Campbell River Project Water Use Plan

Upper and Lower Campbell and John Hart Reservoirs Public Use and Perception Survey

Implementation Year 4

Reference: JHTMON-2

Upper Campbell, Lower Campbell and John Hart Reservoirs and Elk Canyon Public Use and Perception Survey

Study Period: 2018

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EXECUTIVE SUMMARY

The Upper and Lower Campbell and John Hart Reservoirs and Elk Canyon Public Use and Perceptions Study (JHTMON 2) is a 10-year study that will monitor the use and perceptions of recreational users of the Campbell River Reservoir system. This project forms part of the Campbell River Water Use Plan and aims to monitor a selection of performance measures in order to evaluate public use and perceptions.

The study tools and methods were developed during the first year of implementation, between May 2014 and July 2015. Three periods of data collection and analysis have been completed, beginning with Year 2 of the study (August 2015 to July 2016). Year 3 of the study ran between August 2016 and December 2017. This study period was extended in order to synchronize future reporting with the start of the calendar year. Year 4 of the study ran between January 2018 and December 2018. This report summarizes the findings from Year 4.

A total of 548 visitors were surveyed in Year 4. Sampling was focused on eight sites in the project area. A new site at Strathcona Lodge on Upper Campbell Reservoir was added in the spring sampling session, replacing McIvor Lake. Of the sampling locations, Quinsam Campsite had the highest number of survey responses, followed by Elk Falls Lookout.

The management questions addressed by the monitoring program explore how different operating regimes may influence public use and perceptions for river and reservoir users. A summary of the management questions, null hypotheses and results are outlined in Table 1.

The management question for reservoirs focused on determining if there was a relationship between the performance measures of public perceptions with average daily water elevations. No significant relationships were noted between daily average water elevation and all performance measures for reservoirs in Year 4. Comparison of results for the management questions between study years saw significant changes in responses. For several management questions, a greater proportion of respondents had a neutral perception, resulting in fewer positive responses. These differences will be investigated in greater detail in the upcoming Study Year 5 as part of the more comprehensive analyses.

For rivers, the key management question focused on identifying if there was a relationship between river discharge and the performance measures of public perceptions at riverine locations. Significant relationships were identified between river flow rates and all three performance measures, but not at all river locations. A weak, positive correlation was noted at Campbell River where increased flow rates were related to a positive influence on recreation experience. A weak but positive correlation was noted on Campbell River between flow rate and satisfaction with shoreline conditions. At Quinsam River, flow rates were also found to be positively correlated to satisfaction with shoreline as well as for perception of river safety.

The final management question focused on determining how riverine discharge might influence the recreation experience at Elk Falls. When visitor impressions and satisfaction were examined in relation to water flows, no significant relationship was identified although responses were overwhelmingly positive.

A discrete choice experiment (DCE) was prepared for examining the relationship between reservoir operations and public perceptions for the lower Campbell system. The DCE was modelled after the Upper Campbell experiment, removing lakebed features as these were found to not influence decisions in early analysis. DCE data for the Upper Campbell system was collected but not analyzed as efforts were directed towards development of a decision support system (UCDSS) tool for the Upper Campbell system. The UCDSS is described in Section 3.5 of this report.

Table 1. JHTMON2 - Status of management questions and hypotheses after 2018 Study Period

Management Question	Null Hypotheses	2016/2017 Data Analysis Status
For Reservoirs: What is the relationship between reservoir operations and overall recreation benefit and does it lead to competing trade-offs between reservoir based and river-based benefits?	$H_{0\text{-}A}$: Changes in overall satisfaction with the recreation experience, if they occur, are not related to reservoir operations.	1) *Influence on recreation experience* – No significant relationship noted between water levels and influence on recreation experience at reservoir locations from Year 4 data.
		2) *Satisfaction with shoreline conditions* – No significant relationship noted between water levels and satisfaction with shoreline conditions at reservoir locations from Year 4 data.
		3) *Perception of safety* - No significant relationship noted between water levels and perception of safety at reservoir locations from Year 4 data.
		4) *Satisfaction with access to beach* – No significant relationship noted between water levels and satisfaction with beach access at reservoir locations from Year 4 data. *Satisfaction with access to water via boat launch* - No significant relationship noted between water levels and satisfaction with water access via boat launch at reservoir locations from Year 4 data. *Satisfaction with access to water via shoreline* - No significant relationship noted between water levels and satisfaction with water access via shoreline at reservoir locations from Year 4 data.
For Rivers: What is the relationship between river discharge and respective riverine recreation/tourism benefits and is it such that it would necessitate trade-offs between recreation, fish and power benefits?	$H_{0\text{-}B}$: Changes in overall satisfaction with the recreation experience, if they occur, are not related to riverine discharge.	1) *Influence on recreation experience* – Significant relationship noted at Campbell River only between river discharge and influence on recreation experience with a weak, positive correlation.
		2) *Satisfaction with shoreline conditions* – Significant relationships noted at Campbell River and Quinsam River between riverine discharge and satisfaction with shoreline conditions with weak, positive correlations.
		3) *Perception of safety* - Significant relationship noted at Quinsam River between riverine discharge and perception of safety with a weak, positive correlation.
For Elk Canyon Falls: Is there a specific relationship between recreational value and incidence of high spill events and does this support the presently held belief that higher flows should be considered in the future?	$H_{0\text{-}C}$: Changes in overall satisfaction with the recreation experience of visitors to Elk Canyon Falls is not related to riverine discharges (i.e. spill events).	1) *Impressiveness of falls* – No significant relationship noted between riverine discharge and impressiveness of falls from Year 4 data.
		2) *Satisfaction with experience* – No significant relationship noted between riverine discharge and satisfaction with experience at falls from Year 4 data.

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1 INTRODUCTION

As an outcome of the Consultative Committee process (Campbell River Water Use Plan Consultative Committee, 2004), an objective for recreation and tourism in the Campbell River system was articulated: to enhance and protect the quality of recreation and tourism amenities and increase the quality of recreation and tourism opportunities with sustainable carrying capacities. This process determined preferred reservoir elevation ranges and flow rates which were then adopted in the Campbell River Water Use Plan (WUP). During the Consultative Committee process, preferred elevations, flow rates, weighting, seasons, etc. were determined first using professional judgement and local experience, and second, through a public perceptions study and interviews with local experts (BC Hydro, 2013). Following this approach, it was recognized that a more systematic and robust approach to valuing the recreation resource could be possible (BC Hydro, 2013).

This project aims to improve upon previous evaluations of recreation and tourism within the Campbell River system area (BC Hydro, 2013). It aims to systematically establish performance measures for a full range of recreational factors and evaluate the recreation and tourism opportunities through an on-going perception study. The Upper and Lower Campbell and John Hart Reservoirs and Elk Canyon Public Use and Perceptions Study (JHTMON 2) is a 10-year study that will monitor the use and perceptions of recreational and tourism users of the reservoirs, rivers and Elk Falls site within the Campbell River Reservoir system. This study is one of a series of monitoring programs that fulfills BC Hydro's obligations under the Campbell River WUP as approved by the Comptroller of Water Rights.

The study has included: the determination of performance measures in consultation with applicable government agencies, the development of impact hypotheses to address the management questions outlined in the project Terms of Reference (BC Hydro, 2013), sampling design and site selection, questionnaire and discrete choice experiment design, data collection, data entry and management, data analysis, and reporting.

This report summarizes and synthesizes the results of data collection completed between January 2018 and December 2018. This period is referred to as "Year 4" of analysis. Previous reports have summarized data collected in the years between August 2015 and July 2016, referred to as Year 2 in this report, and between August 2016 and December 2017, referred to as Year 3 in this report. Year 3 was extended to align the study with the calendar year (i.e. January to December). Year 1 of the study focused on the development and testing of the sampling design and study tools. The accomplishments of this first year are summarized in the Year 1 implementation report. No data collection was completed during Year 1.

1.1 MANAGEMENT QUESTIONS AND OBJECTIVES

The management questions, objectives and hypotheses to the program were stated in the Terms of Reference (BC Hydro, 2013) and in the Year-1 implementation report (LKT and EDI, 2015). As described in these reports, the Campbell River Recreation Technical Committee identified three management questions to address through the monitoring study. The key management questions were:

1. For Reservoirs: What is the relationship between reservoir operations and overall recreation benefit and does it lead to competing trade-offs between reservoir based and river-based benefits?

2. For Rivers: What is the relationship between river discharge and respective riverine recreation/tourism benefits and is it such that it would necessitate trade-offs between recreation, fish and power benefits?

3. For Elk Canyon Falls: Is there a specific relationship between recreational value and incidence of high spill events and does this support the presently held belief that higher flows should be considered in the future?

These research questions stem from the main objectives for this study which are to 1) develop a more rigorous approach to determining recreation and tourism performance measures for future WUP reviews and 2) carry out an explicit evaluation of the recreation quality achieved, and the trade-offs made during this WUP.

1.2 MANAGEMENT HYPOTHESES

In response to the management questions, we devised the following research hypotheses to be tested by the monitoring program:

For Reservoirs:

The first research hypothesis addresses the relationship between reservoir operations and overall recreation benefits. For the purposes of this study, benefits have been defined as satisfaction with the recreational experience. Testing of this hypothesis is informed by responses to the public use and perceptions survey in association with reservoir operations data available from BC Hydro.

- $\mathbf{H_{0\text{-}A}}$: Changes in overall satisfaction with the recreation experience at reservoirs, if they occur, are not related to reservoir operations.

The second part of the management question asks if reservoir operations lead to competing trade-offs between reservoir based and river-based operations. This component of the management question will be explored by comparing the results of any relationship found between reservoir levels and satisfaction of reservoir recreationists with those of any relationship between riverine flows and satisfaction of riverine-based recreationists.

For Rivers:

This research hypothesis is associated with addressing the relationship between river discharge operations and riverine recreation benefits, as measured by satisfaction with the riverine recreation experience. Testing of these hypotheses is informed by responses to the public use and perceptions survey in association with riverine discharge data available from BC Hydro.

- **H_{0-B}**: Changes in overall satisfaction with the recreation experience at rivers, if they occur, are not related to riverine discharge.

For Elk Canyon Falls:

The final research hypothesis is associated with addressing the relationship between recreational value and incidence of high spill events at Elk Falls. Testing of these hypotheses is informed by responses to the public use and perceptions survey in association with riverine discharge data available from BC Hydro.

- **H_{0-C}**: Changes in overall satisfaction with the recreation experience of visitors to Elk Canyon Falls is not related to riverine discharges (i.e. spill events).

2 METHODOLOGY

The management questions and associated hypotheses are addressed by measuring specific parameters using a public use and perceptions survey along with available water level/river discharge data. This monitor has scheduled annual sampling for 10 years, with sampling occurring across all four seasons. The first year of the project (2014/2015) focused on the study design. Data collection has occurred over three study years to date, including Year 2 (August 2015-July 2017) and Year 3 (August 2015-December 2017). This report picks up after Year 3 of the study, summarizing all data collected between January 2018 and December 2018, referred to as Year 4 in this report.

In Year 4 of the study, several deliverables and tasks were introduced in order to further improve the study. Additional scope items included:

- Digitization of survey for data collection using tablets
- Completion of Decision Support System for the original Discrete Choice Experiment based on Upper Campbell Reservoir
- Development of a new Discrete Choice Experiment based on Lower Campbell Reservoir

2.1 STUDY DESIGN

2.1.1 DETERMINATION OF PERFORMANCE MEASURES AND INFLUENTIAL FACTORS

As identified by BC Hydro, this study utilizes performance measures as a means of gauging success in the provision of quality recreational opportunities as they relate to water management in the Campbell River Reservoir system. Performance measures were determined by consulting with applicable government agencies and BC Hydro. Input was sought from land managers who have a mandate to provide and manage recreation opportunities that may be affected by water management (i.e. water levels in reservoirs, flows in rivers).

The primary government agencies that were consulted included BC Parks of the Ministry of Environment and the Recreation Sites and Trails Branch of Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD). Key informants from BC Parks and Recreation Sites and Trails Branch were engaged by a combination of phone calls, emails and a written exercise designed to address study questions. The compiled responses were then used to develop draft performance measures. These draft performance measures were developed specific to recreational issues associated with water management, as identified by the management agencies. These were subsequently discussed with the same key informants as well as with representatives from BC Hydro, until a final list of performance measures was established. The final performance measures are outlined in Table 2. Further details on the determination of performance measures are described in the Year 1 Implementation report (LKT and EDI, 2015).

Table 2. Water management issues and related performance measures

Management Issue	Performance Measure	Applies to: Reservoir/River/ Both	Applicable Management Hypotheses*
Public safety	▪ Perception of safety while engaged in water-based recreation	Both	H_{0-A} (reservoirs) H_{0-B} (rivers)
Maintaining accessibility	▪ Satisfaction with accessibility to boat launch ▪ Satisfaction with accessibility to shoreline ▪ Satisfaction with accessibility to beach	Reservoir	H_{0-A} (reservoirs)
Protecting shoreline condition for recreation	▪ Satisfaction with shoreline condition for recreation	Both	H_{0-A} (reservoirs) H_{0-B} (rivers)
Maintaining quality recreation experience	▪ Influence of water levels/flows on recreation	Both	H_{0-A} (reservoirs) H_{0-B} (rivers)

* Management hypotheses outlined in Section 1.2

2.1.2 SAMPLING PLAN AND SITE SELECTION

2.1.2.1 Sampling Locations

Sample sites were selected with the aim of maximizing sample size at locations where BC Hydro has operational influence on water conditions (e.g., elevation, flow rate). BC Parks, Recreation Sites and Trails Branch of MFLNRO, and the City of Campbell River were consulted to identify the busiest recreation sites within the study area. Sampling was only conducted at sites that were officially open. As such, sampling did not occur at some locations during the off-season.

Eight locations were originally selected for conducting surveys within the Campbell Reservoir system (see Figure 1). An additional sampling location was added at Strathcona Lodge on Upper Campbell Reservoir to gather additional data of visitor use for this reservoir in Year 4. With limited time and budget available, sampling was dramatically reduced in turn at McIvor Lake following the 2018 winter sampling season. This reservoir was selected for elimination as water elevation data is not available at this location, making analysis of the management questions challenging.

2.1.2.2 Sampling Frequency

Sampling over the course of the monitor has been scheduled to occur across as many of the seasons of the year as possible while still aligning with the operational season of the various recreation areas. Sampling was completed between March 8 to March 27 (winter), May 18 to June 30 (spring), August 4 to August 27 (summer) and September 2 to October 1 (fall). The fall season was bumped a little earlier in Year 4 to align with the closing dates of the provincial campgrounds and recreation sites.

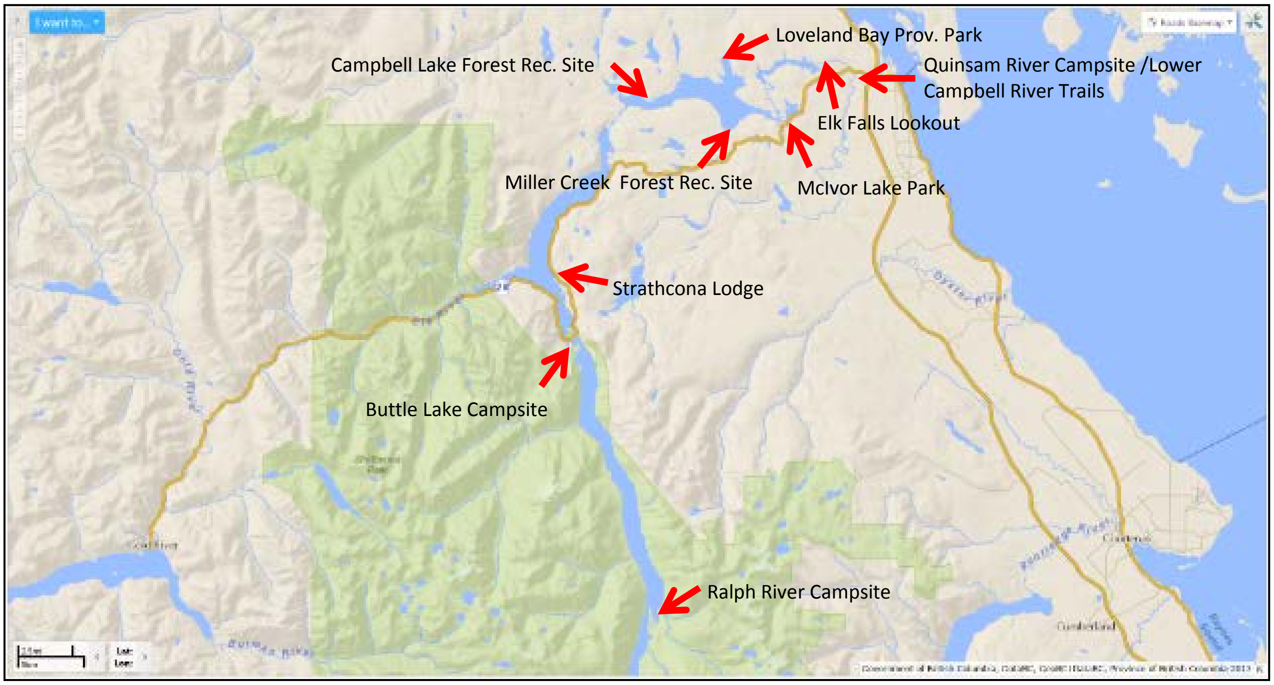


Figure 1. Map of sample locations (adapted from iMapBC)

Total sampling effort was set to 128 interview days per calendar year, providing approximately four interview days per site for the eight major sites across four recreation seasons. Interview days were distributed across the sampling periods and sampling sites, with an effort to sample the various locations on as many different days (and thus different water elevations/flows) as was practical. Additionally, sampling dates were selected to overlap with public holidays and weekends to maximize sampling during periods of high visitation. Two sites were generally sampled concurrently by two surveyors in the morning, and two different sites were surveyed concurrently in the afternoon to promote spatial and temporal coverage. Surveying was completed by employees from the Laich-Kwil-Tach Environmental Assessment Ltd. Partnership (LKT), based in Campbell River, BC

Table 3. Year 4 (January 2018 – December 2018) sampling schedule for each season

Season	Scheduling
Winter (2018)	March 8-March 27, 2018 (Mar 8-12, Mar 15-19, Mar 23-27)
Spring (2018)	May 18-June 30, 2018 (May 18-21, May 25-28, May 31-Jun 3, Jun 7-10, Jun 15-18, Jun 21-24, Jun 28-30)
Summer (2018)	August 4-August 27, 2018 (Aug 4-7, Aug 10-13, Aug 15-19, Aug 24-27)
Fall (2018)	September 2-October 1, 2018 (Sept 2-5, Sept 7-10, Sept 13-17, Sept 21-25, Sept 27-Oct 1)

2.2 SURVEY DELIVERY

The public use and perceptions survey was designed to be delivered as an onsite survey, administered to visitors at sample sites. As practical, all parties at a sample site were approached for inclusion in this study. Sampling sessions were scheduled to occur on site between 9AM and 5PM. When possible, participation was requested after engaging in recreational activities although the survey was designed to be administered at any point during their trip. A representative from each party was asked to participate in the survey and asked to complete the questionnaire onsite. People who refused to participate were thanked for their time and not engaged further. Surveyors tracked the number of individuals they asked to complete the survey, the number who refused and the number who had already taken the survey in the past year. This information was used to calculate a response rate.

A standard introduction statement that summarized the cover letter accompanying the questionnaire was made to all prospective participants. If asked how the surveys would be used, people were told that the information would provide insights into public use and preferences for water management for BC Hydro. Contact information for the BC Hydro technical lead was provided on the survey in the event that anyone had questions or concerns about the project.

2.3 SURVEY DESIGN

The key components during the original design phase of the base questionnaire and discrete choice analysis (DCE) included the following:

- Consultation with BC Hydro and the associated management agencies
- Determination of the Discrete Choice Experiment framework
- Design of the questionnaire and DCE survey tool
- Survey testing and refinements

At the beginning of 2018, several other additional scope items were added, including:

- Digitize survey for delivery using electronic tablets
- Development of Decision Support System for Upper Campbell Reservoir based on the results from the original DCE
- Design and delivery of a new DCE survey focused on Lower Campbell Reservoir

2.3.1 PUBLIC USE AND PERCEPTIONS SURVEY

The main component of the public use survey was developed following social science best principles including those found in Dillman (2007) and Vaske (2008). Considerations were given towards ease of understanding and maximizing survey completion and return rates. The survey was designed to follow a logical flow of questioning and providing instructions to respondents that were clear and concise as possible. A key challenge to the development of the survey was that the same survey needed to be able to collect information about visitors' experiences at various types of waterbodies (e.g. reservoir, river, falls). The survey was designed so that respondents could relay perceptions about their experiences at multiple waterbody types, rather than just the one they were encountered at; individuals were asked to reply based on their experiences at the place they were encountered at that day (e.g., at a reservoir), as well as for other waterbody types they may have visited most recently on the same trip (e.g., at a river the previous day). This approach allowed for gathering more responses regarding each location type, as respondents often visited multiple waterbody types and locations during the same trip.

Testing of a draft survey was completed in April 2015 with a small focus group. The aim of the testing was to use a small number of test surveys to reveal overarching problems, such as awkward wordings, missing response categories, leading statements and issues with duration (e.g. survey too long). Following these revisions, several iterations of the survey were circulated and reviewed between May and July 2015 in order to discuss question content, ordering, wording, range of answer options and question instructions. Review was conducted primarily by representatives from BC Hydro, BC Parks and BC Recreation Sites and Trails. The survey went through numerous drafts and formats until a preferred design was established. The questionnaire was printed in a booklet-style, with each page of the booklet being 5.5" by 8.5" (i.e., an 8.5" by 11" page, folded in half).

The questionnaire utilized a variety of survey question types, including check-list, Likert scale, and some open-ended quantitative questions. The full questionnaire has been designed to take a maximum of 15 minutes although most respondents will typically complete it much faster as only some sections will apply.

Questions were included in the survey to ensure that the impact hypotheses, outlined in Section 1.2 are addressed. The specific questions and how the questions relate to the impact hypotheses are described in further detail in Section 2.3.3. Questions were also included in the survey to directly address the performance measures developed in consultation with the regulatory agencies. Performance measures were addressed using Likert-type rating scales where respondents' attitudes are measured directly. Likert-type scales use fixed choice response formats and are designed to measure attitudes or opinions, typically on a 5- to 7-point scale. These ordinal scales measure levels of satisfaction/dissatisfaction, positive/negative influence, agreement/disagreement, etc.

In order to provide further context to recreational use within the study area, supplemental data were collected, both in the survey and through external data sources. Within the survey, questions were included to characterize respondents in terms of their demographics, recreational interests and habits. Further supplemental data are collected by surveyors in the field such as water levels and weather. Data for these influential factors are also gathered directly from BC Hydro (e.g., reservoir water levels and discharge, as available).

The questionnaire is composed of seven sections:

Section A: Current visit to the Campbell River Reservoir System

Section B: Visit to a Lake/Reservoir

Section C: Future Lake/Reservoir Visits

Section D: Visit to Elk Falls

Section E: Visit to a River

Section F: Past Visits to Campbell River Reservoir System

Section G: About You and Your Party

2.3.2 FUTURE LAKES/RESERVOIR VISITS DISCRETE CHOICE EXPERIMENT

In addition to the standard line of questioning, the survey integrated a stated preference feature (e.g., discrete choice experiment) to measure attitudes and preferences for different levels of environmental conditions.

The project uses stated preference surveys to examine decision influences by presenting respondents with hypothetical but realistic situations that may influence their choice to recreate. The project utilized a discrete choice experiment (DCE) tool to identify preferences for recreational features affected by water use operations and to gather information about public use and perceptions on recreation in the Campbell Reservoirs to inform BC Hydro's Campbell River Water Use Plan. A DCE was developed based on Upper Campbell Reservoir in Year 1, and a second DCE was developed based on Lower Campbell Reservoir in Year 4.

Choice experiment methods were chosen as they allow respondents to simultaneously evaluate different conditions one might observe in a watershed and address associated trade-offs in a comprehensive fashion. Choice experiments are used widely in resource management problems and environmental valuation settings (Adamowicz et al., 1998), as well as in limited water resource contexts (Haider and Rasid, 2002; Willis et al., 2005; Barton & Bergland, 2010; Thacher, 2011).

In 2018, the research team designed and implemented a Lower Campbell Reservoir choice experiment using the following steps:

1. <u>Adapt key recreational performance measures for application in a choice experiment</u>

This step involved the translation of performance measures to variables that can be presented to survey respondents. The project completed this task by working with technical experts, recreation groups, and through extensive testing. Initial options were reviewed and prioritized in technical focus groups and refined in recreational and non-recreational focus groups. One-on-one testing further refined the attributes in the choice experiments described in step 2.

2. <u>Design the survey instrument, including the stated preference choice sets</u>

The project utilized the prioritized list of performance measures from step 1 to develop a recreational questionnaire. The primary purpose of the questionnaire is to present the stated preference choice experiment and collect relevant data into public use and preferences for water management. Design of the questionnaire included preparing questions to collect current recreational activities, satisfaction with their recreation experiences, and preferences as well as "warm" respondents to the conditions expressed in the choice experiment. Draft surveys were pre-tested to ensure lucidity and clarity of the questionnaire and choice experiment.

Lower Campbell Reservoir Discrete Choice Experiment Design Summary

The Lower Campbell Reservoir DCE (like the Upper Campbell DCE) is a discrete choice experiment in which respondents indicate their preference for recreating in hypothetical conditions (presented as a choice set) that might be found in the Lower Campbell Reservoir.

In each choice set, each participant will select their preferred site of two site alternatives (or select 'neither') shown with systematically varied reservoir attributes. Reservoir conditions will be presented in a different way in each of the alternatives for lake level, shoreline conditions, boat ramp features, and debris. Photographic representation will represent each site and respondents will choose: 1) which of the two sites they would prefer to recreate at, or 2) if they would prefer not to recreate at either.

Within the choice experiment section of the survey, respondents are presented with the following scenario:

You will now be presented with six pairs of photos representing different hypothetical lake/reservoir conditions.

The conditions of Site A and Site B will differ in each of the following photo pairs. While some of the photos may not seem ideal, each one of them could occur under certain circumstances.

For each set of pictures please select whether you would choose to recreate in the area represented in Site A or Site B, or neither of them.

There are no right or wrong answers to these special type of research questions but it is important to regard them as real-world situations, in which the selected conditions are available to you. You will be asked to complete a total of six evaluations.

The scenario was developed based on outcomes from earlier consideration of lake/reservoir recreational values and performance measures and updated based on empirical results from the Upper Campbell DCE.

Photos were digitally manipulated from a source photo to represent the varying levels, and conditions shown in Table 4 were chosen in consultation of the above described process and are explained in the following:

Table 4. Attribute values in choice experiment

Attribute	Performance Measure	Levels
Quantity of Debris	Perception of safety	1) No Debris

		2) Little Debris 3) Average Debris 4) A lot of Debris
Water Level	Protecting Visual Aesthetic	1) Low Low 2) Low 3) Average 4) High 5) High High
Shoreline Condition	Shoreline Condition for Recreation	1) Rocky 2) Sandy
Type of Boat Ramp	Access Features	1) None 2) Gravel road 3) Concrete pad

Two design options were considered for the Lower Campbell Reservoir DCE:

A. Repeat using the same design as Upper Campbell DCE:

Given that the Lower Campbell Reservoir experiment features similar attributes as the Upper Campbell Reservoir, option 1 would utilize the same design as previously generated for the Upper Campbell DCE. This would potentially allow for attribute comparison between reservoir sites as the distribution and choice sets between Upper Campbell / Lower Campbell would match (e.g. Choice set 1 for Upper Campbell would be the same as Choice set 1 for Lower Campbell).

B. Generate New Design:

An alternative to using the existing Upper Campbell design would be to generate a new design for the Lower Campbell Reservoir.

While a new design would feature similar attributes as those found in the Upper Campbell DCE, the allocation of choice sets would differ given the random distribution of attributes presented when preparing a new choice design. This new allocation of attributes would provide a second point of validation of recreational values in the Campbell River system and therefore design option B was selected.

Final operationalization of the choice experiment was from option B using a statistical design that presented two photos in choice sets. Each choice set presents two recreational alternatives consisting of 4 elements (see Table 4). An "opt out" option was also given. Table 4 presents the photo elements as well as their levels and coding. The attributes of Quantity of Debris (4 levels), water level (5 levels), shoreline (2 levels), and boat ramp (3 levels) represents a 4x5x2x3 design with 120 possible combinations. To reduce the number of different combinations we used the SAS 9.3 experimental design macro *MktEx* to produce an orthogonal main effects fractional factorial design with minimal overlapping of attribute levels. Use of this macro reduced the number of possible combinations to 48 combinations (see Table 5), blocked into four different versions of six choice sets (2 photos per set), reported as being optimally balanced with >90% D-efficiency. Optimal designs maximize the D-efficiency, which is a criterion on the variance of the parameter estimates.

The D-efficiency of the standard fractional factorial is 100%, but it is not possible to achieve 100% D-efficiency without all variances of the attributes so reduced options are used. Anything above 80% is considered good and acceptable.

Photo book preparation

The resulting 48 combinations are represented in Table 5. To prepare the photo representation of each combination, we utilized a base photo (and a series of reference photos) from Lower Campbell Reservoir, and layered in digital representations of each level. Visual representations of water levels were prepared from historical operational levels providing a more realistic presentation of conditions but reduced visual variance between water levels. The result was a set of 48 photos numbered 1 – 48. Utilizing Adobe InDesign we prepared 4 photobooks containing photos 1-12, 13-24, 25-36, and 37-48. Photo sets were matched to Q15-Q20 in the questionnaire.

