Wild steelhead conservation planning in the Lower Mainland Region

LOWER MAINLAND ADULT STEELHEAD SAMPLING PROGRAM

SNORKEL COUNTS: ALOUETTE, CAPILANO, CHEHALIS, COQUITLAM AND SEYMOUR RIVERS

KANAKA CREEK

SPRING 2002

prepared for the

BC Ministry of Water, Land and Air Protection
Fish and Wildlife Science and Allocation
Surrey, BC

Fisheries and Environmental Services
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ARL report no. 465
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by

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SUMMARY

This report details our second year of snorkel float counts for steelhead trout in six Lower Mainland systems: the Alouette, Capilano, Chehalis, Coquitlam and Seymour Rivers and Kanaka Creek. We conducted seven successful floats between March 10 and May 10, 2002. Additionally, we conducted one trial float and three telemetry tracks of the Capilano River. Within the Lower Mainland region, similar floats were conducted on the Big Silver, Cheakamus, Chilliwack, Coquihalla, Mamquam, Norrish, Silverhope and Ruby systems. These are reported separately.

Fewer floats were completed in 2002 were than were done in 2001, and conditions encountered were often less favourable. Nevertheless, 2002 results provide a useful index of 2002 returns. Snorkel float assessments are an effective, low cost monitoring option for Lower Mainland steelhead streams. These floats provide an index of steelhead abundance, which can be compared within and between years. However, the counts are not an estimate of total escapement, because observer efficiency, fish residence time and run timing data are not available. Estimates of these parameters, based on radio telemetry studies, can be used to calculate total escapement estimates.

Studies of the Cheakamus and Chilliwack rivers suggest that snorkel count efficiency is highly variable. As expected, efficiency is affected by discharge and turbidity. Low, clear winter conditions permit high efficiency, while generally higher, more turbid spring conditions reduce the proportion of fish present actually seen. Efficiency in Lower Mainland streams other than the Cheakamus and Chilliwack has not been estimated.

Data from snorkel floats and from other sources indicate that 2001 and 2002 were years of unusually strong steelhead returns. Available indices suggest that low brood strength and reduced marine survival may affect Lower Mainland returns in coming years. We recommend that snorkel floats be continued, particularly on the Alouette, Chehalis, Coquitlam and Seymour rivers, in order to support management decision making. Maximum snorkel count results in 2002 were:

Stream	# of floats	Survey period	Date of maximum count	Maximum steelhead count	Maximum steelhead per km
Alouette River	1	-	April 4	112	7.5
Capilano River	1	-	April 9	1	trial float
Chehalis River	1	-	March 10	146	20.0
Coquitlam River	3	April 2 – May 10	May 10	53	5.6
Kanaka Creek	1	-	April 21	9	2.6
Seymour River	1	-	April 23	31	2.1

ACKNOWLEDGEMENTS

The Ministry of Water, Land and Air Protection provided initial funding for the project. Further financial and in-kind support was provided by the Alouette River Management Society, BC Hydro and the Kanaka Education and Environmental Partnership Society.

Floats were conducted by a team including: Eva Boehringer, R. Carpenter, Jeff Greenbank, Marc Guimond, Allen Hanson, P. Harding, Dave Hunter, Duane Jesson, Scott Kirkpatrick, Steve Latham, Gord Lewis, Iain Lunn, CEJ Mussell, M. Steinmann, Josh Taylor, Pier van Dishoeck, and James Weger. Many of these individuals volunteered some or all of their time.

Many others assisted with the support for the floaters including: John Heaven, Dave Smith and Debbie Wilkinson (KEEPS), Brian Halabourda and Brian Smith (Seymour Salmonid Society), Goff Longworth (BC Hydro), Jenny Ljungrenn (ARMS), Jack Mussell and family, Steve Olson and Ross Davies.

Peter Caverhill, Brian Clark, Allen Hanson and Ross Neuman, Ministry of Water, Land and Air Protection, initiated the work, obtained initial funding and oversaw completion of the project.

The Capilano snorkel float was conducted in association with an LGL telemetry study. Our work was supported by Troy Nelson, LGL, and Marvin Rosenau, BC MWLAP.

Associated snorkel floats on the Chilliwack and Mamquam Rivers were funded by the Habitat Conservation Trust Fund. Cheakamus River counts were conducted by Ecometric Research and paid for by BC Hydro. Floats of the Big Silver, Coquihalla, Norrish, Silverhope and Ruby systems were conducted by ARL in association with the Sto:lo First Nation and funded by CLIB.

Josh Taylor, Brad Horne and Terry Maniwa provided input on the report. Lynne Campo at Environment Canada provided discharge data. Josh Korman provided data and analyses for the Cheakamus River.

Thanks.

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1 INTRODUCTION

Steelhead trout (*Oncorhynchus mykiss*) are an anadromous salmonid species native to many streams in British Columbia. Both winter- and summer-run stocks exist. A prized recreational species, steelhead may also be caught incidentally in some commercial and aboriginal fisheries. Steelhead escapement to streams in the lower Fraser River system has generally declined over the past two decades (Olmstead and McGregor 1997; Smith *et al.* 2000). Reasons for the decline are thought to include habitat degradation, reduced freshwater and oceanic survival, and harvest of steelhead by commercial, recreational and aboriginal fishermen[1].

Management of steelhead is the responsibility of the provincial Ministry of Water, Land, and Air Protection (MWLAP). Snorkel float surveys to count adult fish are an important management tool used by ministry biologists to assess steelhead stock status. Combined with juvenile density surveys, and with information from steelhead anglers, adult snorkel counts are used to index stock health and to guide management decisions. Management activities can include regulation changes, restoration initiatives and hatchery programs.

A five year (1998 to 2002) *Lower Mainland Wild Steelhead Conservation* program has conducted intensive adult and juvenile surveys, primarily on the Chilliwack and Squamish river systems (e.g. van Dishoeck 2002a, 2002b). In year four of the program, additional funding was obtained to conduct surveys of 2001 winter-run adult returns to the Alouette, Big Silver, Chehalis, Coquitlam and Seymour rivers, as well as to Kanaka Creek (van Dishoeck 2001a). Provincial biologists identified these as important regional systems with inadequate management data for winter stocks. Results suggested that snorkel float surveys could provide a useful, relatively low cost management tool for these stocks.

In 2002, funding was obtained to repeat these floats. This data report details adult steelhead surveys for winter-run fish on the Alouette, Capilano, Chehalis, Coquitlam and Seymour rivers, and Kanaka Creek. We conducted eight floats (seven successful) in these systems between March 10 and May 10, 2002. In addition, a Seymour River summer-run steelhead count was completed with the BC Conservation Foundation. The intent of all surveys was to provide index data for steelhead escapement.

[1] Incidental commercial capture of steelhead is less likely for winter-run stocks than for summer fish. Aboriginal steelhead bycatch and directed steelhead fisheries are poorly documented.

Concurrent 2002 sampling efforts included winter-run adult surveys of the Chilliwack and Mamquam rivers (van Dishoeck 2002a, 2002b). Additionally, MWLAP and ARL biologists, in consultation with the Sto:lo First Nation, obtained funding for winter-run floats of the Big Silver, Coquihalla, Norrish, Silverhope and Ruby systems (Taylor 2002). Fall 2002 juvenile surveys of the Big Silver, Norrish Silverhope and Ruby systems were also conducted (Taylor and van Dishoeck 2002).

Ecometric Research conducted snorkel floats of the Cheakamus River, another important winter-run steelhead stream in the region, in 2002. The BC Hydro-funded program has used radio and visually tagged steelhead to estimate observer efficiency, and to derive rigorous estimates of the total population, based on area-under-the-curve methodology (Korman *et al.* 2002, Korman 2002).

2 BACKGROUND

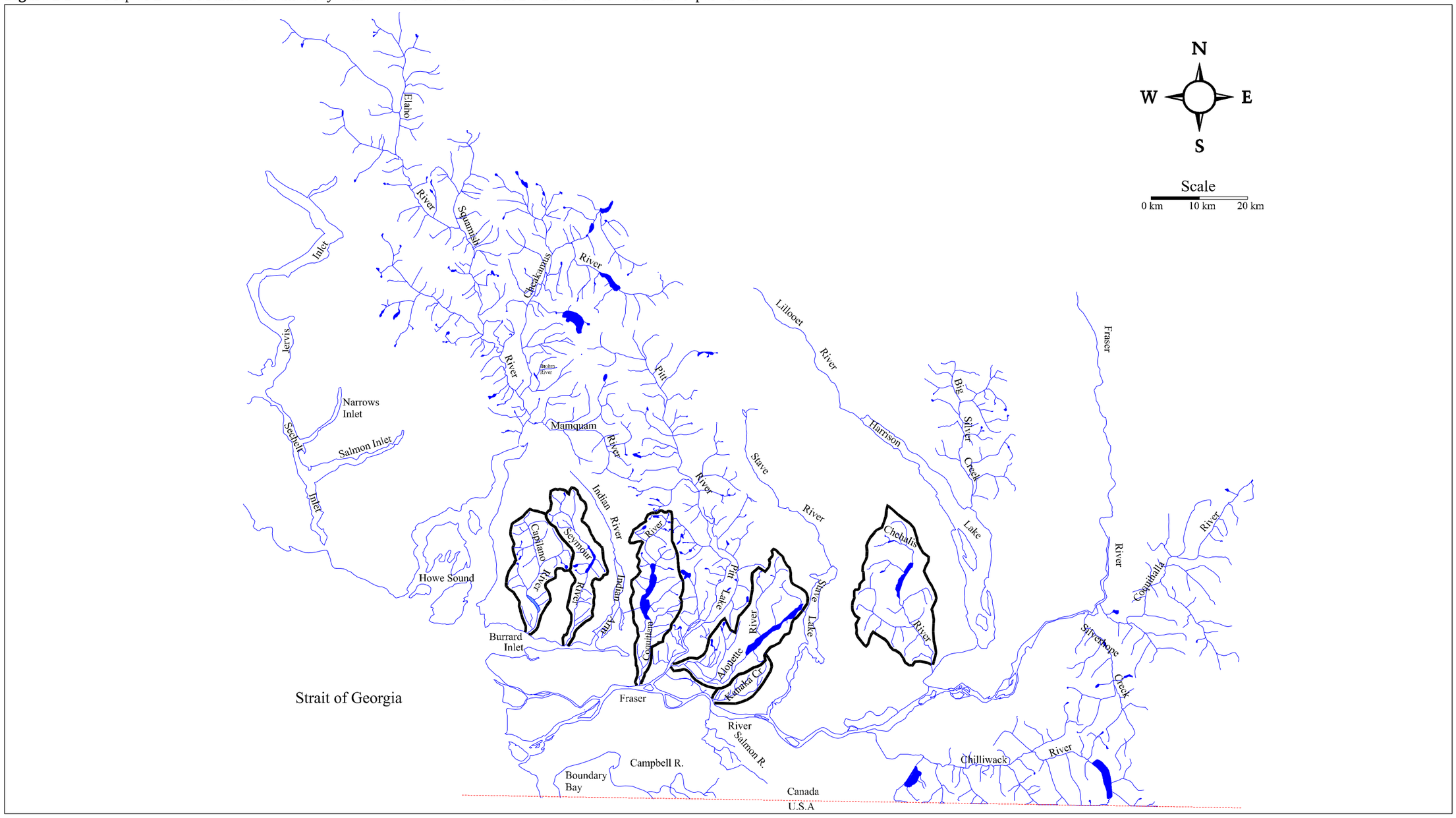
2.1 Study area

The floats conducted in 2002 are a repeat of 2001 counts (van Dishoeck 2001a), with the exception of the Capilano River, which was not floated by us in 2001. Our swim attempt in 2002 was in association with a radio telemetry project (managed by T. Nelson, LGL, White Rock, BC).

The six systems discussed in this report are Lower Mainland steelhead streams with identified conservation management concerns. The Capilano and Seymour rivers drain into the north side of Burrard Inlet (Figure 2.1). The Alouette, Chehalis, Coquitlam and Kanaka systems all drain into the north side of the Lower Fraser River.

Dams operated for water supply or power generation regulate the Alouette, Capilano, Coquitlam and Seymour rivers. As a result, they have experienced substantial habitat alteration. All have also suffered the impacts of their proximity to major urban areas. Kanaka Creek is a much smaller system, impacted by agricultural and urban development and by water extraction. The BC Ministry Water, Land and Air Protection designated Kanaka Creek as a stream sensitive to water withdrawals in March 2000. The Chehalis River is a large, unregulated system with a watershed affected by forest harvesting rather than urban development.

Figure 2.1. Map of Lower Mainland steelhead systems. Watersheds floated in 2002 and discussed in this report are indicated.



2.2 Stock character

All of the systems discussed in this report support stocks of winter-run steelhead. Summer-run stocks are also present in the Capilano, Chehalis and Seymour systems. Most summer- and winter-run steelhead spawn between February and June, but their periods of return migration are quite distinct. Summer-runs return from June through October, while winter-runs return from November through May. As both stocks are present at the time of our surveys, our counts in systems with both races represent an aggregate of the two types. However, summer-run fish have spent more time in freshwater, tend to be much darker, and therefore, can often be distinguished from the winter-run fish.

Hatchery stocking has occurred in all of the systems surveyed (Table 2.1). Our counts therefore represent an aggregate of the wild and hatchery returns. As most hatchery steelhead are marked with an adipose clip, it is possible to distinguish the two. However, on snorkel floats, we are only able to determine stock origin for those fish for which we are able to see the adipose fin (or its obvious absence)[2]. Where possible, we use this ratio to estimate the proportion of hatchery fish in the return. A more reliable estimate of this ratio might be obtained from surveys of the recreational fishery, such as the provincial Steelhead Harvest Analysis.

Table 2.1. Summary of steelhead stocking history in each of the surveyed streams.

System	Years stocked
Alouette River	1938 to 2002
Capilano River	1919 to 2002
Chehalis River	1984 to 2002
Coquitlam River	1938 to 2001
Kanaka Creek	1983 to 1998
Seymour River	1919 to 2002

(FISS 2002)

2.3 Snorkel floats

Snorkel floats provide an index of adult steelhead returns only. If floats are repeated annually, this index can be used to track abundance trends over time.

[2] Visibility conditions (limited water clarity or bubbles) mean that many steelhead observed on snorkel floats cannot be identified as hatchery or wild fish.

However, floats do not provide a measure of total escapement. This is because:

1. swimmers miss some fish;
2. it is not known if fish counted were also enumerated on a previous swim and;
3. floats do not cover the full time period of steelhead returns.

The proportion of fish seen versus those actually present is the *observer efficiency*. The *residence time* is the length of time a fish spends in the survey area, and determines the proportion of new fish counted by a subsequent float. These parameters can be estimated from a sample of fish marked with radio transmitters and external tags. Observer efficiency is estimated as visual tags seen divided by tags known to be present (from tracking). Residence time can also be determined from transmitters. Radio telemetry programs of this type have been completed on the Cheakamus River in 2000 and 2001 (McCubbing and Melville 2000, C. Melville, Instream, pers. comm.). A similar telemetry program was completed on the Chilliwack River in 2000 (Nelson *et al.* 2001).

Estimates of total escapement can be derived from observer efficiency and survey-life data by constructing a run timing curve and using an "area-under-the-curve" calculation (Hilborn *et al.* 1999). These methods were applied to Cheakamus River data for 2000 through 2002 to obtain robust total population estimates (Korman and Ahrens 2000, Korman *et al.* 2002, Korman 2002).

As observer efficiency and run timing data are not available for the streams discussed in this report, results presented are an index of total abundance only.

3 METHODS

3.1 Sampling schedule

Snorkel floats were conducted on fourteen systems in the Lower Mainland in 2002. This report directly addresses results for six of these systems, the Alouette, Capilano, Chehalis, Coquitlam and Seymour rivers and Kanaka Creek. On these six systems, we conducted eight swims between March 10 and May 10, 2002 (Table 3.1). The Capilano River, which we had not swum previously, was surveyed on a trial basis in association with a radio telemetry program. On the remaining systems, we repeated the sections swum in 2001. Due to visibility, access or discharge conditions, some sections were not repeated, or were not surveyed on all floats. Weather and water conditions critically affected our results. For most floats, we enjoyed favourable discharge and visibility, but floats were often rescheduled and some planned floats were not accomplished.

