBSERVATION BEHAVIOURS

During monitoring events on an hourly basis a staff member walked through the parkland observed and recorded what visitors were doing. The data has been collated over the five years but disaggregated by weekday (Figure 93) and weekend (Figure 94). Walking/jogging and cycling have been removed because they were recorded at such high levels that it skews the remainder of the data. It has been clearly documented that walking/jogging and to a lesser extent cycling are the most common activities at Point Fraser. Other common activities were using the services of *About a Bike Hire* and the playground equipment, peaking at various times throughout the day and over weekday or weekend.

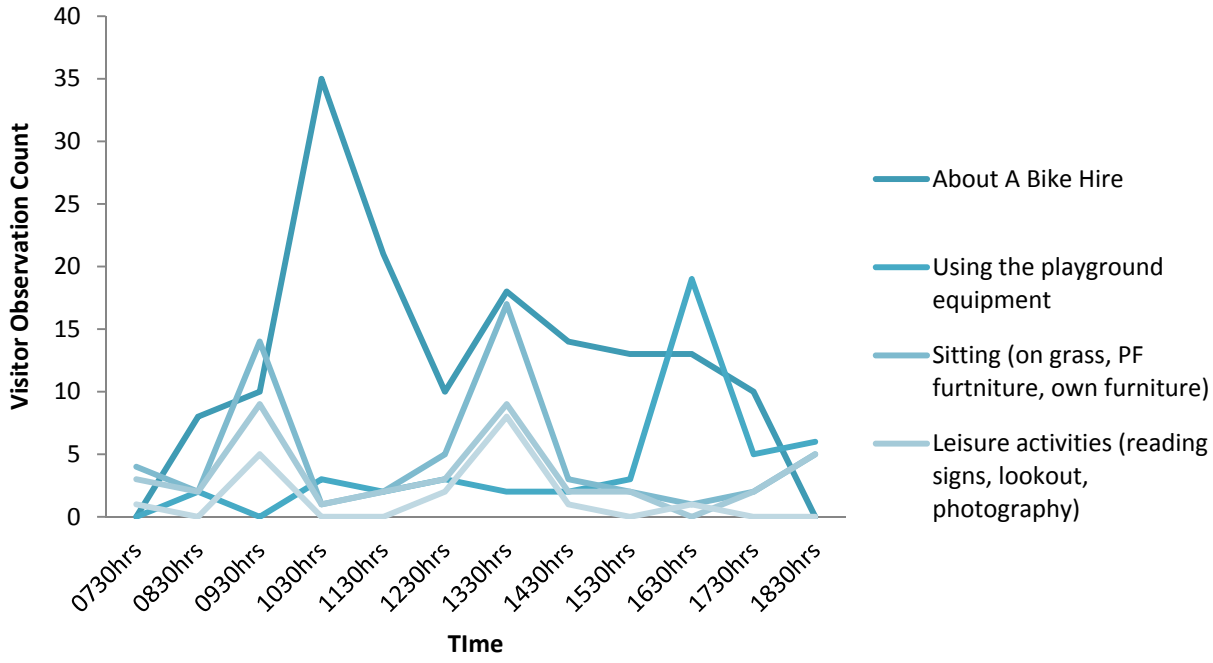


Figure 93. Number of people observed to engage in specific activities during hourly single-pass behaviour observations during the week.

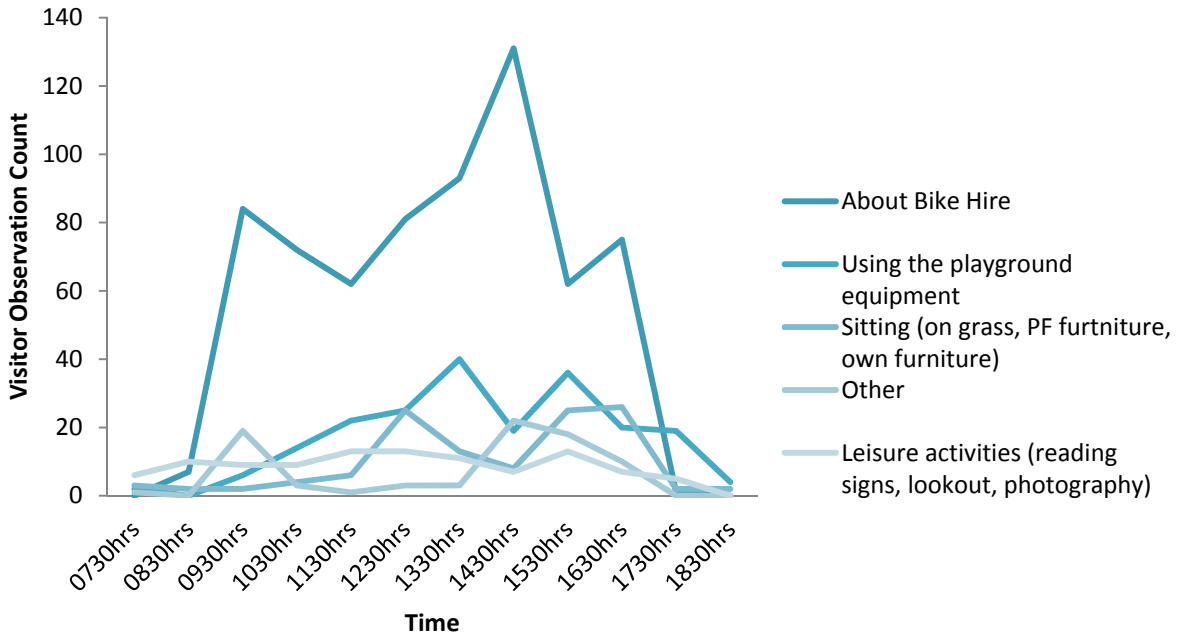


Figure 94. Number of people observed to engage in specific activities during hourly single-pass behaviour observations on the weekend.

At the conclusion of the five year PFMEP, specifically the social monitoring component, it is evident from the data that despite the variety of recreational opportunities for visitors which Point Fraser offers, current use is largely as a thoroughfare for people engaged in exercise activities such as walking, running and cycling. Leisure and recreational activities such as using the barbeque, picnic and playground facilities are evident to a considerably lesser extent. *About a Bike Hire* is a key driver for current recreational activities within the Point Fraser parkland. Although there is considerable infrastructure in the form of visitor interpretation which supports the opportunity for public appreciation of the historical, cultural and environmental significance of Point Fraser, these educational opportunities were little utilised and engaged with. The data highlights that only small numbers of visitors purposely explored interpretative trails or even demonstrated an awareness of opportunities for education at Point Fraser. Tours of Point Fraser, proposed at the outset of the development, did not eventuate. Although the majority of parkland users are locals, there is still a representation of domestic and international visitors who undertake a variety of activities at Point Fraser. Other limitations exist with infrastructure at the parkland that have had an impact on the recreational use of the Point Fraser parkland, for example, the number of toilets and barbeques, lack of tables, appropriate seating, shelter, directional signage and the fact that lighting, though seemingly installed, is not operational. It is not clear whether Point Fraser has been/is being used for events (see original Point Fraser Redevelopment Objectives in Figure 85) and why public guided tours of Point Fraser have not been implemented.