Table 5. Resulting combinations of features presented in Lower Campbell choice experiment

Photo Number	Debris Quantity	Water Level	Shoreline	Boat Ramp
1	(4)A lot of Debris	(4)High	(1) Rocks	(2) Gravel road
2	(3)Average Debris	(1)LOW LOW	(2) Sand	(3) concrete pad
3	(1)No Debris	(2)Low	(1) Rocks	(3) concrete pad
4	(2)Little Debris	(3)Average	(2) Sand	(2) Gravel road
5	(3)Average Debris	(3)Average	(1) Rocks	(3) concrete pad
6	(4)A lot of Debris	(5)HIGH HIGH	(2) Sand	(2) Gravel road
7	(2)Little Debris	(2)Low	(1) Rocks	(2) Gravel road
8	(1)No Debris	(1)LOW LOW	(2) Sand	(1) None
9	(1)No Debris	(5)HIGH HIGH	(1) Rocks	(3) concrete pad
10	(4)A lot of Debris	(4)High	(2) Sand	(1) None
11	(2)Little Debris	(5)HIGH HIGH	(2) Sand	(1) None
12	(3)Average Debris	(2)Low	(1) Rocks	(2) Gravel road
13	(1)No Debris	(2)Low	(2) Sand	(2) Gravel road
14	(4)A lot of Debris	(1)LOW LOW	(1) Rocks	(3) concrete pad
15	(2)Little Debris	(2)Low	(1) Rocks	(1) None
16	(3)Average Debris	(4)High	(2) Sand	(2) Gravel road
17	(2)Little Debris	(1)LOW LOW	(1) Rocks	(2) Gravel road
18	(1)No Debris	(3)Average	(2) Sand	(1) None
19	(4)A lot of Debris	(3)Average	(2) Sand	(3) concrete pad
20	(3)Average Debris	(4)High	(1) Rocks	(1) None
21	(1)No Debris	(4)High	(2) Sand	(3) concrete pad
22	(2)Little Debris	(5)HIGH HIGH	(1) Rocks	(1) None
23	(1)No Debris	(5)HIGH HIGH	(1) Rocks	(2) Gravel road
24	(3)Average Debris	(2)Low	(2) Sand	(1) None
25	(1)No Debris	(2)Low	(2) Sand	(2) Gravel road
26	(3)Average Debris	(4)High	(1) Rocks	(1) None
27	(4)A lot of Debris	(1)LOW LOW	(1) Rocks	(2) Gravel road
28	(1)No Debris	(5)HIGH HIGH	(2) Sand	(3) concrete pad
29	(4)A lot of Debris	(3)Average	(1) Rocks	(1) None

30	(2)Little Debris	(1)LOW LOW	(2) Sand	(2) Gravel road
31	(1)No Debris	(3)Average	(1) Rocks	(1) None
32	(3)Average Debris	(5)HIGH HIGH	(2) Sand	(3) concrete pad
33	(3)Average Debris	(3)Average	(1) Rocks	(3) concrete pad
34	(1)No Debris	(4)High	(2) Sand	(2) Gravel road
35	(2)Little Debris	(4)High	(1) Rocks	(3) concrete pad
36	(4)A lot of Debris	(1)LOW LOW	(2) Sand	(1) None
37	(2)Little Debris	(4)High	(1) Rocks	(3) concrete pad
38	(3)Average Debris	(1)LOW LOW	(2) Sand	(2) Gravel road
39	(4)A lot of Debris	(3)Average	(2) Sand	(3) concrete pad
40	(1)No Debris	(1)LOW LOW	(1) Rocks	(1) None
41	(3)Average Debris	(5)HIGH HIGH	(1) Rocks	(2) Gravel road
42	(2)Little Debris	(4)High	(2) Sand	(3) concrete pad
43	(4)A lot of Debris	(5)HIGH HIGH	(1) Rocks	(3) concrete pad
44	(2)Little Debris	(3)Average	(2) Sand	(2) Gravel road
45	(1)No Debris	(3)Average	(1) Rocks	(2) Gravel road
46	(4)A lot of Debris	(2)Low	(2) Sand	(1) None
47	(4)A lot of Debris	(1)LOW LOW	(1) Rocks	(3) concrete pad
48	(3)Average Debris	(5)HIGH HIGH	(2) Sand	(1) None

Figure 2 presents an example photo set from Book 1 of the field photo books. Site A represents conditions of *average debris*, *LOW LOW water level*, *a sandy shoreline*, and *a concrete boat ramp*. Site B represents *a lot of debris*, *high water level*, *a sandy shoreline*, and *no boat ramp*.

Figure 2. Example photo comparison for the Lower Campbell DCE

3. Data Collection

Data collection for the Lower Campbell Reservoir DCE (like the Upper Campbell Reservoir DCE) will occur through the use of the field survey. Recreationists participating in the study will be shown a blocked set of six photo pairs from the four blocked sets. For the next respondent, another block of six choice pairs are drawn, until the pool of blocked sets is exhausted; upon which another round of the photo sets would start. Respondents selected the recreation site they would most like to visit (or neither) and continued to the next set until they completed six choice sets. The full questionnaire and sampling are described in the previous section.

2.3.3 IMPACT HYPOTHESES AND SURVEY DESIGN

The survey was designed to address the impact hypotheses while also incorporating the performance measures determined at the initial stages of the study design. The impact hypotheses have been divided according to location type within the reservoir system, including: reservoirs, rivers and Elk Falls.

For Reservoirs:

$H_{0\text{-}A}$: Changes in overall satisfaction with the recreation experience at reservoirs, if they occur, are not related to reservoir operations.

We used a two-pronged approach to address the changes in overall recreation benefits as they relate to reservoir operations. The first approach for testing this hypothesis uses respondents' perceptions and opinions regarding the performance indicators as gauges for recreation benefits. Questions Q9, Q10, Q11, Q12 and Q14 in Section B: Visit to a Lake/Reservoir (Appendix B) of the survey present respondents with an opportunity to reflect on the conditions encountered and rate their experiences in relation to the performance measures. These performance measures, indicators of key elements of water management within the reservoirs, include perceptions as they relate to water levels, shoreline conditions, safety and access.

Additionally, the discrete choice experiment provides an alternative approach to addressing this hypothesis, albeit using a stated preference approach instead. The stated preference approach presents respondents with hypothetical scenarios of reservoir operations, represented by digitally altered pictures of a reservoir. Unlike the revealed preference approach which rely on respondents recounting their experience while recreating at the reservoirs and rivers, the stated preference approach, which is based on hypothetical photo scenarios, provides opportunities to explore a broad range of water management scenarios without actually having to release (or retain) water. This approach addresses practical challenges when trying to a) test the extreme ends (e.g. high high or low low) of the reservoir levels; and b) test multiple water levels with the same recreationist whereby that person can actually trade-off difference scenarios with one another. Neither of these opportunities can be practically achieved in a real-life setting. This approach presents an alternative method to determining how changes to reservoir operations may change the desire for a recreationist to visit an area. Questions Q15-Q20 in Section C: Future Lakes/Reservoir Visits provide the opportunity to evaluate changes in overall recreation benefits associated with reservoir operations using this approach.

For Rivers:

$H_{0\text{-}B}$: Changes in overall satisfaction with the recreation experience at rivers, if they occur, are not related to riverine discharge.

The approach for testing this hypothesis uses respondents' perceptions and opinions regarding the performance indicators as gauges for recreation benefits. Questions Q30, Q31, and Q32 in Section E: Visit to a River of the survey present respondents with an opportunity to reflect on the conditions encountered on rivers in the reservoir system and rate their experiences in relation to relevant performance measures. These performance measures, indicators of key elements of water management within the reservoirs, include perceptions as they relate to water flows, shoreline conditions and safety.

For Falls:

$H_{0\text{-}C}$: Changes in overall satisfaction with the recreation experience of visitors to Elk Canyon Falls is not related to riverine discharges (i.e. spill events).

The approach for testing this hypothesis uses respondents' perceptions and opinions as gauges for recreation benefits. Questions Q23 and Q24 in Section D: Visit to Elk Falls of the survey present respondents with an opportunity to reflect on the conditions encountered at the falls and rate their experiences. The proxy measures of benefits focus on satisfaction of their experience and how impressive they found the viewing experience to be.

Supporting Questions

Throughout the survey, a number of questions do not directly contribute to answering the impact hypotheses; rather, these other questions support the survey in a variety of manners. Some questions are included to guide respondents to the relevant sections of the survey. These skip logic instructions guide respondents through the questionnaire, directing respondents past sections that may not apply to them (e.g. Q5, Q21, Q25 and Q34). With the digitization of the survey in this study year, these skip logic questions automatically move respondents through the questionnaire without having to follow instructions. Other questions are included to provide opportunities to relate the respondents' answers to specific times and places (e.g. Q7, Q22 and Q27). This will allow respondents' experiences to be associated to actual BC Hydro data on reservoir/river conditions. Additional questions have been included to allow for additional segmentation and as explanatory variables, such as the activities respondents' participated in and demographic questions. Others allow for more detailed exploration of some of the perceptions of respondents, including the types of safety hazards encountered and activities that were precluded due to water conditions.

2.4 DATA ENTRY AND MANAGEMENT

The task of data entry and management is a key component of this project and required an organized database to store and manage data and facilitate statistical analyses. In previous years, data from the questionnaires and discrete choice experiment were manually entered into a common database (i.e., Microsoft Excel) by a technician, ideally as the surveys were collected. With the move away from paper surveys to a digitized survey administered using an electronic tablet in this study year, data entry was automated, occurring daily when the electronic devices were synchronized with the database at the end of each survey day. The database was examined periodically to ensure that surveys were being synchronized with the database and to highlight any potential data collection issues.

The database was designed to be easily exported to the preferred statistical analysis software packages, IBM SPSS Statistics and Latent Gold, and required appropriate variable labeling and coding of responses. Data were entered by technicians and checked by the study lead. Once all data were entered, the data were examined for outliers, protest votes and any obvious erroneous entries. Outliers were determined using an examination of box and whisker plots, a method for identifying data points that fall outside the usual range of values. A qualitative assessment was then used to determine whether to throw out the outlying data. In particular, the variables that seemed to be prone to extreme or unrealistic answers were associated with respondents recounting whether they had visited any other locations on their current trip. Based on the outliers, it is evident that some respondents were reporting visits to different locations based on completely different trips in the study area, rather than their current trip. For example, a local visitor who was visiting Elk Falls just for the day should only be answering questions related to places they visited that day. If they visited a different location in the study area a week or month before, they should not be reporting on it, as this is considered a different trip.

In general, all responses that referred to visits occurring greater than seven days in the past were removed. This approach was implemented for two reasons. First, experiences that occur in the past are prone to recall bias which can lead to recollection error. Second, this approach helps ensure that respondents were only referring to their current trip. Eight responses regarding visitor experiences at the reservoirs and four responses regarding experiences at the rivers were removed during the analysis of the management questions due potential recollection error, or due to extreme, unrealistic answers.

2.5 DATA ANALYSIS

2.5.1 BASIC QUESTIONNAIRE

Data analysis of the basic questionnaire questions focused on providing basic descriptive statistics and comparative analysis as was appropriate for the different types of data. Descriptive statistics were tabulated for each question. Categorical data was tabulated according to frequency of each potential response. Mean response, standard deviation and standard error were calculated for all questions that used interval data. All questionnaire responses are presented in Appendix A. When appropriate to the discussion of results, some data have been tabulated or presented graphically in the body of the report.

Analysis of the management questions involved identifying potential relationships between the performance indicators and the respective reservoir operations metrics. For reservoirs, correlations were examined between the indicators of safety, satisfaction and experience, and reservoir elevations; for rivers and Elk Falls, correlations were examined between indicators of satisfaction and experience, and discharge. Data for reservoir elevations and discharge were provided as daily averages by BC Hydro. The statistical tests used for investigating these relationships were determined based on the type of statistical data (e.g. interval, ordinal or categorical), the nature of the relationship (e.g. linear, monotonic or non-linear), and type of distribution (e.g. parametric or non-parametric). Results for relevant survey questions were graphed using scatterplots in relation to the average daily elevation or discharge. The variables were tested for normal distribution and the appropriate correlation test selected (e.g., Pearson product-moment correlation or Spearman rank-order correlation coefficient).

When appropriate, comparisons across the different study years have been provided. The statistical tests used for investigating any significant differences were determined based on such factors as the type of data, nature of the distribution, and the homogeneity of variance. In general, the means of interval data (e.g. length of trip) were compared across time using independent t-tests, while categorical data (e.g. satisfaction with recreational experience) was examined using Pearson Chi-Square.

2.5.2 DISCRETE CHOICE EXPERIMENT

For 2018, no analysis was completed regarding the Upper Campbell Reservoir Discrete Choice Experiment. Instead, efforts were focused on the development of a Decision Support System for Upper Campbell Reservoir using Year 2 and Year 3 results for the DCE. Typically, DCE data has been analyzed using Latent Gold 5.0 to estimate multiple multinomial logit models.

Joint analysis of Year 2-4 Upper Campbell data is still recommended to allow for further analysis of classes presented in earlier analysis. This would simply be a repeat of earlier analysis but using the full 2-4 year dataset. A latent class model relates preferences for the reservoir features in the discrete choice experiment to a set of latent variables. A class is characterized by similarities among recreationists that indicate like preference for reservoir features.

As discussed in Section 2.3.2, Study Year 4 also focused on the development of the Lower Campbell Reservoir DCE, although the implementation and integration of this new DCE were not completed in time to allow for any data collection or analysis in 2018. The intent was to gather base images from Lower Campbell Reservoir in the spring or early summer of 2018, and implementation in the summer and/or fall 2018, although this was not achievable due to unfavorable water elevations and weather conditions during the photo collection process. Base photos for the Lower Campbell Reservoir needed to be collected when water elevations were low and when weather conditions were generally sunny. Attempts were made to gather sample images in early summer, but the weather was generally overcast and water levels higher than desired. A second photo session was implemented in the fall, but this delayed the development of the Lower Campbell Reservoir DCE. The new DCE will be implemented in the winter session of Study Year 5 (2019).

2.6 POWER ANALYSIS AND REFINEMENT OF SAMPLING PLAN

A power analysis was completed by Dr. Carl Schwarz using data from Year 2 and Year 3 to help provide further direction regarding the necessary sampling effort to avoid a Type II error. A Type II error is the probability of accepting the null hypothesis when we actually should have rejected it. In this study, a Type II error would mean we concluded that there was no relationship between a performance measure and water elevation/flow when in fact there was. The standard target power of 0.80 was used.

A couple conclusions were drawn based on a review of the data and the power analysis. First, a review of the data suggests that the current approach to data analyses (i.e., correlational analysis), while being the conventional method, may not be the most appropriate approach. Correlational analysis, as utilized in this study, accounts for variation between person-to-person in their satisfaction scores at a particular day (and water level). However, an additional source of variation may be associated with day-specific effects, and not solely associated with water level. These day-specific effects could be related to external factors such as weather or season. A more sophisticated and appropriate approach to analysis would be the application of a linear mixed model (pers. comm., Dr. C. Schwarz, April 12, 2018). Linear mixed models can be considered for future years of data analyses.

Power analyses were completed for each management question at each location with available hydrometric data. This included Upper Campbell Reservoir, Lower Campbell Reservoir and Buttle Lake, Campbell River and Quinsam River, and Elk Falls. To determine the amount of sampling effort required to achieve a power of 0.80, a range of total number of respondents and total number of sampling days were considered while using the trends observed (from Year 2 and Year 3) for each management question. The number of respondents tested ranged from 500 to 1500 at each location, while the total number of sampling days tested ranged from 20 to 60 days at each location. The analyses assumed that number of sampling days were allocated as evenly as possible across the full range of water elevation/flow conditions experienced at each location. For the power analysis, water conditions were grouped into periods of low, medium and high. For example, for Buttle Lake, while testing the power that is achievable using 20 days of sampling, the model would assume that 7 days were allocated to low water level periods, 7 days were allocated to high water levels and 6 were allocated to medium water levels).

Following evaluations of the data by Dr. Carl Schwarz using the results from linear mixed models for each management question and location, it was determined that a target power of 0.80 is not achievable regardless of the total number of interviews or sample days for the reservoir management questions. The evaluation identified that responses at the reservoirs were characterized by large day effects, resulting in a lot of variation. Several models were investigated to try and explain the large day-specific variation, including weather and season, but none improved the fit of the model.

In regard to the riverine management questions, it is not possible to reach a power of 0.80 with only 20 days of sampling at each river location. Forty (40) days of sampling and over approximately 900 respondents at each riverine location would be required to achieve a power of 0.80 in the evaluation of most riverine management questions. Two exceptions were noted for the riverine management questions (i.e. Q30 – Perceptions of River Safety at Quinsam River and Q32 – Influence of River Flow at Campbell River), where a power of 0.80 is not achievable regardless of the total number of interviews or sample days. Similar to the reservoirs, day-specific effects were too large to achieve the desired power, and these effects could not be explained by attributes such as weather and season.

Lastly, the power analyses for the management questions associated with water flows and Elk Falls were also evaluated for required sampling days and total respondents. Q23 (i.e., Impressiveness of Falls) could achieve a power of 0.80 with 500 respondents and 20 days of sampling split across the range of flow conditions. Q24 (i.e. Satisfaction with Experience at Falls) is estimated as requiring at least 40 days of sampling split evenly across water flow levels and 500 respondents to achieve this power.

Based on these findings, the level of sampling required to achieve the desired power of 0.80 will be either very difficult or impossible to implement. In the case of all reservoir-related management questions and some riverine management questions, the high day-effects coupled with the low effect of water conditions on the performance measures, makes achieving the power prohibitive regardless of the number of sampling days or number of respondents. In the cases where the power may be attainable with enough sampling effort, we are also faced with logistical and operational obstacles. These include: limitations to budget to increase number of sampling days, seasonal closures of parks and recreational sites that prevent sampling during the highest and lowest water conditions, and the conflict of coordinating sampling efforts across different location types and varying water levels (e.g. when it is optimal timing based on water flows to sample at river sites, it may not be optimal timing to sample at reservoir sites).

In our best effort to address these short-comings, sampling for 2018 utilized predictions of reservoir elevations provided by BC Hydro to time surveying to high, medium and low conditions. Sampling, however, was still limited to the operational season of the parks and recreation areas. The provincial campsites and recreation sites generally open April or May, and close in mid-September to October. To increase the number of days, sampling at each location was split into half-days, so that the same amount of sampling effort at each location could be spread across more days.

3 RESULTS

3.1 GENERAL

Over the course of 2018, a total of 2645 people were asked if they would complete the survey. Of those, 2086 individuals did not want to participate in the survey. Many individuals reported that they had completed the survey in the past year (274), while most did not provide a rationale for not participating. In total, 548 people agreed to complete the survey, which represents a response rate of 21%. This represents a drop in the number of participants in the study over the previous study periods. Across the study year, summer had the highest number of responses (n=247), followed by spring (n=263) (Figure 3). The timing of the survey was developed to coincide with the recreation season and encourage capturing a wide range of water elevation/flow conditions as possible.

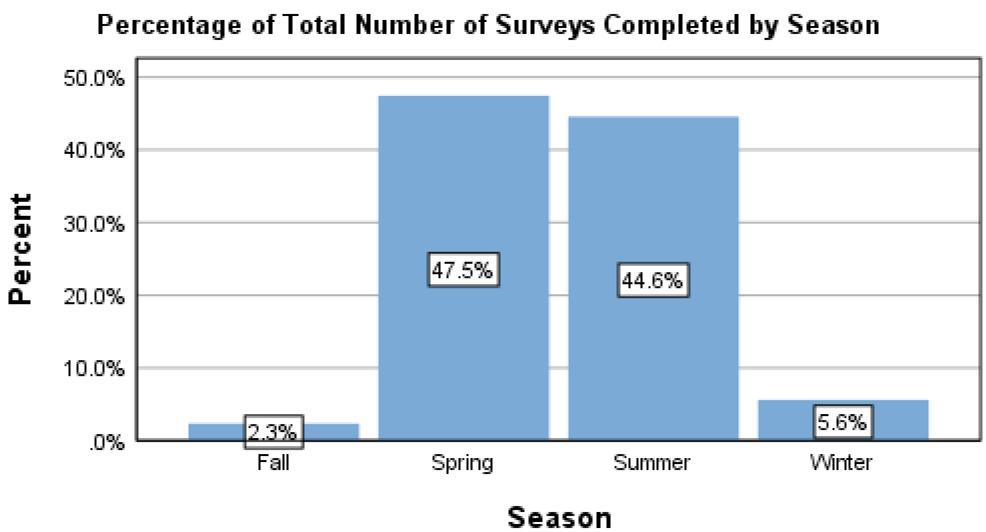


Figure 3. Percentage of the total number of questionnaires completed by season (n=554)

Surveys were focused on eight locations across the study area. A new sampling location was added at Strathcona Lodge on Upper Campbell Reservoir. This location replaced McIvor Lake after the first sampling period (March 8-27, 2018) of the year. McIvor Lake was removed from sampling as this lake lacks hydrometric data and therefore can not be included in the analyses of the management questions. It was replaced with a site on Upper Campbell Reservoir for which hydrometric data are available.

Quinsam Camp (Elk Falls Provincial Park campsite) had the highest number of survey responses (n=126). This location is close to Campbell River, receives both overnight and day users, is adjacent to an extensive trail system, and is open year-round. The areas with the second highest survey responses is Elk Falls Lookout, which is also close to town, open year-round and a popular area for walking for both locals and visitors.

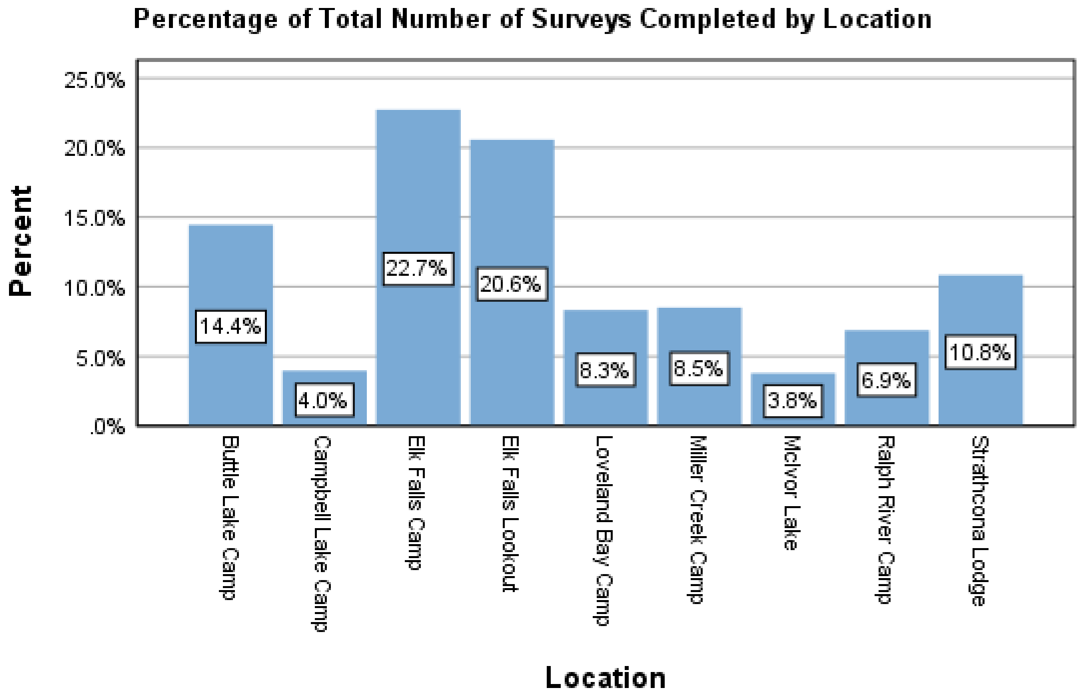


Figure 4. Percent of survey responses according to sample location (n=554)

The average trip length spent in the Campbell River reservoir system by respondents was 3.94 days (n=531, s=3.415), with a median of 3 and mode of 1 day. A Mann-Whitney U test was used to examine differences in trip length between study years because trip lengths were non-parametrically distributed. Average trip length was not significantly different between Year 3 and Year 4 (U=256100, p=0.426). Average trip length in Year 2, however, was significantly lower than both Year 3 (U=702003, p=0.000) and Year 4 (U=388896, p=0.000), with an average trip length was 3.05 days (n=1830, s=3.693). This difference is largely explained by the reduced response rate at Elk Falls which is comprised largely of day visitors and who overwhelmingly dominated the responses in Year 2.

In Year 4, 35.4% of respondents reported being day visitors only, meaning they could be residents or visitors who just were passing through for the day. The proportion of day visitors has fluctuated over the course of the study, largely explained by decreased sampling effort at popular day use areas such as Elk Falls Lookout and McIvor Lake.

The most popular form of accommodation for those staying in the area was trailer (36.8%), followed by tent (24.8%). Camping was most frequently noted (47.1%) as the most important activity in respondents' decision to visit the Campbell River reservoir system, followed by hiking and walking in the area (15.5%).

Most respondents (69.1%) reported visiting the study area before while 30.9% were visiting for the first time. Of those who had visited the area before, the highest frequency of visits was reported in the summer; 80.6% of respondents who had visited the Campbell River reservoir system before reported visiting for 4 days or more on average annually in the summer.

The frequencies for all survey questions are summarized in the appendices. In addition, the following sections examine those survey questions that specifically address the management hypotheses for this project.

3.2 MANAGEMENT HYPOTHESIS – LAKES/RESERVOIRS

The management hypothesis for lakes/reservoirs in the Campbell River reservoir systems is stated as:

$H_{0\text{-}A}$: Changes in overall satisfaction with the recreation experience at reservoirs, if they occur, are not related to reservoir operations.

We tested this hypothesis by comparing perceptions of safety, satisfaction and experience with average daily water elevations at three reservoirs: Buttle Lake, Upper Campbell Reservoir and Lower Campbell Reservoir. Responses to Questions Q9, Q11, Q12 and Q14 in Section B: Visit to a Lake/Reservoir (Appendix B) of the survey were graphed using scatterplots in relation to the average daily elevation.

Correlations between water elevations and the various performance measures were tested using the Spearman's rank-order correlation coefficient (Spearman's correlation, for short). Spearman's correlation is a non-parametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale. Unlike Pearson product-moment correlation, variables in the Spearman's correlation can be ordinal, as well as interval or ratio. Spearman's correlation also assumes that there is a monotonic relationship between the two variables. A monotonic relationship is when either the variables increase in value together, or as one variable value increases, the other variable value decreases. The scatterplots show this general trend.

3.2.1 WATER ELEVATION OF RESERVOIRS

Water levels, measured as daily average elevation in metres, were gathered from BC Hydro Generation Operations. Water levels were only available for three reservoirs in the study area: Buttle Lake, Lower Campbell Reservoir and Upper Campbell Reservoir. Analyses were completed separately for each reservoir as differences in operational water levels (e.g., maximum reservoir elevation) and topography prevent direct comparisons between reservoirs. A summary of water elevations from the BC Hydro data set are provided in Table 6.

Using monitoring data attained through BC Hydro, the mean daily average elevations for Year 4 of the study were 217.08 m for Buttle Lake, 217.07 m for Upper Campbell Reservoir, and 176.87 m for Lower Campbell Reservoir. Buttle Lake and Upper Campbell Reservoir are expected to share similar water elevations due to their direct connectivity.

Table 6. Summary of water elevation data (in meters) for reservoirs in Year 4 (Jan 2018-Dec 2018)

	Upper Campbell Reservoir (meters)	Buttle Lake (meters)	Lower Campbell Reservoir (meters)
Mean	217.08	217.07	176.87
Median	216.99	216.96	176.67
Std. Deviation	1.272	1.260	0.547
Variance	1.617	1.589	0.299
Minimum	214.72	214.90	175.91
Maximum	220.05	220.04	177.74

Water elevations measured throughout the year were compared to those water elevations encountered during the sampling at each reservoir to identify how representative sampling was of the true range of water elevations. As water elevation data was not normally distributed, a One-Sample Wilcoxon Signed Rank Test was used to determine if the median daily water elevations that were encountered during sampling were the same as those observed for the entire year. No significant difference in median water elevation was observed between the times sampled and actual water elevations for Buttle Lake (n=98, p=0.150) and Upper Campbell Reservoir (n=35, p=0.231), although a significant difference in median water elevation between sampling and actual elevations was observed for Lower Campbell Reservoir (n=96, p=0.000), with sampling having a slightly lower median than the actual elevation range.

3.2.2 INFLUENCE OF WATER LEVEL ON RECREATION EXPERIENCE

In Question 9 of the survey, respondents were asked to rate how water levels influenced their recreation experience at the time of their visit on a scale of 1 to 5 (with 1 being "very negative" and 5 being "very positive"). During the 2018 (Year 4) study period, over 60% of all respondents reported that water levels at the time of their visit had either a "somewhat positive" or "very positive" influence on their recreation experience at the reservoir, while only 9.5% of respondents reported that water levels had a "somewhat negative" or "very negative" influence on their recreation experience (Figure 5).

The proportion of responses, pooled from all locations, were significantly different (Pearson's χ^2=59.768, df=8, p=0.000) between years. A post-hoc pairwise comparison of each category (using the Bonferroni correction) was used to identify what these differences were. A pairwise comparison determined that, in particular, respondents in Year 2 had a significantly greater proportion of "very negative" responses compared to other years (Z=6.47, df=1, p=0.000) and a significantly lower proportion of "very positive" responses (Z=-3.92, df=1, p=0.000). Respondents in Year 3 had a significantly lower proportion of "very negative" responses (Z=-4.98, df=1, p=0.000) compared to other study years.