Table 3.1. Rivers surveyed and number of floats completed, selected 2002 floats.

Stream	# of floats	Survey period	Date of max. count
Alouette River	1	-	April 4
Capilano River	1	*trial float*	April 9
Chehalis River	1	-	March 10
Coquitlam River	3	April 2 – May 10	May 10
Kanaka Creek	1	-	April 21
Seymour River	1	-	April 23

3.2 Sampling methodology

Snorkel float methodology was similar across all systems examined, and followed methods used throughout BC. In general, the width of the stream was divided into three lanes and floated by a crew of three. Swimmers frequently stopped to discuss the location of fish seen and to ensure that double-counting did not inflate the final tally. Crews were equipped with dry suits and masks with snorkels. For the majority of floats, the same crew was used for swims in a given system.

We enumerated all of the species that we encountered on snorkel floats (Table 3.2). For steelhead/rainbow trout, we assumed that fish greater than 50 cm fork length were anadromous steelhead, and that smaller fish were resident rainbow trout. No attempt was made to distinguish between various species for suckers, sculpins or lamprey. It is generally difficult to differentiate char on snorkel floats (*i.e.* Bull trout *vs.* Dolly Varden).

Table 3.2. Fish species encountered during 2002 snorkel surveys.

Common Name	Species
Bull trout	*Salvelinus confluentus*
Carp	*Cyprinus carpio*
Coho salmon	*Oncorhynchus kisutch*
Cutthroat trout	*O. clarki clarki*
Dolly Varden char	*S. malma*
Lamprey	*Lampetra sp.*
Suckers	*Catastomus sp.*
Mountain whitefish	*Prosopium williamsoni*
Sculpins	*Cottus sp.*
Steelhead/rainbow trout	*O. mykiss*

When large schools of juvenile fish or non-target species were encountered, we visually estimated the number present. When large groups of steelhead were seen, we obtained the best count possible, which often required multiple passes through

a productive pool. As noted earlier, we made the distinction between summer- and winter-run fish, and between hatchery and wild stocks, where possible.

Measurements of flow stage were taken at various staff gauges found in the watersheds surveyed. If no staff gauge was located, an improvised location was used to obtain relative stage measurements. Discharge data were also obtained from the Water Survey of Canada (L. Campo, Environment Canada, pers. comm.).

We recorded underwater visibility on snorkel floats by estimating the distance between two floaters at the extent of visibility.

3.3 Historical data

Information from snorkel floats conducted on some of the study streams between 1961 and 1999 was obtained from data files maintained at the BC Ministry of Water, Land and Air Protection (MWLAP).

Available data for each of the systems surveyed are presented in Section 4.

4 RESULTS

A summary of steelhead results for 2002 snorkel floats is presented in Table 4.1.

The remainder of the section presents a short description of the sections swum, 2002 sampling results and discharge data for each system. Results are also compared with available information from previous floats. In order to facilitate comparisons, total steelhead counts per kilometre of stream swum (SH/km) are presented whenever sufficient data are available.

Table 4.1. Summary of steelhead snorkel float results in 2002.

Stream	# of floats	Survey period	Date of maximum count	Maximum steelhead count	Maximum steelhead per km
Alouette River	1	-	April 4	112	7.5
Capilano River	1	-	April 9	1	trial float
Chehalis River	1	-	March 10	146	20.0
Coquitlam River	3	April 2 – May 10	May 10	53	5.6
Kanaka Creek	1	-	April 21	9	2.6
Seymour River	1	-	April 23	31	2.1

4.1 Alouette River

The Alouette River, near Maple Ridge, supports a winter steelhead return. One float of the South Alouette River was conducted in 2002. The North Alouette River was not swum in 2001 or 2002.

4.1.1 2002 results

A float of the South Alouette River was conducted on April 4, 2002 (Table 4.2). Complete details for this float are provided in Appendix 3. Ideally, the float would have been conducted earlier in the year, but visibility and access[3] conditions delayed it until early April.

As in 2001, we floated the portion of the river between the Alouette Lake dam and the bridge at 216th Street. This reach, approximately 14.9 km in length was divided into three sections, each swum by two or three floaters. A map of the system is provided in Appendix 2.

Visibility conditions for the April 4 float were disappointing, and varied between the different sections swum. The total count was 112 steelhead, of which 89% were wild (based on 36 fish which could be identified). An aggregate of 112 steelhead represents a count of 7.5 steelhead per kilometre surveyed. Many of the fish that we saw were strongly coloured, suggesting that earlier sampling may have produced a higher count. The peak count in 2001 was on the first float (March 23), and numbers declined thereafter.

Table 4.2. Alouette River snorkel float results, 2002 steelhead survey.

Date	Steelhead	Rainbow	Cutthroat	Trout[1]	Whitefish	Sculpins	Suckers	Carp
April 4	**112**	13	8	1	11	2	81	15

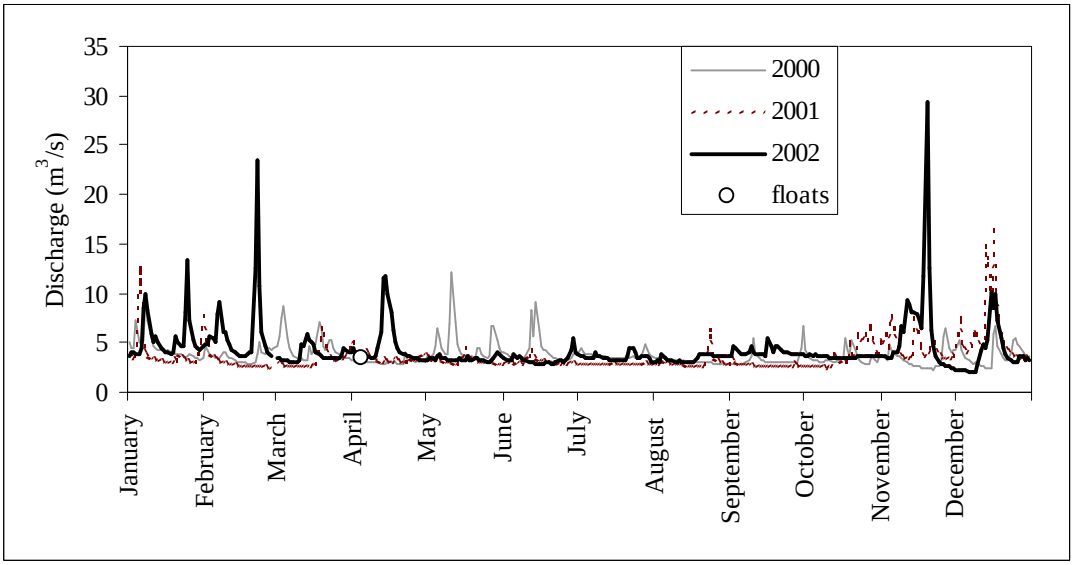
Notes: 1. "Trout" are either rainbow or cutthroat trout – floaters were not able to distinguish the species.

4.1.2 Discharge data

Discharge information for the Alouette River is available from the Water Survey of Canada gauge 08MH005, *Alouette River near Haney*. Gauge information for 2000 – 2002 is presented in Figure 4.1.

[3] snow on the access road to the dam prevented a planned float earlier in the year.

Figure 4.1. Discharge information for the Alouette River near Haney (WSC gauge 08MH005), 2000 - 2002 data.



Circle marks discharge on the float day.

4.1.3 Available historical data

Four floats of the Alouette River were conducted in 2001 (Appendix 4). Results are compared with the 2002 float in Table 4.3.

Table 4.3. Steelhead per kilometre data for Alouette River steelhead floats.

Date	Kilometres surveyed	Discharge (m^3/s)	Visibility (m)	Steelhead	Steelhead per kilometre
March 23, 2001	14.9	3.9	3 - 7.5 m	179	**12.0**
April 5, 2001	13.0	4.4	2 - 5 m	93	**7.2**
April 21, 2001	14.9	3.4	1 - 7 m	149	**10.0**
May 25, 2001	14.9	3.3	2 - 6 m	7	**0.5**
April 4, 2002	14.9	3.3	1 – 6 m	112	**7.5**

Visibility conditions and timing of the 2002 float were most similar to the count conducted on April 5, 2001. Interestingly, the steelhead count per kilometre was also similar (7.2 SH/km in 2001, 7.5 SH/km in 2002; note that the 2001 section was shorter than the 2002 section). This suggests that 2002 floats conducted earlier and under better clarity conditions may have resulted in a peak count similar to that obtained in 2001. Although the single 2002 count is limited by disappointing visibility conditions, it appears reasonable to conclude that the 2002 return was very similar to that experienced in 2001.

Based on data obtained from BC MWLAP files in Surrey, eight floats were conducted on the Alouette River between 1961 and 1996. However, section locations were often cryptic, and maps were usually not appended, so it is difficult to determine which sections were swum. As differing sections were assessed, it is difficult to compare results across different years (lower counts in one year might reflect a shorter survey section only, rather than reduced returns). Complete results for previous swims are summarised in Appendix 4. Steelhead per kilometre swum values could not be calculated because reach lengths could not be determined, and many floats included spot checks of particular pools.

The 2001 maximum count is by far the highest on record for steelhead swims of the Alouette River. As noted, 2002 results suggest a similar return, but more information on the lengths of the sections covered by historical floats is required before meaningful comparisons between years can be made. Note also that 2001 is the only year for which more than one float is available. Factors such as poor conditions, differences in sections swum, and/or inappropriate timing of floats may have resulted in the large differences seen between 2001 counts and previous enumerations.

Some historical data for floats of the North Alouette River are also available (see Appendix 4).

4.2 Capilano River

The Capilano River, which separates North and West Vancouver, supports both winter and summer steelhead stocks. A hatchery program supplements both summer- and winter-runs, with the majority of the summer-run presumed to consist of hatchery fish (M. Rosenau, BC MWLAP, pers. comm.).

An adult steelhead telemetry program was conducted on the Capilano River in 2002 (T. Nelson, LGL, pers. comm.). The presence of a visually and radio tagged population generated interest in the efficacy of snorkel floats as an assessment tool for the system.

4.2.1 2002 results

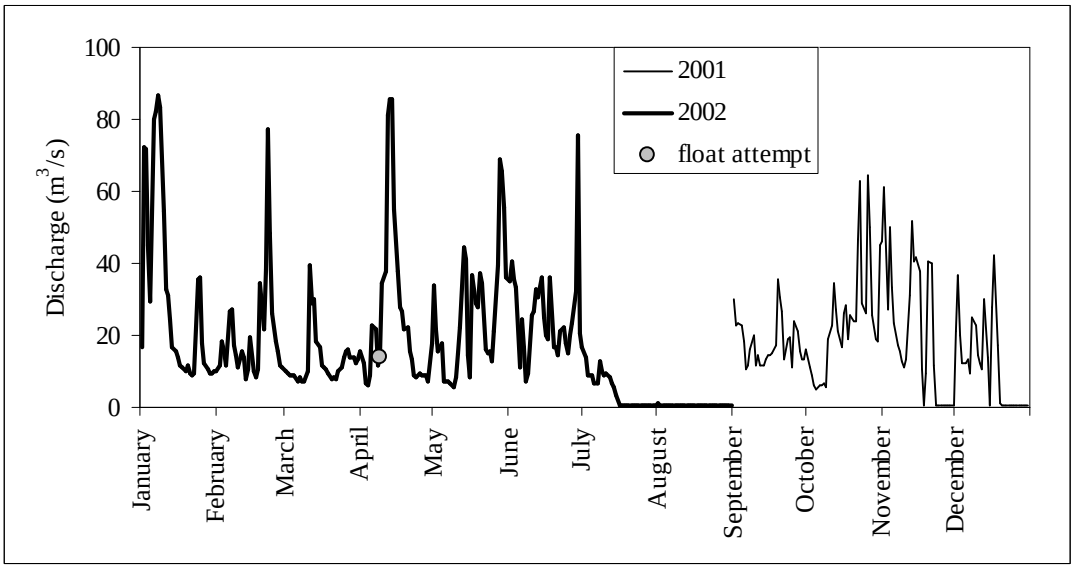
We conducted a single, test float of the Capilano River on April 10, 2002. A single steelhead was identified, but water clarity was not adequate to permit a useful count. We monitored visibility conditions throughout the remainder of the steelhead season, but did not observe conditions suitable for a second float attempt. Based on our observations, it appears that useful snorkel floats of this

system could not be readily obtained on a repeatable basis due to high turbidity and very deep pools. According to hatchery staff, 2002 was a representative year, and poor clarity is common through the steelhead season. However, floats more successful than ours were conducted in 1999 and 2000 (Hatfield 1999, 2000; see Section 4.2.3). For reference, notes on the April 10 float are included in Appendix 3. Appendix 2 provides a map of the system below the Cleveland Dam.

4.2.2 Discharge data

Discharge information for the Capilano River (Figure 4.2) was provided by the GVRD, who operate the dam regulating the system.

Figure 4.2. Discharge information for the Capilano River (Cleveland Dam), available 2001 and 2002 data.



Grey circle marks discharge on the attempted float day.

4.2.3 Available historical data

Construction of the Cleveland Dam in 1954 blocked access to upstream steelhead habitat in the Capilano River. Nevertheless, both summer and winter steelhead populations have persisted. The Capilano Hatchery stocks both summer and winter fish on an annual basis. Through broodstock angling and capture within the fishway, the hatchery has managed to propagate steelhead resulting in small escapements (Hatfield 1999).

Steelhead floats to assess this escapement were conducted in the winter/spring of 1999 and 2000 (Hatfield 1999, 2000). Swims between the hatchery weir and Burrard Inlet observed steelhead densities between 0 and 2.8 fish/km (Table 4.4).

A maximum of 15 steelhead were observed on April 30, 1999. In 2000, the highest count came on April 19 when nine fish were observed. The majority of steelhead were holding in deep, low gradient pools, which hampered efforts to obtain accurate counts. Seven steelhead were also observed on October 7, 1998. These fish were presumably remnants from a population of summer steelhead that are maintained by the hatchery. No efforts were made in this study to distinguish between hatchery and wild fish or between summer and winter stocks. Detailed results from these floats are outlined in Appendix 4.

Hatfield (1999) also conducted streambank surveys of Brothers Creek from October 14, 1998 to January 6, 1999. Brothers Creek is a major tributary of the lower Capilano River (downstream of the dam) and provides good spawning habitat but may be too small and shallow to be considered prime steelhead habitat. During these surveys, only chum and coho salmon were observed.

Table 4.4. Steelhead per kilometre data for Capilano River steelhead floats.

Date	Kilometres surveyed	Discharge (m^3/s)	Visibility (m)	Steelhead	Steelhead per kilometre
January 8, 1999	5.4	9.9	1.5 m	0	**0**
April 1, 1999	5.4	5.1	1.6 – 2.5 m	6	**1.1**
April 30, 1999	5.4	7.9	3 m	15	**2.8**
May 21, 1999	5.4	5.9	3.5 m	5	**0.9**
January 21, 2000	5.4	1.1	3 m	1	**0.2**
February 11, 2000	5.4	2.3	3 m	5	**0.9**
March 17, 2000	5.4	1.0	2 m	1	**0.2**
April 19, 2000	5.4	7.9	3 m	9	**1.7**

4.3 Chehalis River

The Chehalis River, a tributary to the Harrison River near Harrison Mills, supports both summer and winter populations of steelhead trout. A hatchery stocking program exists to augment natural production for both summer- and winter-runs.

Based on our experience in 2001, floats of the Chehalis River can be divided into two sections, each requiring one day to complete. The upper section, between the logging road bridge and Boulder Creek, is 8.0 km in length[4]. The lower section,

[4] Due to its remote nature and inherent risk, a support raft is recommended for this section

from Boulder Creek to Pretty Creek, is about 5.2 km in length. In 2001, we swam an additional 0.4 km downstream of Pretty Creek to Fenn Lodge[5]. A map including these locations is provided in Appendix 2.

This approach does not sample three sections of steelhead accessible habitat:

1. Chehalis Lake and the sections of the Chehalis River immediately upstream and downstream of the lake outlet[6];
2. the Chehalis River downstream of Pretty Creek (to the confluence with the Harrison River);
3. Statlu Creek.