The aims of the social monitoring component of PFMEP are achieved utilising the three data collection instruments; Visitor Observation Counts, Visitor Surveys and Visitor Observation Behaviours. Visitor usage is determined through the Demographics and Park Use sections of the Visitor Survey. Visitor usage is observed by the Visitor Observation Counts conducted during monitoring events and is confirmed by results from the Visitor survey regarding activities undertaken. An understanding about why visitors used Point Fraser is gathered through Park satisfaction and Overall Satisfaction sections of the Visitor Survey.

7.10.4EVALUATION OF DATA COLLECTION METHODS

7.10.4.1 EVALUATION OF SUITABILITY OF PARAMETERS INCLUDING WHICH ONE SHOULD BE EXTENDED INTO THE FUTURE AND IF ADDITIONAL MONITORING PARAMETERS ARE REQUIRED.

Four social monitoring parameters were proposed to collect and analyse the assessment of the quality, quantity and type of recreational and educational use of Point Fraser as outlined in the City of Perth, Point Fraser Monitoring & Evaluation Program (PFMEP), 2010-2011 document (CoP, 2010). The social monitoring data collection methods included visitor surveys, feedback forms, observation counts and observation behaviours. Out of the review of the social monitoring parameters which have been used over the past five years, two additional data collection tools are suggested to complement modified data collection methods, including key user group interviews/focus groups and car park data.

The details, including the dates and data collection methods, of the social monitoring events conducted over the five year program are outlined in Table 77.

Table 77. Details of Year 1 to 5 Social Monitoring events.

			Dates of Data Collection		Types of Data Collection	
Year		**Round**	**Weekday**	**Weekend**	**Visitor Observations & Behaviour Counts**	**Visitor Surveys**
YEAR 1 - 2010	May	1	Wed 19 May 2010	Sat 29 May 2010	Yes	Yes
	October	2	Wed 27 Oct 2010	Sat 30 Oct 2010	Yes	Yes
YEAR 2 - 2011	May	3	Wed 25 May 2011	Sat 28 May 2011	Yes	Yes
	October	4	Wed 26 Oct 2011	Sat 5 Nov 2011	Yes	No
YEAR 3 - 2012	May	5	Wed 23 May 2012	Sat 26 May 2012	Yes	No
	October	6	Wed 24 Oct 2012	Sat 27 Oct 2012	Yes	No
YEAR 4 - 2013	May	7	Wed 22 May 2013	Sat 25 May 2013	Yes	Yes
	October	8	Wed 23 Oct 2013	Sat 26 Oct 2013	Yes	Yes
YEAR 5 - 2014	May	9	Wed 28 May 2014	Sat 31 May 2014	Yes	Yes
	October	10	Wed 22 Oct 2014	Sat 25 Oct 2014	Yes	Yes

7.10.4.2 VISITOR SURVEYS

The visitor survey is a three page paper survey which questions respondents about demographics (gender, age, resident), park use (mode of travel, frequency, visiting with, time stayed, activities undertaken, main reason for visiting) park satisfaction (quality, importance and availability of park features), overall satisfaction (overall satisfaction, repeat visitation, recommend visitation). Please see Appendix A for a copy of the visitor survey.

The visitor surveys were conducted on a weekday (Wednesday) and a weekend day (Saturday) in the same week twice per year, in May and October. The visitor surveys were offered to any visitors entering Point Fraser Parkland via the three entry points, SMC1, SMC2 and SMC3 (**Error! Reference source not found.**) throughout the parkland as per specified survey protocol between 7am and 6pm during monitoring events. During Round 3 (May 2011) it was noted that there was survey saturation with high levels of visitors refusing and expressing frustration at being asked to complete another visitor survey. Therefore a decision was made that there would be no visitor surveys for Round 4 (October 2011), Round 5 (May 2012) and Round 6 (October 2012), just visitor counts and observations. Despite the issues with survey saturation, a good baseline was yielded through the 1,242 visitor surveys collected over the monitoring program (Table 78).

Table 78. Number of surveys collected

	Survey rounds							
	Round 1	**Round 2**	**Round 3**	**Round 7**	**Round 8**	**Round 9**	**Round 10**	
	May-10	**Oct-10**	**May-11**	**May-13**	**Oct-13**	**May-14**	**Oct-14**	**Total**
Weekday	69	73	89	48	84	43	82	488
Weekend	123	99	115	81	159	65	112	754
TOTAL	192	172	204	129	243	108	194	1242

Before the initial rollout, the survey was substantially modified from the template provided in the original brief to achieve improvements with regards to readability and comprehension, maximising completion rate and facilitating analysis. Despite these modifications and subsequent pilot testing, some additional minor changes were made to the survey over the five year period in response to issues identified during data collection and entry. These changes included:

- In both Questions 10 (How would you rate the quality of the following features of Point Fraser? (Please circle)) and Question 11 (How would you rate the availability of facilities for your Point Fraser experience? (Please circle)), initially seating and tables were combined. However, given that there are no tables at Point Fraser it was considered necessary to separate them to make the data clearer and to get an accurate idea of both tables and seating individually.
- Question 12, "What is your main reason for visiting Point Fraser today? (Select only 1)". This question was reworded to make it clearer due to the high rates of multiple selections making the data unable to be analysed. The purpose of the question was to solicit a single reason for the visit to Point Fraser. Despite attempts to make the wording of this question clearer, there were still high rates of non-compliance yielding up to 25% of responses invalid.

To harness additional value out of the survey and in response to broader changes to Point Fraser arising from the construction of a mixed-use hospitality development on-site, the following additions were also made to the survey:

- Question 10, "How would you rate the quality of the following features of Point Fraser? (Please circle)" was modified to "How would you rate the quality and importance of the following features of Point Fraser? (Please circle)".
- Following the start of the construction for the mixed use hospitality development, in Round 7, two extra questions were added at the end of the survey, Question 17a "How do you think the new facilities will affect your experience of the Point Fraser parkland? Please comment." and Question 17b "In your view, does the type of development fit with the place and space of Point Fraser? Please comment." The purpose of these questions was to gauge the level of acceptance and general views of the new hospitality development at Point Fraser.

A number of limitations have been identified with the visitor survey including:

- Reference to signage in the survey does not make a distinction between directional, informational or interpretive signage. Use, perception, needs and effectiveness of different types of signage in the reserve are aspects that warrant further research.
- There was no definition of 'education' presented in the survey and as such it was up to the respondents to identify what they considered to be education. As no guided tours were offered during the survey period, it is considered that this response relates predominately to the signage or visitor interpretation.
- There were high rates of 'not applicable' or 'didn't matter' selected in response to park satisfaction, specifically quality, importance and availability of park features. This suggests that either the respondent was passing through the park and did not need to use these facilities or they were unaware of them.