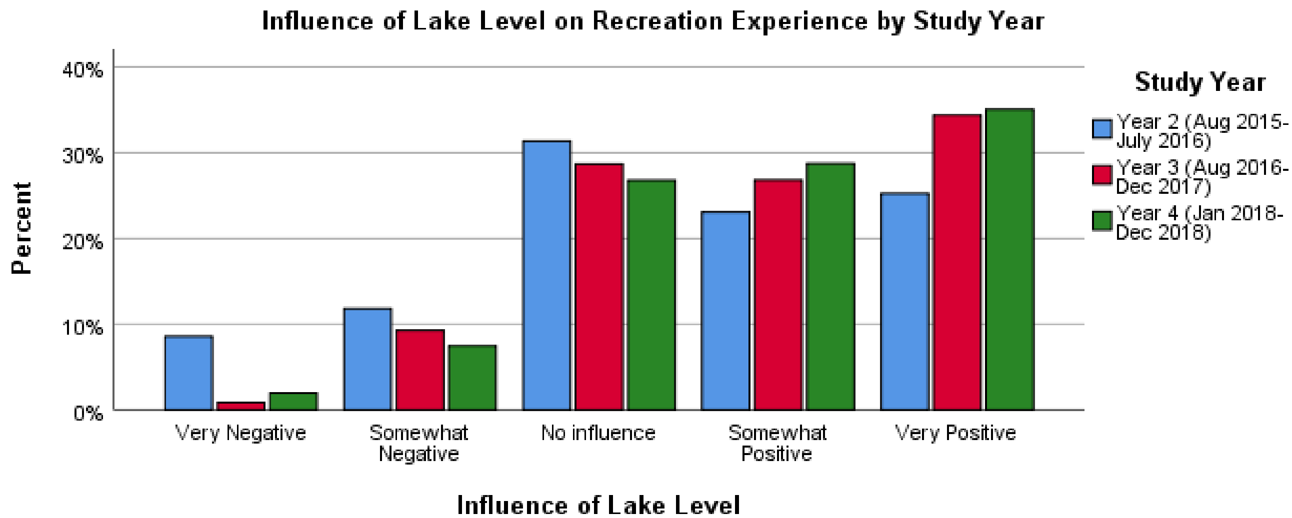


Figure 5. Frequency of responses for influence of water level on recreation experience at reservoirs (n=1465)

Scatterplots were developed to depict the influence of water levels on respondents' recreation experience in relation to daily average water elevation for the reservoirs for Year 4 (see Figure 6, Figure 7 and Figure 8). No strong trends are evident at the three reservoirs where lake elevations are available. A Spearman's rank-order correlation was run to examine this relationship. No significant correlations were identified between influence on recreation experience and water levels for any of the three reservoirs with elevation data available.

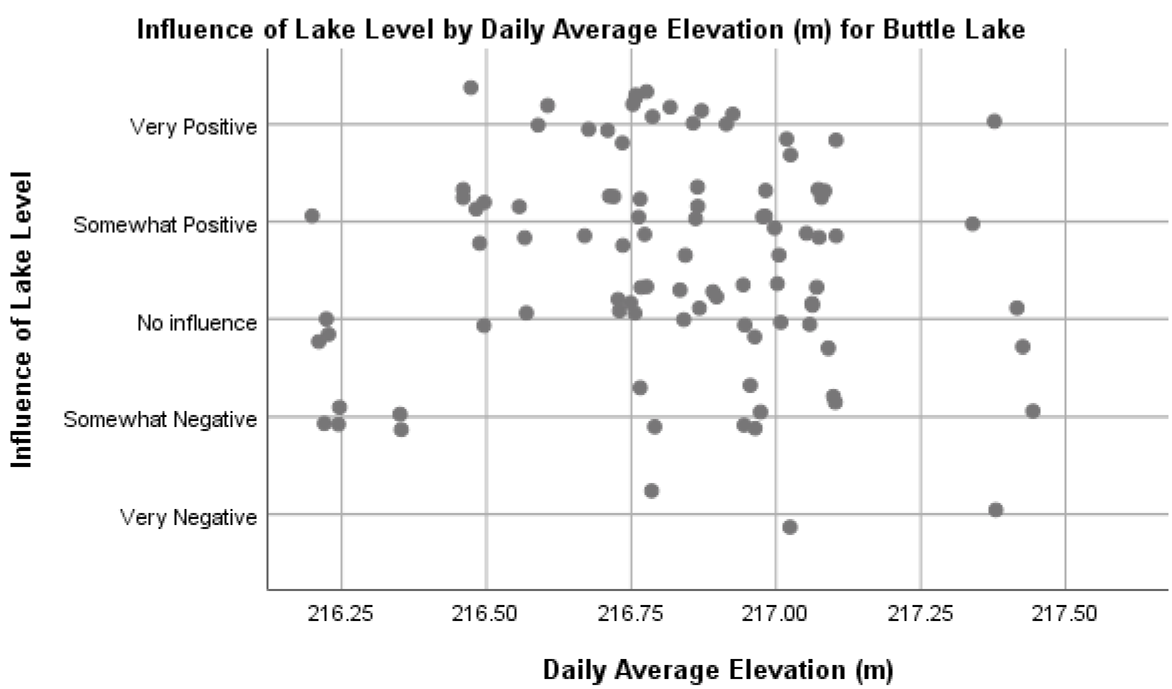


Figure 6. Influence of water level on recreation experience in relation to average daily water level for Buttle Lake (n=101)

In Year 2 of the study (i.e., the first year of data collection), a positive correlation was identified between recreation experience and water levels for Buttle Lake. Based on the data from Year 2, respondents at Buttle Lake associated decreases in water elevation with more negative recreational experiences. Neither Lower Campbell nor Upper Campbell Reservoirs resulted in a significant correlation. Very low water levels were not encountered during Study Years 3 and 4 as they were in Year 2, which may explain the change in significance.

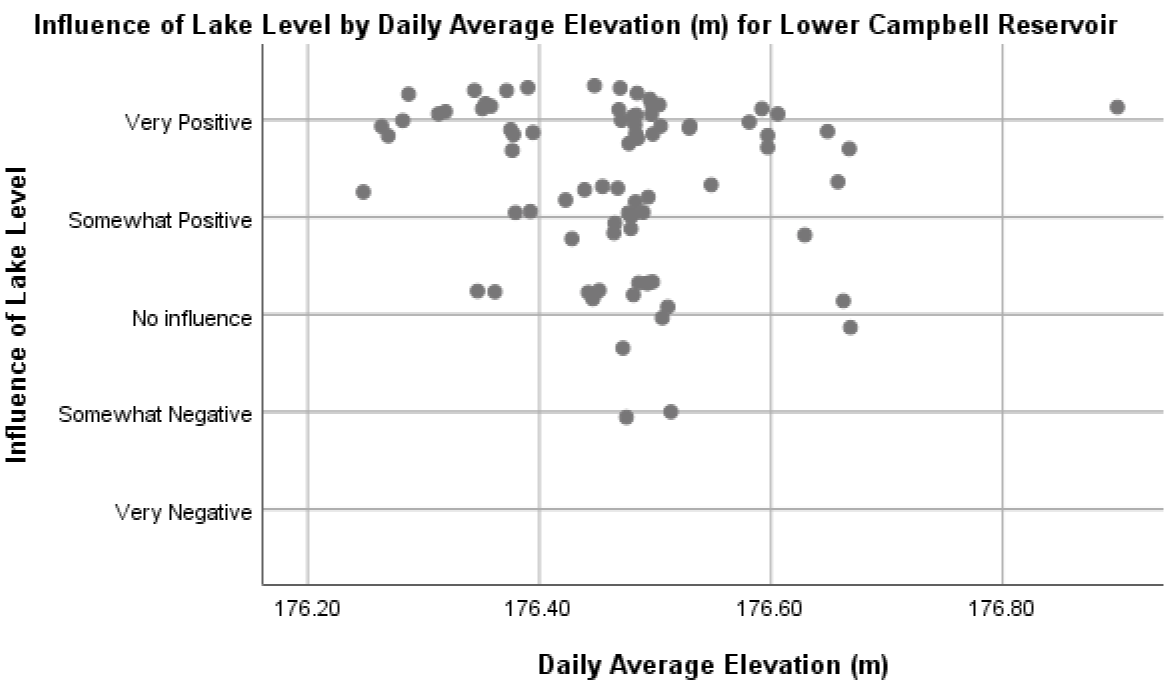


Figure 7. Influence of water level on recreation experience in relation to average daily water level for Lower Campbell Reservoir (n=83)

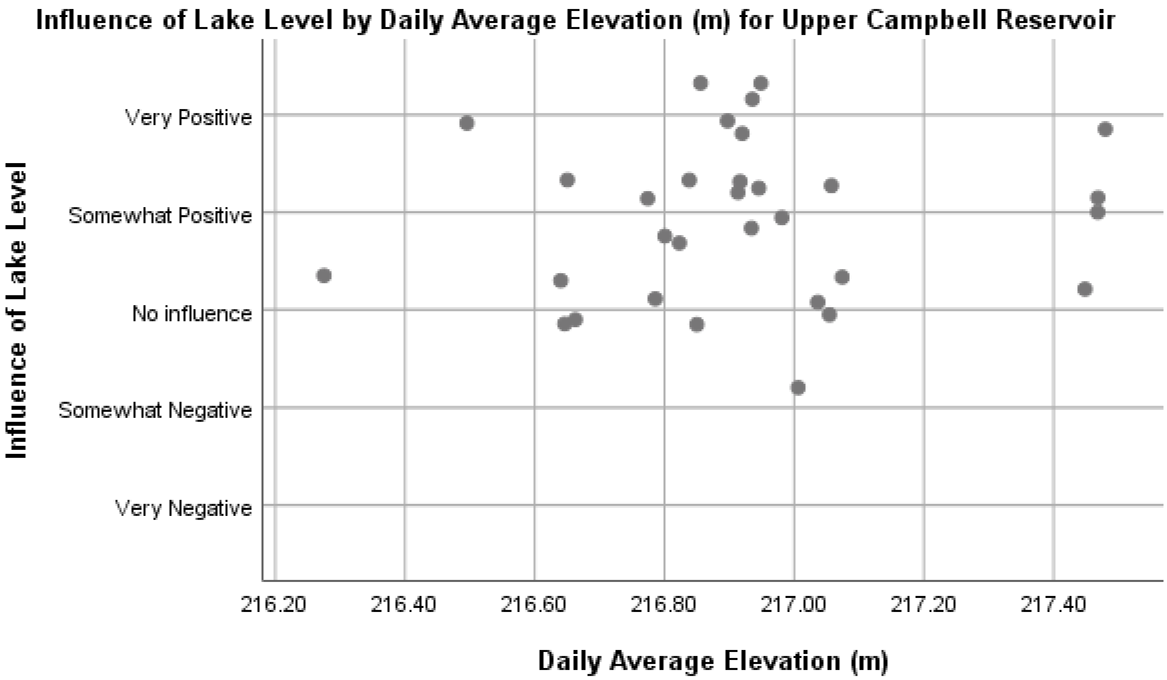


Figure 8. Influence of water level on recreation experience in relation to average daily water level for Upper Campbell Reservoir (n=32)

3.2.3 SATISFACTION WITH SHORELINE CONDITIONS

In Question 11, respondents were asked to rate how satisfied they were with shoreline conditions while engaged in water-based recreation at the time of their visit on a scale of 1 to 5 (with 1 being "very dissatisfied" and 5 being "very satisfied"). Respondents were generally satisfied with shoreline conditions at the reservoirs, with the majority (62.9%) of respondents reporting that they were either "somewhat satisfied" or "very satisfied" (Figure 9). The responses were significantly different (Pearson's χ^2=71.659, df=8, p=0.000) between years. A pairwise comparison of each category using the Bonferroni correction identified several significant differences across the years. In Year 2, we observed a significantly disproportionate level of respondents being "very dissatisfied" with shoreline condition (Z=5.7, df=1, p=0.000), followed by a significant drop in respondents reporting being "very dissatisfied" in Year 3 (Z=-4.2, df=1, p=0.000). Other significant differences are noted in this current year, Year 4, where a greater proportion of respondents responded that they were "neither satisfied or dissatisfied" (Z=5.5, df=1, p=0.000) and a significant drop in the number of respondents who reported being "very satisfied" with shoreline conditions (Z=-3.0, df=1, p=0.003). The proportion of respondents replying they were "somewhat dissatisfied" or "very dissatisfied" continued to be similar to previous years.

This apparent change in respondents who were "very satisfied" was further examined with the anticipation that it may have been related to the introduction of Strathcona Lodge on Upper Campbell Reservoir as a new survey location, but a similar shift was also observed at Buttle Lake. Other explanatory factors were not explored, although other possibilities could include a change in shoreline conditions experienced by respondents (although unlikely), a change in the population sample (e.g., a growing segment of visitors who may no longer be participating due to survey fatigue) or change in response associated with visitors completing the survey on a different medium (i.e., on an e-tablet).

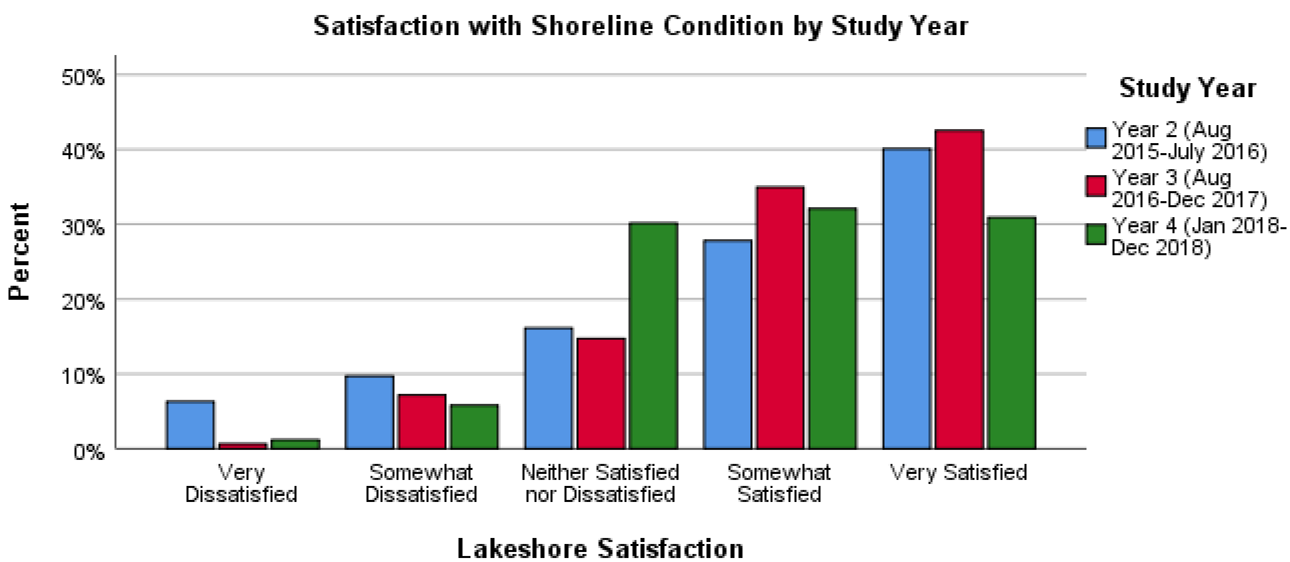


Figure 9. Frequency of responses for satisfaction with shoreline conditions at reservoirs by study year (n=1465)

Scatterplots were developed to depict the satisfaction with shoreline conditions in relation to daily average water elevation for the reservoirs (see Figure 10, Figure 11 and Figure 12). No strong trends were evident in the scatterplots at Buttle Lake, Lower Campbell Reservoir or Upper Campbell Reservoirs for Year 4. Similar to Year 3 of the study, a Spearman's rank-order correlation was run to examine any potential relationships, but no significant relationships were detected.

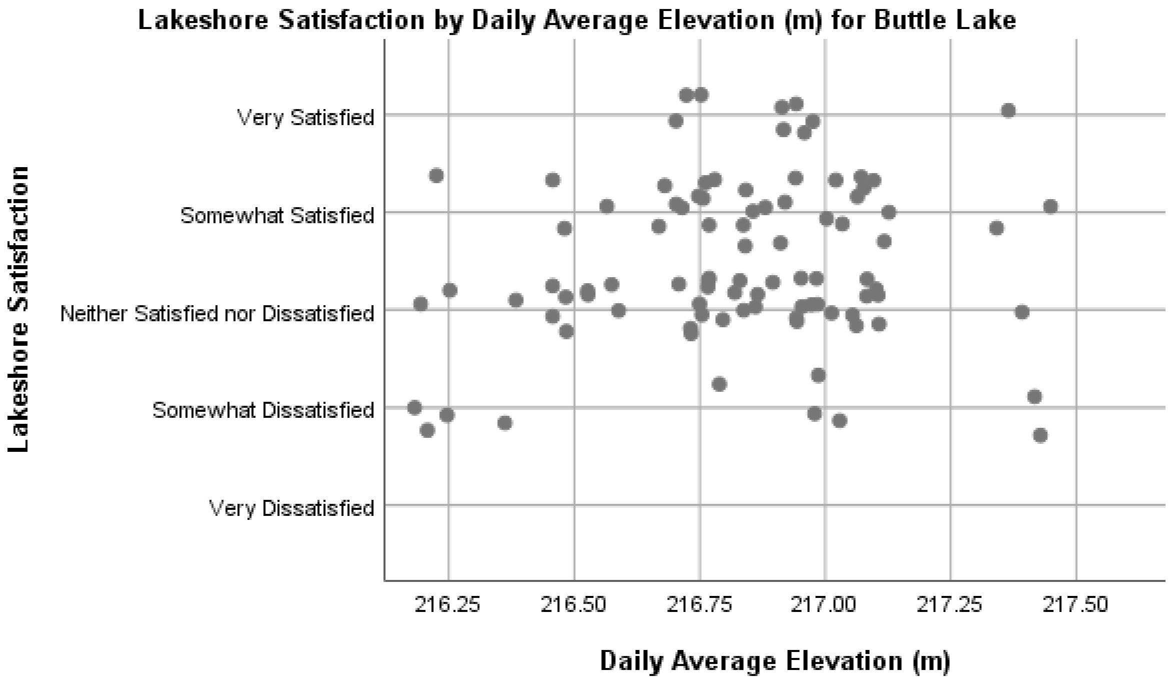


Figure 10. Satisfaction with shoreline conditions in relation to daily average water level for Buttle Lake (n=98)

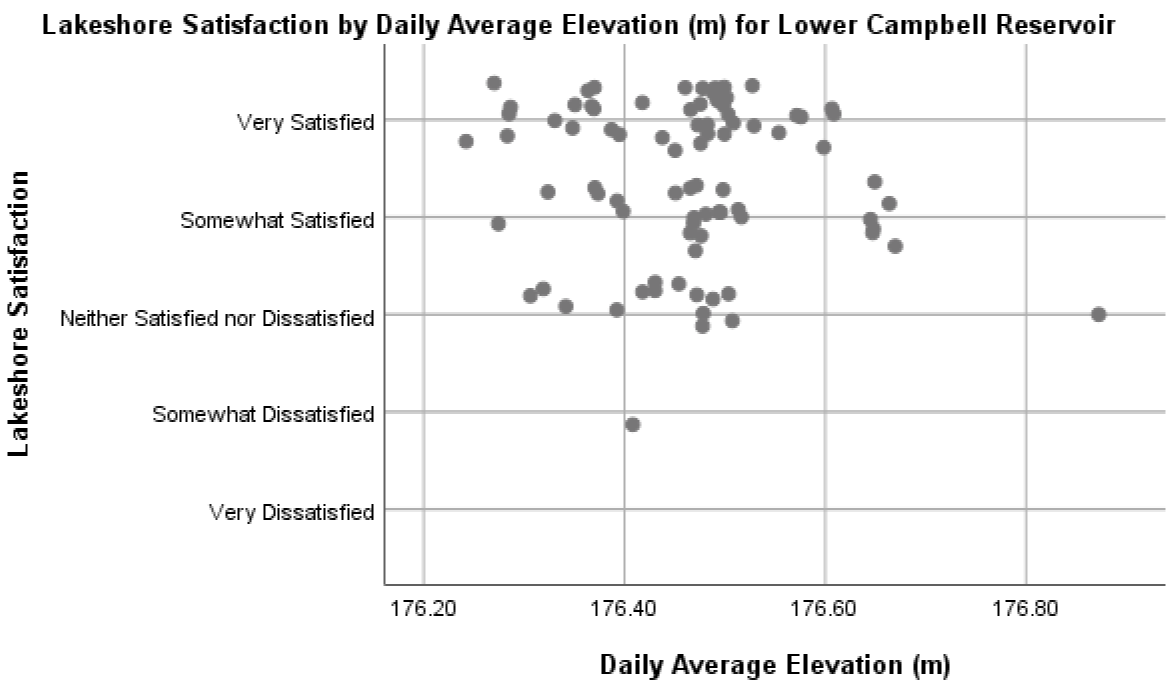


Figure 11. Satisfaction with shoreline conditions in relation to daily average water level for Lower Campbell Reservoir (n=88)

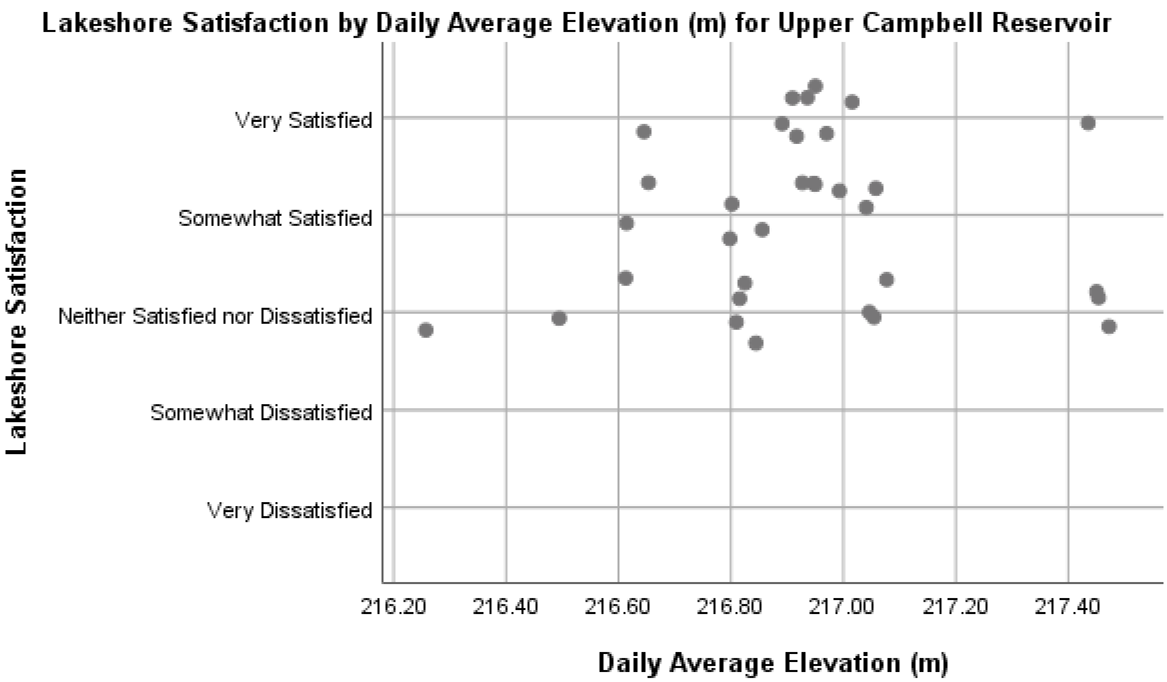


Figure 12. Satisfaction with shoreline conditions in relation to daily average water level for Upper Campbell Reservoir (n=34)

3.2.4 PERCEPTION OF SAFETY

Question 12 asked respondents to rate how safe they felt engaging in water-based activities on a scale of 1 to 5 (with 1 being “very unsafe” and 5 being “very safe”) given water levels at the time of their visit. The majority of respondents (36.0%) reported feeling “very safe” while recreating at a reservoir within the Campbell Reservoir system, while another 32.2% of respondents reported feeling “somewhat safe” (Figure 13).

The distributions of responses were compared between all study years, and a significant difference in distributions was detected (Pearson's χ^2=49.088, df=8, p=0.000). A pairwise comparison of each category using the Bonferroni correction identified several significant differences across the years. Significantly fewer respondents reported feeling “very safe” in Year 4 than in previous years (Z=-4.2, df=1, p=0.000). Similarly, in Year 4, a greater proportion of visitors in reported that they felt “neither safe nor unsafe” while recreating in the area. There was no significant change in the proportion of respondents who reported feeling unsafe however.

In an effort to explain this shift, the responses were examined according to location, with the thought that perhaps the difference could be explained by the addition of Strathcona Lodge on Upper Campbell Reservoir, but the same shift was observed at Buttle Lake as well. Lower Campbell Reservoir continued to have a high proportion of respondents reporting being “somewhat safe” and “very safe”. Other explanations were not investigated in detail but could be related to a change in the population sample, or an unidentified change in site conditions.

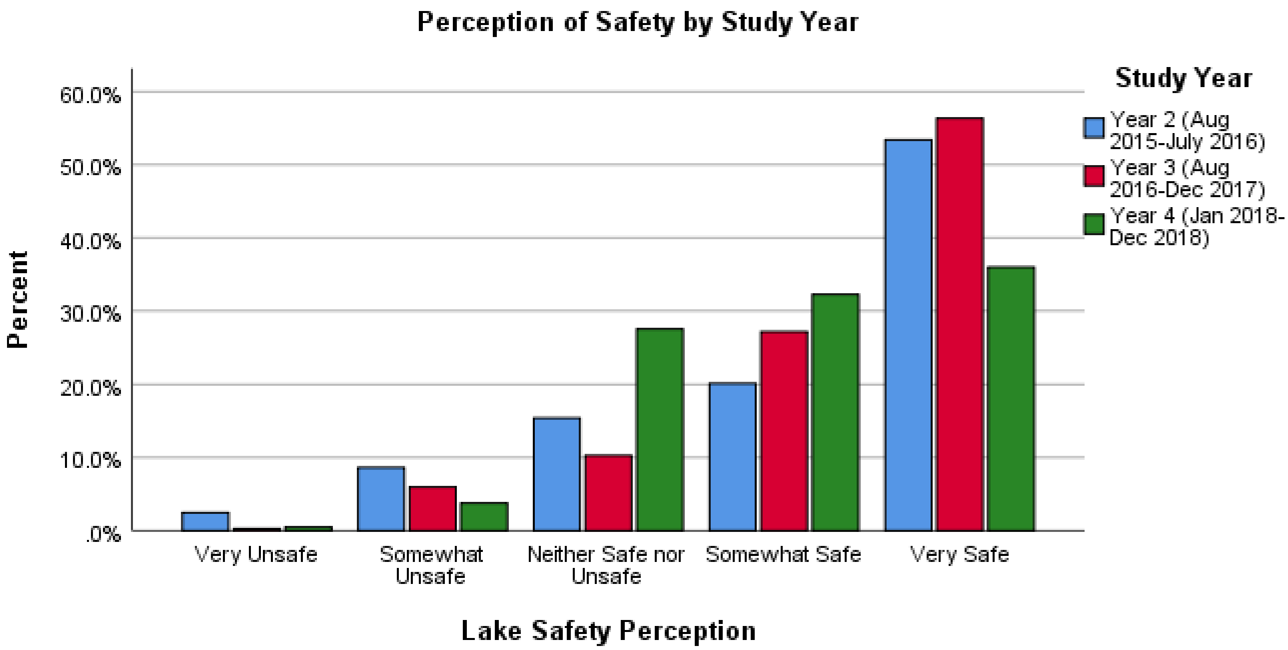


Figure 13. Frequency of responses for perception of safety while recreating at reservoirs by study year (n=1469)

Scatterplots were developed to depict respondents' perception of safety in relation to daily average water elevation for the reservoirs (see Figure 14, Figure 15 and Figure 16). A Spearman's rank-order correlation was used to examine any potential relationship between perceptions of safety and daily average elevations at the three reservoirs, but no significant relationships were identified (Figure 14). In Year 2, a weak but significant correlation between perceptions of safety and water levels was observed for Buttle Lake (n=199, r_s=0.374, p=0.000), although this was not detected in Year 3 or Year 4.