4.3.1 2002 results

We conducted only one float of the Chehalis River in 2002. On March 10, a crew of three swam the lower section of the Chehalis River between Boulder and Pretty creeks (a 7.3 km section). Discharge and visibility conditions during this swim were ideal, although bubbles and whitewater limited snorkel float effectiveness in some pools. Detailed results for the float, including counts per section swum, are summarised in Appendix 3.

Unfortunately, snow on the road blocked access to the upper section on March 10, so the section from the upper logging road bridge downstream to the Boulder Creek confluence could not be sampled. A float of both sections later in the season was not possible.

A total of 146 steelhead were counted during the March 10, 2002 float in the section between Boulder Creek and Pretty Creek. This represents a count of 20.0 steelhead per kilometre surveyed. The vast majority of the steelhead encountered on the float (95%) were located between Boulder Creek and the Morris Valley Road bridge. Downstream of the bridge, a newly formed branch of the Chehalis River flows eastward into the Chehalis Indian Reserve below the Easter Seals Camp. An additional braid veers away from the old channel

[5] A significant channel shift occurred between 2001 and 2002 floats. The majority of the river now flows through an eastern braid, downstream of the Morris Valley Road bridge and upstream of the Chehalis River hatchery. This new channel was choked with wood and unsafe to swim in 2002. The water level was so low downstream of Pretty Creek that we finished our float at that point.

[6] Spot checks within this reach have been conducted in previous years (Appendix 4.3.3).

downstream of the hatchery. The braided river has little flow remaining in the old channel, and provides poor cover for adult steelhead. Although this likely explains the low steelhead count in this section, spawned out coho salmon were prevalent despite the low flow.

We were able to identify 28 steelhead on the float; 22 (79%) were wild and 6 were of hatchery origin. In addition, one dark fish was seen in the canyon section (Boulder Creek to powerline) that we identified as a summer steelhead. Rainbow trout, Dolly Varden, cutthroat and whitefish were the only other fish identified during this swim (Table 4.5).

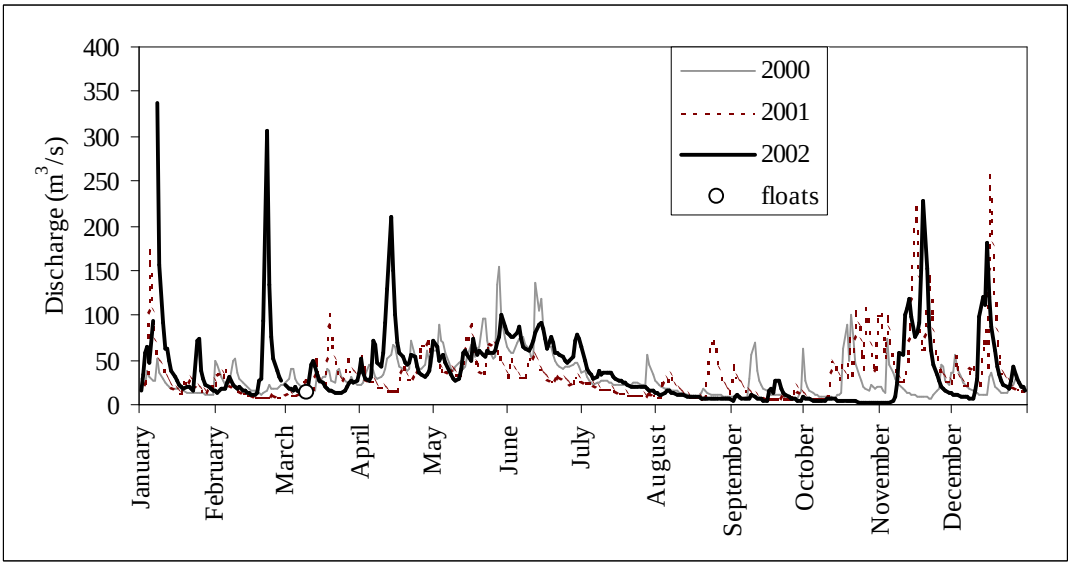
Table 4.5. Chehalis River snorkel float results, 2002 steelhead surveys.

Date	Steelhead	Summer Steelhead	Rainbow	Cutthroat	Dolly Varden	Coho	Whitefish
March 10	**146**	1	13	4	5	50	1

4.3.2 Discharge data

Discharge information for the Chehalis River is available from the Water Survey of Canada gauge 08MG001, *Chehalis River near Harrison Mills* (Figure 4.3).

Figure 4.3. Discharge information for the Chehalis River near Harrison Mills (WSC gauge 08MG001), 2000 - 2002.



Circle marks discharge on the float day.

4.3.3 Available historical data

Snorkel float results are available for nine years between 1981 and 2001. However, winter steelhead were only sampled during five of these years (1981, 1985, 1986, 1989 and 2001; Table 4.7). Other floats were conducted between July and October to sample summer steelhead returns (Appendix 4). Table 4.7 indicates the total number of fish that could be identified as hatchery or wild and the percentage of these that were wild.

Two of the winter/spring snorkel counts approach the maximum count obtained in 2002 (121 steelhead on February 20, 1986 and and 170 steelhead on February 19/20, 2001). However, the distances covered during the floats differ dramatically. The count completed in 1986 was for a section only 2 km in length, while the section floated in February 2001 was 15.6 km in length. The float on March 2002 covered 7.3 km of stream length. Steelhead per kilometre results are summarised in Table 4.6.

Table 4.6. Steelhead per kilometre data for Chehalis River winter steelhead floats.

Date	Kilometres surveyed	Visibility (m)	Discharge (m^3/s)	Steelhead	Steelhead per kilometre
March 10, 1981	12.5	5 m	mod.	29	**2.3**
February 7, 1985	2.0	clear	low	16	**8.0**
February 20, 1986	2.0+	clear	v. low	121	**~ 60**
February 15, 1989	3.5	clear	v. low	58	**16.6**
February 19/20, 2001	15.6	10 - 15+	9.64, 9.18	170	**10.9**
April 1, 2001	8.1	6 – 8+	53.7	80	**9.9**
March 10, 2002	7.3	6 – 7+	13.3	146	**20.0**

The very high count on February 20, 1986 indicates either an exceptionally strong return in that year and/or a very heavy concentration of fish in the lower river section, between the First Canyon Pool (just upstream of the Morris Valley Road) and Pretty Creek. All other previous winter steelhead floats have found lower densities of fish than those observed in 2002.

Table 4.7. Historical winter/spring snorkel float data for the Chehalis River, 1981 – 2001.

Date	Reach	Length (km)	Vis. (m)	D/c[1]	Crew	Total SH[2]	% wild (# ID)[3]	CT	RB	WF	DV	CO	CH	CM	SK
March 10, 1981	Upper Bridge to Morris Valley Road ('MVR')	12.5	5 m	mod.	2/3	**29**	? (0)	0	0	0	0	0			0
February 7, 1985	MVR to Stump Hole (Pretty's)	2.0	clear	low	2	**16**	88% (16)					300-500			
February 20, 1986	First Canyon Pool to Pretty's	2.0+	clear	v. low	2	**121**	? (0)					800-1000			
February 15, 1989	Sandhole to Pretty's	3.5	clear	v. low	2	**58**	36% (14)	1				lots			
February 19/20, 2001	Upper logging road bridge to Fenn Lodge	15.6	10 - 15 m	9.64/ 9.18	3 + raft	**170**	? (0)	0	6	0	2	383	0	0	0
April 1, 2001	Boulder Creek to below Fenn Lodge	8.1	6 – 8+ m	53.7	3	**80**	96% (16)	1	5	4	3	0	1	0	0

Notes: 1. "D/c" is discharge in m^3/s where available.
2. "Total SH" – total steelhead observed; "CT" - cutthroat trout; "RB" – rainbow trout; "WF" – whitefish; "DV" – Dolly Varden char; "CO" - coho salmon; "CH" – chinook salmon; "CM" – chum salmon; "SK" – sockeye salmon.
3. Indicates the percentage of fish identified as wild, (and the number of fish identified as either hatchery or wild).

4.4 Coquitlam River

The Coquitlam River supports a winter population of steelhead trout. Provincial hatchery programs have stocked marked (fin clipped) steelhead in the system as recently as 1996 (MWLAP 2002). However, a community hatchery program has also released unmarked steelhead into the Coquitlam River.

Three Coquitlam River floats were conducted in 2002 (Table 4.8). The river was split into two sections, each swum by a crew of two. The sections were from the Coquitlam Reservoir Dam to "Lewis' Pool", at the gravel pits, and from Lewis' Pool to the blue footbridge upstream of the Lougheed Highway. The combined distance for these two sections was 9.5 km. Access directions for each of these locations are provided in Appendix 2. Due to poor visibility conditions, a section of the river between the Or Creek confluence and Lewis' pool was not assessed on April 26 (Appendix 3).

4.4.1 2002 results

Results for 2002 floats are summarised in Table 4.8. On the day of the float, one crew would swim the upper section while another crew swam lower section. Visibility conditions were generally moderate to poor. On April 2, visibility was only 1 – 4. On April 26, it was worse (<1 – 3 m), and a portion of the float had to be abandoned. The final float on May 10 enjoyed the best visibility, as it ranged between two and six metres. Detailed results, including counts per section swum, are summarised in Appendix 3.

On April 2, we saw 46 steelhead in the 9.5 km section between the dam and the blue footbridge (4.8 steelhead/km). Most (29) were observed in the reach between Lewis' Pool and the Oxbow Sidechannel interpretative sign.

On April 26, a total of 31 steelhead were observed between the dam and the blue footbridge. However, turbidity introduced by Or Creek precluded any meaningful underwater observations in the reach between Or Creek and Lewis' Pool. As a result, the total length of stream floated was only 6.7 km long (4.6 steelhead/km).

On May 10, we counted 53 steelhead in the section between the dam and the blue footbridge (same section as April 2 float; 5.6 steelhead/km). The steelhead were distributed more evenly throughout the section than on previous floats. Numerous juvenile salmonids were also observed during the survey.

Table 4.8. Coquitlam River snorkel float results, 2002 steelhead surveys.

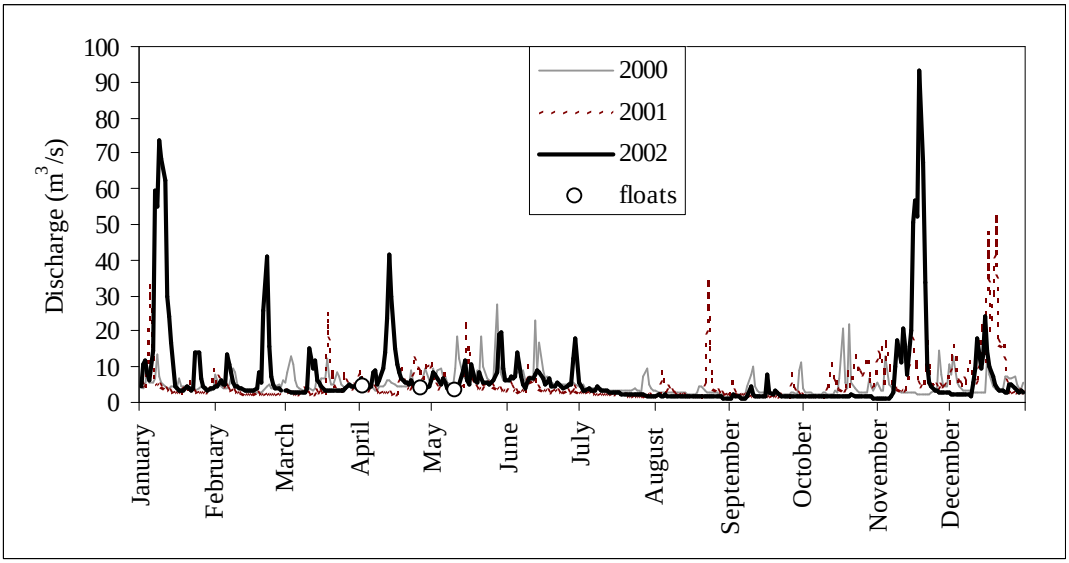
Date	Steelhead	Rainbow	Whitefish	Juvenile salmonids	Redds
April 2	**46**	1	1	1	3
April 26	**31**	2	3	1	
May 10	**53**	15		106	

Only three redds were observed in 2002, all of which were detected on the first float in the upper section of the Coquitlam River. One of the redds was too small to have been dug by a steelhead; therefore, only two potential steelhead redds were discovered.

4.4.2 Discharge data

Discharge information for the Coquitlam River is available from the Water Survey of Canada gauge 08MH002, *Coquitlam River at Port Coquitlam*. Gauge information, for 2000 - 2002**,** is graphed in Figure 4.4.

Figure 4.4. Discharge information for the Coquitlam River at Port Coquitlam (WSC gauge 08MH002), 2000 - 2002 data.



Circles mark discharge on a float day.

4.4.3 Available historical data

Steelhead snorkel float counts were done in five years between 1977 and 2001 (Table 4.9). In 1999, a series of six floats were conducted between April 2 and May 23 (Decker and Lewis 1999). Three floats were conducted in March and

April 2001. Historical results for the Coquitlam River and a tributary, Or Creek, are summarised in Tables 4.10 and 4.11.

Historical steelhead snorkel float data for the Coquitlam River are also summarised in Appendix 4.

Table 4.9. Steelhead per kilometre data for Coquitlam River steelhead floats.

Date	Kilometres surveyed	Visibility (m)	Discharge (m^3/s)	Total SH	Steelhead per kilometre
May 25, 1978	~ 4.5	clear	v. low	5	**1.1**
March 26, 1980	3.0	0.5-2m	?	4	**1.3**
April 2, 1999	2.5	?	?	13	**5.2**
April 4, 1999	2.5	?	?	13	**5.2**
April 24, 1999	2.5	?	?	15	**6.0**
May 8, 1999	2.5	?	?	12	**4.8**
May 15, 1999	2.5	?	?	12	**4.8**
May 23, 1999	2.5	?	?	2	**0.8**
March 22, 2001	4.5	3.5 – 7.5 m	3.59	28	**6.2**
April 9, 2001	8.1	3.5 – 5 m	2.89	64	**7.9**
April 27, 2001	9.5	1 – 4 m	6.81	49	**5.2**
April 2, 2002	9.5	1 – 4 m	5.73	46	**4.8**
April 26, 2002	6.7	<1 – 3 m	?	31	**4.6**
May 10, 2002	9.5	2 – 6 m	?	53	**5.6**

Table 4.10. Historical snorkel float data for the Coquitlam River, 1977 – 2001.

Date	Reach	Length (km)	Visibility	D/c	SH	RB	CO	Redds	Juv CO	Comments
March 11, 1977	Upstream of Or Creek	?	0.6m	mod.						No float due to fine clay siltation.
May 25, 1978	Dam to gravel pit	~ 4.5	clear	v. low	**5**	2			150	Too late. Most fish were kelts.
March 2, 1979	Dam to Or Creek	1.6	<0.3m	low			2	13		Sudden siltation of river (by bank slumping following thaw?) reduced visibility so float not worthwhile.
March 26, 1980	Or Creek to Upper Coquitlam River Park	3.0	0.5-2m	?	**4**					Fish bright and in good condition. Slumping banks reduced visibility.
April 2, 1999	Or Creek to Partride Creek	2.5	?	?	**13**			1		
April 4, 1999	Or Creek to Partride Creek	2.5	?	?	**13**			5		
April 24, 1999	Or Creek to Partride Creek	2.5	?	?	**15**			12		
May 8, 1999	Or Creek to Partride Creek	2.5	?	?	**12**			4		
May 15, 1999	Or Creek to Partride Creek	2.5	?	?	**12**			0		
May 23, 1999	Or Creek to Partride Creek	2.5	?	?	**2**					
March 22, 2001	Dam to gravel pits	4.5	3.5–7.5m	3.59	**28**	4				
April 9, 2001	Dam to OxBow sidechannel	8.1	3.5-5m	2.89	**64**	12		17	32	Also 4 unknown fish were observed
April 27, 2001	Dam to blue footbridge	9.5	1-4m	6.81	**49**	1		11		

Table 4.11. Historical snorkel float data for Or Creek, 1978 – 1980.