- Some terms/items were not well understood by participants, e.g. 'furniture' and 'About Bike Hire'

The visitor surveys have been a suitable data collection tool that has yielded a detailed baseline documenting the types of visitors, use and satisfaction with the Point Fraser parkland, pre-and during the construction of the mixed use hospitality development. Continuing the survey beyond the construction into the operational phase would provide opportunities to longitudinally track visitor characteristics, use and satisfaction with the site. It would also enable pre- and post-development comparisons to ascertain and document any impacts (positive and/or negative) and perceived changes from the perspective of site users.

Recommendations for future visitor surveys:

a) Review the visitor survey in light of future aims of the monitoring program and where possible, shorten it without compromising comparability against the established baseline data.
b) Consideration and trialling of conducting visitor surveys electronically on handheld tablets using surveying software such as Qualtrics or Survey Monkey. For example, a shade structure could be erected in the middle of the parkland (near playground) and visitors who pass by would be invited to complete a survey. If possible offer an incentive for the completion of the survey e.g. free parking or coffee. Advantages of this approach would be automatic data entry, minimising incomplete surveys (ability to force responses) and minimising incorrect completion (e.g. multiple responses to single response items).
c) Log the number of survey invitations, rejections and non-approaches. While a census approach was taken during the PFMEP, rejections and non-approaches were not formally counted. Doing so would help monitor against survey saturation. If the number of rejections was getting high, then the survey strategy would need to be reviewed.
d) Include a screening question asking whether a participant had previously completed a Point Fraser Visitor Survey. If yes, participants would be diverted to a secondary survey probing for sense of place, perceived change and place attachment.
e) Invite visitors who complete a survey to provide their contact details to participate in a future in-depth interview. This would facilitate the recruitment of key user group participants (e.g. early morning exerciser (walker/runner), early morning exerciser (cyclist), commuter, young family, using interpretative trails, using barbeque / picnic facilities, using bike hire and/or using commercial facilities) for an in-depth exploration of awareness, connections, values and use of the parkland.

7.10.4.3 FEEDBACK FORM

The feedback form was proposed in the PFMEP 2010-2011 Monitoring Brief (COP, 2010). It was expected that visitors who attended a tour at Point Fraser would be given the opportunity to complete a feedback form. However, to date the City of Perth has not established a Point Fraser Tour and therefore this data has not been collected.

7.10.4.4 OBSERVATION COUNTS

The observation counts were completed on a one page form counting the number of visitors entering and exiting the park either walking/running or cycling at each site. An observer was stationed at each of the three entries, SMC1, SMC2, and SMC3. Though not part of the original brief, at SMC1 entrance data was also collected for people passing outside the park to gather information on the level of potential audience and/or commuters bypassing the parkland. The observation counts were conducted two days in the same week, on a weekday, Wednesday and weekend, Saturday monitoring events and twice per year, in May and October, between 7am and 6pm, for one 15 minute period per hour.

To analyse the data, the counts recorded every 15 minutes were extrapolated out to hourly data by multiplying by four. The observation counts have provided a good indication of the peak periods that the park was used and to some extent the flow direction and type of activity, given the high rates of walking, running and cycling through the parkland.

Recommendations for observation counts:

a) Reconsider the overall aim of the observation counts with regards to the necessity to survey all entrances and the need for directional information. Considering proposed changes to visitor survey protocols, basic visitor volume data could be ascertained from the combination of survey completions, rejections and non-approaches. If logged against time, this information would also facilitate temporal distribution across the survey days. In addition or as an alternative, consideration should be given to visitor counters installed at each entrance. They have the potential to provide detailed quantitative and flow direction data.

7.10.4.5 OBSERVATION BEHAVIOURS

The observation behaviours were completed on a one page form recording the type of activities the visitors in the park were doing at a point of time. There was space for additional comments to be recorded. A surveyor would walk throughout the whole park once per hour, every hour over the day to record the behaviours of visitors. Where possible the same staff member recorded this data to ensure there was consistency with the interpretation and collection. The observation behaviours were conducted two days in the

same week, on a weekday, Wednesday and weekend, Saturday monitoring events and twice per year, in May and October, between 7am and 6pm.

The observation behaviours provide a snapshot of how the parkland is use over the day. This confirms the data collected related to activity from the visitor survey.

Recommendations for observation behaviours:

a) Shift to a more targeted observation approach is suggested, focussing on one or two key functions of the parkland each survey event to achieve a more in-depth insight into specific functions of the parkland and visitors' engagement therewith. For example, observations could focus specifically on park-user engagement with interpretive signage; playground use; etc.

7.10.4.6 OTHER DATA COLLECTION TOOLS

Two additional data collection tools have been proposed to add to the existing social monitoring tools used at Point Fraser. The key user group interview provides an opportunity to conduct a more in depth semi structured interview over the telephone with a respondent who has completed a visitor survey. The visitor survey respondent would be invited to participate in the key user group interview and if agreed, would provide contact details to be contacted at a later date. The respondent would be invited to participated based on their fit as a member of an identified key user group, for example, early morning exerciser (walker/runner), early morning exerciser (cyclist), commuter, young family, using interpretative trails, using barbeque / picnic facilities, using bike hire and using commercial facilities. The semi structured interview format would enable the collection of more detailed and specific data in regard to the use of the parkland and would complement the short visitor survey.

Car park data yielded from car parking machines would record the number of vehicles entering and exiting the park and duration of stay, as required during monitoring events. Utilising data from car parking machines would remove the need to have visitor counts conducted at this entry/exit point.

7.10.5 EVALUATION OF MONITORING LOCATIONS AND INFRASTRUCTURE AND WHETHER ADDITIONAL SITES OR INFRASTRUCTURE SHOULD BE INCLUDED.

The current monitoring locations provide a good spread over the park to capture the entry and exit of park visitors. This has provided solid baseline data for park entry and use. Current monitoring locations should be reconsidered in light of the aims and priorities of future monitoring, exploration of alternative monitoring approaches as outlined in previous sections, and the impacts on visitor usage and flow arising from the new multi-use hospitality development.

7.10.6EVALUATION OF MONITORING FREQUENCY.

The proposed data collection tools include: visitor surveys, observation counts, observation behaviours and key user group interviews. Given that the construction of the new mixed use hospitality development is due for completion in the next year and that this will likely change the use of the park, it is proposed to have an intensive data collection of social monitoring instruments for two years. This would include collecting data twice per year in May and October for two days each on a Wednesday and a Saturday and would document how the use of the park has been impacted following the new development. Following this the data collection should be held every second year in October for 2 days, on a Wednesday and a Saturday.

7.10.7LESSONS LEARNT

The lessons learnt from the five years of the collection of social monitoring data include:

a) Monitor the level of acceptance and rejection of the visitor survey tool to assess if survey saturation is an issue.
b) Opportunities to present data more simply and visually. The data presentation format prescribed in the project brief was not amenable to ease of use, practicality and easy interpretation and understanding of the data.
c) Data meets the Social Monitoring aims but does not fully address the overall Point Fraser Redevelopment Objectives. Thus there are opportunities to better align monitoring protocols and instruments with the original Point Fraser Redevelopment Objectives and review the aims of the Social Monitoring component.