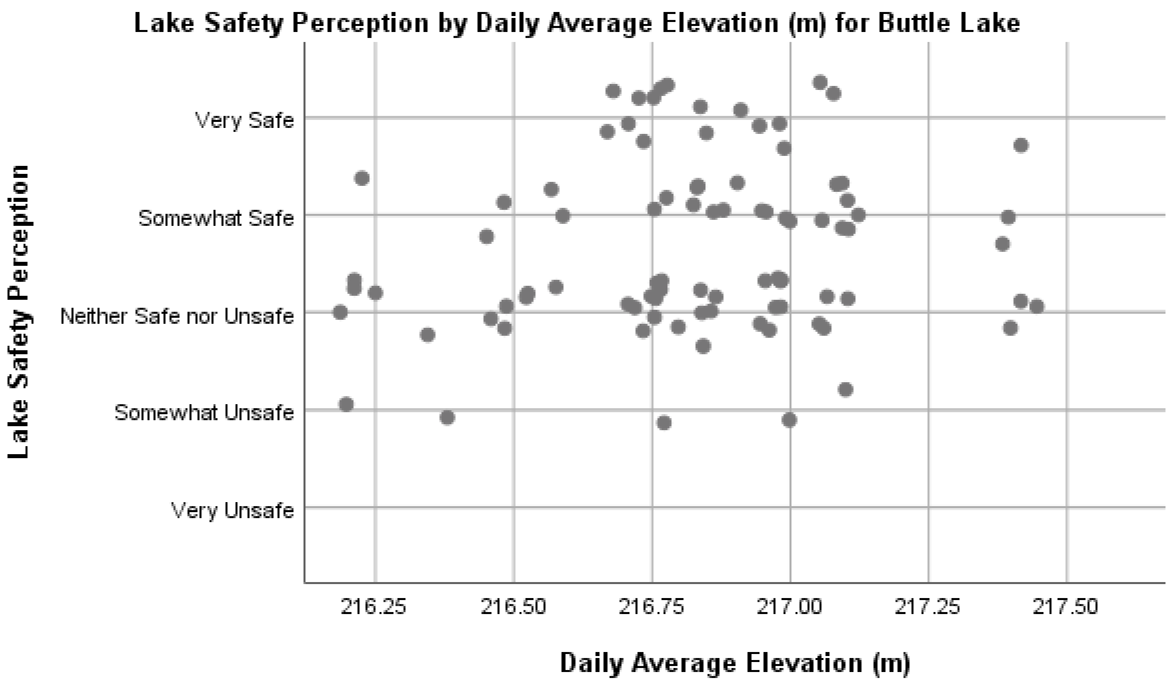


Figure 14. Perception of safety in relation to daily average water level for Buttle Lake (n=94)

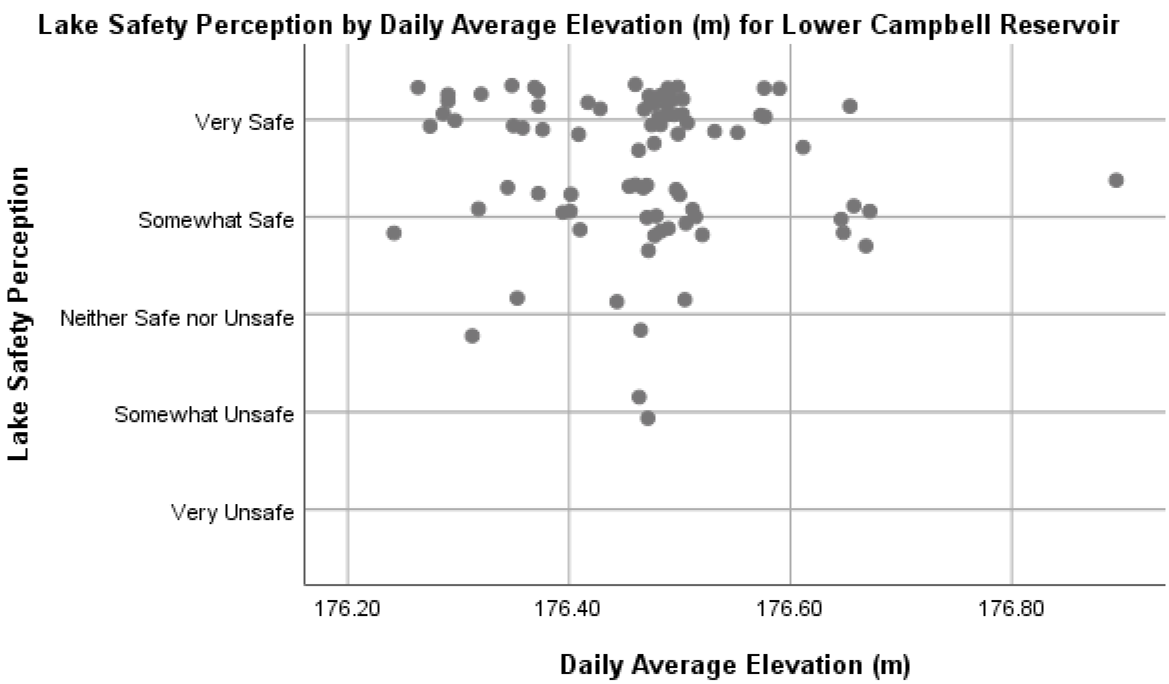


Figure 15. Perception of safety in relation to daily average water level for Lower Campbell Reservoir (n=86)

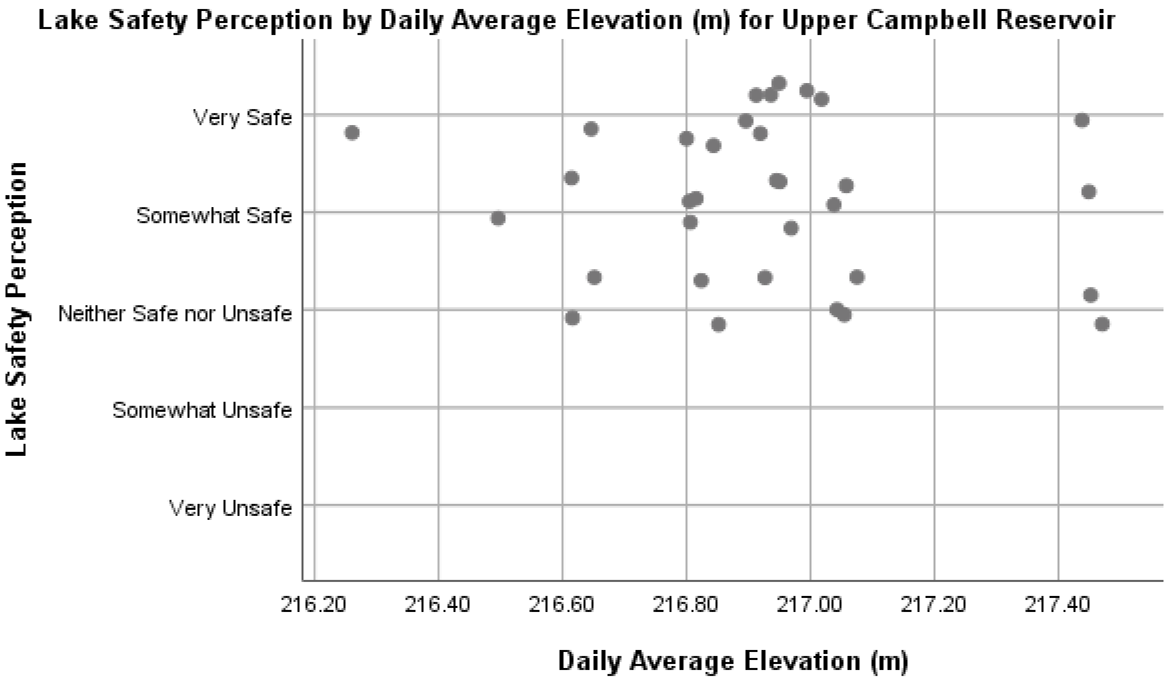


Figure 16. Perception of safety in relation to daily average water level for Upper Campbell Reservoir (n=34)

3.2.5 SATISFACTION WITH ACCESS

Question 14 of the survey asked respondents to rate how satisfied they were with access to the reservoir on a scale of 1 to 5 (with 1 being "very dissatisfied" and 5 being "very satisfied") at the time of their visit. Three options for access were rated, including access to beach, access to the water via a boat launch, and access to the water via the shoreline.

3.2.5.1 Access to Beach

Collectively, the majority of respondents at reservoirs (60.7%) were either "very satisfied" or "somewhat satisfied" with access to the beach (Figure 17). The proportion of responses are significantly different (Pearson's χ^2=46.052, df=10, p=0.000) across years. Using a pairwise comparison of each category, several significant differences were noted across the years. The proportion of respondents reporting being "very dissatisfied" varies significantly, particularly in Year 2, where a greater proportion of respondents reported being "very dissatisfied" (Z=4.4, df=1, p=0.000), and in Year 3, where a lower proportion of respondents reported being "very dissatisfied" (Z=-3.9, df=1, p=0.000). In Year 4, we also observed a significant drop in the proportion of respondents who reported being "very satisfied" (Z=-3.6, df=1, p=0.000).

These changes were further examined by examining the responses according to sampling location to see if that the responses were influenced by the addition of Strathcona Lodge on Upper Campbell Reservoir. This did not appear to explain the changes, as Buttle Lake had a greater proportion of individuals replying that they were "somewhat dissatisfied" with access to the beach, where as respondents at Upper Campbell

Reservoir simply had a greater proportion of individuals responding that this simply was "not applicable". Other explanations were not explored although these might include a change in access to the beach at Buttle Lake, or simply a shift in the sample population.

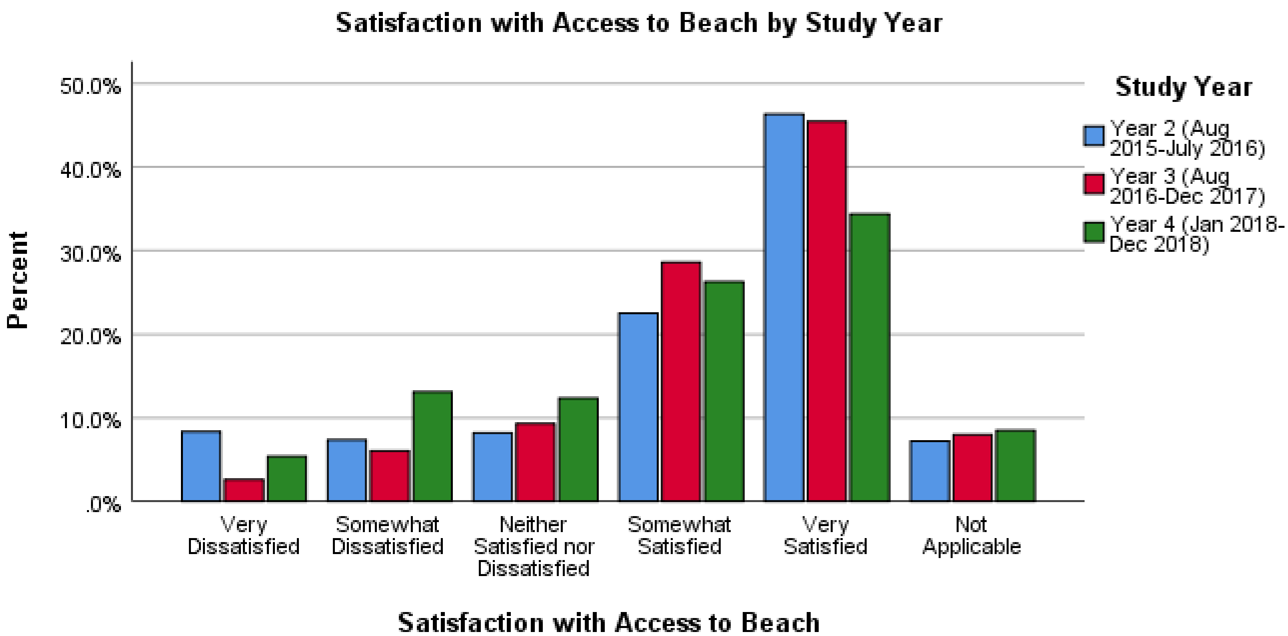


Figure 17. Satisfaction with access at reservoirs to beach for all respondents (n=1060)

Scatterplots were developed for Buttle Lake, Upper Campbell and Lower Campbell to depict satisfaction with access to the beach in relation to daily average water elevation for the reservoirs (see

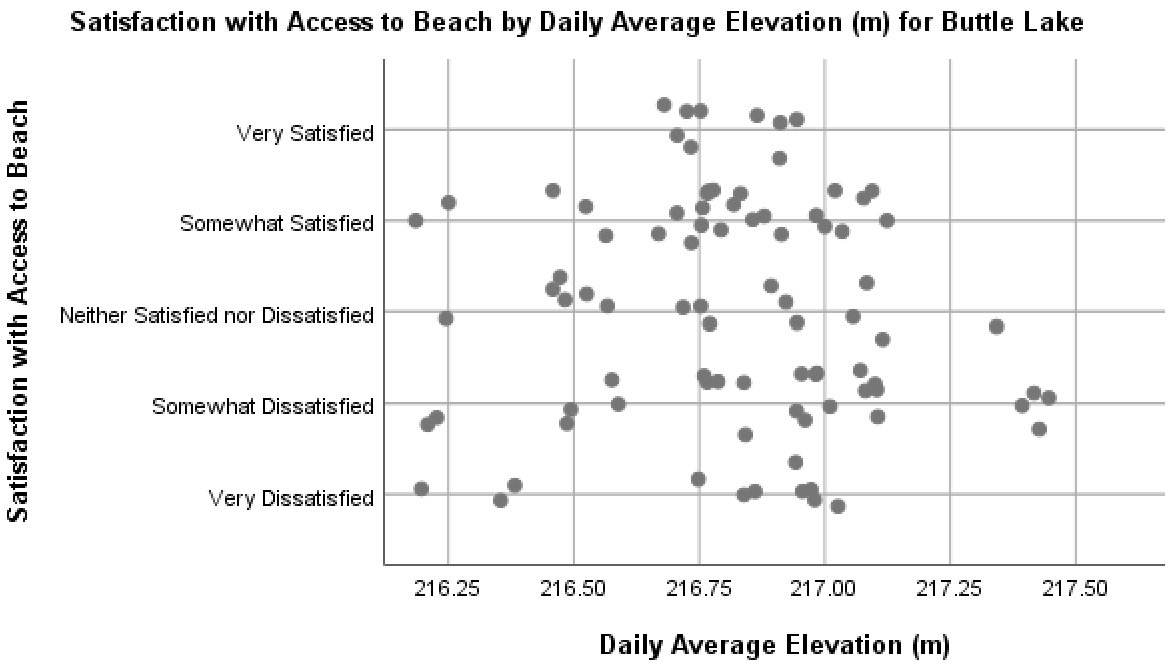


Figure 18, Figure 19 and Figure 20). No significant correlation was identified between satisfaction with beach access and water levels at any of the three reservoirs at the 95% confidence level in this study year. In Year 2, a significant relationship between satisfaction with beach access and water levels was identified at Buttle Lake (n=183, r_s=0.553, p=0.000).

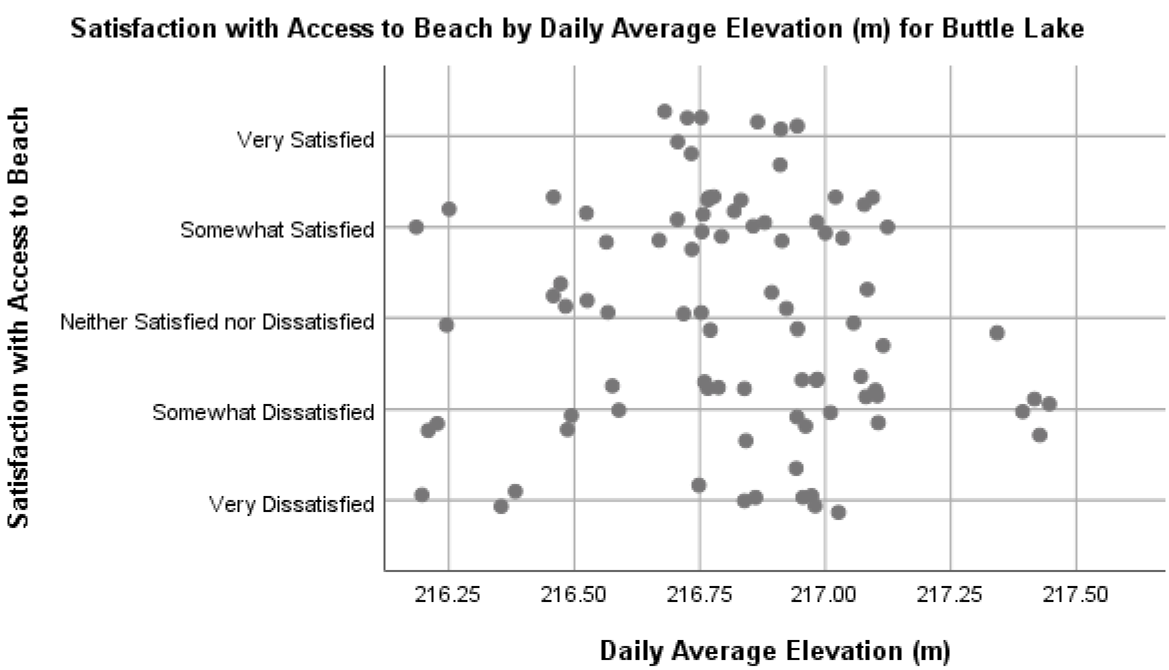


Figure 18. Satisfaction with access to the beach in relation to daily average water level for Buttle Lake (n=98)

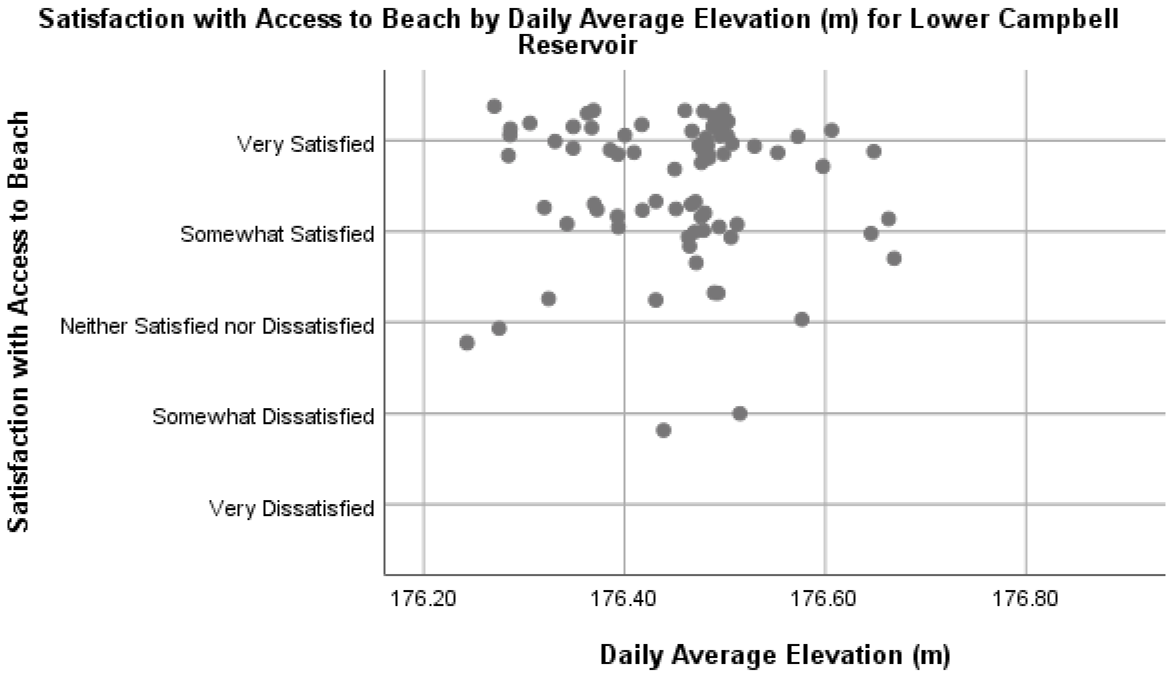


Figure 19. Satisfaction with access to the beach in relation to daily average water level for Lower Campbell Reservoir (n=88)

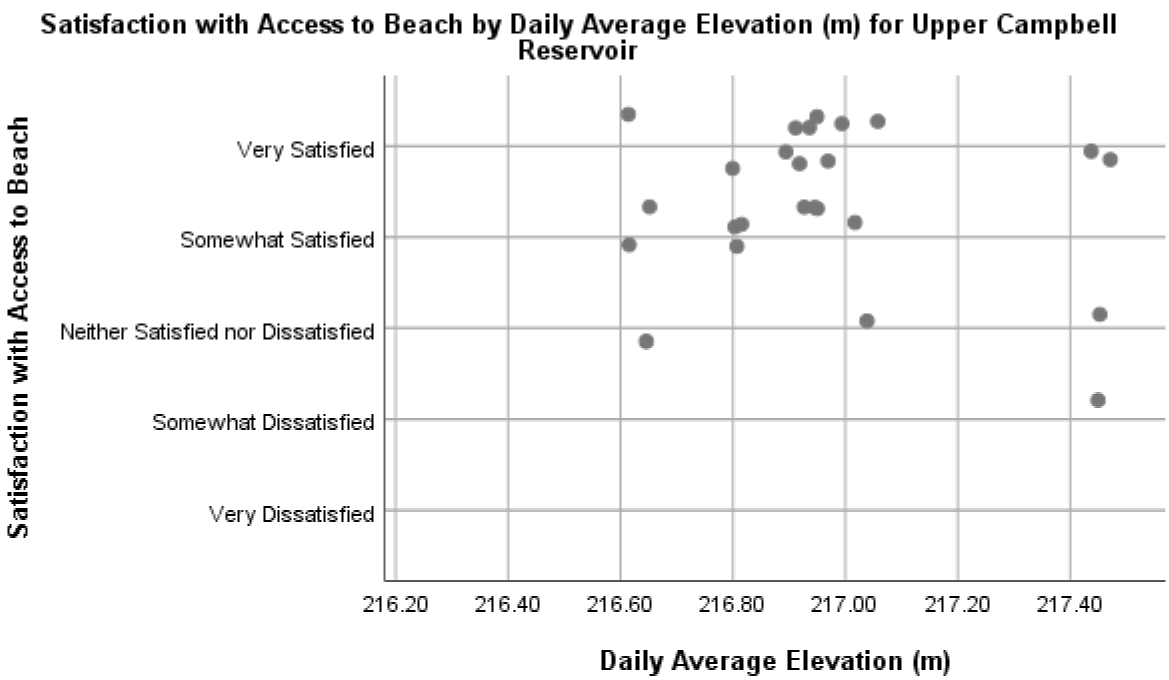


Figure 20. Satisfaction with access to the beach in relation to daily average water level for Upper Campbell Reservoir (n=34)

3.2.5.2 Access to Water via Boat Launch

When respondents were asked to rate their satisfaction with access to the water via boat launches, the greatest proportion of respondents (31.3%) reported that this did not apply, implying that a large proportion of people did not use boat launches while recreating at reservoirs. A total of 37.4% of respondents reported that they were either "very satisfied" or "somewhat satisfied" with access to water via boat launches.

The proportion of responses are noted as being significantly different across the three study years (Pearson's χ^2=65.008, df=10, p=0.000). A pairwise comparison of each category using the Bonferroni correction identified several significant differences across the years. Significant differences in distributions across the years include a greater proportion of respondents in Year 2 who reported being "very dissatisfied" (Z=5.20, df=1, p=0.000), and the lower proportion of respondents in Year 3 who reported being "very disappointed" with access to the water from boat launches at the time of their visit (Z=-4.50, df=1, p=0.000). In Year 2, we also observed a significantly lower proportion of respondents who were "neither satisfied nor dissatisfied" (Z=-3.50, df=1, p=000). Lastly, in Year 3, a significantly higher proportion of respondents reported being "very satisfied" (Z=3.10, df=1, p=0.002). A larger proportion of respondents in Year 3 reported being satisfied compared to Year 2 (Figure 21).

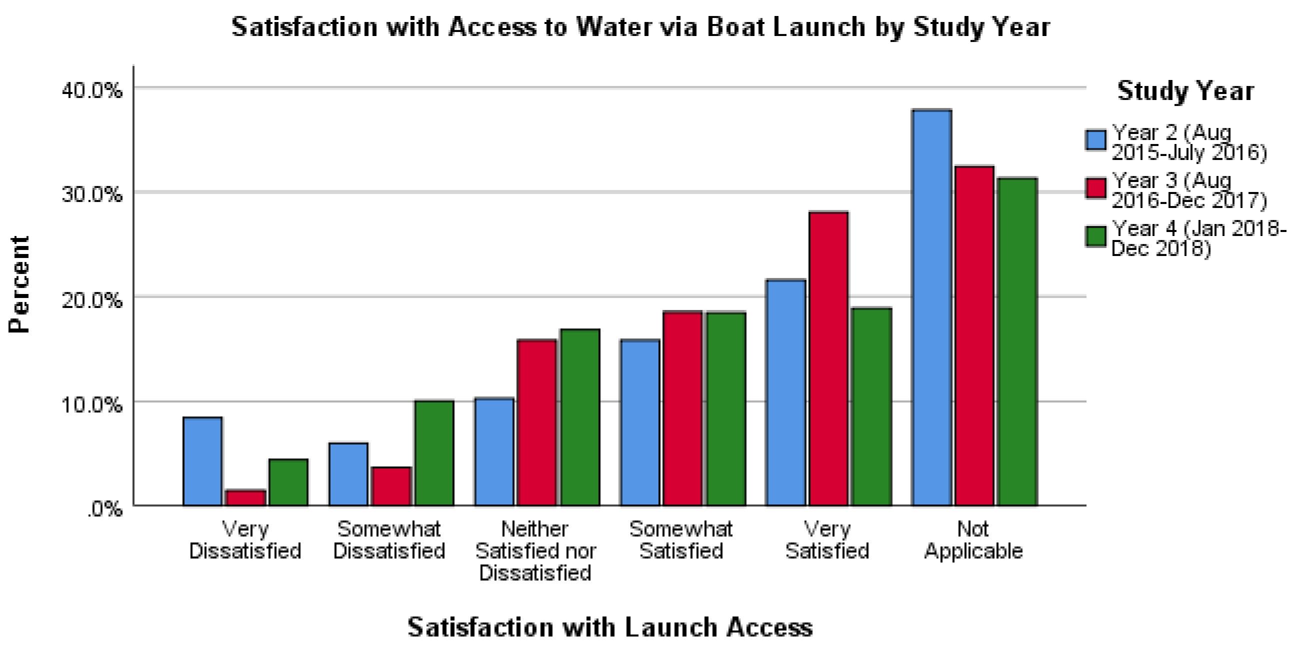


Figure 21. Satisfaction with access at reservoirs to water via boat launch for all respondents (n=1005)

Differences between reservoirs were again examined to see if the inclusion of Strathcona Lodge resulted in changes in perception. Again, this did not appear to be the case as respondents at Buttle Lake also varied considerably to the previous study year, with an increased proportion of respondents replying that they were "somewhat dissatisfied" with access to water via boat launch. There was no observed increase in respondents reporting dissatisfaction at Lower Campbell or Upper Campbell Reservoirs; rather, the greatest change at these locations was in the proportion of individuals replying that access to boat launch access was "not applicable" to their trip.

Scatterplots were developed to depict respondents' satisfaction with access to the reservoirs via boat launches in relation to daily average water elevation (see Figure 22, Figure 23 and Figure 24). No trends were apparent at the three reservoirs examined in the scatterplots, nor were any significant relationships identified from the Spearman's rank-order correlation. In Year 2, a significant correlation was identified between lake level and satisfaction with boat launch access to the water at Buttle Lake (n=130, r_s=0.586, p=0.000), however a similar result was not in either Year 3 or 4.