Date	Reach	Length (km)	Visibility	D/c	SH	RB	CO	Redds	Juv CO	Comments
March 2, 1978	lower 500 m	0.5	< 0.3 m	low						Sudden siltation of river - float not worthwhile.
May 25, 1978	Lower reach	0.8	clear	v. low		5			150	
March 26, 1980	lower 500 m	0.5	2 m							

Notes: Data for 1999 floats from Decker and Lewis (1999) and for 2001 from van Dishoeck (2001a). All other data from BC MWLAP Surrey files.

4.5 Kanaka Creek

Kanaka Creek, in Maple Ridge, supports both wild and hatchery populations of winter steelhead trout, although the most recent stocking occurred in 1998 (MWLAP 2002).

With a crew of three, we completed a single float on Kanaka Creek on April 21, 2002 covering the 3.4 km section between the upper falls (Cliff Falls) and the fish fence at 240th Street (Table 4.12). Access to the upper section requires lowering floaters into the canyon (we used climbing equipment to rappel down).

4.5.1 2002 results

Results for the 2002 float are summarised in Table 4.12, with complete information for each reach tabulated in Appendix 3. Visibility conditions were generally poor (2 to 2.5 metres) as there was an organic, 'tea' colouration to the water. On April 21, we counted nine steelhead in Kanaka Creek (2.6 steelhead/km). Since visibility conditions were poor, we undoubtedly missed fish, particularly in deep sections. No steelhead were observed upstream of the lower falls at 112th Avenue, although they were present above these falls in 2001.

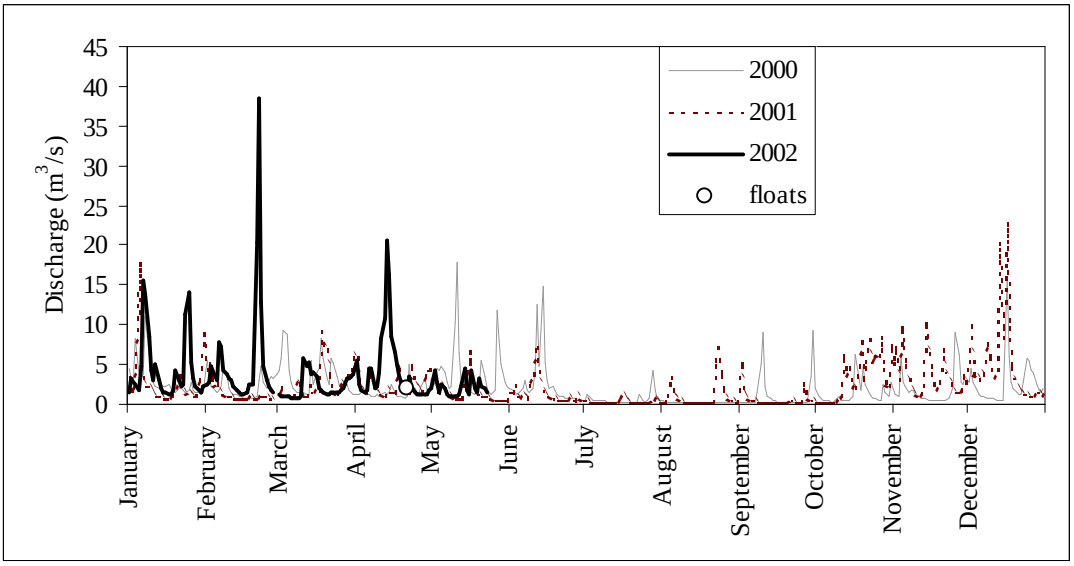
Table 4.12. Kanaka Creek snorkel float results, 2002 steelhead surveys.

Date	Steelhead	Rainbow	Cutthroat	Juvenile Trout	Whitefish	Suckers	Notes
April 21	**9**	8	3	6	3	1	redds observed

4.5.2 Discharge data

Discharge information for Kanaka Creek is available from the Water Survey of Canada gauge 08MH076, *Kanaka Creek near Webster Corners*. Gauge information, for 2000, 2001 and January 1 to May 23, 2002**,** is graphed in Figure 4.5.

Figure 4.5. Discharge information for Kanaka Creek near Webster Corners (WSC gauge 08MH076), 2000, 2001 and available 2002 data.



Circle marks discharge on the float day.

4.5.3 Available historical data

Floats have been conducted on Kanaka Creek in three other years. Historical float information is summarised in Table 4.13. Data from 2001 illustrate the variability associated with swims at different times in the spring. The single 2002 float encountered the highest density of steelhead recorded to date.

Table 4.13. Steelhead per kilometre data for Kanaka Creek steelhead floats.

Float date	Reach	Length (km)	Visibility (m)	Discharge (G2; m)	Steelhead	SH per km
February 5, 1982	Upper falls to fish fence	3.4	< 2	low	**2**	**0.6**
January 25, 1996	Falls to 'George Street'	?	clear	v. low	**4**	**?**
February 21, 2001	Lower falls to fish fence	2.6	1+ - 4	0.08	**1**	**0.4**
March 13, 2001	Upper falls to fish fence	3.4	1 - 1.5	0.20	**0**	**0**
April 26, 2001	Upper falls to fish fence	3.4	1 - 3	0.10	**7**	**2.1**
May 11, 2001	Upper falls to fish fence	3.4	2 - 4	0.05	**5**	**1.5**
April 21, 2002	Upper falls to fish fence	3.4	2 – 2.5	0.17	**9**	**2.6**

4.6 Seymour River

The Seymour River, in North Vancouver, supports winter and summer steelhead returns, with both wild runs augmented by hatchery production.

4.6.1 2002 results

The Seymour River was floated by a volunteer crew on April 23, 2002. Four pairs of swimmers each floated a separate section of the river. A total of 31 steelhead were observed between the Seymour Falls Dam and the bend immediately downstream of the '88 Pool' (14.5 km; Table 4.14). This represents 2.1 fish per kilometre surveyed. Of the five steelhead that could be identified, four were wild (80%). Visibility conditions ranged between two and three metres over the course of the swim. The majority of the fish were seen between the Spur 4 and Twin Bridges. More detailed information for the float is summarised in Appendix 3.

Table 4.14. Seymour River snorkel float results, 2002 steelhead survey.

Date	Steelhead	Rainbow	Dolly Varden	Notes
April 23	**31**	2	1	5 steelhead idenitified: 4 wild and 1 hatchery

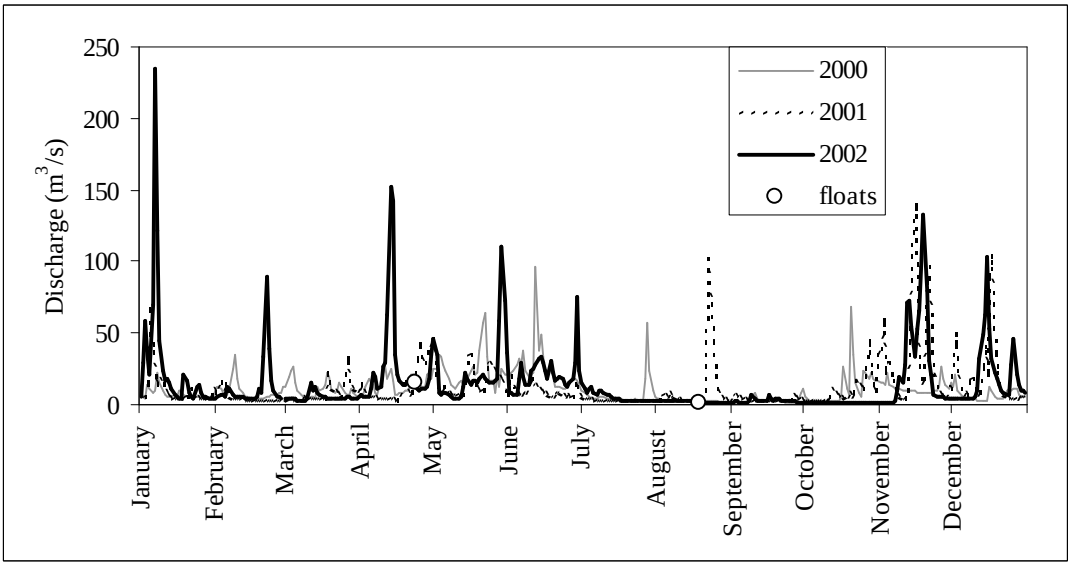
An additional float of the Seymour River was conducted in the summer (August 18, 2002) by the BC Conservation Foundation to assess the summer steelhead population. The results of that float are summarised in Appendix 3.

4.6.2 Discharge data

Discharge information for the Seymour River is available from the Water Survey of Canada gauge 08GA030, *Seymour River near North Vancouver* (Figure 4.6).

Note that the canyon should not be swum in future if the staff gauge reading (at Twin Bridges) is greater than about 0.60 m. On the April 23, 2002 swim, the staff gauge reading was 0.66 m (WSC discharge was 14.9 m^2/sec), and three sections in the canyon proved to be unsafe for swimmers. On April 7, 2001, the staff gauge reading was 0.40 m, discharge was 5.22 m^3/s, and the canyon was completed safely.

Figure 4.6. Discharge information for the Seymour River near North Vancouver (WSC gauge 08GA030), 2000 - 2002.



Circles mark discharge on a float day.

4.6.3 Available historical data

Previous records of floats conducted for winter steelhead are available for the years 1987 and 2001 (Table 4.15). Data from floats conducted for both winter and summer steelhead are included in Appendix 4.

Table 4.15. Steelhead per kilometre data for Seymour River steelhead floats.

Float date	Reach	Length (km)	Visibility (m)	Discharge (m^3/s)	Steelhead	SH per km
March 26, 1987	Dam to '88'	14.1	?	?	**128**	**9.1**
April 3, 1987	Dam to '88'	14.1	?	?	**166**	**11.8**
April 7, 2001	Dam to railway bridge	17.3	2 - 8 m	3.81	**52**	**3.0**
April 23, 2002	Dam to bend d/s '88'	14.5	2 – 3 m	?	**31**	**2.1**

Excellent returns of steelhead were assessed on two floats in 1987 (128 fish on March 26 and 166 fish a week later). During the float on March 26, 1987, 56 of the 67 steelhead identified were wild fish (84%). On April 3, 1987, 67 of the 99 steelhead identified (68%) were of wild origin. The 1987 floats ended 400 metres upstream of the 2002 winter float, but otherwise covered the same sections.

The float conducted on April 7, 2001 encompassed the entire anadromous length of the Seymour River. Of seventeen steelhead that we were able to identify, eleven (65%) were wild (including a dead fish) and six (35%) were hatchery fish.

The steelhead count in 2002 was the lowest on record. Relatively high flows and poor visibility may have substantially reduced efficiency, such that a disproportionate number of fish were missed. Steelhead per kilometre results for the Seymour River were notably higher in 1987 than in 2001 or 2002.

5 DISCUSSION

Snorkel floats alone provide only an index of abundance, not an estimate of total escapement. Each float provides an index of the number of fish in the river on the swim day, but is an underestimate because some fish are missed. Although multiple counts within a given year may indicate the progression of the run, we do not know how many of the fish observed were also present on earlier floats. Despite these limitations, a snorkel index can provide useful evidence of abundance trends over a number of years (assuming that methods and float conditions are similar).

Snorkel floats are further limited because they rely on adequate water clarity. If turbidity or discharge conditions reduce visibility, efficiency is reduced. In addition, many steelhead runs continue through the spring freshet. Freshet conditions can make further snorkel floats impossible. A snorkel float index performs poorly for that portion of the run which returns during freshet.

Despite these limitations, work in 2001 and 2002 suggests that snorkel float surveys may provide robust, long term management indices for steelhead in Lower Mainland streams. However, index results for 2001 and 2002 are often difficult to assess because, for most of the systems we surveyed, few historical floats are available for comparison purposes.

As larger systems support more steelhead, a direct comparison of counts between systemsis not useful. We calculated the number of steelhead seen per kilometre of river surveyed to generate an index comparable between systems. This index also allows some comparison across years when different sections of the same river were surveyed. Results per kilometre can also be used to assess stock status in a particular stream in relation to provincial management objectives. However, the fish/km index can be misleading. Adult steelhead tend to hold in large pools. The inclusion of one of these pools adds very little to the total distance surveyed, but may add significant numbers to the total count. Some past surveys have conducted ‘spot checks’ of the best steelhead holding habitat only. In these cases, large total counts are obtained from very short sections of surveyed stream.

5.1 Observer efficiency

No information is available to estimate the proportion of fish seen in the rivers discussed in this report. Data of this kind is available for the Cheakamus River in 2000 and 2001, and for the Chilliwack River in 2000. In the absence of stream specific estimates, these observer efficiencies can be used to indicate the rough proportion of fish seen using our methodology. However, as observer efficiency is a product of factors such as water clarity, depth and stream width, the proportion of fish seen in Kanaka Creek, for example, is undoubtedly different from estimates for larger systems.

Estimates of observer efficiency for the Cheakamus and Chilliwack Rivers are based on radio telemetry programs using radio tagged steelhead (McCubbing and Melville 2000, Nelson *et al. 2001*, C. Melville, Instream, pers. comm.). As would be expected, observer efficiency is highly variable, and is affected by discharge, turbidity and weather (brighter days make for better visibility). Generally, efficiency declines over the survey season as low, clear mid-winter conditions give way to higher, more turbid spring flows.

Observer efficiency for Cheakamus River floats in 2000 and 2001 is indicated in Table 5.1. Data were provided by Josh Korman (Ecometric, pers. comm.).

Table 5.1. Observer efficiency for Cheakamus River floats, 2000 and 2001.

2000				2001			
Date	**Tags observed**	**Tags available**	**Observer efficiency**	**Date**	**Tags observed**	**Tags available**	**Observer efficiency**
Feb 18, 00	0	1	0.00	Feb 7, 01	3	6	0.50
Feb 28, 00	1	1	1.00	Feb 23, 01	3	6	0.50
Mar 15, 00	3	3	1.00	Mar 8, 01	3	6	0.50
Mar 29, 00	2	3	0.67	Mar 20, 01	1	10	0.10
Apr 9, 00	2	7	0.29	Mar 24, 01	1	15	0.07
Apr 27, 00	4	4	1.00	Apr 4, 01	14	30	0.47
May 15, 00	0	3	0.00	Apr 11, 01	14	25	0.56
				May 3, 01	1	15	0.07
				May 21, 01	1	10	0.10

Observer efficiency for the Chilliwack River in 2000 was extremely variable (Table 5.2). Again, the range of efficiencies encountered was considerable, with all detected tags seen in some sections, and none of the tags seen through other reaches (van Dishoeck 2001b).

Table 5.2. Observer efficiency for Chilliwack River floats, 2000.

Date	km swum	Tags observed	Tags available	Observer efficiency
Feb 15 – 18, 2001	39.5	12	51	0.24
Mar 20 – 21, 2001	19.6	10	26	0.39
Apr 3, 2001	5.6	0	3	0.00
Apr 26 – 27, 2001	19.7	3	28	0.11

5.2 Development of total escapement estimates

To determine total escapement, estimates of observer efficiency and fish residence time, as well as parameters of a run timing curve, are required. Area-under-the-curve estimates (Hilborn *et al.* 1999) of total steelhead escapement have been calculated for the Cheakamus River (Korman and Ahrens 2000, Korman *et al.* 2002, Korman 2002).

No total escapement estimates are available for the Lower Mainland streams surveyed in 2002. However, an accessible, relatively small river such as the Alouette would provide an ideal study system. Results could be applied regionally, in concert with data from the Cheakamus and Chilliwack Rivers.

5.3 2002 results

Results in 2002 corroborate 2001 data suggesting strong steelhead returns. For the Alouette, Chehalis, Coquitlam and Seymour Rivers, winter float counts in 2002 were somewhat lower than in 2001. However, in most cases, more swims were conducted in 2001.

For the Alouette River, four swims were conducted in 2001, with the maximum count (179) obtained on March 23. In 2002, only one swim was possible, later in the year (112 fish on April 4). Note, however, that a later season count in 2001 was also higher than the 2002 count (149 fish on April 21, 2001).