It became clear after the first two monitoring rounds that many respondents were not aware that they were in a place called Point Fraser though they were very positive about the place and space in which they found themselves. Thus there are real opportunities to raise

awareness of Point Fraser as a place to visit in its own right. Signage such as a welcoming entrance statements including the name Point Fraser, maps identifying the reader's location and providing an overview of the site and opportunities therein, and clear directional signage to guide visitors through the parkland would all contribute to visitor's ease of orientation and is likely to facilitate improved use, recognition and site appreciation.

Despite the continued general lack of awareness of Point Fraser as a destination in its own right, towards the latter half of the five year monitoring program comments from local users solicited through the visitor survey did reflect a strong attachment and sense of place to the site. It was clear that having a natural space in close proximity to the city was highly valued and recognised as unique.

7.11 CONCLUSION AND RECOMMENDATIONS

7.11.1CONCLUSIONS

Point Fraser is highly valued by regular local users for providing a natural space close to the city centre, with a growing sense of place apparent in the monitoring data. More broadly, however, the five year monitoring period highlights a persistent lack of awareness about the parkland, its features and values and the site is predominately used as a thoroughfare and commuter car park. While there is appreciation for elements of the original development objectives, particularly those relating to the aesthetics and closeness to nature, there is much room for improvement in terms of achieving them. Nonetheless, it is anticipated that relatively simple and low-cost improvements such as the addition of effective locational and directional signage, public transport access and free 4hour parking for park users, would greatly enhance community use of this important place. Improved toilet facilities would also address a strongly highlighted need. Monitoring and evaluation of the use of Point Fraser parkland remains important to facilitate targeted and effective investments in the management of the site. It is vitally important, nonetheless, that the monitoring and evaluation loop is closed and linked to implementation of changes with view towards continual improvement. Without this connection, there is little point in monitoring.

7.11.2RECOMMENDATIONS

14. It is recommended that no further social monitoring data are collected until at least 1 year after the commercial development is completed and operational. The survey instruments are recommended to be modified to ensure they deliver more relevant information as outlined in the report

8 CONCLUSIONS

Point Fraser was developed in 2004 to convert former lawn area to a recreation space, with environmental values. In addition, a wetland was constructed to intercept and treat a stormwater drain from East Perth (catchment 18.3 ha) that had previously discharged untreated into the Swan River. In 2010, the City of Perth (COP) contracted the Mine Water and Environment Research Centre at Edith Cowan University to undertake a comprehensive monitoring program at the site. The aim was to determine how well the wetland and to a lesser extent other components of the development achieved the goals originally set for the site. This report covers monthly monitoring of water quality in the wetland from January to December 2014 and reviews the 5 years of monitoring data from the site.

1. The quality of urban stormwater discharging to the Swan River long term, as a result of the redevelopment of Point Fraser by determining the amount of pollutant removal via the constructed wetland;
2. The on-going ecological health of the constructed wetland via its conformance with relevant water quality guidelines and legislation requirements.

Results suggest that water quality is generally within the normal ranges that might be expected in stormwater wetland on the Swan Coastal Plain. A major issue over the 5 years of the project has been salt intrusion into the wetland from influx of saline Swan River water during high tides, and incoming slightly salty water from stormwater and Lake Vasto. It appears that the 2013 installation of a valve on the outflow from W4 has substantially reduced salt levels within the system. The consequences of the high salinities experienced in 2012 and 2013 are reflected in changes in changes in wetland vegetation in terms of species distribution - encouraged a near monoculture of *Juncus kraussii*. Also the salinity has reduced the vitality of the plants resulting in release of nitrogen, that has caused likely net export of nitrogen from the wetland over 2013-14. The main loss of water from the wetland is evaporation which further concentrates the salt up to undesirable levels over the summer months particularly in W3. Increased inflow and the outflow valve will however probably keep salinities in the wetland within acceptable levels in future years.

Solar powered monitoring stations were established at both inlet and outlets to the wetland. These were designed to allow for quantification of nutrient loads in and out of the system so that the overall removal efficiency could be determined. Overall, the monitoring system struggles to obtain very accurate data at the inflow. The inlet structure makes monitoring difficult and the acoustic Doppler instrument currently used to measure water velocity does not operate satisfactorily primarily due to nature of the inflow rather than a failure of the instrument itself. Improved quantities of inflow would improve the ability to accurately measure those flows. Through use of an ECU bubble

flow meter, it has been possible to produce meaningful data. Flows into the wetland are well below predictions in the original design and are barely adequate to test the effectiveness of the system. The low inflows contribute to the City having to top-up the wetland excessively using water from Lake Vasto.

The volume of water stored in the wetland when full is estimated to be approximately 2,000 m^3. For example, evaporation in January 2012 was approximately 1,000 m^3 (similar in February and March), with negligible other inputs, this means that substantial inputs will be required from Lake Vasto. Given the location, there are no real options to increase the storage of the wetland to allow it to carry water throughout the summer. Examination of the depth data from Zone 2, suggests that in the absence of inputs, water levels drop by up to 50 mm a day in January and 20 mm in May (where 10 mm equates to approximately 34 m^3 of water) based on 2012 data. As the rate of water level decline is relatively constant, this suggests that the majority of the water is being lost via evapotranspiration. Top-up water from Lake Vasto is required to maintain the plants within the wetland over the summer months. Ideally, only limited top-ups should be required however low inflows and low rainfall have contributed to requirements for over 7,000 m^3 of water to be required for the wetland in 2014. There is evidence that issues associated with the automated top-up system are responsible for the loss of top-up water (possibly 1,000-2,000 m^3) back to the drainage network (backflow) or outflow.

The team has identified in previous years issues associated with the inlet structure that means that much of the water (46% of the total water inputs in 2012, 13% in 2014) that enters the wetland later drains back into the drainage network, and as such it is effectively lost from the wetland. The reasons are two-fold, firstly the shallow slope of all the drains relative to the wetland mean that it is particularly susceptible to the relative heights of water in the incoming drains compared to the wetland (i.e. if the wetland is higher, water drains out and vice versa), and secondarily as there is probably a leak in the drainage network which is continuously reducing the height of the drain water allowing backflow to occur. Backflow is not desirable simply as it would be more useful for the water to move through the wetland, adding to storage and dilution. Use of valves on the bubble up grate (BUG) is considered unlikely to be successful as the relative height difference is so slight that there is unlikely to be sufficient head to allow the valve to close and the installation could reduce inflows. Raising the height of the BUG is a possibility for reducing backflow; however this would also potentially reduce inflows. Another issue that has been noted is that excessive growth of plants has the effect of impeding flows through the wetland. Prevention of damming by plants could be achieved by selective removal of plants. Plants in the centre of Zone 1, sit in approximately 200 mm of soil over the liner. Removal of plants would need to be done carefully to prevent damage to the liner. Based on plant harvesting for the monitoring program it would be possible but difficult to remove the plants. Alternatively cutting the

plants below the water line may be a viable solution – it may not prevent them growing back but would be quick and easy. The role the plants are designed to play is to still the water in W2 allowing particulates to settle. Removal of plants within 1 m of the boardwalk should be sufficient to allow flows to move unimpeded into Pond 2, whilst not losing the stilling function.