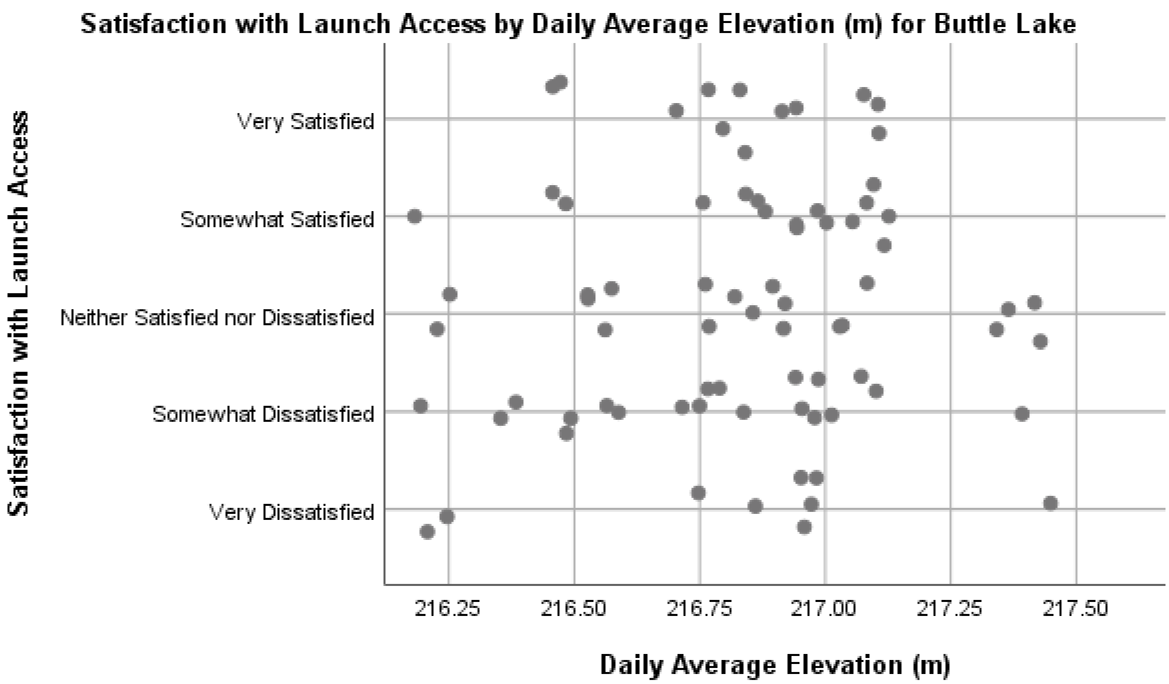


Figure 22. Satisfaction with access to the water via boat launch in relation to daily average water level for Buttle Lake (n=98)

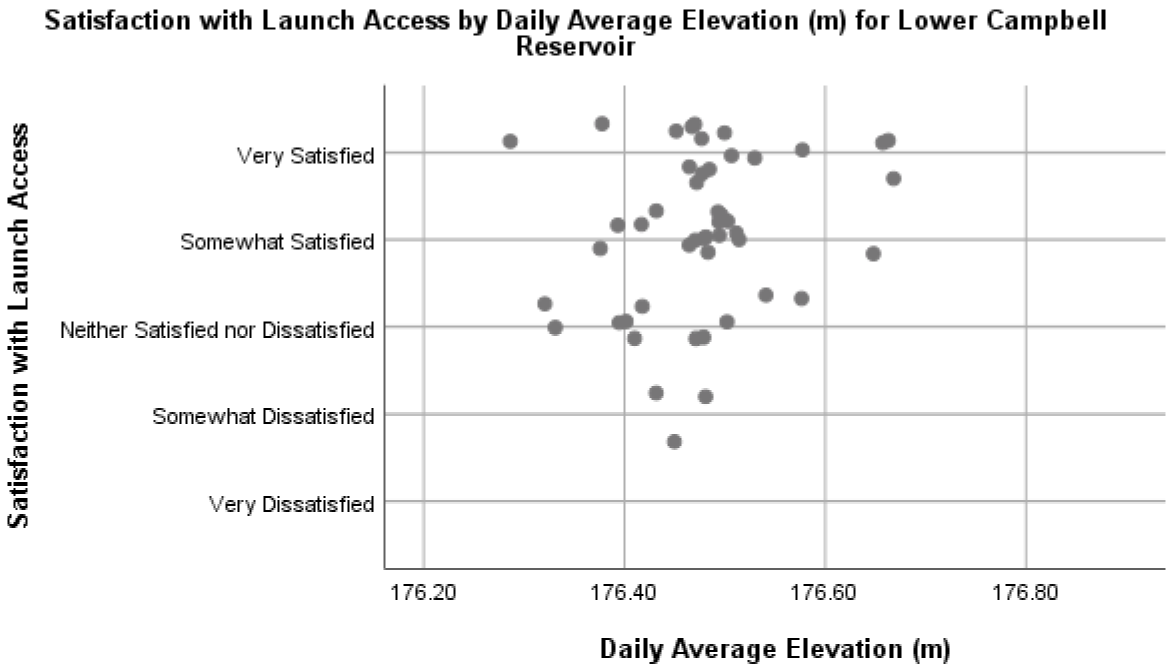


Figure 23. Satisfaction with access to the water via boat launch in relation to daily average water level for Lower Campbell Reservoir (n=88)

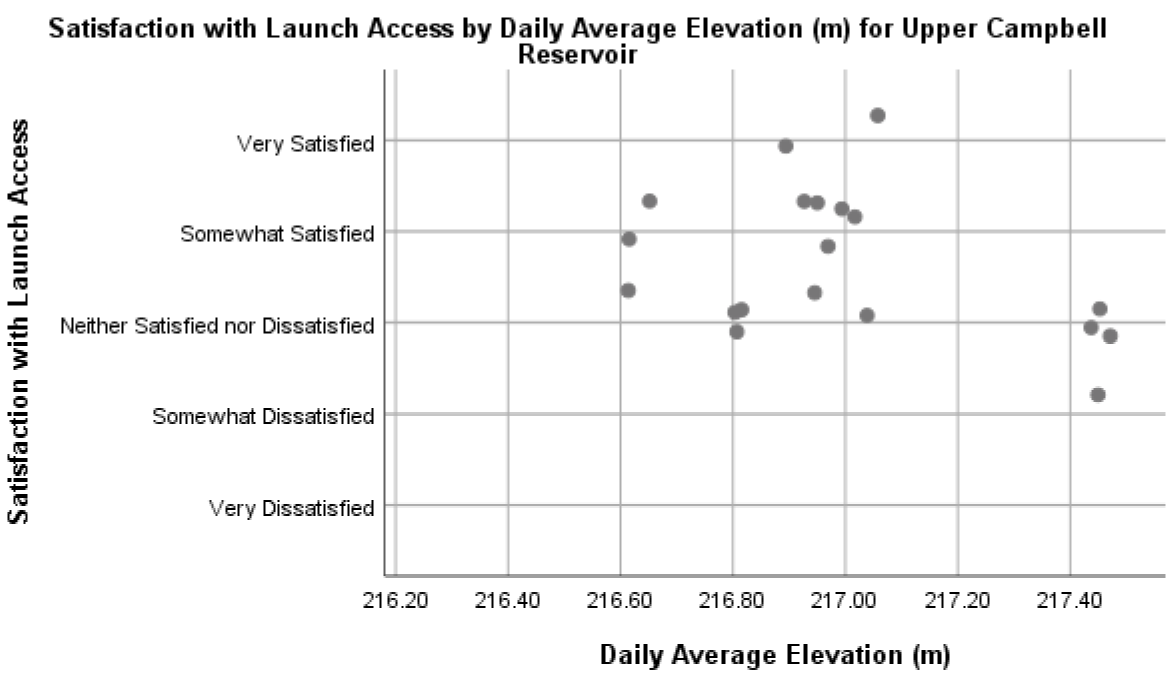


Figure 24. Satisfaction with access to the water via boat launch in relation to daily average water level for Upper Campbell Reservoir (n=34)

3.2.5.3 Access to Water via Shoreline

A total of 57.1% of respondents reported that they were either "very satisfied" or "somewhat satisfied" when respondents were asked to rate their satisfaction with access to the water via the shoreline (see Figure 25). The distribution of responses differed significantly across the three study years (Pearson's χ^2=62.538, df=10, p=0.000). Using a post-hoc pairwise comparison, significant differences were noted in the proportion of respondents who reported being "very dissatisfied" in Year 2 (Z=5.00, df=1, p=0.000) and Year 3 (Z=-5.10, df=1, p=0.000). In Year 3, a significantly greater proportion of respondents reported being "somewhat satisfied" than other years (Z=-3.1, df=1, p=0.002).

The responses were further examined according to sample location to help determine if the observed changes were the result of the addition of Strathcona Lodge on Upper Campbell Reservoir. Similar to previous management questions, however, there seemed to be no specific connection. Shifts in responses were noted at Buttle Lake, with a greater proportion of respondents responding they were dissatisfied with shoreline access to the water. This was not observed at Upper Campbell or Lower Campbell Reservoir. Other explanations were not explored for this reporting period, although it could be a response to different shoreline conditions (if any), changes in the sample population or for some other unidentified reason.

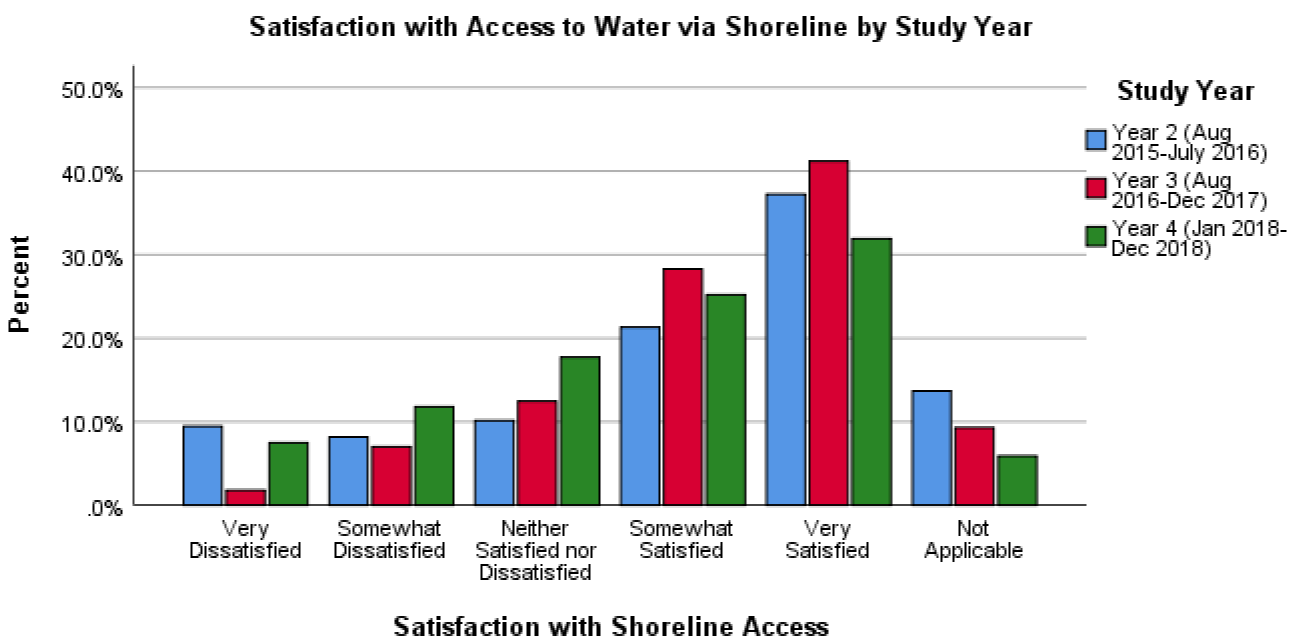


Figure 25. Satisfaction with access at reservoirs to water via shoreline for all respondents (n=1044)

Satisfaction with access to the water via the shoreline was graphed in relation to daily average water elevation in scatterplots for Buttle Lake, Upper Campbell Reservoir and Lower Campbell Reservoir (see Figure 26, Figure 27 and Figure 28). As with the other reservoir performance measures in Year 4, no significant correlations were identified between satisfaction with access to the water via the shoreline and water levels at the three reservoirs.

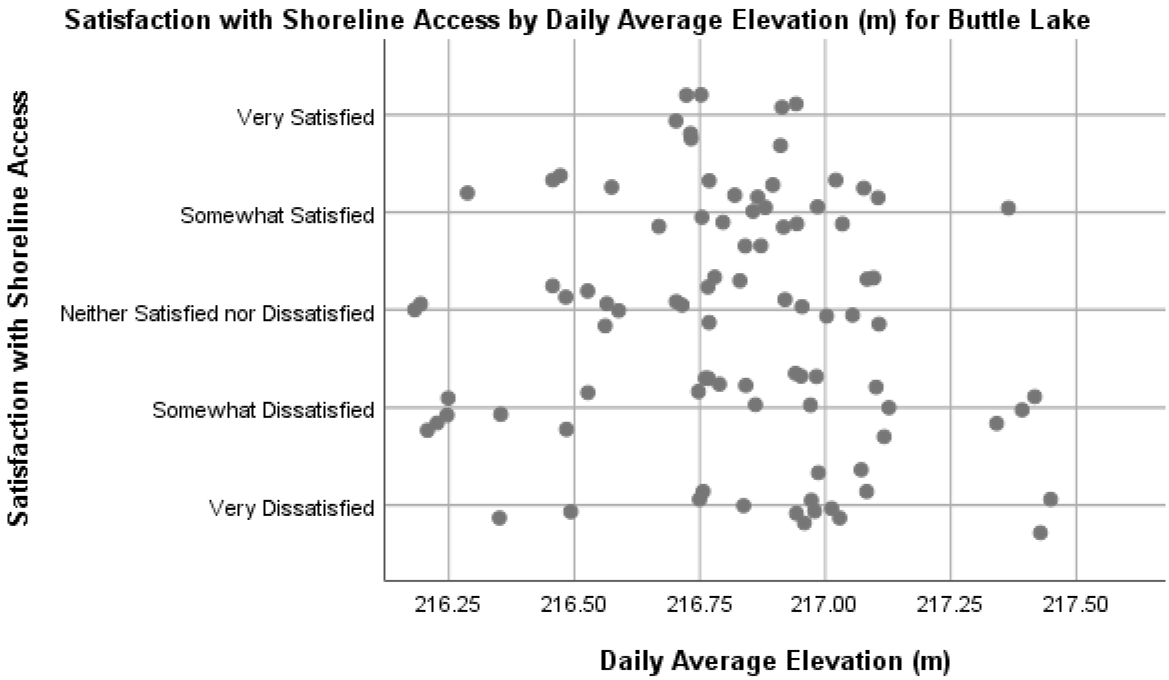


Figure 26. Satisfaction with access to the water via shoreline in relation to daily average water level for Buttle Lake (n=100)

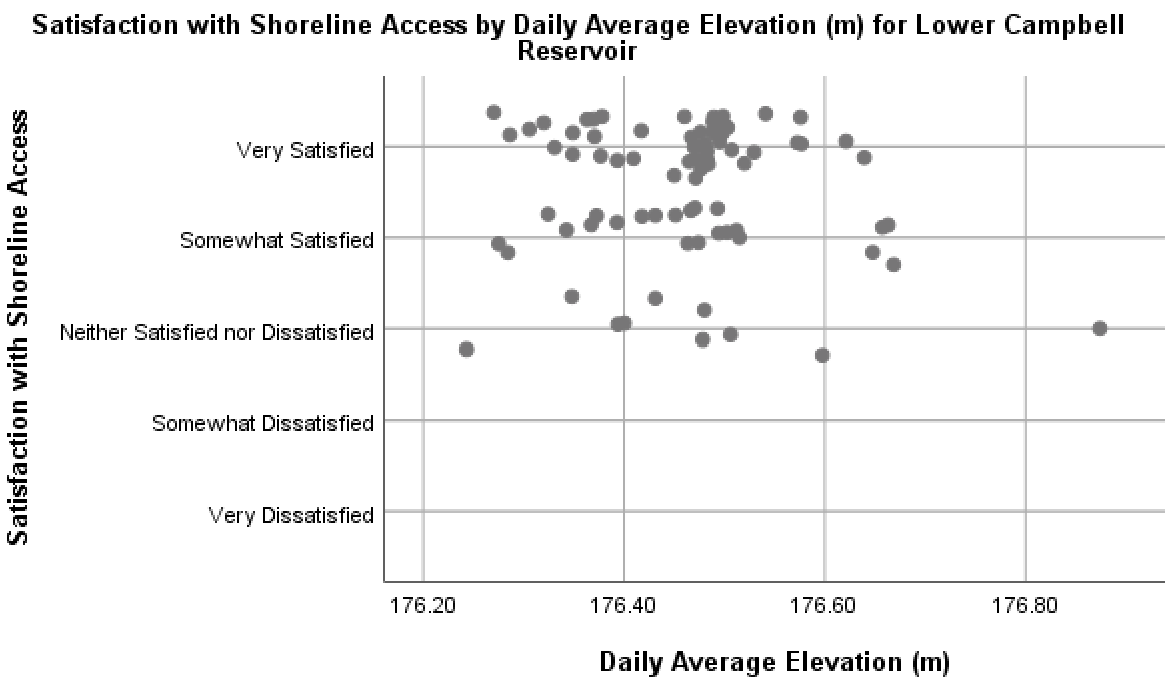


Figure 27. Satisfaction with access to the water via boat launch in relation to daily average water level for Lower Campbell Reservoir (n=88)

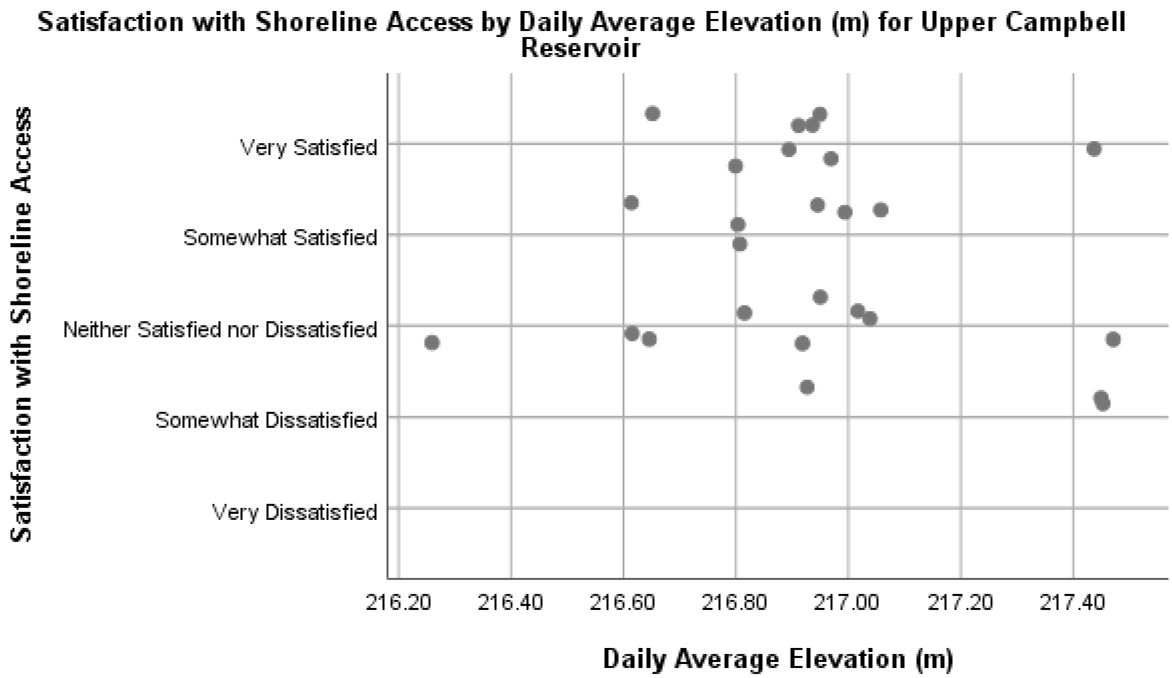


Figure 28. Satisfaction with access to the water via boat launch in relation to daily average water level for Upper Campbell Reservoir (n=34)

3.3 MANAGEMENT HYPOTHESIS – RIVERS

The management hypothesis for rivers in the Campbell River reservoir systems is stated as:

$H_{0\text{-}B}$: Changes in overall satisfaction with the recreation experience at rivers, if they occur, are not related to riverine discharge.

We tested this hypothesis by comparing perceptions of safety, satisfaction and experience with average daily flow rates for two rivers in the study area: Quinsam River and Campbell River. Responses to Q30, Q31 and Q32 in Section E: Visits to Rivers (Appendix B) of the survey were graphed using scatterplots in relation to the average daily water flow. Correlations between average daily flow rates and the various performance measures were tested using the Spearman rank-order correlation coefficient.

3.3.1 FLOW RATES OF RIVERS

River discharge or flow rate, measured as daily average flow rate in cubic metres per second (m^3/s), was gathered for two rivers: Quinsam River and Campbell River. The water flow data was provided from BC Hydro Generation Operation, and were collected from the following stations:

- For Quinsam River: Quinsam R nr Campbell R
- For Campbell River: Campbell R nr Campbell R

Analyses had to be completed separately for the two rivers as volumes differ greatly between the two systems, and thus were not directly comparable. A summary of water flows from the BC Hydro data set are provided in Table 7. Based on the monitoring data, the mean daily average flow rates for Year 4 of the study were 92.25 m^3/s for Campbell River and 8.20 m^3/s for Quinsam River.

Table 7. Summary of water flow data (in cubic meters/second) for rivers in Year 4

	Campbell River (m^3/s)	Quinsam River (m^3/s)
Mean	92.253	8.195
Median	107.209	5.700
Std. Deviation	36.906	8.976
Variance	1362.029	80.572
Minimum	29.233	2.010
Maximum	203.627	76.110

Water flow data measured throughout the year were compared to those flowrates encountered during the sampling at Campbell River and Quinsam River to identify how representative sampling was of the true range of water flows. As water flow data were not normally distributed, a One-Sample Wilcoxon Signed Rank Test was used to determine if the median daily water flow that were encountered during sampling were the same as those actually observed for the entire year. A significant difference in median water flow rates was observed between the dates sampled and actual water flows observed throughout the year for Campbell River (n=30, p=0.000) and Quinsam River (n=36, p=0.000).

3.3.2 INFLUENCE OF WATER FLOW ON RECREATION EXPERIENCE

Question 30 asked respondents to rate how water flows influenced their recreation experience on a scale of 1 to 5 (with 1 being "very negative" and 5 being "very positive") given river conditions at the time of their visit. Approximately 73% of respondents reported that water flow had either a "somewhat positive" or "very positive" influence on their recreation experience at the rivers.

The responses are noted as being significantly different across the years (Pearson's χ^2=51.501, df=8, p=0.000) (Figure 29). Using a pairwise comparison of each category (using the Bonferroni correction), several specific categories were identified as differing from each other. In Year 4, a significantly greater proportion of respondents than other study years replied that river flows had a very positive influence on their experience (Z=4.7, df=1, p=0.000). In Year 3, a disproportionate number of respondents reported having a somewhat positive experience (Z=3.30, df=1, p=0.001). In Year 2, a greater proportion of respondents expressed that water flows had no influence on their experience (Z=4.90, df=1, p=0.000), while a lower proportion in Year 2 reported that flows had a very positive influence (Z=-4.6, df=1, p=0.000).

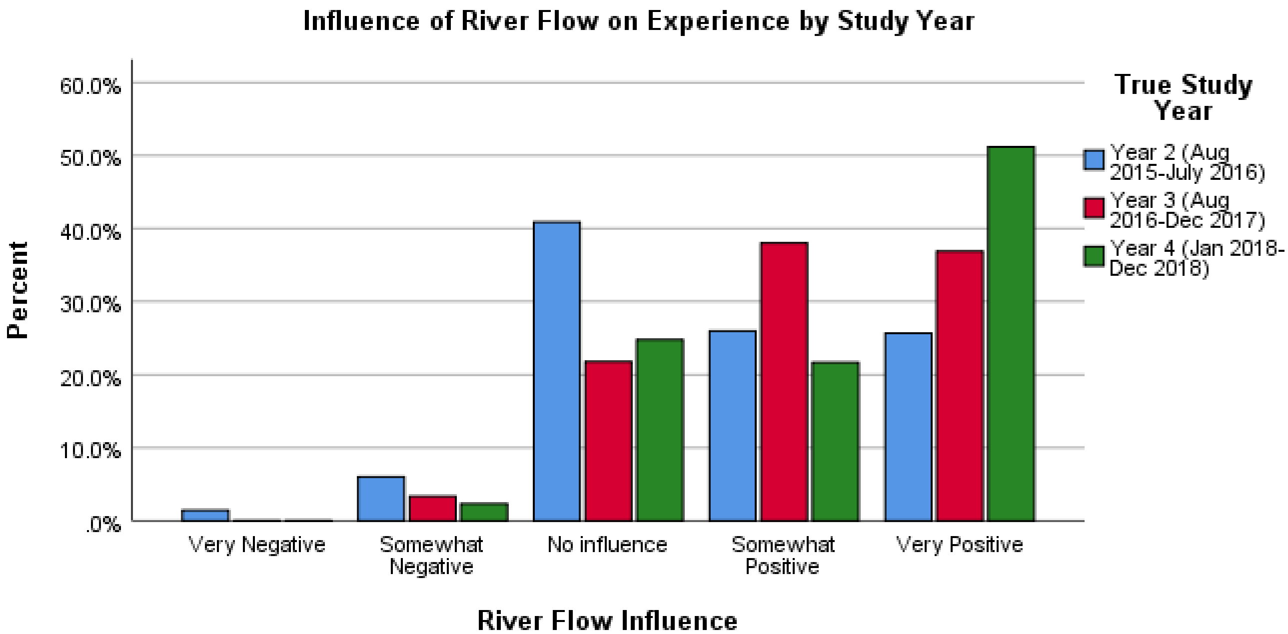


Figure 29. Frequency of responses for influence of river flow on experience while recreating at the river (n=658)

The influence of water flows on respondents' recreation experience was graphed in relation to daily average water flows for the rivers as scatterplots (see Figure 30 and Figure 31). No strong trends were apparent in the scatterplots for Quinsam River and Campbell River. A Spearman's rank-order correlation was run to examine this relationship. A weak but significant correlation was noted at Campbell River where increased water flow related to an increasing positive influence on recreation experience ($n=44$, $r_s=0.379$, $p=0.011$). No significant relationship was noted for Quinsam River.

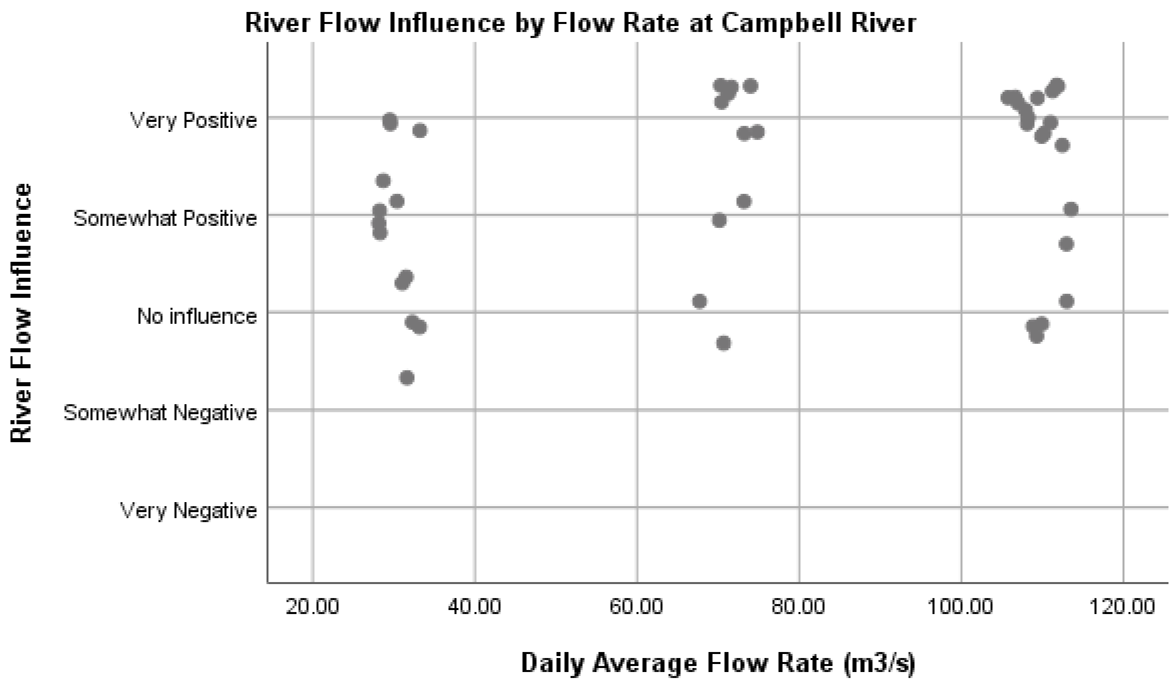


Figure 30. Influence of water flows on recreation experience in relation to average daily water flow for Campbell River (n=44)

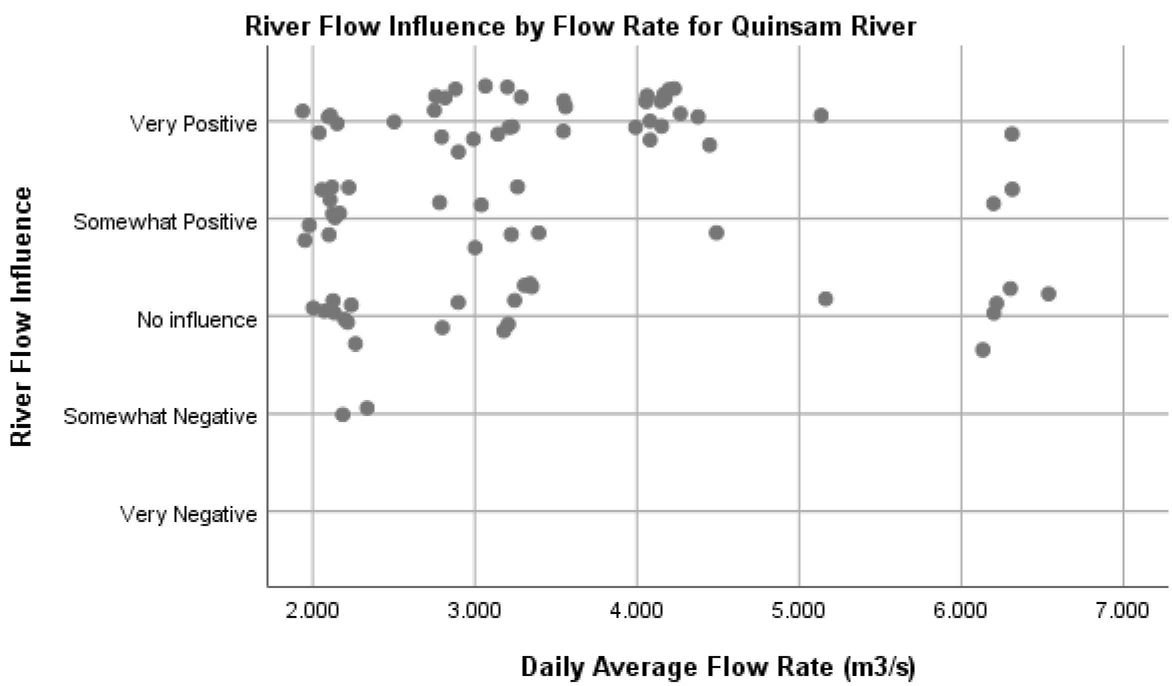


Figure 31. Influence of water flows on recreation experience in relation to average daily water flow for Quinsam River (n=82)

3.3.3 SATISFACTION WITH SHORELINE CONDITIONS

Question 31 asks riverine visitors to rate how satisfied they were with shoreline conditions while engaged in water-based recreation at the time of their visit on a scale of 1 to 5 (with 1 being "very dissatisfied" and 5 being "very satisfied"). Respondents were generally satisfied with shoreline conditions along the rivers, with the majority (71%) of respondents reporting that they were either "somewhat satisfied" or "very satisfied".

The responses are noted as being significantly different across the years (Pearson's χ^2=18.320, df=8, p=0.019). Overall the data suggests that there is some statistically significant difference between satisfaction with shoreline conditions between study years, but a pairwise comparison of each category (using the Bonferroni correction) could not identify which specific categories differ significantly from each other. Figure 32 depicts the frequency of responses, which shows an increased frequency of respondents in Year 4 who reported being neither satisfied or dissatisfied with shoreline conditions.