Our floats of the Capilano River were not successful, although telemetry tracking data was obtained (Nelson *et al.* 2003). The system suffered from particularly poor visibility conditions in the spring of 2002. Given the numerous deep pools (>4 m), which are used as holding areas by steelhead, clear water conditions are preferable to obtain accurate counts. Floats in previous years have been more successful (Hatfield 1999, 2000), suggesting that suitable discharge and turbidity conditions can be expected in some years on this system.

On the Chehalis River, we conducted two floats in 2001 and only a single float, of the lower river section, in 2002. The count in this section in 2002 (146 fish) represented a density of 20.0 fish/km. This was much higher than our 2001 index, as the maximum count in that year (146 fish on February 19 and 20) was obtained over a much longer section (10.6 fish/km).

Floats of the Coquitlam River in 2002 suggested slightly lower returns than those observed in 2001. Our best count in 2001 was 7.9 steelhead per kilometre surveyed on April 9. In 2002, the April 2 count represented 4.8 fish/km, and the April 26 count 4.6 fish/km. However, the later April survey was constrained by poor visibility, so our count is probably lower than a more 'usual' index of the total number of steelhead present on that day.

On Kanaka Creek, only one float was conducted in 2002. The count on this float (nine steelhead), is higher than our maximum count over three 2001 floats (seven fish). The difference is unlikely to be significant.

On the Seymour River, the 2001 count was done on April 7, and 53 steelhead were seen. In 2002, the single count was done April 23, under visibility conditions that were considerably worse, and only 31 fish were seen. Although it is likely that the returns in both years were of similar size, our ability to detect this, based on the snorkel float data, is poor.

5.4 Comparison with other Lower Mainland systems

Recent data from other systems in the Lower Mainland region suggest generally strong escapements in 2001 and 2002. These results occur in the context of relatively low returns in 1998 through 2000. For example, the maximum 2001 Chilliwack River count was 45.4 steelhead per km and the highest 2002 count was 37.1 fish/km (van Dishoeck 2001c, van Dishoeck 2002a). In contrast, the 2000 maximum count was 10.7 fish/km (van Dishoeck 2001b). On the Mamquam River, peak 2001 and 2002 counts were 7.6 and 4.5 fish/km respectively, while 1999 and 2000 counts were 1.6 and 1.0 fish/km (van Dishoeck 2002b).

Total escapement estimates are available for the Cheakamus River for 1996, 1997 and 1999 – 2002 (Korman 2002), based on area-under-the-curve models and predicted observer efficiency. These estimates suggest that escapement in 2001 and 2002 were unusually high in comparison to steelhead returns in 1996 through 2000. High adult escapements in Lower Mainland rivers are likely related to recent improvements in marine survival rates at the Keogh River, an index system on Vancouver Island (B. Ward, BC MWLAP, pers. com.).

Results for other Lower Mainland systems floated in 2002 are more difficult to interpret, because little historical information is available for comparison (Taylor 2002). Winter floats of the Coquihalla River and Big Silver, Norrish and Silverhope Creeks provide useful baseline data for these systems, in a year with relatively strong regional escapements. Floats of Ruby Creek suggest that snorkel surveys may not be an effective adult steelhead assessment tool for this system.

Conservation concerns remain for Lower Mainland steelhead stocks. The effect of weak returns in years prior to 2001 is uncertain, but suggests poor seeding of freshwater habitat. A juvenile survey of Kanaka Creek was conducted in 2001 (van Dishoeck 2002c). The sample size was small (five sites) and the data available for comparison is very limited (two sites in 1979 and one site in 1984). Although critically limited, the available information suggests that 2001 juvenile abundance was lower than densities sampled in previous years. No recent juvenile surveys for other systems addressed in this report are available.

For the Chilliwack River, assessment programs indicate relatively low densities of fry in 1998 through 2000, followed by improved abundance in 2001 (van Dishoeck 2002d). Data for the Cheakamus system suggest that fry densities were similar in 1999 and 2000, and improved in 2001 (van Dishoeck 2002e). Densities in 2001 were broadly similar to results for 1988, a period of strong steelhead escapement for south coastal streams (Ward 2000). Although limited, this data suggests that weak adult escapement in years prior to 2001 did affect juvenile abundance. In contrast, densities on the Mamquam River were only marginally higher in 2001 than were results for 1999 and 2000 (van Dishoeck 2002e).

Consequences for subsequent adult returns are unclear, but these weak brood years may not produce large adult escapements, even if ocean conditions remain good. Preliminary indications from the Keogh River suggest that, in fact, two years of relatively strong marine survival have been followed by more modest returns (B. Ward, BC MWLAP, pers. com.). Continued monitoring of Lower Mainland stocks is required to determine the impacts of weak year classes and variability in marine survival.

6 CONCLUSIONS

Snorkel float assessments are an effective, relatively low cost monitoring technique for Lower Mainland steelhead streams. The floats provide an index of steelhead abundance, which can be compared within and between years. However, this index does not provide an estimate of total escapement unless fish residence time, observer efficiency, and run timing can be independently

determined. A radio telemetry program is the ideal tool to generate these estimates. Studies of this type on the Cheakamus and Chilliwack rivers indicate that snorkel count efficiency is highly variable, and suggest that application of efficiency estimates from one system to counts from another system would be unreliable.

This report details 2002 floats on the Alouette, Chehalis, Coquitlam and Seymour Rivers and Kanaka Creek. We conducted seven successful days of snorkel floats in these systems between March 10 and May 10, 2002. Results were compared to similar floats done in 2001. An attempt was made to float the Capilano River on April 9, 2002 but the visibility was very low. Snorkel floats conducted on other Lower Mainland steelhead streams in 2002 are reported separately.

We divided the systems surveyed into sections that could be completed by crews of two or three floaters in one day. Rivers with more than one such section were swum by multiple crews (Alouette, Coquitlam, Seymour). In all cases, the surveyed section was shorter than the anadromous reach of the stream. However, with the exception of the Chehalis River in 2002, the sections floated represent the majority of the critical steelhead habitat present. As long as future floats are conducted in similar reaches, index results are comparable. Due to access, discharge and visibility conditions, not all reaches could be floated on all surveys (e.g. Chehalis, Coquitlam). When this was the case, intra-year comparisons rely on sections common to all floats, or on calculation of a fish per kilometre survey index.

Results from 2001 and 2002 surveys suggest that returns may have been higher than in recent years. However, the data available for comparison tend to be critically limited. Information from other sources, including floats of the Chilliwack, Mamquam and Cheakamus systems, anecdotal angler reports, and data from other steelhead streams in the south coastal region (Vancouver Island snorkel floats, Keogh River counting fence) also suggest improved steelhead returns in these years. Nevertheless, conservation concerns remain for these stocks. For example, available data suggests weak brood years in many Lower Mainland streams in 1998 through 2000. Effects on returns in coming years are uncertain. As a result, continued monitoring is critical to determine the long-term status of these steelhead populations.

6.1 Recommendations

- ***obtain funding to continue long term snorkel float monitoring.***

  Results in 2001 and 2002 indicate that snorkel floats on the Alouette, Chehalis, Coquitlam, Kanaka and Seymour systems can be effective. Our data represent a useful baseline. Monitoring through future years will refine indexing techniques and provide data critical to conservation management decisions. Counts in the Capilano system may be effective in some years, although our experience suggests that this is a difficult river to survey.

- ***obtain a ratio of hatchery to wild fish from snorkel count observations.***

  While adipose clips can be difficult to observe, future floats should obtain the hatchery to wild ratio based on fish for which a positive determination is possible.

- ***conduct a radio telemetry program on the Alouette River, in association with snorkel floats.***

  The Alouette River provides an ideal system for a study of this kind. This would produce robust total escapement estimates for the Alouette River, as well as observer efficiency estimates for an additional south coastal system.

- ***pursue other indices of steelhead stock status.***

  Other indices, such as juvenile density surveys, provide more complete data on steelhead abundance and allow for calibration of a snorkel float index. A program of this type has been conducted successfully on Kanaka Creek in 2001 (van Dishoeck 2002c).

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APPENDIX 1

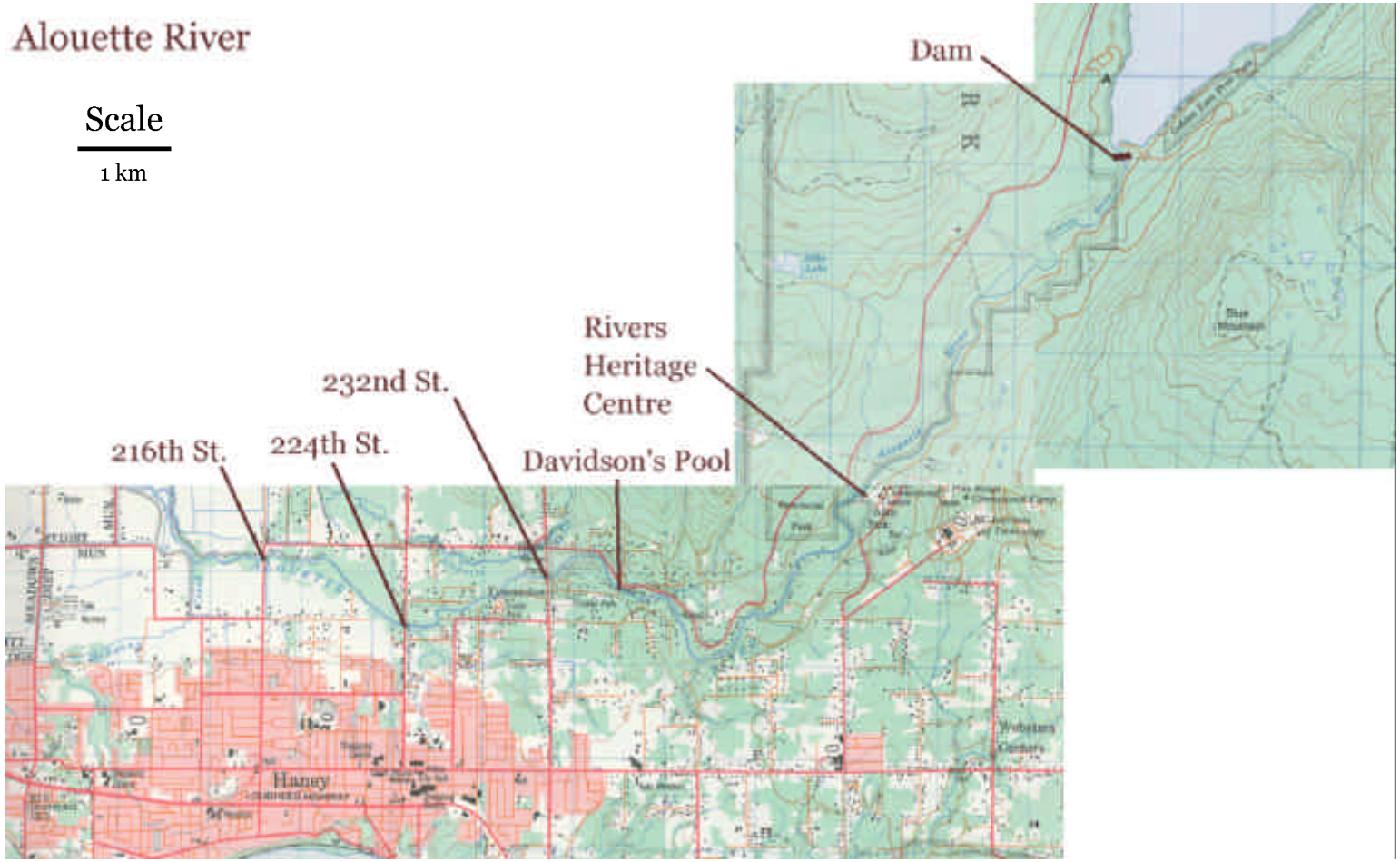
SCHEDULE OF STEELHEAD SNORKEL COUNTS CONDUCTED

SPRING 2002

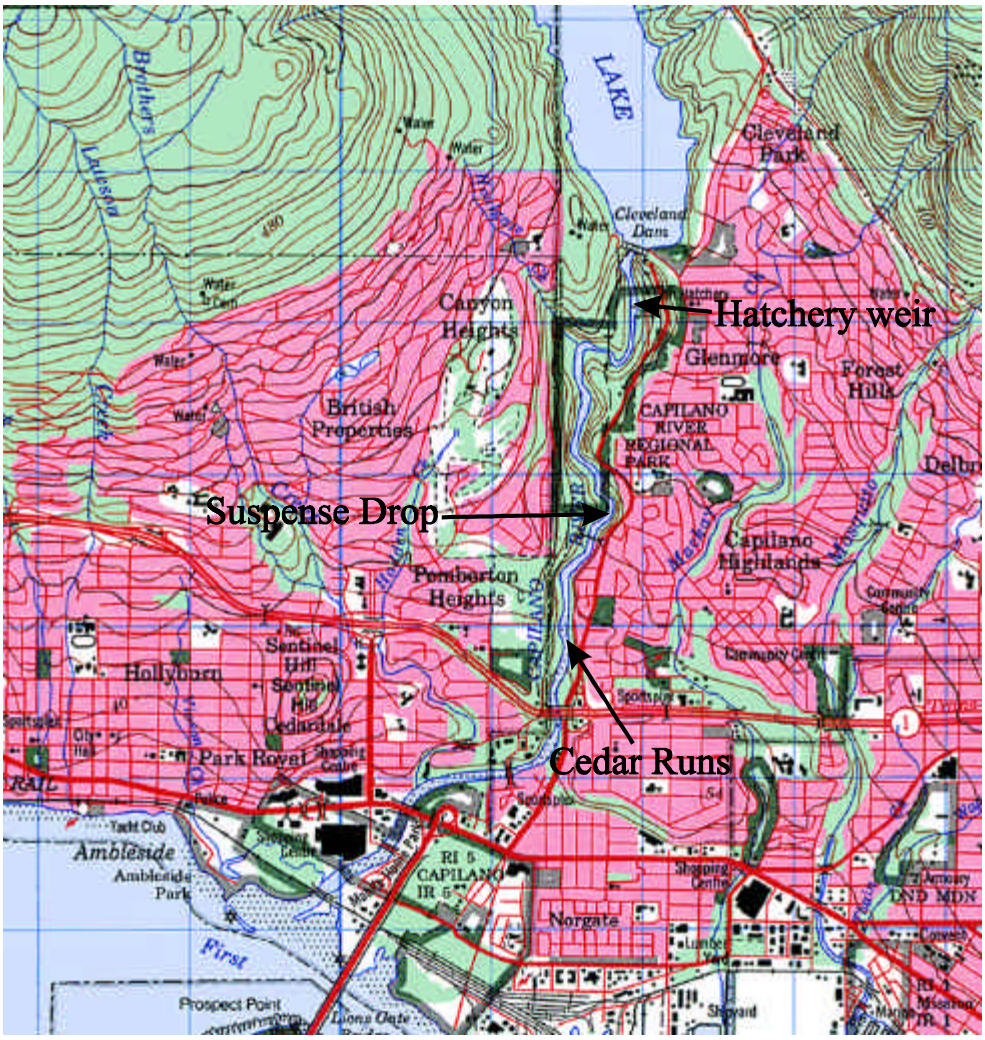
2002	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March						1	2
	3	4	5	6	7	8	9
	10 Chehalis	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
April	31	1	2 Coquitlam	3	4 Alouette	5	6
	7	8	9 Capilano	10	11	12	13
	14	15	16	17	18	19	20
	21 Kanaka	22	23 Seymour	24	25	26 Coquitlam	27
May	28	29	30	1	2	3	4
	5	6	7	8	9	10 Coquitlam	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	