In 2014, the wetland was likely a net exporter of nitrogen with a removal efficiency of -24 to 26% (depending on water estimate used), but was effective at removing phosphorus (63-70%) and total suspended materials (41-76%). Total N on a number of occasions exceeded the target concentrations for discharge. Removal of P appeared successful in preventing exceedances of the target values for discharge. Generally performance of the wetland was good for the five years of the study, it should be noted that this was under very low flow conditions (significantly below design) and that during the only year (2013) with recorded moderate inflows that performance declined. It is likely however that removal efficiencies based on the load of nutrients entering the wetland would decline with increased flows – it is likely that concentrations of nutrients would still remain under the target values.

Wetland vegetation has survived a series of low rainfall years and high salinities in the wetlands over the project; however *Juncus kraussii* is out-competing the other species, with all the others on the decline. Although *Eleocharis acuta* appeared healthy, the degree of coverage has declined substantially with only a reasonable pocket remaining in W4. *Baumea articulata* and *Typha domingensis* has suffered a large dieback, possibly due to increasing salinity. The impact of the high salinities in the wetland in 2012/13 are only now being felt in low productivity in the plants, with excessive release of nitrogen. This illustrates the role that plants play in nutrient uptake – they are a nutrient pool rather than store. Biofilms (not measured) on plants are generally consisted to be more important in uptake of nutrients from the water and conversion to the sediment as a sink. The sediment in W3 was substantially more effective at removing nutrients than the Supersorb clay in W2.

3. The quality of wetland habitat and the quantity and quality of breeding places for native avifauna presence, behaviours and habitat use;

Biodiversity measured through bird and macroinvertebrate communities showed communities rich in cosmopolitan common taxa. A total of 37 bird species from 23 families have been recorded which is very encouraging given the scale of the wetland. Macroinvertebrate communities in zone 1 were substantially different to those recorded in previous years and Zone 2. Zone 2 communities were similar to previous years. Increasing salinity in zone 1 may be responsible for the changes seen. Overall species richness was higher than in 2012 at 26 taxa. Although salinity over the five year project

negatively impacted on macroinvertebrate diversity, evidence of recovery with declining salinities in 2013/14 can be seen.

4. The quality, quantity and type of recreational and educational use of Point Fraser by determining the diversity of visitor presence, behaviour, use, expectations and satisfaction and awareness of reports/information specific to Point Fraser performance; and

Social monitoring was undertaken to see how people use the site. Point Fraser does not appear to be a destination of choice but is used extensively as people pass through it primarily for exercise or park in the car parks to access the city. Most respondents viewed Point Fraser positively with 91% stating they would visit again. There was concern about the lack of facilities, although it was accepted that the commercial development may address these. A few respondents were not supportive of commercial developments at Point Fraser fearing their impact on the environment. The time taken for the commercial development to be completed was also identified as an issue by the majority of users. *About a Bike Hire* is a key driver for current recreational activities within the parkland.

5. The long term integrity and quality of the restoration of the foreshore edge, as a result of the redevelopment of Point Fraser by determining vegetation health and structural reliability.

Foreshore monitoring has revealed erosion and plant loss (including trees) along the foreshore particularly in area 1. Area 2 was largely inaccessible due to construction of the commercial development.

9 SUMMARY OF RECOMMENDATIONS

1. It is recommended that increasing the inflows is desirable to fully test system for nutrient removal – although it is likely that removal efficiency will decline (although export nutrient concentrations should not exceed trigger values). The additional inflows due to the low storage capacity for water in the wetland will probably not substantially reduce the reliance on top-up water from Lake Vasto but should keep salinities at acceptable levels. The City is investigating why inflows are lower than designed.
2. It is recommended that the City purchase bubble flow modules for both ISCO autosamplers to replace those belonging to ECU, as these have proved very reliable. Monitoring inflows and outflows in the wetland remains a difficult task requiring specialist knowledge.
3. It is recommended that regular monitoring of water quality within the wetland continue. This should include quantification of inflows and outflows and within lake sampling (scheme presented in the Appendices). Monitoring is needed to determine whether the wetland meets target discharge concentrations and would be useful in evaluating the wetland system if inflows are increased.
4. The subtle gradient in the wetland ensures that small variations in the automated cut-offs for the top-up system can lead to water loss via backflow or through the outflow. It is recommended that the City regularly checks the automated system during the summer months to check correct operation of the system.
5. Backflow works against the aims of the wetland in treating water discharged to the Swan River, especially as where currently water is being discharged is not known. Reducing or eliminating backflow would also aid in maintaining water levels within the system reducing reliance on top-up. The issue of backflow is currently being investigated by the City.
6. It is also recommended that research be undertaken to reduce the damming effect of plants noted within the wetland to improve flow paths and ensure that all the wetland is being used for treatment.
7. It is not recommended to add more or replace the Supersorb clay in W1 and W2 as it appears to make little contribution to nutrient uptake within the wetland.
8. Ongoing annual sediment monitoring for metals and nutrients is not recommended. It is recommended that sediment monitoring every 2-3 years would be useful.
9. It is recommended that the sediment in W2 not be allowed to accumulate to be above the base of the weir between the two zones. The rate of accumulation of sediment is relatively low at present but may increase with larger inflows.
10. Ongoing vegetation monitoring for nutrients and biomass is not considered necessary. It is recommended that annual assessments of the plant coverage are continued so that changes in coverage and possible die-back are detected allowing appropriate actions to be taken.

11. It is recommended that remediation activities be undertaken as soon as possible to protect the foreshore and existing vegetation along Area 1.
12. It is recommended that ongoing monitoring of the foreshore continue as detailed in the PFMEP. However, it is essential that action is taken by the City as soon as issues are reported to protect the foreshore.
13. Although the avifauna and aquatic macroinvertebrate monitoring has shown there has been a slight increase in biodiversity within the wetland over the five years, it is not considered that ongoing monitoring is warranted. If further monitoring was to be considered then a frequency of every 2-3 years would be sufficient.
14. It is recommended that no further social monitoring data are collected until at least 1 year after the commercial development is completed and operational. The survey instruments are recommended to be modified to ensure they deliver more relevant information as outlined in the report.