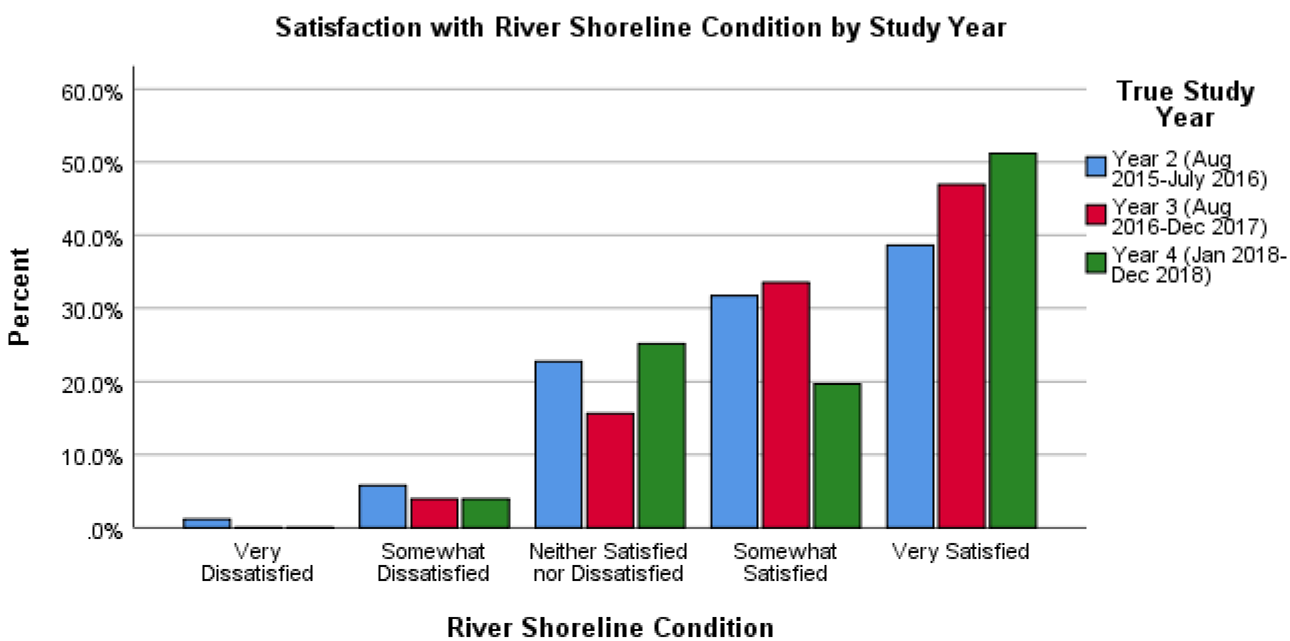


Figure 32. Frequency of responses for satisfaction with shoreline conditions at rivers (n=653)

Scatterplots were developed to depict the satisfaction with shoreline conditions in relation to daily average water flows for the rivers. No strong trends were noted (see Figure 33 and Figure 34) although significant correlations were identified using a Spearman's rank-order test. On Campbell River, a positive correlation was noted between average daily flow rate and satisfaction with shoreline conditions (n=44, r_s=0.460, p=0.002), suggesting that as people were generally more satisfied with higher water levels although, as indicated in the scatterplot, there is a lot of variation and the correlation is weak. On Quinsam River, a similar correlation was identified (n=80, r_s=0.371, p=0.001) although, again, this correlation is weak with high variability as indicated in the scatterplot. It is important to note that, sampling only captured a lower range of flow conditions at Quinsam River this study year despite efforts to sample across various season. Therefore, the evaluation does not indicate how respondents might respond at much higher flow rates.

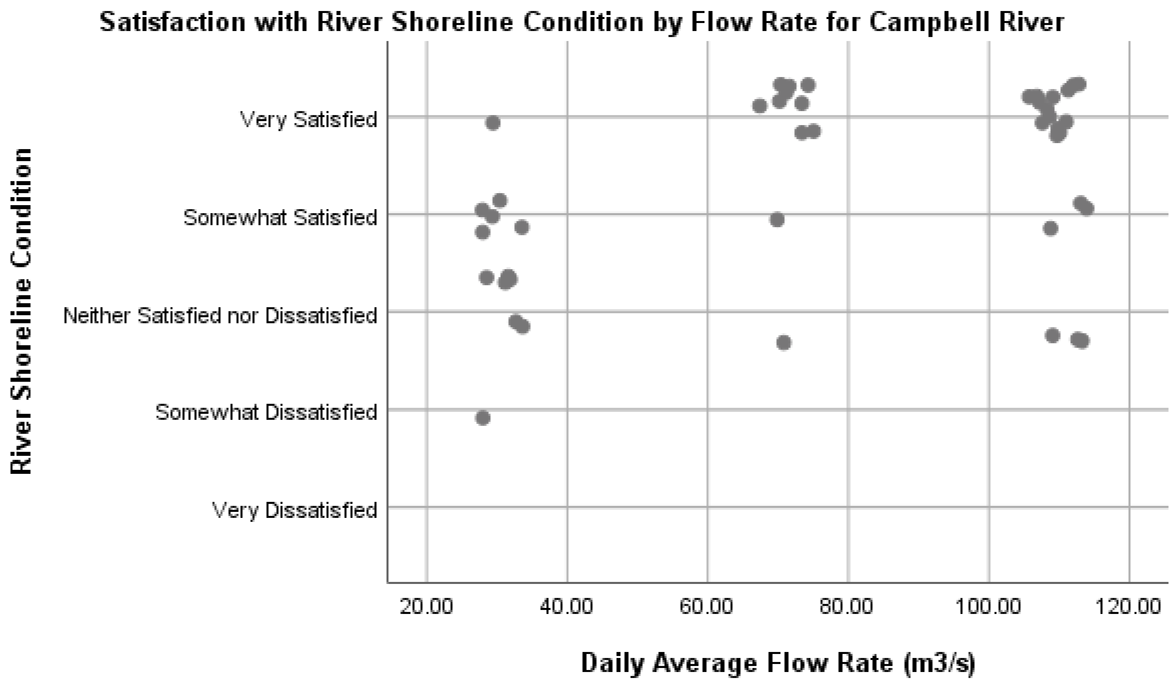


Figure 33. Satisfaction with shoreline conditions in relation to daily average water flow for Campbell River (n=44)

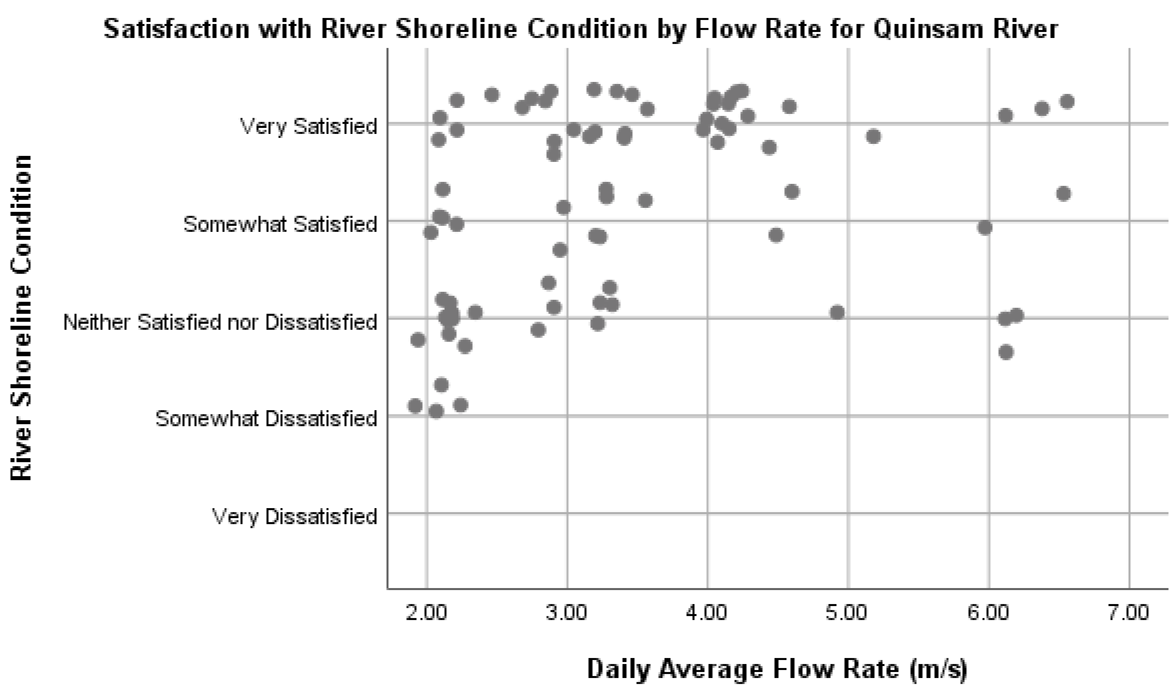


Figure 34. Satisfaction with shoreline conditions in relation to daily average water flow for Quinsam River (n=81)

3.3.4 PERCEPTION OF SAFETY

In Question 32, respondents were asked to rate how safe they felt engaging in water-based activities at the rivers on a scale of 1 to 5 (with 1 being "very unsafe" and 5 being "very safe") given water levels at the time of their visit. Approximately half of respondents (56.3%) reported feeling "very safe" while recreating at a reservoir within the Campbell Reservoir system, with another 25.8% reported feeling "somewhat safe". No significant differences in the distribution of answers were identified across years (Pearson's χ^2=7.879, df=8, p=0.445).

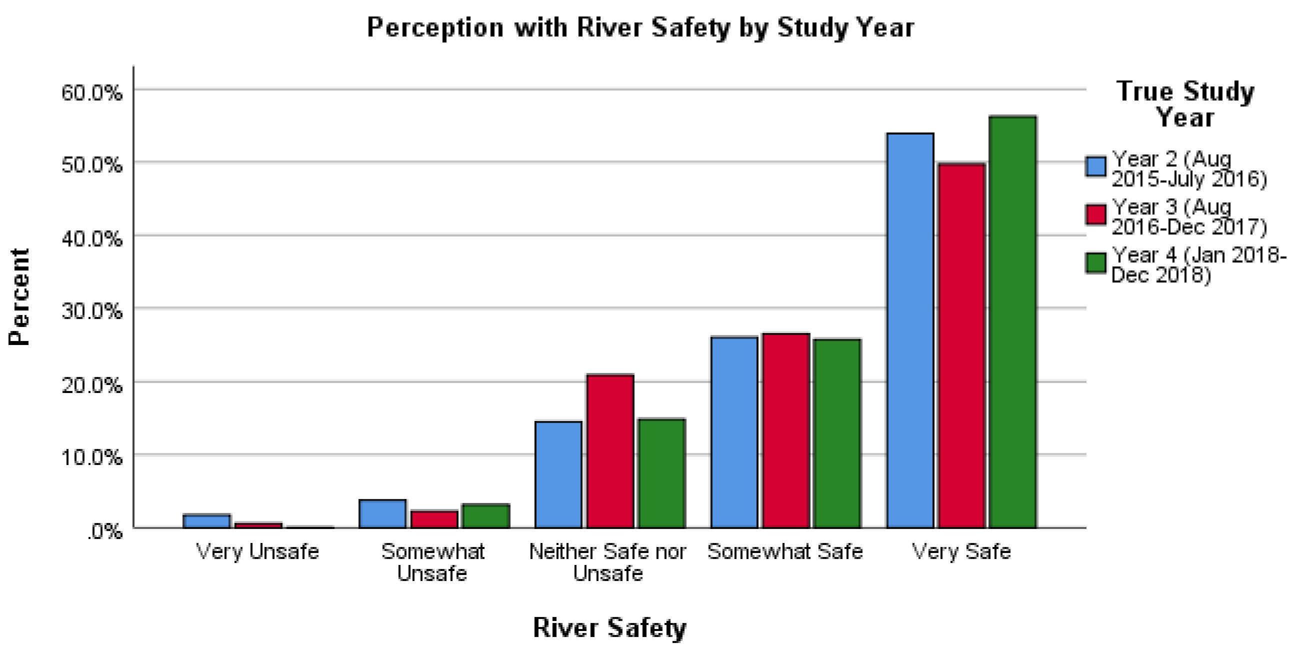


Figure 35. Frequency of responses for perception of safety while recreating at rivers (n=650)

Scatterplots were developed to depict respondents' perception of safety in relation to daily average water flows for the rivers (see Figure 36 and Figure 37). While the Spearman's rank order test identified no significant correlation at Campbell River, a weak but significant positive correlation was identified at Quinsam River (n=80, r_s=0.269, p=0.016). As noted previously, this result should be interpreted with caution given the lack of high flow rates encountered during sampling.

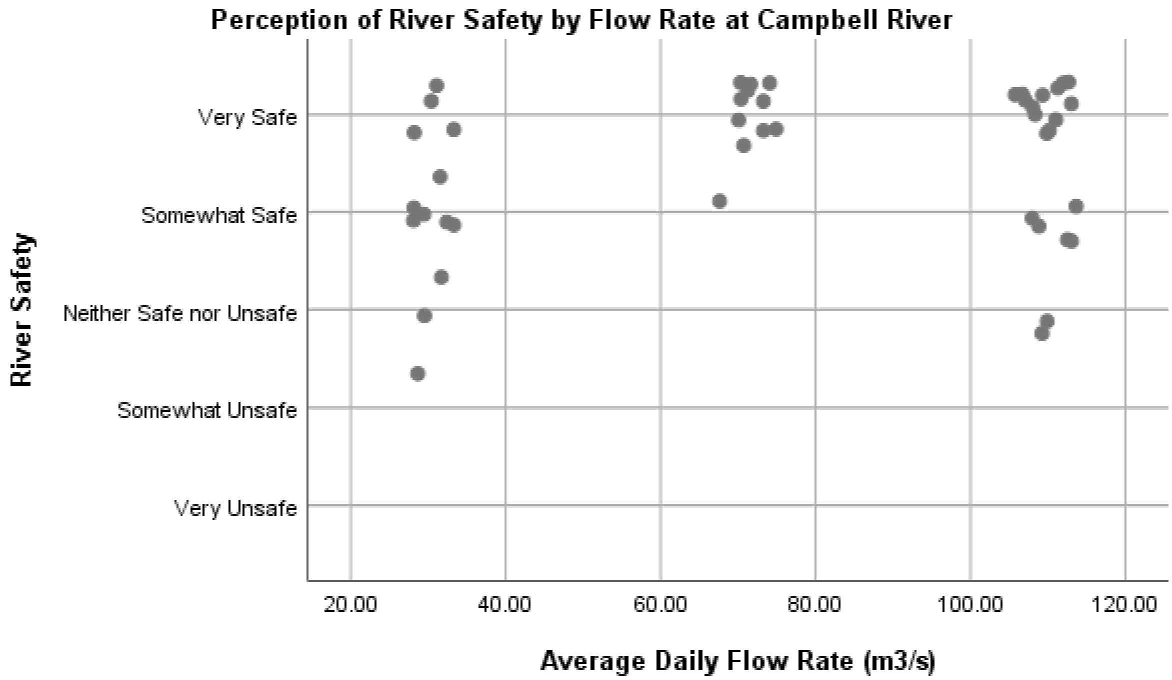


Figure 36. Perception of safety in relation to daily average water flows for Campbell River (n=44)

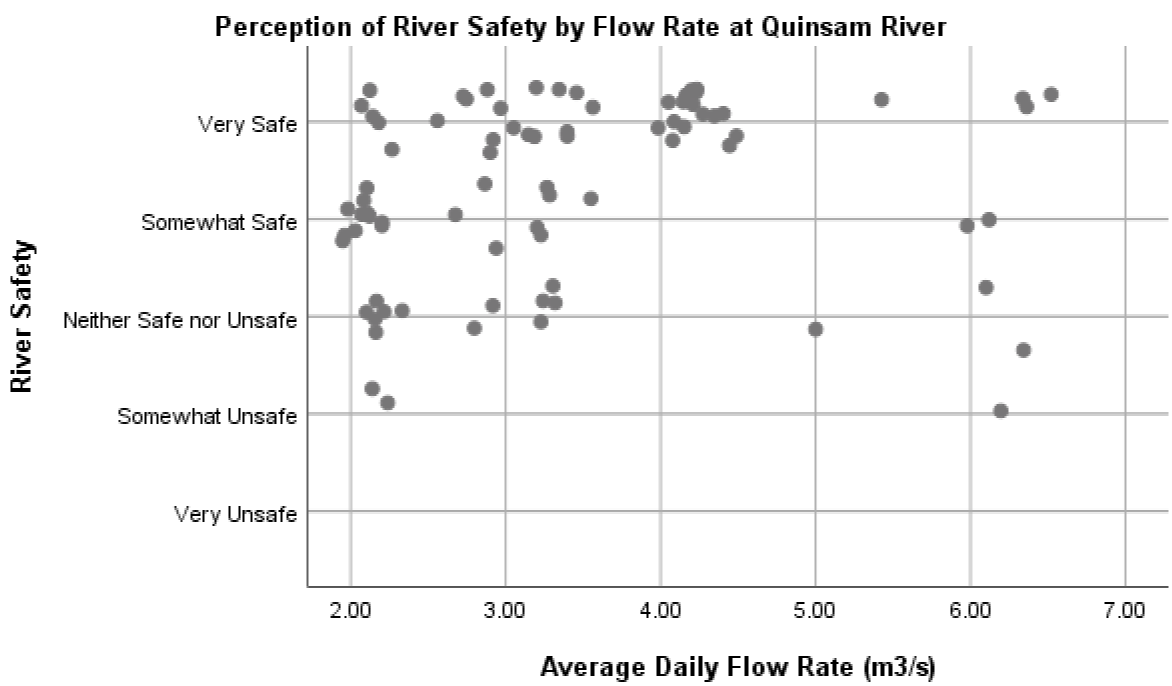


Figure 37. Perception of safety in relation to daily average water flows for Quinsam River (n=81)

3.4 MANAGEMENT HYPOTHESIS – FALLS

The management hypothesis for rivers in the Campbell River reservoir systems is stated as:

$H_{0\text{-}C}$: Changes in overall satisfaction with the recreation experience of visitors to Elk Canyon Falls is not related to riverine discharges (i.e. spill events).

We tested this hypothesis by comparing visitor satisfaction and impressiveness at Elk Falls with average daily flow rates for Campbell River. Responses to Q23 and Q24 in Section D: Visit to Elk Falls (Appendix B) of the survey were graphed using scatterplots in relation to the average daily water flow. A line of best fit was applied on the scatterplots to illustrate the general trends, although the method used to apply the line of best fit, the Pearson product-moment correlation, is not appropriate for this type of data. As noted in the sections on reservoirs and rivers, a more appropriate test for examining correlation between ordinal variables (i.e., Likert scales) and interval data (i.e., average daily elevation) is Spearman rank-order correlation coefficient.

River discharge for Elk Falls, measured as daily average flow rate, was gathered from BC Hydro for Campbell River using data from the “Campbell River near Campbell River” station.

3.4.1 IMPRESSIVENESS OF FALLS

Question 32 asks respondents to rate how impressive Elk Falls were at the time of their visit on a scale of 1 to 5 (with 1 being “very unimpressive” and 5 being “very impressive”). Most respondents reported that they were either “very impressed” (78.0%) or “somewhat impressed” (14.1%) by Elk Falls at the time of their visit (Figure 38).

A statistical difference was identified between the distribution of responses across the three study years (Pearson’s χ^2=29.030, df=8, p=0.000). Using a pairwise comparison of each category (using the Bonferroni correction), several specific categories were identified as differing from each other. In Year 4, a significantly greater proportion of respondents was identified as responding that the falls were very impressive (Z=-4.92, df=1, p=0.000), with a corresponding drop in those responding that the falls were somewhat impressive (Z=3.92, df=1, p=0.000).

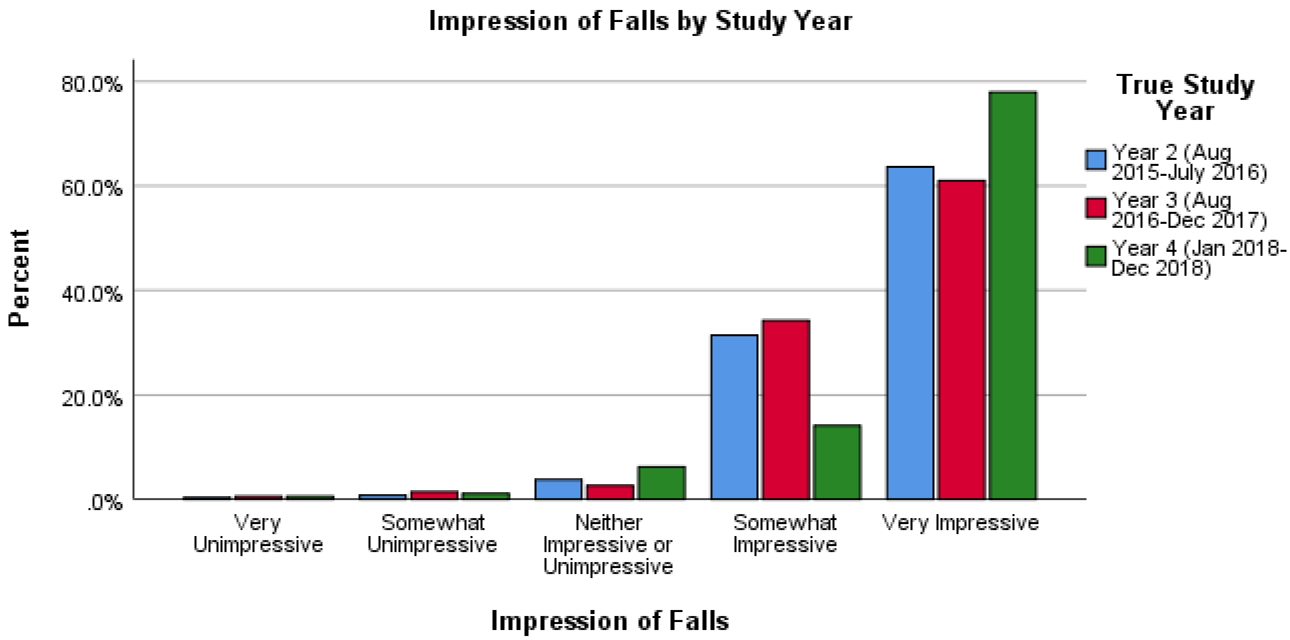


Figure 38. Frequency of responses for impressiveness of Elk Falls (n=1437)

A scatterplot was developed to depict respondents' ratings of impressiveness of the falls in relation to daily average water flows for Campbell River (see Figure 39). A Spearman's rank-order correlation was run to examine this relationship, but no significant correlation was identified suggesting that discharge does not influence visitors' impression of Elk Falls.

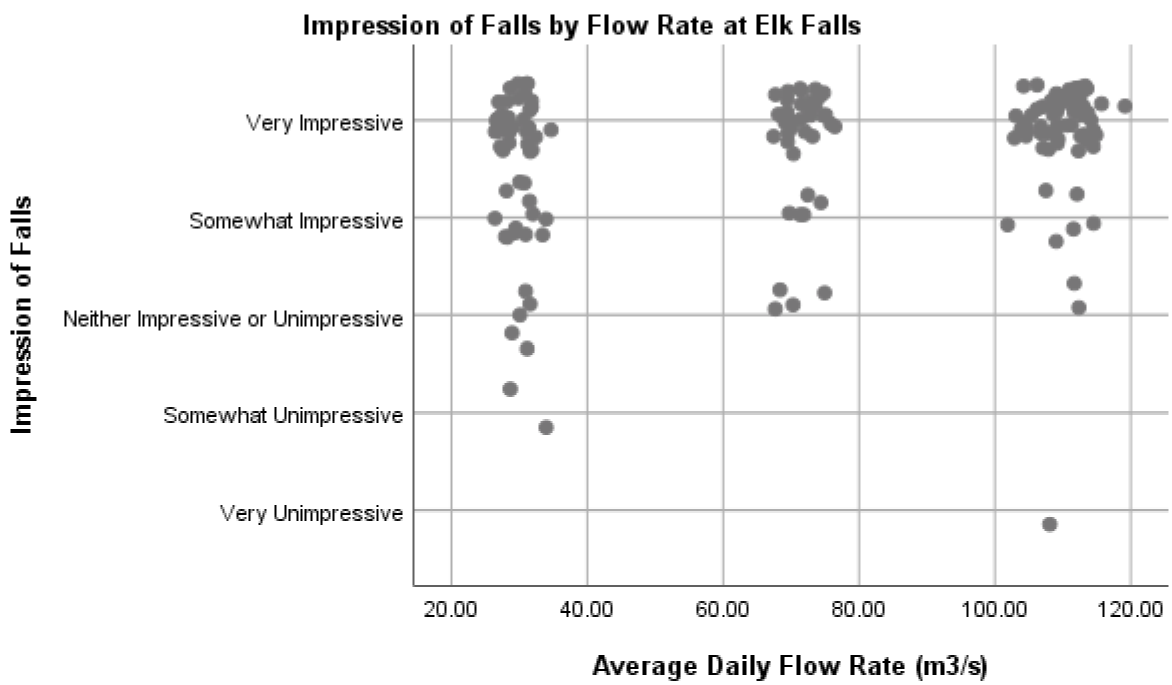


Figure 39. Impressiveness of falls in relation to daily average water flows for Elk Falls (n=177)

3.4.2 SATISFACTION WITH EXPERIENCE AT FALLS

In Question 24, respondents were asked to rate how satisfied they were with the viewing experience at Elk Falls on a scale of 1 to 5 (with 1 being "very dissatisfied" and 5 being "very satisfied"). Respondents reported a high degree of satisfaction with their experience at Elk Falls with 80.9% stating they were "very satisfied" (Figure 38). No statistical difference was identified between the distribution of responses between study years (Pearson's $\chi 2=10.386$, df=8, p=0.239).

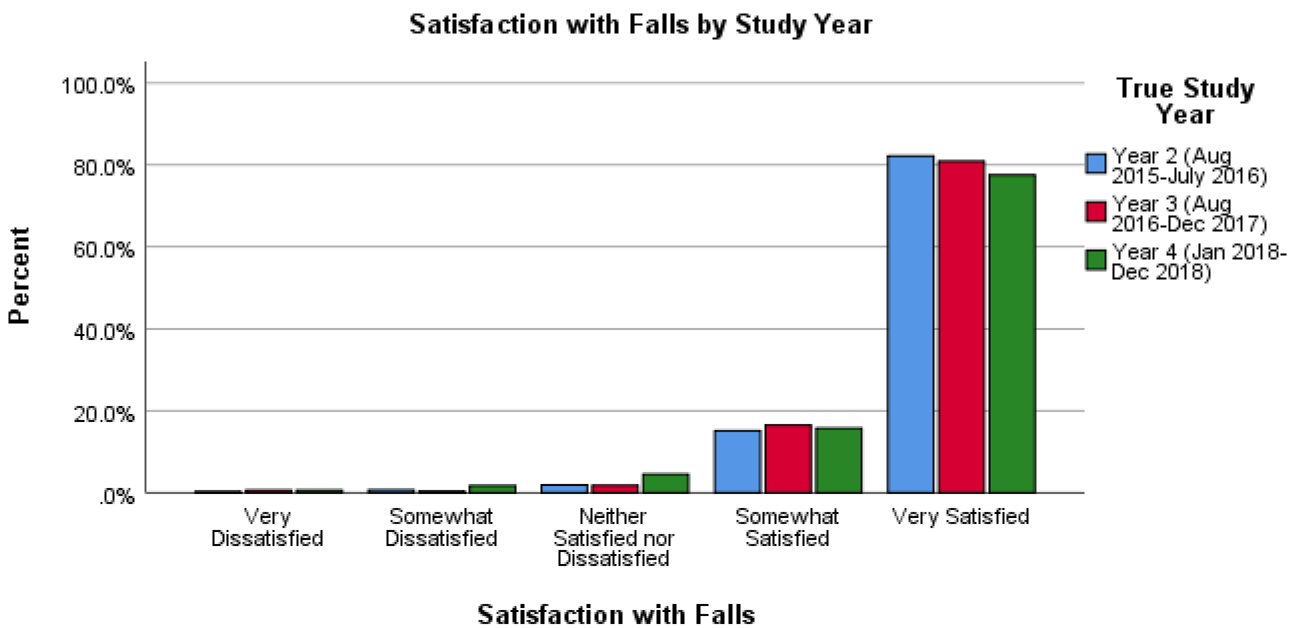


Figure 40. Frequency of responses for satisfaction with experience at Elk Falls (n=1436)

A scatterplot of respondents' ratings of satisfaction at the falls in relation to daily average water flows for Campbell River does not indicate any notable trend (see Figure 41). A Spearman's rank-order correlation was run to examine this relationship, but no significant correlation was identified suggesting that discharge does not influence visitors' impression of Elk Falls.

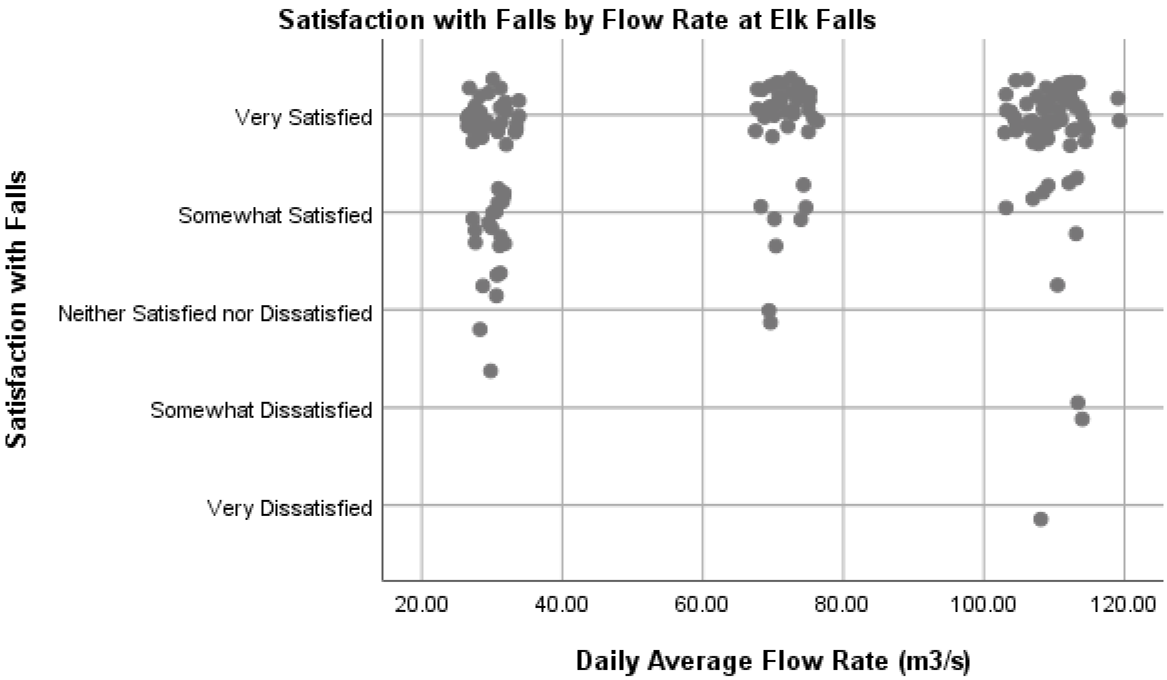


Figure 41. Satisfaction with experience at falls in relation to daily average water flow (n=178)

3.5 UPPER CAMPBELL DECISION SUPPORT SYSTEM

To study the effects of the Upper Campbell preferences across all attributes – as opposed to individual parameter estimates – on people's recreational choices, a decision support system was developed for the Upper Campbell (UCDSS) in Microsoft Excel. The UCDSS is based on the parameter estimates of the statistical model developed by analyzing Year 2 and Year 3 data, which predicts the likelihood of choice for any one scenario (i.e. combinations of attributes) in the context of the presented alternatives.