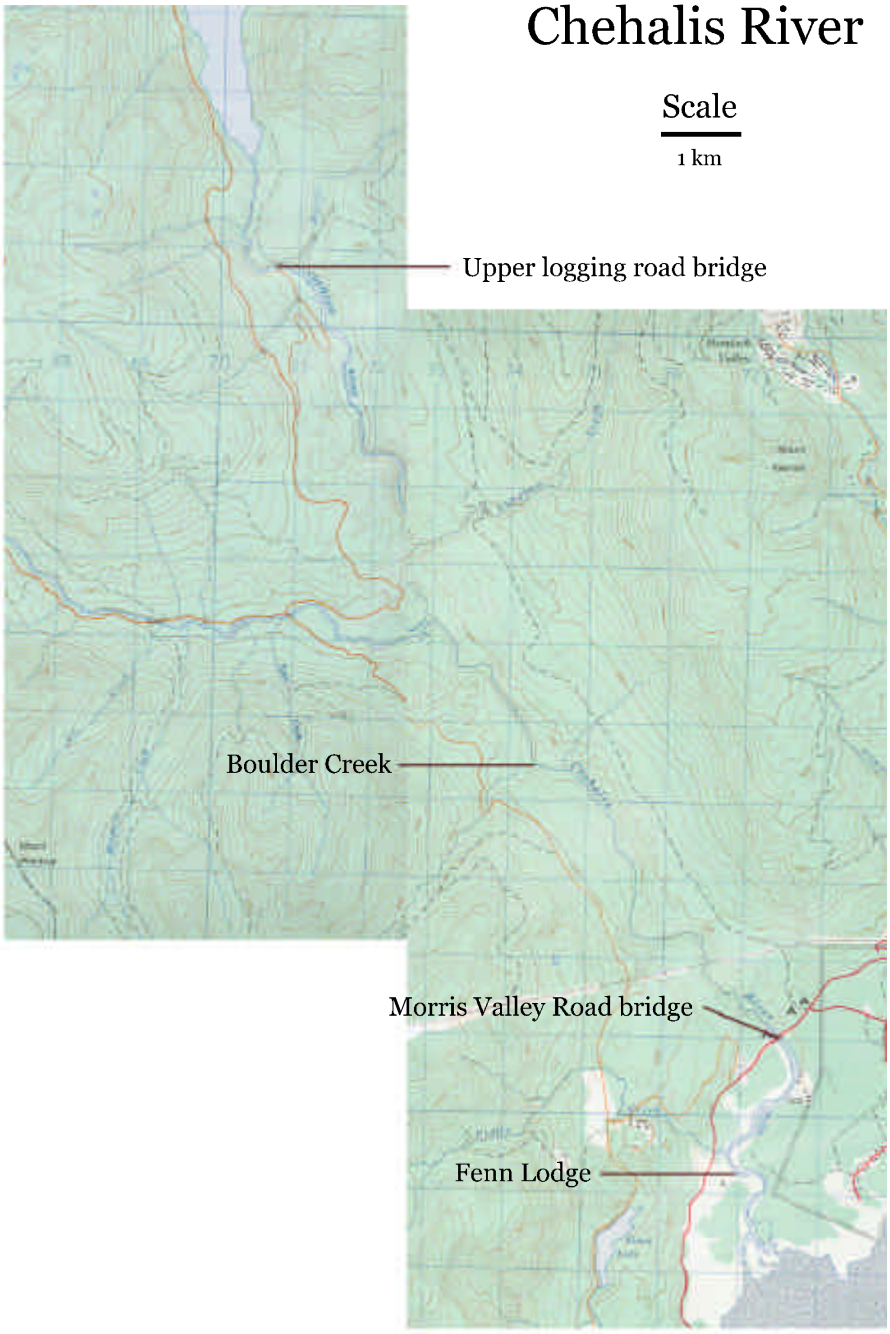
APPENDIX 2

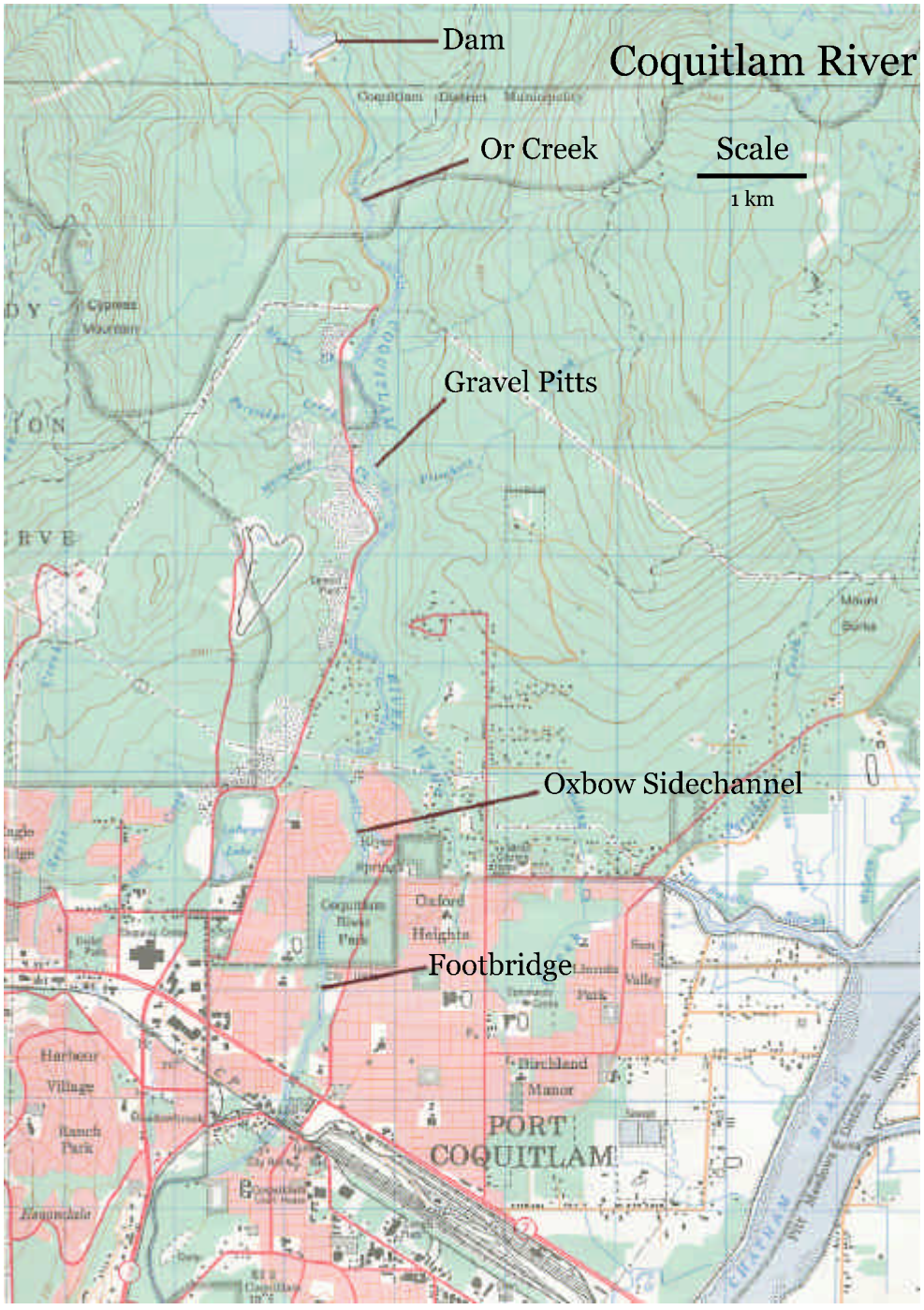
ACCESS DIRECTIONS FOR 2002 FLOATS

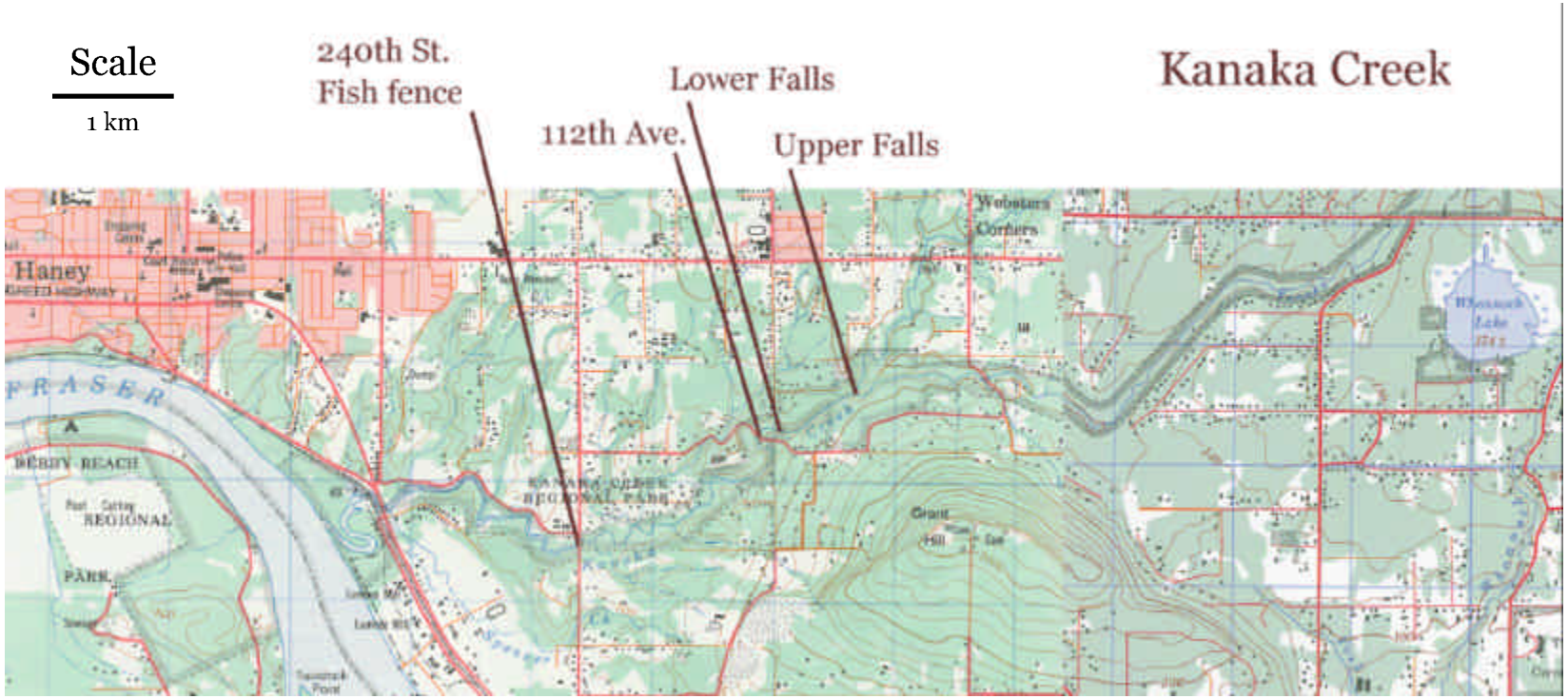

Alouette River
Scale
1 km
Dam
Rivers
Heritage
Centre
232nd St.
224th St.
216th St.
Davidson's Pool
Hanney

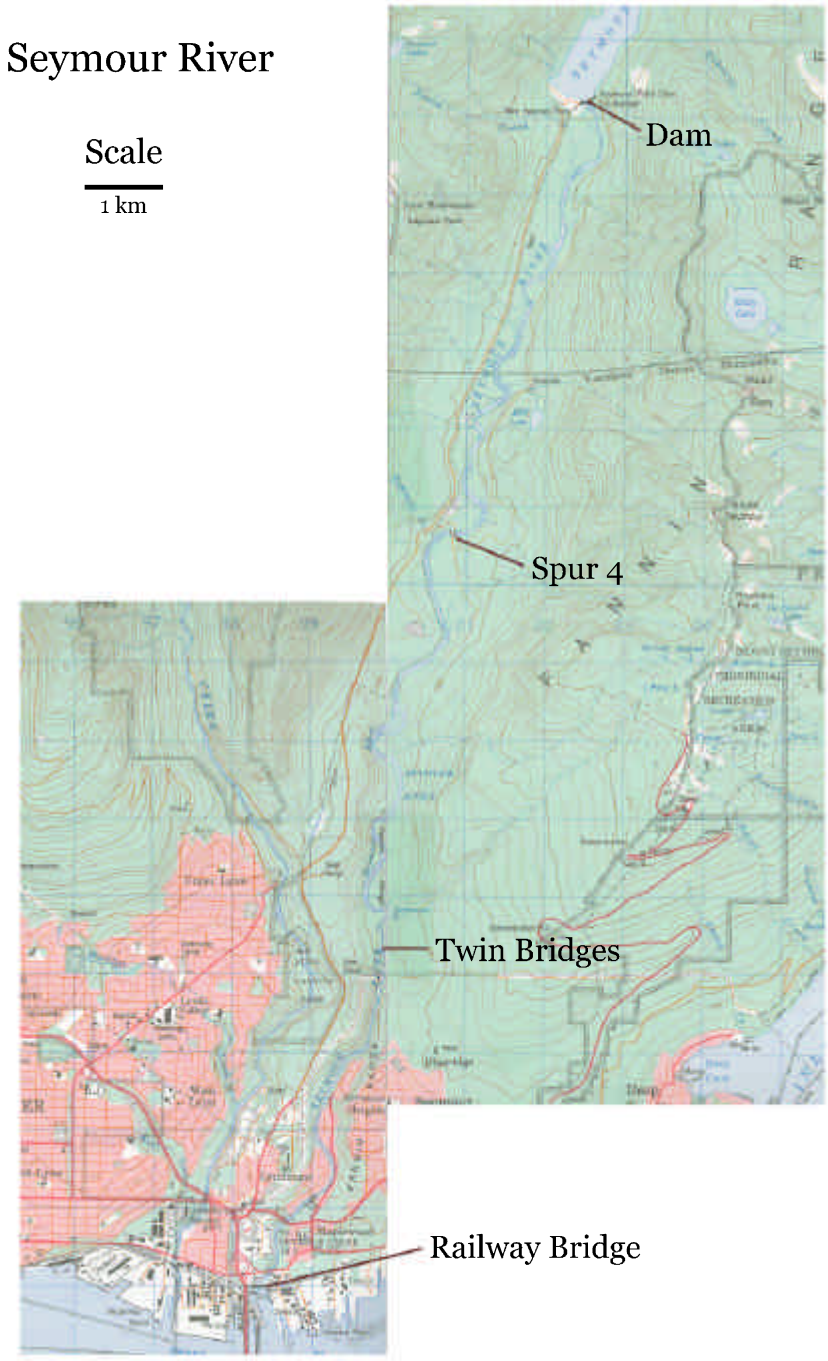
Capilano River




Chehalis River
Scale
1 km
Upper logging road bridge
Boulder Creek
Morris Valley Road bridge
Fenn Lodge


Dam
Coquitlam River
Or Creek
Scale
1 km
Gravel Pitts
Oxbow Sidechannel
Footbridge
PORT
COQUITLAM


Scale
1 km
240th St.
Fish fence
112th Ave.
Lower Falls
Upper Falls
Kanaka Creek
Haney
Websters
Corners
FRASER
BERRY REACH
REGIONAL
PARK
KANAKA CREEK
REGIONAL PARK
Grant
Hill


Seymour River
Scale
1 km
Dam
Spur 4
Twin Bridges
Railway Bridge

APPENDIX 3

DETAILED RESULTS FOR 2002 FLOATS

Aquatic Resources Limited **Pier van Dishoeck**

Alouette River Snorkel Floats 2002 **604.816.4180**

April 4, 2002 Shuttle: Sabrina, ARMS

Dam to ARMS	**ARMS to 232nd**	**232nd to 216th**
Allen Hanson	Pier van Dishoeck	CEJ Mussell
Dave Hunter	Duane Jesson	Steve Latham
	Iain Lunn	

Weather clear, sunny and warm
Water temp. 5.5 °C @ 0915
Visibility disappointing: depended on depth, sunshine & angle
Upper section: 5 - 6m in am, 3-4m by trib. 2-3m in pm
Middle section: 1-4m in am, 1-2+ m in pm
Lower section: ~ 4 m in am, 1-3 m in pm
Gauge 0.8m at dam (?); 27 on Steve Latham gauge

Date	Local name	Steelhead	Rainbow	Trout	Cutthroat	Whitefish	Sculpins	Suckers	Carp	Notes
April 4, 2002	Dam to tributary creek	10	1	0	1	0	2			and two crayfish
April 4, 2002	Tributary creek to ARMS	26	2	0	4	0				
April 4, 2002	ARMS to park	9	1	0	1	0				
April 4, 2002	Park to powerline	28	2	1	1	0				
April 4, 2002	Powerline to Davidson's pool	6	0	0	0	0				
April 4, 2002	Davidson's pool	2	6	0	0	11		6		could not see bottom of Davidson's Pool
April 4, 2002	Davidson's pool to 232nd Bridge	12	1	0	1	0				
April 4, 2002	232nd Bridge to 224th Bridge	6	0	0	0	0				
April 4, 2002	224th Bridge to 216th Bridge	13	0	0	0	0		75	15	and one fry
Total:		**112**	**13**	**1**	**8**	**11**	**2**	**81**	**15**	

Many of the fish we saw were very strongly coloured and had apparently been in the system for some time.
Some were very battered, and we observed evidence of redds, although it was difficult to produce a redd count.
There were some bright, fresh fish observed, although these were the minority.