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11 APPENDIX

11.1 APPENDIX A – OBSERVATION COUNT DATA SHEETS

Version 2.20052010

Point Fraser

Observation – Count (SMC1 - Park)

Recorder Name:……

Date: …… Time:……

Weather Conditions:……

Any safety/health hazards:……

Site Code: ***SMC1*** *(*see diagram on back page)* Site Name: ***West entrance***

Time	Walking/Running		Bicycling		Other (Please note)
	IN*	OUT*	IN*	OUT*	
7-7.15am					
8-8.15am					
9-9.15am 10-10.15am					
11-11.15am					
12-12.15pm					
1-1.15pm					
2-2.15pm					
3-3.15pm					
4-4.15pm					
5-5.15pm					
6-6.15pm					

Comments (also use back of page):

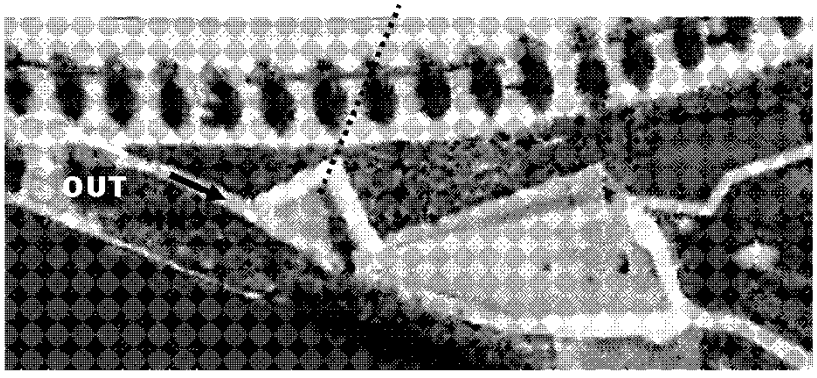
POINT FRASER MONITORING & EVALUATION PROGRAM (2010-2011) Page 1 of 4

Point Fraser

Observation – Count (SMC1 - Park)

Comments (contd.):

Position of surveyor SMC1 (Park & Road counts)



Version 2.20052010

Point Fraser

Observation – Count (SMC1 - Road)

CITY of PERTH

Recorder Name:……

Date: …… Time:……

Weather Conditions:……

Any safety/health hazards:……

Site Code: ***SMC1*** *(*see diagram on back page)* Site Name: ***West entrance***

Time	Walking/Running TO City*	Walking/Running FROM City*	Bicycling TO City*	Bicycling FROM City*	Comments
7-7.15am					
8-8.15am					
9-9.15am					
10-10.15am					
11-11.15am					
12-12.15pm					
1-1.15pm					
2-2.15pm					
3-3.15pm					
4-4.15pm					
5-5.15pm					
6-6.15pm					

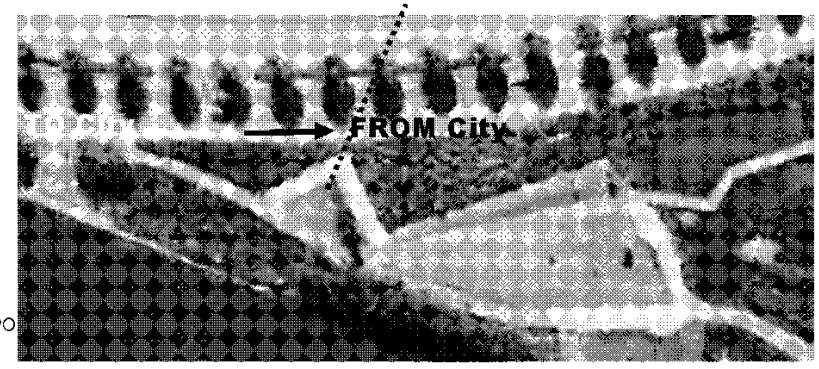
Comments (also use back of page):

Point Fraser

Observation – Count (SMC1 - Road)

Comments (contd.):

Position of surveyor SMC1 (Park & Road counts)



PO

Version 2.20052010

Point Fraser

Observation – Count (SMC2)

Recorder Name:……

Date: …… Time:……

Weather Conditions:……

Any safety/health hazards:……

Site Code: ***SMC2*** *(*see diagram on back page)* Site Name: ***East entrance***

Time	Walking/Running IN*	Walking/Running OUT*	Bicycling IN*	Bicycling OUT*	Other (Please note)
7-7.15am					
8-8.15am					
9-9.15am					
10-10.15am					
11-11.15am					
12-12.15pm					
1-1.15pm					
2-2.15pm					
3-3.15pm					
4-4.15pm					
5-5.15pm					
6-6.15pm					

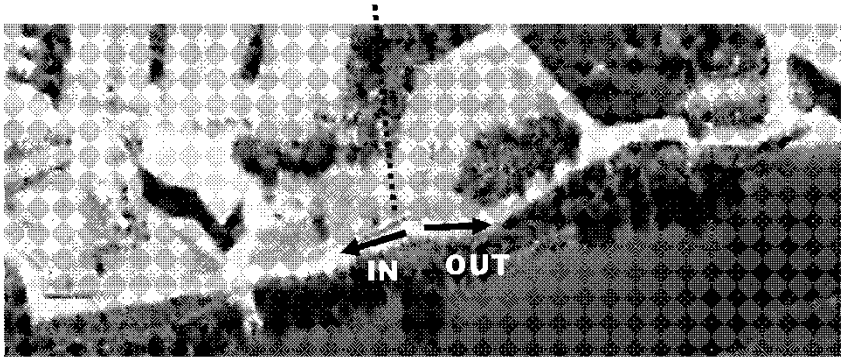
Comments (also use back of page):

Point Fraser

Observation – Count (SMC2)

Comments (contd.):

Position of surveyor SMC2 (counts)



Version 2.20052010

Point Fraser

Observation – Count (SMC3)

Recorder Name:……

Date: …… Time:……

Weather Conditions:……

Any safety/health hazards:……

Site Code: ***SMC3*** *(*see diagram on back page)* Site Name: ***Carpark entrance***

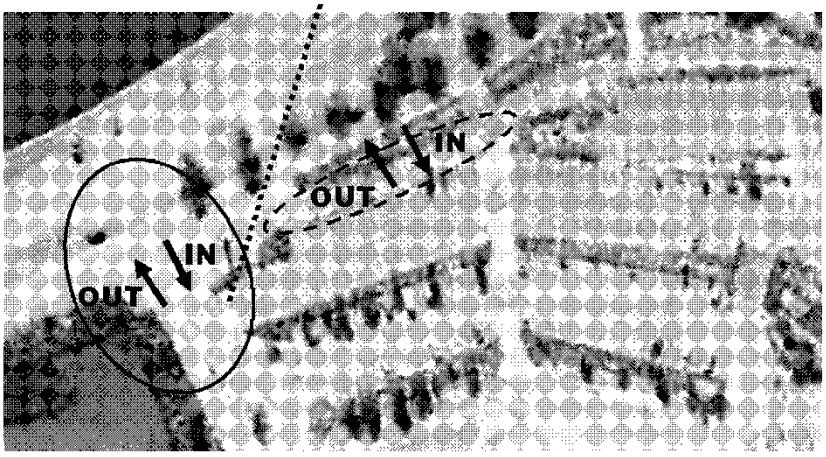
	Road Entrance*						***Pedestrian Entrance / Garden beds****	
Time	**Walking/Running**		**Bicycling**		**Vehicle**		**Walking**	
	IN	**OUT**	**IN**	**OUT**	**IN**	**OUT**	**IN**	**OUT**
7-7.15am								
8-8.15am								
9-9.15am								
10-10.15am								
11-11.15am								
12-12.15pm								
1-1.15pm								
2-2.15pm								
3-3.15pm								
4-4.15pm								
5-5.15pm								
6-6.15pm								