The UCDSS is based on the combined effect attribute preferences have on individual choices. The UCDSS features a regression model (see equation below) used to predict the probability individual i selects alternative j at replication t given attribute values z_{it}^{att} and predictor values z_{it}^{pre} for all responses y_{it}. The conditional logit model has the form (Vermunt and Magidson 2005):

$$P\left(y_{it} = j \middle| z_{it}^{att}, z_{it}^{pre}\right) = \frac{\exp\left(\eta_{j|z_{it}}\right)}{\sum_{j'=1}^{J} \exp\left(\eta_{j'|z_{it}}\right)}$$

The likelihood of recreationist choosing to recreate at a given reservoir is indicated by the above equation. Employing it to power the UCDSS, we used parameter estimates (i.e. part worth utility) from the CE to calculate overall utility of different management scenarios allowing us to approximate the probability of choice for one alternative over another. Changes in the exponent of the sum of utilities (i.e. preference values for each of the reservoir attributes or conditions) for a given reservoir can thus change the likelihood (i.e. %) of that reservoir being chosen by recreationist. In its simplest form, a DSS can be designed in Microsoft Excel, by replicating the layout of the DCE in the survey (i.e. in this case with the scenarios A and B, as well as a choose neither option). After programming, the levels for each attribute can be changed and the program calculates the likelihood of choice for any one of the scenarios. Adjusting reservoir features reveals the relative market share (a prediction of recreationists who would choose to recreate at the reservoir given the presented reservoir features).

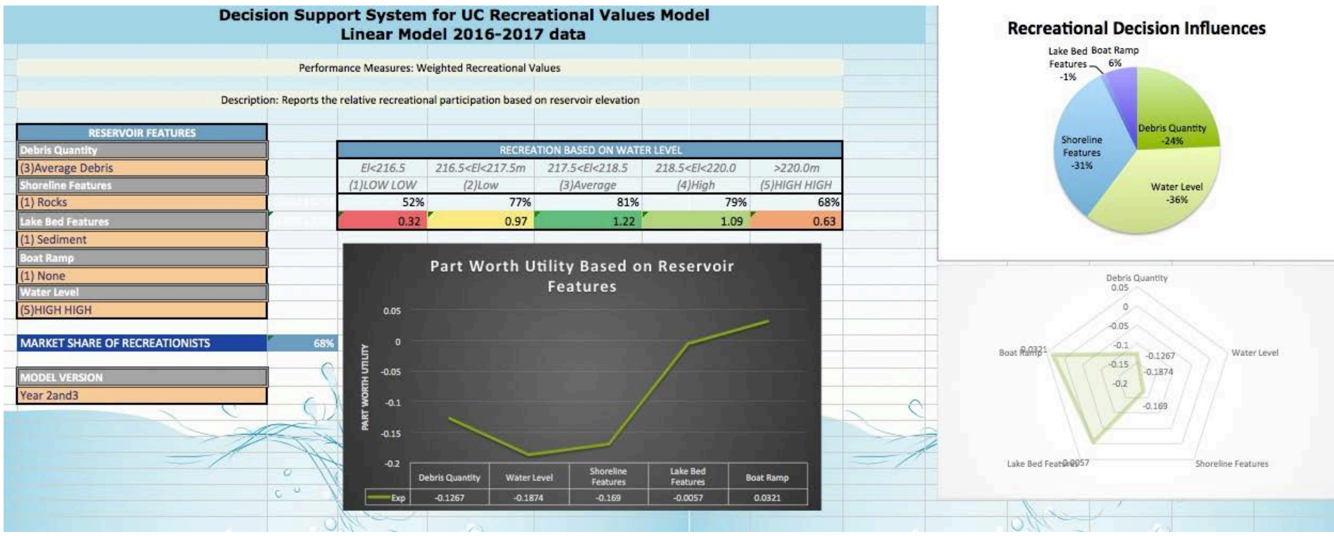


Figure 42. Screenshot of the Upper Campbell Decision Support System in Microsoft Excel

An initial analysis (using a regression model based on combined Year 2 and Year 3 data) resulted in presentation of the following market shares distributions based on the following combined reservoir features (e.g. decision scenarios).

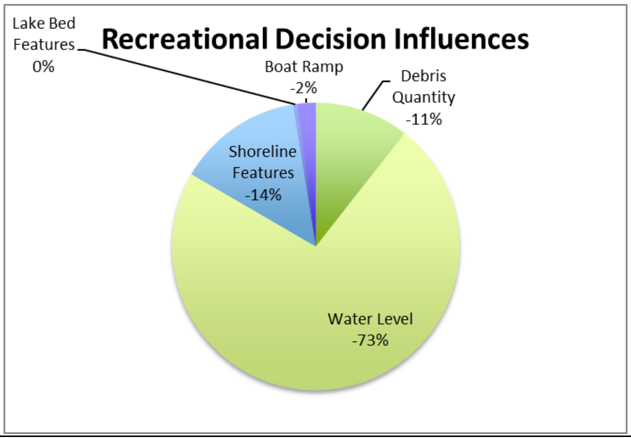
1. **Reservoir features <u>least</u> likely to elicit recreational visits** – Based on individual preferences expressed in the regression model, reservoirs featuring ***average debris, rocky shores, sediment lakebeds, and concrete boat launch pad***[1] would elicit fewer visits than other reservoir conditions. The relative market share for different water levels with these set of reservoir conditions (compared to choosing neither site) is shown in Figure 43 and the relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir is shown in Figure 44.

RECREATION BASED ON WATER LEVEL				
El<216.5	216.5<El<217.5m	217.5<El<218.5	218.5<El<220.0	>220.0m
(1)LOW LOW	(2)Low	(3)Average	(4)High	(5)HIGH HIGH
51%	76%	80%	78%	67%
0.30	0.91	1.15	1.03	0.60

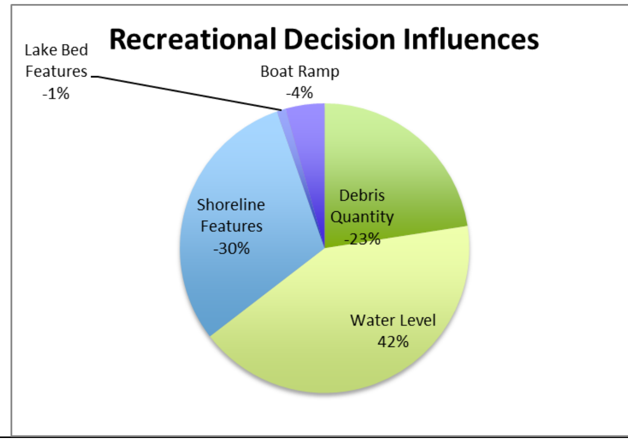
[1] The type of boat launch is insignificant in overall decisions but is included in the regression model for alignment with experimental approach.

Figure 43. Market share (% of recreationist choosing to recreate at the reservoir compared to choosing neither) of recreationists visiting a reservoir with average debris, rocky shores, sediment lakebeds, and a concrete boat launch by water level. Total utility at each water level is shown below % values.

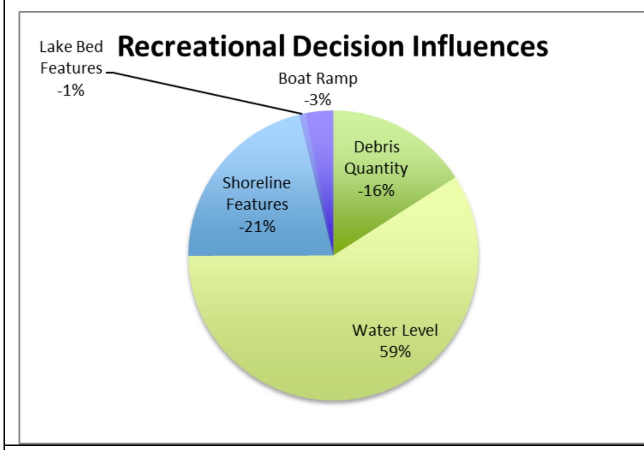
(1)LOW LOW



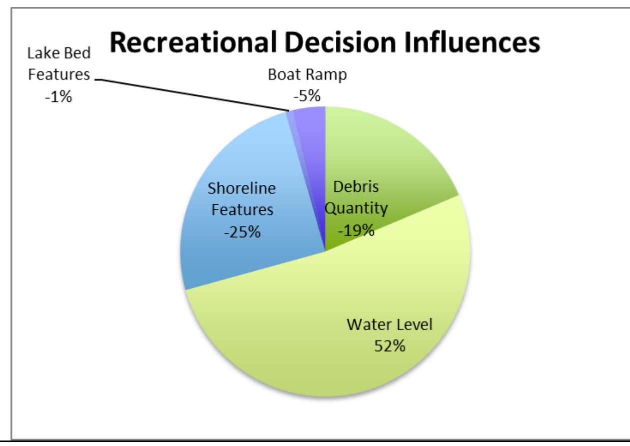
(2)Low



(3)Average



(4)High



(5)HIGH HIGH

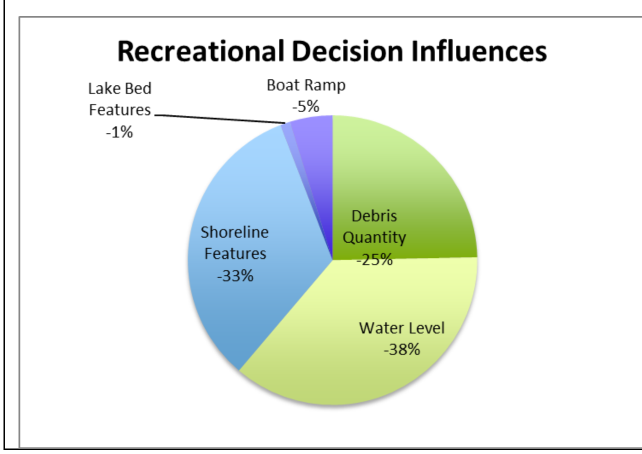


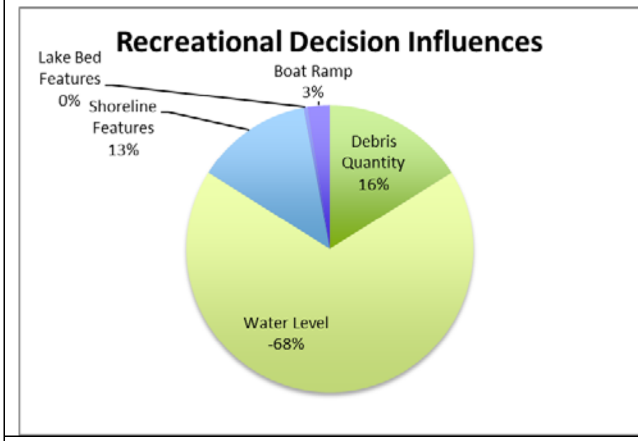
Figure 44. Relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir with average debris, rocky shores, sediment lakebeds, and a concrete boat launch by water level. Negative (-%) values indicate negative utility for the reference attribute level.

2. **Reservoir features most likely to elicit recreational visits** – Based on individual preferences expressed in the regression model, reservoirs featuring ***no debris, sandy shores, grass/woody lakebeds, and no boat launch pad*** would elicit more visits than other reservoir conditions. The relative market share for these conditions (compared to the status quo of choosing neither) is shown in Figure 45 and the relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir is shown in Figure 46.

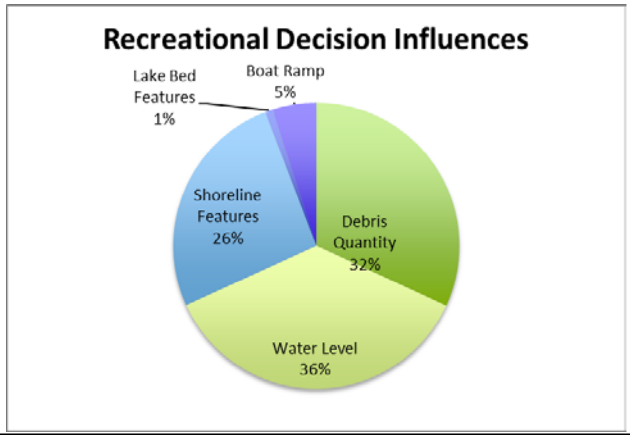
RECREATION BASED ON WATER LEVEL				
El<216.5	216.5<El<217.5m	217.5<El<218.5	218.5<El<220.0	>220.0m
(1)LOW LOW	(2)Low	(3)Average	(4)High	(5)HIGH HIGH
68%	87%	89%	88%	81%
0.63	1.92	2.42	2.16	1.25

Figure 45. Market share (% of recreationist choosing to recreate at the reservoir compared to choosing neither) of recreationists visiting a reservoir with no debris, sandy shores, grass/woody lakebeds, and no boat launch by water level. Total utility at each water level is shown below % values.

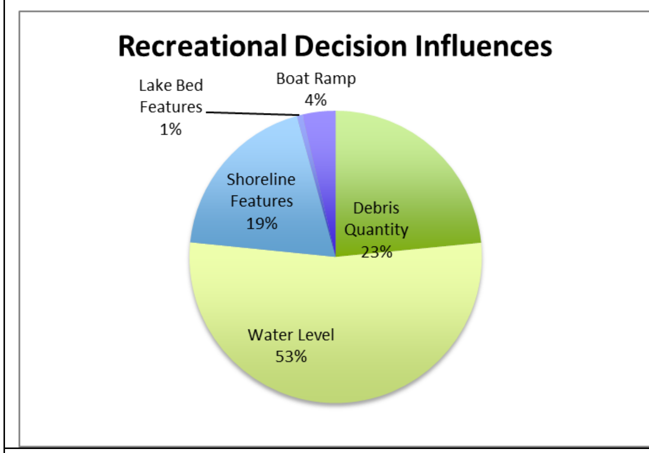
(1)LOW LOW



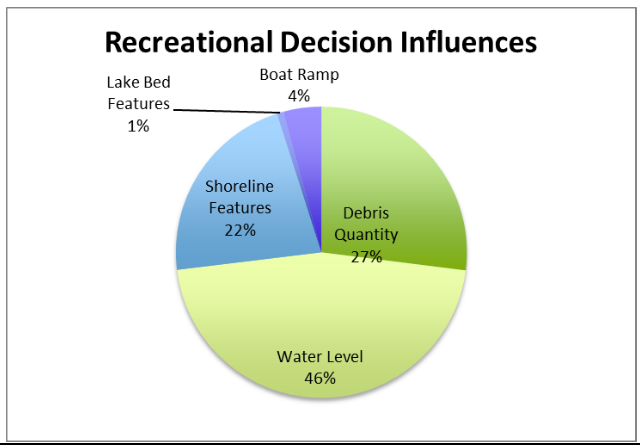
(2)Low



(3)Average



(4)High



(5)HIGH HIGH

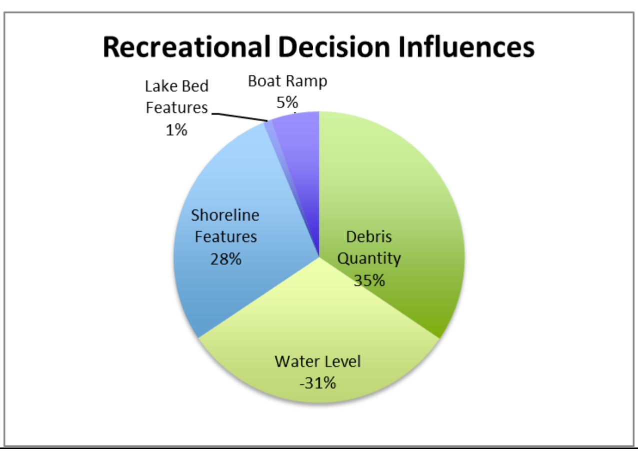


Figure 46. Relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir with no debris, sandy shores, grass/woody lakebeds, and no boat launch by water level. Negative (-%) values indicate negative utility for the reference attribute level.

3. **Reservoir conditions where water level most likely influences recreational decisions** – Examining individual preferences for each reservoir feature (e.g. debris, shoreline, sediment features, boat launch, and water level) reveals the combination of features where water level is most likely to influence recreationist decisions to recreate at the reservoir (i.e. the levels for debris, shoreline, sediment features, and boat launch have the least impact, leaving water level the most influencing factor in the decision). These reservoirs feature ***little debris, rocky shores, sediment lakebeds, and gravel road boat launches***. The relative market share for this combination of reservoir features (compared to the status quo of choosing neither) is shown in Figure 47 and the relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir is shown in Figure 48.

RECREATION BASED ON WATER LEVEL				
El<216.5	*216.5<El<217.5m*	*217.5<El<218.5*	*218.5<El<220.0*	*>220.0m*
(1)LOW LOW	*(2)Low*	*(3)Average*	*(4)High*	*(5)HIGH HIGH*
55%	79%	82%	81%	71%
0.35	1.07	1.35	1.20	0.70

Figure 47. Market share (% of recreationist choosing to recreate at the reservoir compared to not going) of recreationists visiting a reservoir with little debris, rocky shores, sediment lakebeds, and a gravel boat launch by water level. Total utility at each water level is shown below % values.

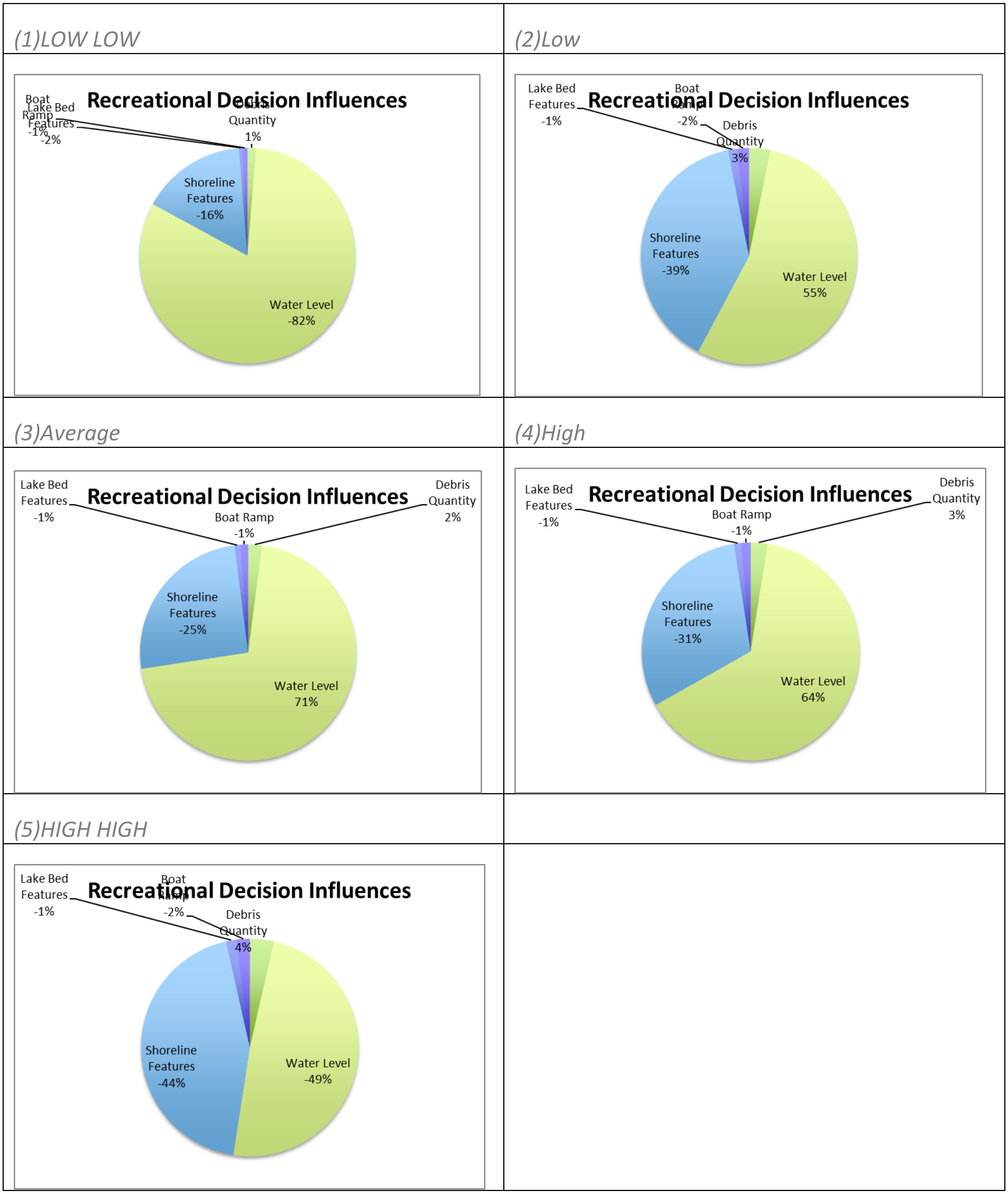


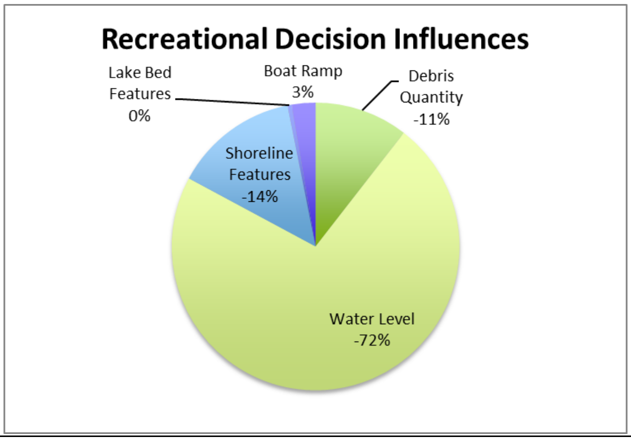
Figure 48. Relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir with little debris, rocky shores, sediment lakebeds, and a gravel boat launch by water level. Negative (-%) values indicate negative utility for the reference attribute level.

4. **Reservoir conditions most characteristic of Upper Campbell Reservoir** – Existing reservoir conditions in the Upper Campbell Reservoir present the following combination of features: ***No boat launch, rocky shoreline, sediment lakebed, and average debris levels.*** The relative market share for these conditions (compared to the status quo of choosing neither) is shown in Figure 49 and the relative scale of each reservoir feature contributing to the decision of recreationists visiting a reservoir is shown in Figure 50.

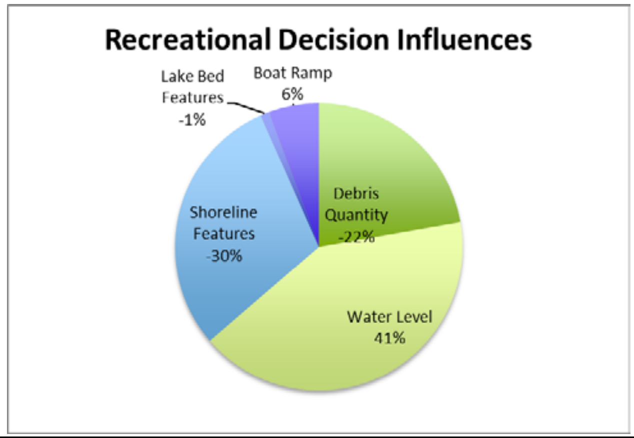
RECREATION BASED ON WATER LEVEL				
El<216.5	*216.5<El<217.5m*	*217.5<El<218.5*	*218.5<El<220.0*	*>220.0m*
(1)LOW LOW	*(2)Low*	*(3)Average*	*(4)High*	*(5)HIGH HIGH*
52%	77%	81%	79%	68%
0.32	0.97	1.22	1.09	0.63

Figure 49. Market share (% of recreationists choosing to recreate at the reservoir compared to not going) of recreationists visiting the existing Upper Campbell Reservoir with average debris, rocky shores, sediment lakebeds, and no boat launch by water level. Total utility at each water level is shown below % values.

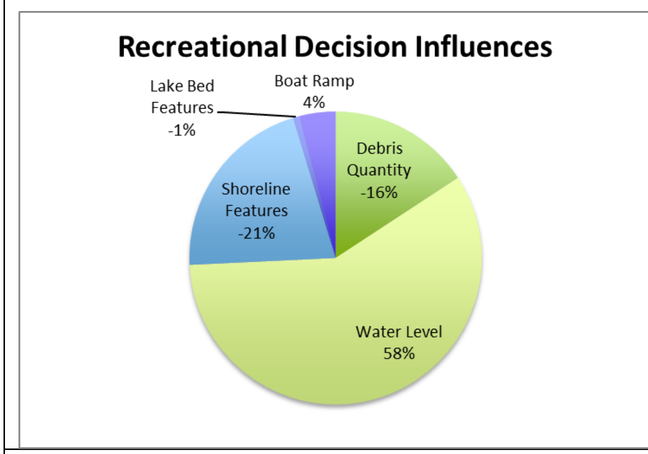
(1)LOW LOW



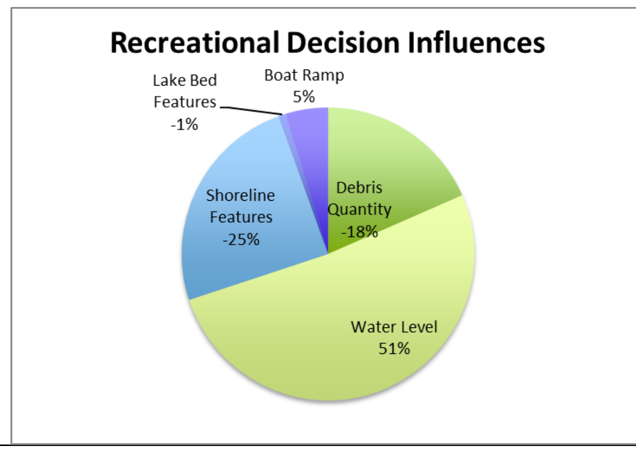
(2)Low



(3)Average



(4)High



(5)HIGH HIGH

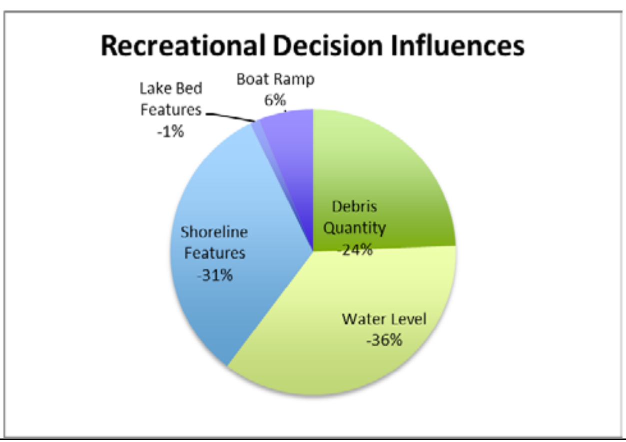


Figure 50. Relative scale of each reservoir feature contributing to the decision of recreationists visiting the existing Upper Campbell reservoir with average debris, rocky shores, sediment lakebeds, and no boat launch by water level. Negative (-%) values indicate negative utility for the reference attribute level.

5. **Reservoir conditions most likely to compensate for LOW LOW water levels** – LOW LOW water levels are least preferred by recreationists. During LOW LOW water conditions, shoreline features (i.e. sandy shores) and debris levels can compensate for LOW LOW conditions. Clearing debris can increase recreational visits by 8% (compared to those shown in Figure 43) and sandy shorelines can further increase recreational visits by another 8%. During LOW LOW water conditions, shoreline features and debris levels account for between 25% and 29% of the overall sum of total utility (influenced by other reservoir features) with higher utility values indicating a greater preference by recreationist for the given conditions.

4 DISCUSSION

Investigations of public use and perceptions of the Campbell Reservoir system have now been completed for 3.5 years, revealing some interesting developments since the first year of data analysis. Continued data collection has provided a deeper understanding of public perceptions of recreational use in the study area and revealed further insights into how different operating regimes may influence perceptions. The analyses have also provided a general characterization of the people, activities and patterns of use in the study area.

In general, respondents had favourable perceptions of their experiences at the reservoirs, rivers and waterfalls as gauged by the performance measures. For reservoirs, the performance measure with the highest frequency of positive responses in Year 4 (2018) was regarding perceptions of safety, where a total of 36% of reservoir visitors reported feeling "very safe" while engaged in recreation at a reservoir and a further 32% reported feeling "somewhat safe". This remained the performance measure with the highest frequency of positive responses, although the proportion of respondents reporting they felt "very safe" was lower then previous study years. This difference could not be explained by the addition of a new sampling location at Strathcona Lodge on Upper Campbell Reservoir.

In contrast, the performance measures with the highest frequency of negative responses were regarding access to the beach and access to the water via shoreline. A total of 19.3% of respondents reported being either "somewhat dissatisfied" or "very dissatisfied" with access to the water via the shoreline, and a similar 18.5% of respondents reported "somewhat dissatisfied" or "very dissatisfied" with access to the beach. These figures are similar to those observed in Year 2, although Year 2 included a period of very low water elevation at Buttle Lake which had a negative influence on visitors' access. A similar very low water period was not observed during the study period in Year 4 although further examination did identify that the bulk of negative responses were from respondents at Buttle Lake. The proportion of individuals reporting dissatisfaction with access to the beach and water via shoreline remained largely consistent at Upper and Lower Campbell Reservoirs between years.