Steelhead that we could confirm:	Wild	Hatchery
Dam to ARMS	9	2
ARMS to 232nd	12	0
232nd to 216th	11	2
Total:	**32**	**4**
	89%	**11%**

Aquatic Resources Limited with LGL **Pier van Dishoeck/Troy Nelson**

Capilano River Snorkel Floats 2002 **604.816.4180**

April 9, 2002

Crew: Pier van Dishoeck, Allen Hanson, Steve Latham

Mobile Track: CEJ Mussel

Weather	Overcast in am; raining during float
Water temp.	Not measured, estimated = 3°C
Visibility	Very poor: 2 – 2.5 m at best According to hatchery staff and Eric Carlisle, clarity has been the best that it has been so far this year. We could not see the bottom of any of the deep pools.
Gauge	30 cm higher than concrete sill at fish weir.

Unfortunately, visibility was not adequate to conduct a snorkel count.
Only three fish were observed. One out of the water while jumping a rapid, and two underwater.

A spaghetti tag that appeared white (not yellow or orange), was observed moving upstream in a deep pool at river metre 5010, but the fish itself could not be seen in the gloom.

One rainbow was observed at river metre 4210.
One steelhead was observed at river metre 2900.

Unless clarity improves drastically, snorkel floats appear not to be a viable assessment tool for Capilano steelhead.

Mobile tracking was conducted on April 9, 22 and July 11, 2002.

Aquatic Resources Limited **Pier van Dishoeck**

Chehalis River Snorkel Floats 2002 **604.816.4180**

March 10, 2002

Crew: Pier van Dishoeck, Allen Hanson, CEJ Mussel

Shuttle: Steve Olson

Weather Rain and snow overnight, heavy rain on day of float
Water temp. Not measured, estimated = 3°C
Visibility 6 – 7 + m @ Boulder Creek.
Excellent throughout float – no trouble seeing the bottom of all pools.
Reduced to about 3 m by dirty water input at and near hatchery outfall.
Gauge 6" below lowest board on intake u/s of bridge.

Date	Local name	Steelhead	Rainbow	Dolly Varden	Coho	Cutthroat	Whitefish
March 10, 2002	Boulder Creek to Pipeline	71	5	1		4	1
March 10, 2002	Pipeline to Morris Valley Road bridge	68	8	1	1		
March 10, 2002	Morris Valley Road bridge to Hatchery Hole	4		3	12		
March 10, 2002	Hatchery Hole	1			29		
March 10, 2002	Hatchery Hole to Pretty Creek	2			8		
Total:		**146**	**13**	**5**	**50**	**4**	**1**

Steelhead in same section when swum February 19, 2001: **95**

Steelhead that we could confirm:	Wild	Hatchery	Total Wild/Hatch	Fish seen	% identified	% wild	Summer	Winter	Total summer/winter	Fish seen	% identified	% winter
Boulder Creek to Pipeline	20	3	23	71	32	87	1	23	24	71	34	96
Pipeline to Morris Valley Road bridge	2	1	3	68	4	67	0	6	6	68	9	100
Morris Valley Road bridge to Hatchery Hole	0	0	0	4	0		0	0	0	4	0	
Hatchery Hole	0	0	0	1	0		0	0	0	1	0	
Hatchery Hole to Pretty Creek	0	2	2	2	100	0	0	0	0	2	0	

Aquatic Resources Limited **Pier van Dishoeck**

Coquitlam River Snorkel Floats 2002 **604.816.4180**

April 2, 2002

Dam to Lewis'	Lewis' to footbridge
Pier van Dishoeck	Gord Lewis
Dave Hunter	Allen Hanson
	Eva Boehringer

Weather High overcast in am; clear and sunny by pm.
Water temp. 5.5°C @ 1630
Visibility U/s Or: 1 - 3 m; d/s Or: 2 - 4 m.
At Lewis' in am: 3 m
½ way through lower section: 2-3m; 1-2m for remainder of lower section.
Gauge just d/s of dam:0.34m; @ fish fence bridge: 0.3m
staff gauge d/s of Lewis': 0.50m; staff gauge just u/s blue footbridge: 0.40m

Date	Local name	Steelhead	Rainbow	Whitefish	Juvenile Coho	Redds	Notes
April 2, 2002	Dam to Ozone plant	1		1		1	small (not steelhead) redd in spawning channel at the dam
April 2, 2002	Ozone plant to fish fence bridge	4	1			2	2 largish redds just u/s of the fish fence
April 2, 2002	Fish fence bridge to Or Creek	1			1		
April 2, 2002	Or Creek to Boulder Rapid above first house	1					
April 2, 2002	Boulder Rapid above first house to Lewis'	8					
April 2, 2002	Lewis' pool to Oxbow s/c interpretive sign	29					
April 2, 2002	Oxbow s/c interpretive sign to blue footbridge	2					
Total:		**46**	**1**	**1**	**1**	**3**	

Third swimmer in lower section swam behind, and recorded separately those fish not seen by Lewis and Hanson.
Boehringer saw 4 steelhead in addition to the 31 seen by Lewis and Hanson.

Aquatic Resources Limited **Pier van Dishoeck**

Coquitlam River Snorkel Floats 2002 **604.816.4180**

April 26, 2002

Dam to Or Creek	Lewis' to footbridge
Gord Lewis	Pier van Dishoeck
Allen Hanson	Steve Latham

Weather Rain overnight; heavy rain in am; light rain over day.
Water temp. 6.5°C @ 1530
Visibility U/s Or: 2 - 3 m; d/s Or: <1 m.
At Lewis' in am: 2 –3 m
½ way through lower section: 1+m; <1-1+m for remainder of lower section.
Gauge just d/s of dam:0.37m; @ fish fence bridge: 0.34m
staff gauge d/s of Lewis': 0.49m; staff gauge just u/s blue footbridge: 0.42m

Date	Local name	Steelhead	Rainbow	Whitefish	Juvenile Salmonids	Notes
April 26, 2002	Dam to Or Creek	12	1		1	
April 26, 2002	Or Creek to Boulder Rapid above first house	not floated				Or Creek had very high turbidity and precluded floating beyond this point.
April 26, 2002	Boulder Rapid above first house to Lewis'	not floated				
April 26, 2002	Lewis' pool to concrete lock blocks	10		2		
April 26, 2002	Concrete lock blocks to RST	3				Marked decrease in visibility at lock blocks
April 26, 2002	RST to powerline	4				
April 26, 2002	Powerline to blue footbridge	2	1	1		
Total:		**31**	**2**	**3**	**1**	

Poor visibility. Upper section floaters pulled out at Or Creek.
Section between Or Creek and Lewis' NOT FLOATED.

Aquatic Resources Limited **Pier van Dishoeck**

Coquitlam River Snorkel Floats 2002 **604.816.4180**

May 10, 2002

Dam to Lewis'	Lewis' to footbridge
Pier van Dishoeck	Dave Hunter
Josh Taylor	Jeff Greenbank

Weather Clear and sunny.
Water temp. 9.0°C @ 1530
Visibility U/s Or: 3 – 4 + m; d/s Or: 5 – 6 m.
Decreased to 2 – 3 m in some places.
About 3 m d/s of Lewis'.
Gauge @ fish fence bridge: 0.31m
staff gauge d/s of Lewis': 0.47m.

Date	Local name	Steelhead	Rainbow	Whitefish	Juvenile Salmonids	Notes
May 10, 2002	Dam to RCMP bridge	9	4	0	55	
May 10, 2002	RCMP bridge to Or Creek	1	0	0	0	
May 10, 2002	Or Creek to Boulder Rapid above first house (Dr.'s Pool)	9	2	2	5	
May 10, 2002	Boulder Rapid above first house to Lewis'	15	5	2	12	
May 10, 2002	Lewis' Pool to RST	9	1	2	9	Two of the nine steelhead were in the RST.
May 10, 2002	RST to blue footbridge	10	3	0	25	
Total:		**53**	**15**	**6**	**106**	

Aquatic Resources Limited **Pier van Dishoeck**

Kanaka Creek Snorkel Floats 2002 **604.816.4180**

April 21, 2002

Crew: Pier van Dishoeck, Allen Hanson, CEJ Mussell

Shuttle: John Heaven

Weather Overcast with light drizzle; no rain over previous days.
Water temp. 7.0°C
Visibility 2.5 m at Cliff Falls.
~2 m further downstream.
Gauge Mid-river: 99 cm
Fish fence: 17 cm

Date	Local name	Steelhead	Rainbow	Cutthroat	Whitefish	Suckers	Juv. trout	Notes
April 21, 2002	Cliff Falls to Lower Falls	0	0	0	0	0	5	
April 21, 2002	Lower Falls to 112 Ave bridge	2	4	3	1	0	0	redds observed
April 21, 2002	112 Ave bridge to horse trail	7	2	0	2	0	1	
April 21, 2002	Horse trail to 240 bridge	0	2	0	0	1	0	
Total:		**9**	**8**	**3**	**3**	**1**	**6**	

Aquatic Resources Limited **Pier van Dishoeck**

Seymour River Snorkel Floats 2002 **604.816.4180**

April 23, 2002

Seymour Falls Dam to Pat's Pool	**Pat's Pool to Spur 4 Bridge**	**Spur 4 Bridge to Twin Bridges**	**Twin Bridges to d/s '88 Pool'**
Marc Guimond	James Weger	M. Steinmann	Pier van Dishoeck
Scott Carpenter	Steve Latham	P. Harding	Allen Hanson
		S. Kirkpatrick	

Weather Clear and sunny.
Water temp. 4.5°C at Twin Bridges.
Visibility 3 + m at Twin Bridges.
2 + m at '88 Pool'.
2 – 3 m overall.
Gauge 0.66 m at Twin Bridges.

Date	Local name	Steelhead	Rainbow	Dolly Varden	Hatchery SH smolts	Notes
April 23, 2002	Seymour Falls Dam to Pat's Pool	1				
April 23, 2002	Pat's Pool to Spur 4 Bridge	3				
April 23, 2002	Spur 4 Bridge to Twin Bridges	17				
April 23, 2002	Twin Bridges Pool	1				
April 23, 2002	Twin Bridges Pool to Cable Bridge	6	2			3 id, all wild
April 23, 2002	Cable Bridge to '88 Pool'	2			92	1 id, hatchery
April 23, 2002	'88 Pool' to corner d/s of '88 Pool'	1		1	7	1 id, wild
Total:		**31**	**2**	**1**	**99**	

The canyon should not be swum at this level. Three sections were not passable by floaters. Swim at 0.60 m or lower. Swum at 0.44 m last year and that was OK.

BC Conservation Foundation **Allen Hanson**

Seymour River Snorkel Floats 2002 **604.576.1432 ext.307**

August 18, 2002

Seymour Falls Dam to Spur 7	Pat's Pool to Coho Creek	Big Rock to Twin Bridges	Twin Bridges to Swinburne
Pier van Dishoeck	Marc Guimond	Mike Steinmann	Allen Hanson
Wayne Halabourda	Scott Kirkpatrick	Paul Harding	Cory Hryhorczuk

Weather Clear and sunny.
Water temp. 4.5°C at Twin Bridges.
Visibility 8 + m at Twin Bridges.

Gauge ~0.0 m – sand covers up to 0.70 m on the gauge, water was approximately up to the 0.0 mark

Date	Local name	Steelhead	Coho	Chinook	Rainbow	Cutthroat	Juveniles	Notes
August 18, 2002	Seymour Falls Dam to Spur 7	10	47	0	?	1	150	1,4
August 18, 2002	Pat's Pool to Coho Creek	9	700	1	?	4	?	2,3
August 18, 2002	Big Rock to Twin Bridges	2	30	2	?	3	?	
August 18, 2002	Twin Bridges to Swinburne	22	230	5	17	18	300	3,4,5
Total:		**43**	**1007**	**8**	**17**	**26**	**~450**	

1. Most of the steelhead and coho in Section 1 were in the Dam Pool.
2. Most of the coho in Section 2 were in Pat's Pool and the Old Dam Pool.
3. It was difficult to see steelhead amidst large schools of coho, this was especially problematic in deep (and dark) pools of the canyon.
4. Moderate to high densities of juvenile salmonids.
5. Approximately 30% of cutthroat were of hatchery origin (no adipose fin).

? = Not reported for that section.

APPENDIX 4

AVAILABLE HISTORICAL DATA

South Alouette River - Historical Steelhead Snorkel Float data

Date	Reach	Wild SH	Hatch SH	Unk. SH	CT	RB	TR	Comments
March 20, 1961	Dam to "Station A-16" (1.25 miles)			4				no map to delimit sections, high turbidity, float late in season, some redds observed
	"Station A-13 to Station A-12" (1.25 miles)			1				
	"Station A-12 to Station A-8.1"			4				
	Total			**9**				
January 22, 1976								River too dirty to float.
March 4, 1977	"Stream section #3" (?)			5				weather: overcast, 6oC; water conditions: "medium" flow, visibility = 10 - 12 feet
	"Stream section #4" (?)			32		1		visibility dropped to 6-8 feet at 224th St. Br., and very poor in section d/s of bridge
	"Stream section #5" (?)			3				
	Total			**40**		**1**		
April 2, 1980	Dam Pool, YMCA Pool and Mike Creek confluence to Alco Park			0				weather: sunny; water conditions: "low and clear"
	Alco Park to 240th Street			8				also 3 redds and 1 SH killed by an angler
	240th Street to Wagon Wheel Trailer Court			4				
	Wagon Wheel to 216th Street			4				
	Total			**16**				
February 5, 1981	Davidson's *seine haul*	6	1	-				seine haul
February 6, 1981	224th to 216th	2		6				weather: sunny and cold; water conditions: low, clear and cold
	Wagon Wheel - 224th Street *spot check*	13		3				this was a *spot check* of major holding pools
	Park *spot check*							visibility in lower river poor
	Eagans *spot check*							10 % hatchery fish
	Davidson's *spot check*	10						
	Big Rock *spot check*	1						kelt (?)
	Glower's to Oliver's logjam and lower pool *spot check*	3	2					
	Glazier *spot check*		1					
	Frenchman's A-frame to Island Pool *spot check*	1						
	Total	**36**	**4**	**9**				**Total SH count = 49**

South Alouette River - Historical Steelhead Snorkel Float data (cont'd)

Date	Reach	Wild SH	Hatch SH	Unk. SH	CT	RB	TR	Comments
February 26, 1990	228th to 216th	3		4	13			water conditions: low; visibility about 2m, too murky for deeper pools
	Egans to Park				13			
	Davidson's							too dirty
	Gowers to Big Rock	1		2	7			
	Frenchman's to Glazier	3		15	3			
	Total	**7**	**0**	**21**	**36**			**Total SH count = 28**
March 10, 1992	Alco Park to Glazier	9	3	2	12			previous floats *of the same section*: April 2, 1980: 8 SH (100% wild);
	Gowers to Big Rock				1			Feb. 6, 1981: 18 SH (83% wild); Feb. 26, 1990: 21 SH (100% wild).
	Davidson's (seine)	4	3					all fish seined from Davidson's were kelts
	Total	**13**	**6**	**2**	**13**			**Total SH count = 21**
March 3, 1995	Dam to Mud Creek			0				
	Mud Creek to "3.1 km"	1						male
	"3.1 km" to "4.0 km"	2						1 male, 1 female
	"4.0 km" to "4.9 km"	5	2					1 W male, 4 W females, 1 H male, 1 H female
	"4.9 km" to "5.3 km"	2						1 male, 1 female
	Frenchman's *spot check*	4	2					2 W males, 2 W females, 1 H male, 1 H female
	Hot Rocks *spot check*			0				
	Davidson's *spot check*			0				22% hatchery
	Total	**14**	**4**	**0**				**Total SH count = 18**
January 25, 1996	Mud Creek *spot check*			0				water conditions: very low and clear
	Total			**0**				