Point Fraser

Observation – Count (SMC3)

Comments:

Position of surveyor SMC3 (counts)



11.2 APPENDIX B – VISITOR SURVEY

Point Fraser

Visitor Surveys

Participant Information

Dear Visitor,

The City of Perth has contracted Associate Professor Mark Lund and his research team from the School of Natural Sciences at Edith Cowan University (ECU) to conduct a monitoring and evaluation program for Point Fraser. Point Fraser is a wetland that has been built by the City to treat stormwater runoff from the roads before it enters the Swan River. Associated with the wetland, the City has created an area of public amenity, including some commercial activities, playground and areas for enjoyment of nature. The City has also rehabilitated the foreshore of the Swan River.

As part of the evaluation program the City would like to know how Point Fraser is being used by the public, for what and how the facilities provided meet community needs. To help answer this question, the research team invites you to complete a short 15 min survey now with us, or in your own time (where you can mail in the completed survey) or online at the City of Perth website (under Point Fraser). The survey is completely anonymous with no identifying information collected. There is however opportunity to include a contact name and address, if you would like to City to provide a response based on your feedback. The information collected by the survey will be analysed by the ECU team and presented to the City annually in publically available reports – no information that would lead to the identification of participants appears in the report or is retained by ECU.

The information you provide will be used by the City to improve the facilities and amenity values of Point Fraser. As Point Fraser is a leading example of constructed wetland design in Western Australia, the results from this survey will help inform new wetlands being built.

Completion of the survey is voluntary, and participants must be over 18 years old. This survey has the approval of the ECU human ethics committee. Further information on the project can be obtained from the City of Perth or by contacting Associate Professor Mark Lund at ECU on Tel. 6304 5644 or email m.lund@ecu.edu.au

POINT FRASER MONITORING & EVALUATION PROGRAM (2010-2011)

Time: ..... *Date:* ..../...../201... *Surveyor Name:* Version 5.13052013

Point Fraser Visitor Survey

Thank you for visiting Point Fraser in the City of Perth. We would greatly appreciate if you could take a moment of your time and tell us about your experience.

1. Where are you from? (where do you normally live)

Australia: Postcode ..... & State.....

Overseas: City..... & Country.....

2. Your gender:

☐ Male ☐ Female

3. Your age:

☐ Under 21 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ Over 60

4. How did you travel to Point Fraser?

☐ On Foot ☐ By Car ☐ By Boat

☐ By Bicycle ☐ By Public Transport ☐ Other (please specify): .....

☐ Mixture of above (please specify): .....

5. How often do you visit Point Fraser?

☐ First time ☐ Daily ☐ Weekly ☐ Monthly ☐ Once or twice a year ☐ Less than once a year

6. Who are you visiting Point Fraser with?

☐ On my own ☐ Partner/Spouse ☐ Other family

☐ Friends ☐ Work associates ☐ Community group

☐ Other (please specify): .....

7. What time did you arrive at Point Fraser? (Select only 1)

Morning (am)						**Afternoon (pm)**					
6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6

8. How long are you planning to stay at Point Fraser?

☐ just passing through ☐ < 1 hour ☐ 1-2 hours ☐ 2-4 hours ☐ Over 4 hours

9. What activities are you doing at Point Fraser? (Select all that apply)

☐ BBQ/Picnic ☐ Visit for general enjoyment ☐ Exploring interpretive trails

☐ Photography ☐ Visiting playground ☐ Using services of About Bike Hire

☐ Walking ☐ Cycling ☐ Running/jogging

☐ Other (please specify):.....

10. How would you rate the **quality** and **importance** of the following features of Point Fraser? (please circle)

	Quality: Very poor ← → Very good						Importance: Low ← → High					
Overall cleanliness	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Access	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Playground facilities	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Scenic beauty	1	2	3	4	5	N/A	1	2	3	4	5	N/A
BBQ facilities	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Toilet facilities	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Signage	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Seating	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Tables	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Education	1	2	3	4	5	N/A	1	2	3	4	5	N/A
About Bike Hire	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Staff interaction	1	2	3	4	5	N/A	1	2	3	4	5	N/A
Other (please specify)_____	1	2	3	4	5	N/A	1	2	3	4	5	N/A

11. How would you rate the **availability** of facilities for your Point Fraser experience? (please circle)

	Too few	About right	Too many	Didn't matter
Toilets	1	2	3	4
BBQs	1	2	3	4
Seating	1	2	3	4
Tables	1	2	3	4
Signage	1	2	3	4
No. of other people	1	2	3	4
Other (please specify)_____	1	2	3	4

Please turn page

12. What is your **main** reason for visiting Point Fraser today? (Select only 1)

- ☐ Spending time with friends & family
- ☐ Exercising
- ☐ Experiencing nature
- ☐ Learn about storm water
- ☐ Seeing wildlife
- ☐ Scenery
- ☐ Doing something new & different
- ☐ Proximity to the City
- ☐ Rest and relax
- ☐ Learn about the environment
- ☐ Proximity to the river
- ☐ For solitude
- ☐ Other (please specify): .....

13. Do you think you will visit Point Fraser again?

☐ Yes ☐ No ☐ Maybe

b) Why or why not? Please explain. (Please provide as much detail as possible.) ……

……

……

14. Would you recommend visiting Point Fraser to others?

☐ Yes ☐ No ☐ Maybe

15. Overall, how satisfied were you with your visit to Point Fraser? (circle only 1)

	Very dissatisfied	◄			**Very satisfied** ►
Overall Experience	1	2	3	4	5

16. Do you have any suggestions how we could improve your experience at Point Fraser?

……

……

17. Finally, construction of the following development is underway at Point Fraser:

18.

Three single-storey buildings with:

- a boutique brewery	- sky garden
- cafes & restaurants	- waterfront alfresco dining
- tourist retail outlets	- take-away facilities
- function centre	- late-night supper club

A) How do you think the new facilities will affect your **experience** of the Point Fraser parkland?

☐ Positive ☐ Negative ☐ No change

Please comment: ……

……

……

B) In your view, does the type of development **fit with the place and space** of Point Fraser?

☐ Yes ☐ No

Please comment: ……

……

……

Thank you for your time.