The management question for reservoirs involved comparing the performance measures with average daily water elevations. Similar to Year 3, no significant correlations were identified in Year 4 between daily average water elevation and the various performance measures for the three reservoirs. Significant relationships were identified in Year 2 between water elevations and the various performance measures, although these relationships were only observed at Buttle Lake. No significant relationships were noted for Upper or Lower Campbell Reservoirs. The rationale for why no significant relationships were noted in Year 4 is uncertain. One possible explanation could be associated with the limited range of water elevations that were experienced by respondents during sampling in Year 4. Efforts were made in Year 4 to extend sampling at the reservoirs across more days in an effort to capture a wider range of water elevations. These efforts, however, were still limited by the need to sample during the operational periods of the various parks and recreation sites. With most sites only being open between late spring and early fall, some of the most extreme ranges of water elevations may not have been sampled (e.g. high water in early spring). Furthermore, extreme water elevations, both high and low, are generally avoided during management of the reservoirs unless necessary due to power needs and other management requirements (e.g. maintaining downstream river flows for fish and other ecological demands). Analysis in Year 2 suggested that extremely low water conditions (as experienced at Buttle Lake in 2015) might result in lower satisfaction by visitors. This conclusion is supported by results from the Discrete Choice Experiment for Upper Campbell Reservoir, which demonstrated that respondents' choices are most influenced by extreme water levels (e.g. LOW LOW, and HIGH HIGH as described in the Upper Campbell Decision Support System). This observation suggests that correlations between water elevation and performance measures might not have been detected in Year 3 or 4 as a result of respondents not being sampled during periods of very low water elevation when water levels are most influential.

The frequency of responses for performance measures at the river locations indicate that respondents generally had positive perceptions regarding their recreational experience at riverine environments in the Campbell River reservoir system. Year 4 had the highest frequency of respondents reporting very positively for all three riverine performance measures in comparison to the other study years. Over 50% of respondents responded very positively. Perception of safety at rivers had the highest frequency of very positive responses, with 56.3% of river visitors reporting feeling "very safe" while engaged in recreation at a river.

As with the results for reservoirs, responses to the performance measure questions associated with river recreation were compared between study years to identify any significant changes. Significant differences in the distribution of responses were noted for the influence of river flow on experience, and satisfaction with shoreline conditions. In both cases, a general increase of very positive responses and fewer somewhat positive responses were noted in Study Year 4 compared to previous years. The rationale for these significant shifts in opinion were not explored.

In order to address the management questions for riverine environment, correlations were explored between water flow rates and the responses to the riverine performance measure questions. Significant relationships were identified between river flow rates and all three performance measures, but not at all river locations. A weak, positive correlation was noted at Campbell River where increased flow rates were related to a positive influence on recreation experience. A similar weak but positive correlation was noted on Campbell River between flow rate and satisfaction with shoreline conditions. At Quinsam River, river flow rates were also found to be positively correlated to satisfaction with shoreline. A weak but significant positive correlation was identified at Quinsam River for perception of river safety. These results should be interpreted with caution as sampling in Year 4 did not coincide with the more-extreme ranges of water flows (e.g. no responses during very high and very low flows at either river location). The development of a discrete choice experiment focused on a riverine environment in future study years might provide more insights into this relationship.

Compared to the river and reservoir locations, Elk Falls had the highest frequency of positive responses overall. Over 93.2% of respondents at Elk Falls reported being “very satisfied” or “somewhat satisfied” with their recreation experience, and 92.1% of respondents at Elk Falls described the waterfalls as being “very impressive” or “somewhat impressive”. When these performance measures were examined in relation to water flows, as per the management question for Elk Falls, it is evident that flow rate does not appear to have any significant relationship to the impression or satisfaction of visitors to the falls. Rather, visitors to Elk Falls seem to have a positive experience regardless of the flow, based on the flow conditions experienced by respondents in Year 4. Comparisons of results for the Elk Falls performance measures identified a significant difference in the distribution of responses in Year 4, with a higher frequency than previous years responding that the falls were very impressive.

In addition to findings specific to each location type (i.e., reservoirs, rivers, falls), the study aims to identify any potential relationships and trade-offs for visitor experience between location types as a result of water management in the reservoir system. Of particular interest is how reservoir operations may influence visitor experiences at riverine locations. The hypothesis is that management of riverine flows may often come with a trade-off to water levels in the reservoirs, and vice versa. Retaining higher water elevations within the reservoirs, for example, generally requires a reduction in water flows in the rivers downstream; similarly, maintaining base flows in the rivers may require drawing down reservoir water elevations. Water management of the reservoirs has an inevitable effect on downstream riverine flows. However, BC Hydro is capable of managing releases in a variety of ways that can influence the downstream flow dynamics (e.g. releases completed in pulses vs. releases completed as a more-gradual drawdown). Such management options may provide opportunities to mitigate any potential trade-offs that may be associated particular flow dynamics. As noted in the results, the relationship between water flows and satisfaction of riverine-based recreationists was not definitive although results in Year 4 appeared to support that higher flow rates were sometimes associated with more positive perceptions.

The relationship between visitor satisfaction and water elevations at reservoirs was inconclusive. Results from Year 2 of the study suggested that higher water elevations at reservoirs were associated with more positive recreational experiences, but only at Buttle Lake, although this relationship was not significant in Year 3 or 4. Assuming that satisfaction generally improves at higher water elevations at reservoirs, these outcomes suggest that reservoir and river-based operations could conflict with one another in some settings (e.g., maintaining higher water elevations in the reservoirs with subsequent lower flows in the rivers might result in greater satisfaction for reservoir users and reduced satisfaction for river users). Given the lack of significant relationships in all reservoir locations in Year 4, however, this relationship is uncertain and still needs to be explored further. Future surveying using a discrete choice experiment focused on rivers and using results from the reservoir-based DCEs may provide some more clarity.

In the developed Upper Campbell Decision Support System (UCDSS) one can compare how many recreationists (i.e. what percentage of the sample population) would choose to recreate on any combination of possible reservoir conditions (240 possible combinations of conditions for the Upper Campbell system). The UCDSS provides information about intended choices allowing managers to make more informed decisions about water reservoir operations. For example, the UCDSS allows for development of performance criteria associated with tested reservoir attributes – such as water operations affecting reservoir levels – on recreationists' decisions to recreate. This information can inform planners about water reservoir management strategies that may maximize recreational values, among broader performance criteria. Further, information from the UCDSS can measure the effect of existing operational criteria. The UCDSS can be utilized and shared between stakeholders to demonstrate the effect management decisions (from those affecting the attributes measured in the DCE) have on recreational choices.

To date, the analyses associated with this monitor contributes to our understanding of public use and perceptions in the Campbell Reservoir system but also highlights limitations to which conclusions can be drawn. The power analyses, based on results from Year 2 and Year 3, identified that it will be difficult, if not impossible, to achieve a desired power of 0.80 for many of the performance measures. The small effect that water conditions appear to have on visitors' perceptions and preferences, large variability between respondents, and practical constraints to sampling across the full range of water conditions (e.g., closures of parks and recreational sites for much of year, limited number of sample days available) all make achieving the desired power challenging.

Despite these challenges, efforts were made to increase the power of the study, and further adjustments may be possible in future years. In order to maximize the power of the study, sampling in 2018 was spread across more days, and focused only on locations where hydrometric data are available (e.g. elimination of McIvor Lake and addition of Strathcona Lodge on Upper Campbell Reservoir). Additionally, some of these shortcomings can be addressed by the discrete choice experiments, as they allow us to test preferences at extreme water conditions through alternative methods, allowing insights that can support in the evaluation of the management questions.

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APPENDIX A. BASIC DESCRIPTIVE STATISTICS OF RESPONSES FOR SURVEY QUESTIONS

1. a) Are you a day visitor or overnight visitor?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Day Visitor	188	33.9	35.4	35.4
	Overnight Visitor	343	61.9	64.6	100.0
	Total	531	95.8	100.0	
Missing	System	23	4.2		
Total		554	100.0		

b) How many days are you spending in the Campbell River Reservoir System on this trip?

Number of days in area

N	Valid	531
	Missing	23
Mean		3.94
Median		3.00
Mode		1
Std. Deviation		3.415
Variance		11.659
Minimum		1
Maximum		21

2. If staying overnight in the Campbell River system area, what type of accommodation are you using?

		Responses		Percent of Cases
		N	Percent	
Accomodation Type[a]	Tent	89	24.8%	25.9%
	Motorhome	54	15.0%	15.7%
	Trailer	132	36.8%	38.5%
	Camper	41	11.4%	12.0%
	Cabin	32	8.9%	9.3%
	Other	1	0.3%	0.3%
	Hotel	6	1.7%	1.7%
	Friend/Family	3	0.8%	0.9%
	Rental/BnB	1	0.3%	0.3%
Total		359	100.0%	104.7%

a. Group

3. What activity was the most important for you in your decision to visit the Campbell River Reservoir system for this trip?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Beach	10	1.8	1.9	1.9
	Boat	4	.7	.8	2.7
	Camp	247	44.6	47.1	49.8
	Canoe	2	.4	.4	50.2
	Dog	49	8.8	9.4	59.5
	Falls	33	6.0	6.3	65.8
	Fish	29	5.2	5.5	71.4
	Hike	81	14.6	15.5	86.8
	Kayak	7	1.3	1.3	88.2
	Other	8	1.4	1.5	89.7
	Picnic	6	1.1	1.1	90.8
	Sight-seeing	36	6.5	6.9	97.7
	Swim	12	2.2	2.3	100.0
	Total	524	94.6	100.0	
Missing		30	5.4		
Total		554	100.0		

Other activities listed:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		546	98.6	98.6	98.6
	Biking	2	.4	.4	98.9
	Relaxing	1	.2	.2	99.1
	Visiting	4	.7	.7	99.8
	Wedding	1	.2	.2	100.0
	Total	554	100.0	100.0	

4. Which areas in the Campbell River system have you visited or anticipate visiting for recreational activities for recreational activities on this trip?

		Responses		Percent of
		N	Percent	Cases
Areas visited during trip[a]	Elk Falls	126	18.6%	24.2%
	Campbell River	79	11.7%	15.2%
	Lower Campbell Reservoir	105	15.5%	20.2%
	Upper Campbell Reservoir	63	9.3%	12.1%
	Quinsam River	128	18.9%	24.6%
	Salmon River	5	0.7%	1.0%
	McIvor Lake	37	5.5%	7.1%
	Buttle Lake	130	19.2%	25.0%
	Other	5	0.7%	1.0%
Total		678	100.0%	130.4%

a. Group

5. Have you recreated on the water or on the shore of any lakes/reservoirs in the Campbell River system during this trip?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	254	45.8	47.4	47.4
	Yes	282	50.9	52.6	100.0
	Total	536	96.8	100.0	
Missing	3	18	3.2		
Total		554	100.0		

6. Which lake/reservoir did you recreate at most recently on this trip?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Buttle Lake	103	18.6	36.9	36.9
	Lower Campbell Lake	99	17.9	35.5	72.4
	McIvor Lake	34	6.1	12.2	84.6
	Other	6	1.1	2.2	86.7
	Upper Campbell Lake	37	6.7	13.3	100.0
	Total	279	50.4	100.0	
Missing	System	275	49.6		
Total		554	100.0		

7. When was your most recent visit to this lake/reservoir?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Today	208	37.5	74.6	80.3
	Yesterday	44	7.9	15.8	100.0
	Two days ago	11	2.0	3.9	84.2
	Other	16	2.9	5.7	5.7
	Total	279	50.4	100.0	
Missing	System	275	49.6		
Total		554	100.0		

8. During your most recent visit to this lake/reservoir, what activities did you participate in?

		Responses		Percent of Cases
		N	Percent	
Lake Activities[a]	Camping	163	20.3%	59.9%
	Windsurfing	1	0.1%	0.4%
	Waterskiing	3	0.4%	1.1%
	Swimming	53	6.6%	19.5%
	Beach activities	59	7.4%	21.7%
	Viewing falls	10	1.2%	3.7%
	Power boating	31	3.9%	11.4%
	Fishing	86	10.7%	31.6%
	Kayaking	68	8.5%	25.0%
	Picnicking	62	7.7%	22.8%
	Dog walking	67	8.4%	24.6%
	Canoeing	11	1.4%	4.0%
	Hiking/Walking	88	11.0%	32.4%
	Wildlife Viewing	21	2.6%	7.7%
	Other	4	0.5%	1.5%
	Sightseeing (general)	43	5.4%	15.8%
	SUP	9	1.1%	3.3%
	ATV	3	0.4%	1.1%
	Biking	19	2.4%	7.0%
Total		801	100.0%	294.5%

a. Group

9. Based on your most recent activities at the lake/reservoir, how did water levels influence your recreation experience?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Positive	89	16.1	35.0	100.0
	Somewhat Positive	73	13.2	28.7	65.0
	No influence	68	12.3	26.8	36.2
	Somewhat Negative	19	3.4	7.5	9.4
	Very Negative	5	.9	2.0	2.0
	Total	254	45.8	100.0	
Missing	System	300	54.2		
Total		554	100.0		

10. Thinking of the lake/reservoir that you recreated at most recently, were there any water-based or shore-based activities that you were going to participate in that you were unable to do specifically because of the water level?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	251	45.3	96.9	96.9
	Yes	8	1.4	3.1	100.0
	Total	259	46.8	100.0	
Missing	System	295	53.2		
Total		554	100.0		

Activities identified that respondents were unable to do because of the water level:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		550	99.3	99.3	99.3
	Some activities (activity unspecified)	1	.2	.2	99.5
	Swimming	1	.2	.2	99.6
	Launch boat	1	.2	.2	99.8
	Water too high (activity unspecified)	1	.2	.2	100.0
	Total	554	100.0	100.0	

11. Based on your most recent activities at the lake/reservoir, how satisfied were you with the shoreline conditions while engaged in water-based recreation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	80	14.4	30.9	100.0
	Somewhat Satisfied	83	15.0	32.0	69.1
	Neither Satisfied nor Dissatisfied	78	14.1	30.1	37.1
	Somewhat Dissatisfied	15	2.7	5.8	6.9
	Very Dissatisfied	3	.5	1.2	1.2
	Total	259	46.8	100.0	
Missing	System	295	53.2		
Total		554	100.0		

12. Based on your most recent activities at the lake/reservoir, how safe did you feel engaging in water-based recreation given water levels at that time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Safe	103	18.6	40.2	100.0
	Somewhat Safe	80	14.4	31.3	59.8
	Neither Safe nor Unsafe	61	11.0	23.8	28.5
	Somewhat Unsafe	10	1.8	3.9	4.7
	Very Unsafe	2	.4	.8	.8
	Total	256	46.2	100.0	
Missing	System	298	53.8		
Total		554	100.0		

13. What conditions, if any, did you encounter during your time recreating at the lake/reservoir that posed a safety concern to you?

		Responses		Percent of
		N	Percent	Cases
Safety Concerns[a]	Floating Debris	5	1.7%	1.9%
	Visible Stumps	56	19.1%	21.5%
	Hidden Stumps	30	10.2%	11.5%
	Boat Launch Conditions	6	2.0%	2.3%
	Other	11	3.8%	4.2%
	No Safety Concerns	185	63.1%	70.9%
Total		293	100.0%	112.3%

a. Group

Other safety concerns mentioned for lakes/reservoirs:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		544	98.2	98.2	98.2
	Broken glass on beach	2	.4	.4	98.6
	Condition of dock	5	.9	.9	99.5
	Cut trees	1	.2	.2	99.6
	Debris	1	.2	.2	99.8
	Massive outflow	1	.2	.2	100.0
	Total	554	100.0	100.0	

14. Given the water levels at the time, how satisfied were you during your most recent activities at the reservoir with access to…:

a) the beach?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	89	16.1	34.4	91.5
	Somewhat Satisfied	68	12.3	26.3	57.1
	Neither Satisfied nor Dissatisfied	32	5.8	12.4	30.9
	Somewhat Dissatisfied	34	6.1	13.1	18.5
	Very Dissatisfied	14	2.5	5.4	5.4
	Not Applicable	22	4.0	8.5	100.0
	Total	259	46.8	100.0	
Missing	System	295	53.2		
Total		554	100.0		

b) the water via a boat launch?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	47	8.5	18.9	68.7
	Somewhat Satisfied	46	8.3	18.5	49.8
	Neither Satisfied nor Dissatisfied	42	7.6	16.9	31.3
	Somewhat Dissatisfied	25	4.5	10.0	14.5
	Very Dissatisfied	11	2.0	4.4	4.4
	Not Applicable	78	14.1	31.3	100.0
	Total	249	44.9	100.0	
Missing	System	305	55.1		
Total		554	100.0		

c) the water via the shoreline?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	81	14.6	31.9	94.1
	Somewhat Satisfied	64	11.6	25.2	62.2
	Neither Satisfied nor Dissatisfied	45	8.1	17.7	37.0
	Somewhat Dissatisfied	30	5.4	11.8	19.3
	Very Dissatisfied	19	3.4	7.5	7.5
	Not Applicable	15	2.7	5.9	100.0
	Total	254	45.8	100.0	
Missing	System	300	54.2		
Total		554	100.0		

15. NOTE: Questions 15-20 in the survey are associated with the Discrete Choice Experiment and are summarized in the body of the report.

21. Have you visited Elk Falls during this trip?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	357	64.4	66.5	66.5
	Yes	180	32.5	33.5	100.0
	Total	537	96.9	100.0	
Missing		17	3.1		
Total		554	100.0		

22. When was your most recent visit to Elk Falls?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Today	116	20.9	64.4	72.2
	Yesterday	34	6.1	18.9	100.0
	Two days ago	16	2.9	8.9	81.1
	Other	14	2.5	7.8	7.8
	Total	180	32.5	100.0	
Missing		374	67.5		
Total		554	100.0		

23. Just based on water flows you observed at the falls on your most recent visit, how impressive would you rate Elk Falls?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Impressive	138	24.9	78.0	100.0
	Somewhat Impressive	25	4.5	14.1	22.0
	Neither Impressive or Unimpressive	11	2.0	6.2	7.9
	Somewhat Unimpressive	2	.4	1.1	1.7
	Very Unimpressive	1	.2	.6	.6
	Total	177	31.9	100.0	
Missing	System	377	68.1		
Total		554	100.0		

24. How satisfied were you with your viewing experience of Elk Falls?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	138	24.9	77.5	100.0
	Somewhat Satisfied	28	5.1	15.7	22.5
	Neither Satisfied nor Dissatisfied	8	1.4	4.5	6.7
	Somewhat Dissatisfied	3	.5	1.7	2.2
	Very Dissatisfied	1	.2	.6	.6
	Total	178	32.1	100.0	
Missing	System	376	67.9		
Total		554	100.0		

25. Have you recreated on the water or on the shore of any rivers in the Campbell River system during this trip?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N	390	70.4	73.9	73.9
	Y	138	24.9	26.1	100.0
	Total	528	95.3	100.0	
Missing	3	26	4.7		

Total	554	100.0		

26. Which river did you recreate at most recently on this trip?

		Responses		Percent of Cases
		N	Percent	
River Visited[a]	Quinsam River	88	63.8%	63.8%
	Campbell River	47	34.1%	34.1%
	Other	3	2.2%	2.2%
Total		138	100.0%	100.0%

a. Group

Other rivers:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		553	99.8	99.8	99.8
	Ralph	1	.2	.2	100.0
	Total	554	100.0	100.0	

27. When was your most recent visit to this river?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Today	111	20.0	81.6	87.5
	Yesterday	16	2.9	11.8	100.0
	Two days ago	1	.2	.7	88.2
	Other	8	1.4	5.9	5.9
	Total	136	24.5	100.0	
Missing		418	75.5		
Total		554	100.0		

28. During your most recent visit to this river, what activities did you participate in?

		Responses N	Responses Percent	Percent of Cases
River Activities[a]	Camping	35	13.2%	26.9%
	Fishing	53	19.9%	40.8%
	Swimming	5	1.9%	3.8%
	Beach activities	3	1.1%	2.3%
	Boating	1	0.4%	0.8%
	Hiking/Walking	68	25.6%	52.3%
	Picnicking	12	4.5%	9.2%
	Dog walking	35	13.2%	26.9%
	Canoeing	1	0.4%	0.8%
	Kayaking	2	0.8%	1.5%
	Wildlife Viewing	16	6.0%	12.3%
	Sightseeing	33	12.4%	25.4%
	Other	2	0.8%	1.5%
Total		266	100.0%	204.6%

a. Group

Other activities respondents reported participating in:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		552	99.6	99.6	99.6
	Biking	1	.2	.2	99.8
	Tubing	1	.2	.2	100.0
	Total	554	100.0	100.0	

29. Thinking of the river that you recreated at most recently, were there any water-based activities that you were going to participate in that you were unable to do specifically because of the river-flow conditions?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	126	22.7	96.9	96.9
	Yes	4	.7	3.1	100.0
	Total	130	23.5	100.0	
Missing		424	76.5		
Total		554	100.0		

Activities identified that respondents were unable to do because of the river flow conditions:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		550	99.3	99.3	99.3
	Rapids	1	.2	.2	99.5
	Tubing	3	.5	.5	100.0
	Total	554	100.0	100.0	

30. Based on your most recent activities at the river, how did water flows influence your recreation experience?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Positive	66	11.9	51.2	100.0
	Somewhat Positive	28	5.1	21.7	48.8
	No influence	32	5.8	24.8	27.1
	Somewhat Negative	3	.5	2.3	2.3
	Total	129	23.3	100.0	
Missing	System	425	76.7		
Total		554	100.0		

31. Based on your most recent activities at the river, how satisfied were you with the shoreline conditions while engaged in water-based recreation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Satisfied	65	11.7	51.2	100.0
	Somewhat Satisfied	25	4.5	19.7	48.8
	Neither Satisfied nor Dissatisfied	32	5.8	25.2	29.1
	Somewhat Dissatisfied	5	.9	3.9	3.9
	Total	127	22.9	100.0	
Missing	System	427	77.1		
Total		554	100.0		

32. Based on your most recent activities at the river, how safe did you feel engaging in water-based recreation given the current water flow?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Safe	72	13.0	56.3	100.0
	Somewhat Safe	33	6.0	25.8	43.8
	Neither Safe nor Unsafe	19	3.4	14.8	18.0
	Somewhat Unsafe	4	.7	3.1	3.1
	Total	128	23.1	100.0	
Missing	System	426	76.9		
Total		554	100.0		

33. What conditions, if any, did you encounter during your time recreating on the river that posed a safety concern to you?

		Responses		Percent of Cases
		N	Percent	
River Safety Concerns[a]	High flows	9	6.9%	7.0%
	Floating debris	2	1.5%	1.6%
	Poor access conditions	5	3.8%	3.9%
	Exposed hazards	2	1.5%	1.6%
	None	113	86.3%	88.3%
Total		131	100.0%	102.3%

a. Group

Other safety concerns mentioned for rivers:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	554	100.0	100.0	100.0
	Total	554	100.0	100.0	100.0

34. Is this your first visit to the Campbell River system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	369	66.6	69.1	69.1
	Yes	165	29.8	30.9	100.0
	Total	534	96.4	100.0	
Missing		20	3.6		
Total		554	100.0		

35. On average, how many days per season do you typically visit the Campbell River system?

a) Spring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4 days plus	202	36.5	56.4	78.8
	2-3 days	80	14.4	22.3	22.3
	Once	39	7.0	10.9	100.0
	Less than once	4	.7	1.1	79.9
	Never	33	6.0	9.2	89.1
	Total	358	64.6	100.0	
Missing	System	196	35.4		
Total		554	100.0		

b) Summer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4 days plus	291	52.5	80.6	93.4
	2-3 days	46	8.3	12.7	12.7
	Once	12	2.2	3.3	100.0
	Less than once	6	1.1	1.7	95.0
	Never	6	1.1	1.7	96.7
	Total	361	65.2	100.0	
Missing	System	193	34.8		
Total		554	100.0		

c) Winter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4 days plus	65	11.7	18.4	29.9
	2-3 days	41	7.4	11.6	11.6
	Once	37	6.7	10.5	100.0
	Less than once	22	4.0	6.2	36.2
	Never	189	34.1	53.4	89.5
	Total	354	63.9	100.0	
Missing	System	200	36.1		
Total		554	100.0		

d) Fall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4 days plus	110	19.9	31.2	48.2
	2-3 days	60	10.8	17.0	17.0
	Once	35	6.3	9.9	100.0
	Less than once	11	2.0	3.1	51.3
	Never	137	24.7	38.8	90.1
	Total	353	63.7	100.0	
Missing	System	201	36.3		
Total		554	100.0		

36. What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	314	56.7	60.9	60.9
	Male	202	36.5	39.1	100.0
	Total	516	93.1	100.0	
Missing		38	6.9		
Total		554	100.0		

37. What is your current age?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 25	41	7.4	7.9	100.0
	25-34	91	16.4	17.6	17.6
	35-44	139	25.1	26.9	44.6
	45-54	95	17.1	18.4	63.0
	55-64	78	14.1	15.1	78.1
	64 plus	72	13.0	14.0	92.1
	Total	516	93.1	100.0	
Missing	7	38	6.9		
Total		554	100.0		

38. How many people are in your party today?

Party Size

N	Valid	505
	Missing	49
Mean		3.39
Median		3.00
Mode		2
Std. Deviation		2.462
Variance		6.064
Minimum		1
Maximum		24

39. Where do you currently reside (i.e., where you have lived for more than 6 months out of the past year)?

a) City

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100 Mile House	1	.2	.2	.2
	Alert Bay	1	.2	.2	.4
	Bella Bella	1	.2	.2	.6
	Bellingham	1	.2	.2	.8
	Black Creek	2	.4	.4	1.2
	Burnaby	4	.7	.8	2.0
	Calgary	7	1.3	1.4	3.4
	Cambridge	1	.2	.2	3.6
	Campbell River	237	42.8	47.9	51.5
	Canmore	1	.2	.2	51.7
	Chemanius	1	.2	.2	51.9
	Coeur d alene	1	.2	.2	52.1
	Comic Valley	1	.2	.2	52.3
	Comox	16	2.9	3.2	55.6
	Comox Valley	2	.4	.4	56.0
	Coombs	4	.7	.8	56.8
	Cortez	1	.2	.2	57.0
	Cortez Island	2	.4	.4	57.4

	Courtenay	27	4.9	5.5	62.8
	Cranbook	1	.2	.2	63.0
	Cumberland	8	1.4	1.6	64.6
	Duncan	10	1.8	2.0	66.7
	Edmonton	2	.4	.4	67.1
	Gold River	5	.9	1.0	68.1
	Grande Cache	1	.2	.2	68.3
	Kamloops	5	.9	1.0	69.3
	Kelowna	8	1.4	1.6	70.9
	Ladysmith	1	.2	.2	71.1
	Langley	2	.4	.4	71.5
	Lantzville	2	.4	.4	71.9
	Lethbridge	2	.4	.4	72.3
	Maple Ridge	1	.2	.2	72.5
	Melbourne	1	.2	.2	72.7
	Nanaimo	20	3.6	4.0	76.8
	Olympia	1	.2	.2	77.0
	Ottawa	1	.2	.2	77.2
	Parksville	7	1.3	1.4	78.6
	Port Alberni	6	1.1	1.2	79.8
	Port Coquitlam	2	.4	.4	80.2
	Port Hardy	3	.5	.6	80.8
	Port McNeill	1	.2	.2	81.0
	Portland	1	.2	.2	81.2
	Powell River	2	.4	.4	81.6
	Prince George	1	.2	.2	81.8
	Quadra	3	.5	.6	82.4
	Quadra Island	1	.2	.2	82.6
	Regina	2	.4	.4	83.0
	Richmond	3	.5	.6	83.6
	Sacramento	2	.4	.4	84.0
	Sayward	1	.2	.2	84.2
	Seattle	4	.7	.8	85.1
	Shawnigan lake	1	.2	.2	85.3
	Sidney	1	.2	.2	85.5
	Sooke	4	.7	.8	86.3
	Strasbourg	1	.2	.2	86.5

	Surrey	2	.4	.4	86.9
	Tofino	3	.5	.6	87.5
	Toronto	4	.7	.8	88.3
	Ucluelet	1	.2	.2	88.5
	Vancouver	9	1.6	1.8	90.3
	Vancouver WA	1	.2	.2	90.5
	Vernon	4	.7	.8	91.3
	Victoria	34	6.1	6.9	98.2
	Washington DC	1	.2	.2	98.4
	Whistler	2	.4	.4	98.8
	Williams Lake	1	.2	.2	99.0
	Wiltshire	1	.2	.2	99.2
	Winnipeg	1	.2	.2	99.4
	Woss	1	.2	.2	99.6
	Yakima	1	.2	.2	99.8
	Zeballos	1	.2	.2	100.0
	Total	495	89.4	100.0	
Missing		59	10.6		
Total		554	100.0		

b) Province/State

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	AB	17	3.1	3.4	3.4
	BC	457	82.5	90.9	94.2
	CA	3	.5	.6	94.8
	DC	1	.2	.2	95.0
	FL	1	.2	.2	95.2
	MA	1	.2	.2	95.4
	ON	11	2.0	2.2	97.6
	OR	1	.2	.2	97.8
	SK	3	.5	.6	98.4
	WA	8	1.4	1.6	100.0
	Total	503	90.8	100.0	
Missing	11	51	9.2		
Total		554	100.0		

c) Country

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Canada	490	88.4	97.0	97.0
	England	1	.2	.2	97.2
	Netherlands	1	.2	.2	97.4
	USA	13	2.3	2.6	100.0
	Total	505	91.2	100.0	
Missing		49	8.8		

APPENDIX B. CAMPBELL RESERVOIRS PUBLIC USE AND PERCEPTIONS SURVEY