11.3 APPENDIX C – OBSERVATION BEHAVIOUR DATASHEET

Version 2.20052010

Point Fraser

Observation - Behaviour

Recorder Name:……

Date: …… Time: ……

Weather Conditions:……

Any safety/health hazards……

……

Behaviour	No. of People	Behaviour	No. of People
Sitting on grass		Taking Photos	
Sitting on Point Fraser furniture Sitting on own furniture		Using the Playground equipment Using the toilets	
Waiting for BBQ		Using commercial facility 1	N/A
Using BBQ Waiting for About Bike Hire		Using commercial facility 2 Using commercial facility 3	N/A N/A
Using About Bike Hire		Walking / Running	
Using About Bike Hire Equipment		Bicycling	
Reading Signs			
Using the look out			
Comments:			

POINT FRASER MONITORING & EVALUATION PROGRAM (2010-2011) Page 1 of 2

11.4 APPENDIX D – POINT FRASER SOCIAL MONITORING PHOTO GALLERY

PARK ENTRANCES

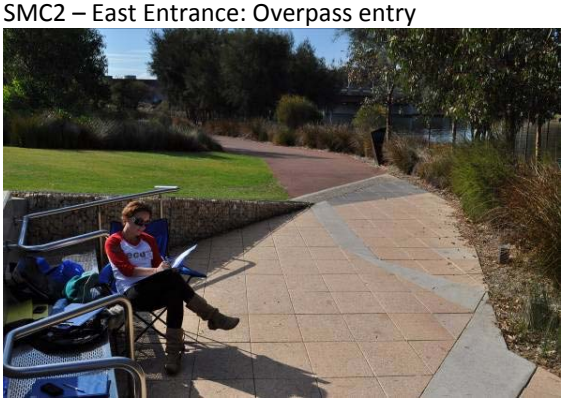
SMC1 – West Entrance

SMC1 – West Entrance: Surveyor conducting counts

SMC2 – East Entrance: Bridge underpass entry

SMC2 – East Entrance: Overpass entry

SMC2 – Conducting visitor surveys



SMC2 – Conducting visitor counts

SMC3 – Car park entrance: Outside cycle path

SMC3 – Car park signage

SMC3 – Commuters shortcutting to CBD

SMC3 – Commuters crossing road to CBD

SMC3 – Informal tracks / Shortcuts

SMC3 – Hidden roadside sign for carpark entry

USER ACTIVITIES

Running / Exercising

Cycling

Quad-bike riding (using hire equipment)

Enjoying scenery

FACILITIES

Toilets

Lookout

BBQ – note lack of table, seating or shade

BBQ – note bin and drink fountain

Sculpture

Sculpture also usable as seating

SEATING

Example of seating – not amenable for a family picnic or barbeque

Example of seating – artistic but impractical and uncomfortable

PLAYGROUND

View towards playground and Kiosk (not operational)

Playground equipment

Playground equipment

Playground equipment – Wheelchair accessible swing

ABOUT BIKE HIRE

Hire store - closed

Hire store with equipment

SURVEY POINTS

Surveyor conducting counts at SMC1

Surveyor conducting counts at SMC2

SIGNAGE

Out of date sign highlighting the development of a café / restaurant commencing in 2008 or 2009

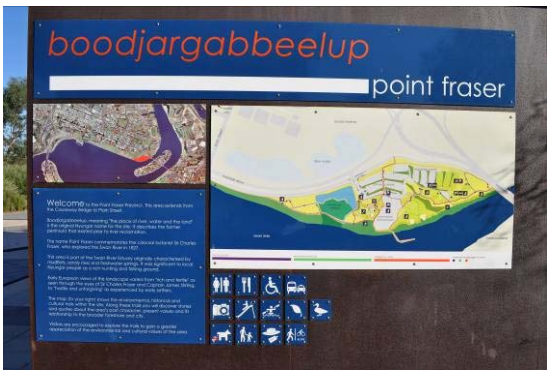
Pay display carpark sign

Directional sign

Educational sign

Directional sign along outside bike path – very small print and lots of writing

Educational sign



Information sign


Instructional sign


Entrance statement – welcome sign near SMC3

Information and instructional sign near SMC2

Car park entrance sign along road – obstructed by shrubs

Lack of signage? – Driver got confused in the car park area how to get to About Bike Hire and attempted access via the boardwalk from the car park

VANDALISM


Damaged lawn from vandals conducting donuts with cars


Tire marks in car park from vandals conducting donuts and burnouts with cars

11.5 APPENDIX E – MINIMAL RECOMMENDED MONITORING SCHEME

11.5.1KEY AIMS

1) Quantify efficiency of PF wetland for nutrient and metal removal
2) Provide guidance on whether water quality within the wetland poses a risk to biota living in or visiting the wetland
3) Vegetation coverage and foreshore monitoring
4) Social monitoring to determine how the park is being used and viewed by users
5) Biodiversity monitoring
6) Sediment monitoring

11.5.2METHODS

Aim 1 - Quantify efficiency of PF wetland for nutrient and metal removal

Maintenance and operation of current equipment.

Consumable costs associated with upkeep of equipment to keep it operational. The telemetry requires two phone services and there is a charge for online provision of the data. Annually requires about 10 h of time to ensure it is running properly.

Regular emptying of samples (should be stored no more than one week) from autosamplers

In previous years, there are about 20 weeks per year where there is either inflow or outflow, therefore there 20 trips to the site are recommended. Preparing for sampling, collecting samples (on site) and post processing takes an estimated 3 hours. Samples to be analysed for TP, TN, Cl, Ca, Mg, Na, K, Al, As, Cd, Co, Cu, Fe, Hg, Mn, Ni, Pb, Zn and TSS – cost $85. Based on previous years, an estimated total of 60 samples for both outflow and inflow are required to get a reasonable estimate of nutrient loads.

Estimating loads

It will take about 5 hours to sort and order the data for delivery to COP, if no further reporting is required (minimum).

Aim 2 - Provide guidance on whether water quality within the wetland poses a risk to biota living in or visiting the wetland

Samples will be taken monthly from all 4 ponds for the entire year and from Lake Vasto for 6 months (needed to calculate loads from Vasto). Only 8 trips have been budgeted as it is assumed that there will be some overlap with the autosampler trips. A total of 4 h has been allowed for preparation, collection and post sampling processing. Use of multimeter (Datasonde 5, Hydrolab) means that pH, ORP, conductivity, turbidity, chlorophyll a, dissolved oxygen can be measured instantly. Samples to be analysed for NOx, NH_3, FRP, TP and TN, DOC, Cl , SO_4, Ca, Mg, Na, K, Al, As, Cd, Co, Cu, Fe, Hg, Mn, Ni, Pb, Zn. Hardness can obtained by calculation (only needed for ANZECC guidelines), additional metals better cover possible contaminants, Cl and SO_4 useful in broader understanding of processes within the wetland. TSS not needed within the ponds.

Aim3 - Vegetation coverage and foreshore monitoring
Recommended to occur once annually as per PFMEP.
Aim 4 - Social monitoring to determine how the park is being used and viewed by users

Aim 5 - Biodiversity monitoring

Aim 6 - Sediment monitoring

Recommended to occur once every 2-3 years as per PFMEP. The social monitoring should not be repeated until at least one year after the commercial development is fully operational.