South Alouette River - Historical Steelhead Snorkel Float data (cont'd)

Date	Reach	Wild SH	Hatch SH	Unk. SH	CT	RB	TR	Comments
March 23, 2001	Dam to tributary creek			5	5	1		weather: sunny, good weather since Tuesday
	Tributary creek to RHC			39	14	5		water conditions: visibility between 3 - 7.5 m
	RHC to park			10	1	2		
	Park to powerline			61	1	6		this cutthroat was a hatchery fish
	Powerline to Davidson's pool			6		5		
	Davidson's pool (float #1)			0		2		angler hooked and landed ~7lb. Wild SH immediately after we swam the pool
	Davidson's pool (float #2)			8		0		could not see the bottom of this deep pool
	Davidson's pool (best count)			8		2		
	Davidson's pool to 232nd Bridge			3		1		
	232nd Bridge to 216th Bridge			47		4		steelhead in this reach appeared small; some fish strongly coloured and battered (redding)
	Total			**179**	**21**	**26**		
April 5, 2001	Dam to tributary creek			12			1	five of the SH seen were in and around the WRP structures
	Tributary creek to RHC			29	1		7	some evidence of early redd construction through section of river (u/s and d/s of RHC)
	RHC to powerline			43	1			gravel in upper river section is compacted and addition of stockpiled material considered beneficial
	Powerline to Davidson's pool			4				weather: rain overnight, heavy rain over duration of float
	Davidson's pool (float #1)			1				water conditions: visibility generally between 2 - 5 m
	Davidson's pool (float #2)			1				
	Davidson's pool (best count)			1				
	Davidson's pool to 232nd Bridge			0				
	232nd Bridge to 224th Bridge			4				
	224th Bridge to 216th Bridge			-				this section was floated, but no attempt made to look for fish b/c visibility was <1 m due to very dirty creek at 224th Bridge
	Total			**93**	**2**		**8**	

South Alouette River - Historical Steelhead Snorkel Float data (cont'd)

Date	Reach	Wild SH	Hatch SH	Unk. SH	CT	RB	TR	Comments
April 21, 2001	Dam to tributary creek			20	3	3		of 18 steelhead identified in section u/s of RHC, 16 were wild and 2 were hatchery fish (89% wild)
	Tributary creek to RHC			16	3	3		extensive evidence of redd construction
	RHC to powerline			67	13	3		one dead wild male upstream of powerlines, too deep to check out
	Powerline to Davidson's pool			6	6			one dead wild female @ powerlines run; lots of fungal growth, no evidence of angler induced injuries
	Davidson's pool (float #1)			3				one dead wild female @ pool u/s of Davidson's Pool; appeared incompletely spawned, although no eggs expressed
	Davidson's pool (float #2)			14			6+	weather: clear and sunny day of float, as well as night and day beforehand
	Davidson's pool (best count)			14			6	water conditions: visibility 7m @ dam, decreasing to 1-4m by 216th Bridge
	Davidson's pool to 232nd Bridge			5			1	of 19 steelhead identified in section d/s of RHC, 13 were wild and 6 were hatchery fish (68% wild)
	232nd Bridge to 224th Bridge			13	6			includes 2 hatchery cutthroat
	224th Bridge to 216th Bridge			8	3			also many sucker fry over soft substrate
	Total			**149**	**34**	**9**	**7**	
May 25, 2001	Dam to Mud Creek				1		21	TR are juveniles
	Mud Creek to tributary creek			1		1	11	
	Tributary creek to RHC			2	11	7	112	may have been 2 other SH present; dace in excavated redd; CT # includes 1 hatchery CT
	RHC to first split						52	many dead juveniles (~20 dead fish, around 120mm FL, slightly discoloured)
	First split to Doberman Pool				10		82	
	Doberman Pool to u/s Davidson's Pool			4		29	50	weather: clear and sunny, warm
	Davidson's Pool							water conditions: 2 - 5 m visibility, depending on sunshine and location
	Davidson's Pool to 232nd Bridge					6	90	
	232nd Bridge to 224th Bridge				1	2	5	
	224th Bridge to 216th Bridge				2	2	24	several dead crayfish
	Total			**7**	**54**	**18**	**447**	

North Alouette River - Historical Steelhead Snorkel Float data

Date	Reach	SH	RB	Juv RB	CO	Juv CO	Comments
January 22, 1976	UBC Research Forest Gate to 228th & 132nd	25	6	1	6		
	228th & 132nd to 220th street dike	16			17		400 yards between sections *not swum.*
	220th street dike to d/s Neaves (sp?) Road	-					
	d/s Neaves Road to confluence w/ S. Alouette	-					
	Total	**41**	**6**	**1**	**23**		
March 3, 1977	Obstruction to 232nd St. Bridge	4					Water conditions: "medium" flow, "good" visibility.
	232nd St. Bridge to ? (not recorded)	-			1 (dead)	15	
	Total	**4**	**0**	**0**	**1 (dead)**	**0**	
March 18, 1981	Birch Ave. d/s to Bus Stop Pool	3					Water conditions: excellent, low and clear.
	Bus Stop Pool to 224th	0					"An unknown number of fish could have been
	224th to Park Lane	7					missed in several thick, extensive log jams."
	Total	**10**					

Capilano River - Historical Winter Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge (m^3/s)	Steelhead	CT	CO	SH juv	CO juv	CM	CH
February 24, 1998	?	moderate	?		**1**					
January 8, 1999	Hatchery weir to Suspense Drop	1.5 m	9.9	0						
	Suspense Drop to Cedar Runs	1.5 m	9.9	0						
	Cedar Runs to estuary	1.5 m	9.9	0						
			Total	0						
April 1, 1999	Hatchery weir to Suspense Drop	1.6 m	5.1	5						
	Suspense Drop to Cedar Runs		5.1	1						
	Cedar Runs to estuary	2.5 m	5.1	0						
			Total	**6**						
April 30, 1999	Hatchery weir to Suspense Drop	3 m	7.9	9	11	1	1			
	Suspense Drop to Cedar Runs	3 m	7.9	4		2	3			
	Cedar Runs to estuary	3 m	7.9	2	1	6	10			
			Total	**15**	**12**	**9**	**14**			
May 21, 1999	Hatchery weir to Suspense Drop	3.5 m	5.9	2	3			~100		
	Suspense Drop to Cedar Runs	3.5 m	5.9	1	1	3				
	Cedar Runs to estuary	3.5 m	5.9	2	2					
			Total	**5**	**6**	**3**		**~100**		
January 21, 2000	Hatchery weir to Suspense Drop	3 m	1.1			1				
	Suspense Drop to Cedar Runs	3 m	1.1	1						
	Cedar Runs to estuary	3 m	1.1							
			Total	**1**		**1**				
February 11, 2000	Hatchery weir to Suspense Drop	3 m	2.3	1						
	Suspense Drop to Cedar Runs	3 m	2.3	3						
	Cedar Runs to estuary	3 m	2.3	1						
			Total	**5**						

Capilano River - Historical winter steelhead snorkel float data (cont'd)

Date	Reach	Visibility	Discharge	Total SH	CT	CO	SH juv	CO juv	CM	CH
March 17, 2000	Hatchery weir to Suspense Drop	2 m	1.0	1		1				
	Suspense Drop to Cedar Runs	2 m	1.0							
	Cedar Runs to estuary	2 m	1.0							
			Total	**1**		**1**				
April 19, 2000	Hatchery weir to Suspense Drop	3 m	7.9	3						
	Suspense Drop to Cedar Runs	3 m	7.9	4						
	Cedar Runs to estuary	3 m	7.9	2						
			Total	**9**						

Capilano River - Historical Summer Steelhead Snorkel Float data

October 7, 1998	Hatchery weir to Suspense Drop	3 m		5		164	534	1745		
	Suspense Drop to Cedar Runs	3 m		2			213	110		
	Cedar Runs to estuary	3 m			1	4	153	84		
			Total	**7**	**1**	**168**	**900**	**1939**		
November 27, 1998	Hatchery weir to Suspense Drop	1.7 m				36			3	2
	Suspense Drop to Cedar Runs	1.7 m				5			2	3
	Cedar Runs to estuary	1.7 m								
			Total			**41**			**5**	**5**

Chehalis River - Historical Winter Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge	Wild SH	Hatch. SH	Unk. SH	Total SH	CT	RB	WF	DV	CO	CH	CM	SK
March 10, 1981	Upper Bridge to Top Falls	5 m	moderate			14	14								
	Top Falls to Boulder Creek	5 m				11	11								
	Boulder Creek to Highway Bridge	5 m				4	4								
			Total	**0**	**0**	**29**	**29**	**0**	**0**	**0**	**0**	**0**			**0**
February 7, 1985	Morris Valley Bridge to Pretty's	clear	low	14	2		16					300-500			
February 20, 1986	First Canyon Pool to Pretty's	clear	v. low			121	121					800-1000			
February 15, 1989	Sandhole to Pretty's	clear	v. low	5	9	44	44	1				lots			
February 20, 2001	Upper logging road bridge to pool above Statlu Creek	15 + m				27	27		3			3			
	Pool above Statlu Creek to Boulder Creek	15 + m				47	47		1			2			
February 19, 2001	Boulder Creek to Morris Valley Road	15 + m				87	87		2		1	39			
	Morris Valley Road to Pretty Creek	10 + m				8	8				1	287			
	Pretty Creek to Fenn Lodge	10 + m				1	1					60			
			Total			**170**	**170**		**6**		**2**	**391**			
April 1, 2001	Boulder Creek to Morris Valley Road bridge	10 + m		11	5	18	34	1	4		2				
	Morris Valley Road bridge to Below Fenn Lodge	10 + m		8	16	22	46		1	4	1		1		
			Total				**80**	**1**	**5**	**4**	**3**		**1**		

Chehalis River - Historical Summer Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge	Wild SH	Hatch. SH	Unk. SH	Total SH	CT	RB	WF	DV	CO	CH	CM	SK
August 23, 1988	Boulder Creek to Morris Valley Road	10+ m	moderate - low		2		2				2	1			9
August 24, 1988	Pop's Hole to Boulder Creek	10+ m	moderate - low	5	11		16				6	1			3
	Morris Valley Road to lower Pretty's	10+ m	moderate - low					4							
			Total	**5**	**13**	**0**	**18**	**4**	**0**	**0**	**8**	**2**			**12**
October 2, 1989	Pop's Hole to Boulder Creek	clear	v. low	1	17		18					500			
October 3, 1989	Upper Falls	clear	v. low								1	150			
	First Canyon	clear	v. low									3		2	
	Lake Outlet to Outlet Falls	clear	v. low		5		5					75			
	200 m u/s Upper Bridge to Maisal Creek	clear	v. low		1		1					6			
			Total	**1**	**23**	**0**	**24**	**0**	**0**	**0**	**1**	**734**		**2**	**0**
August 28, 1990	Boulder Creek to Morris Valley Road	4 - 5+ m	?			4	4					2			3
August 29, 1990	Pop's Hole to Boulder Creek	4 - 5+ m	?			55	55				1	3	6		57
August 30, 1990	Lake falls to Maisal Creek	4 - 5+ m	?			15	15								
August 31, 1990	Chehalis outlet to falls	4 - 5+ m	high			12	12		4						
September 5, 1990	u/s and d/s of Upper Falls	4 - 5+ m	?						1			6			9
			Total	**0**	**0**	**86**	**86**	**0**	**5**	**0**	**1**	**11**	**6**	**0**	**69**
September 24, 1991	Lake outlet to first falls	8 m				3	3					4			
	Upper Falls	8 m										200			
September 25, 1991	Lower falls to Boulder Creek	8 m				2	2					300			
	Boulder Creek to Morris Valley Road	8 m				2	2					200			
			Total	**0**	**0**	**7**	**7**	**0**	**0**	**0**	**0**	**704**	**0**	**0**	**0**
July 28, 1992	Lake outlet to Maisal Creek	8 m				75	75						3		
	Upper Falls	8 m				24	24								
July 27, 1992	Lower falls to Boulder Creek	8 m				71	71						30		
	Boulder Creek to Morris Valley Road	8 m				22	22						65		
	Morris Valley Road to Hatchery	8 m				1	1						30		
			Total	**0**	**0**	**193**	**193**	**0**	**0**	**1**	**3**	**0**	**128**	**0**	**0**

Coquitlam River - Historical Steelhead Snorkel Float data

Coquitlam River

Date	Reach	Visibility	Discharge	SH	RB	Juv ?	CO	Redds	Juv CO
March 11, 1977	Upstream of Or Creek	0.6 m	moderate			3			
March 2, 1978	Dam to Or Creek	< 0.3 m	low				2	13	
May 25, 1978	Dam to gravel pitt	clear	v. low	5	2				150
March 26, 1980	Or Creek to Upper Coq. R. Park	0.5 - 2 m	?	4					
April 2, 1999	Or Creek to Partride Creek			13				1	
April 4, 1999	Or Creek to Partride Creek			13				5	
April 24, 1999	Or Creek to Partride Creek			15				12	
May 8, 1999	Or Creek to Partride Creek			12				4	
May 15, 1999	Or Creek to Partride Creek			12				0	
May 23, 1999	Or Creek to Partride Creek			2					
March 22, 2001	Dam to Rotary Screw Traps	4 m		25	4	5			
	RST to Lewis'	7 m		3	0	0			
			Total	**28**	**4**	**5**			
April 9, 2001	Dam to Or Creek	3.5 - 5 m		1	5			13	32
	Or Creek to Hydro Lines	3.5 - 5 m		19	3			4	
	Hydro Lines to Lewis'	3.5 - 5 m		13	4				
	Lewis' Pool	3.5 - 5 m		2					
	Lewis' Pool to Oxbow s/c	3.5 - 5 m		29					
			Total	**64**	**12**			**17**	**32**
April 27, 2001	Dam to Ozone Plant	1 - 4 m		2		70		2	
	Ozone Plant to Fish Fence Bridge	1 - 4 m		9		4			
	Fish Fence Bridge to Or Creek	1 - 4 m		2		1			
	Or Creek to Boulder Rapid above first house	3 - 5 m		9		1			
	Boulder Rapid above first house to Lewis'	1.5 - 2 m		8		4			
	Lewis' Pool to blue footbridge	1 - 4 m		19		6		9	2
			Total	**49**		**86**		**11**	**2**

Or Creek (tributary of Coquitlam River)

Date	Reach	Visibility	Discharge	SH	RB	Juv ?	CO	Redds	Juv CO
March 2, 1978	Lower 500 m	< 0.3 m	low						
May 25, 1978	Lower reach	clear	v. low		5				150
March 26, 1980	Lower 500 m	2 m	?						

Kanaka Creek - Historical Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge	Steelhead	Cutthroat	Rainbow	Comments
February 5, 1982	Upper falls to 240th Street Bridge	< 2 m	low	2	5		No fish were seen between the upper and lower falls. Many fish may have been missed (poor vis., deep pools, log jams).
January 25, 1996	Falls to George Street (?)	clear	v. low	4			Whether upper or lower falls is not recorded.
February 21,2001	Lower falls to horse trail	~ 4 m		0	1	4	at least one of the cutthroat was a hatchery fish
	Horse trail to 240 Bridge	1 - 2 m		1	1	0	steelhead was in pool at the claybanks bend
			Total	1	2	4	
March 13, 2001	Cliff Falls to Lower Falls			0	0	0	many of the deeper pools which may have held
	Lower Falls to 112 Ave Bridge	1.5 m		0	2	0	steelhead were too deep for us to see the bottom
	112 Ave Bridge to horse trail	1 m		0	0	1	
	Horse trail to 240 Bridge	<1 m		0	0	1	
			Total	**0**	**2**	**2**	
April 26, 2001	Cliff Falls to Lower Falls	1 - 3 m		1	3	0	lots juvenile salmonids in upper river
	Lower Falls to horse trail	1 - 3 m		4	2	0	all ST seen were strongly coloured (no chrome fish)
	Horse trail to 240 Bridge	1 - 3 m		2	3	1	4 of the steelhead were identified as wild
			Total	**7**	**8**	**1**	
May 11, 2001	Cliff Falls to Lower Falls	2 - 4 m		2	0		large schools of coho smolts (presumed hatchery
	Lower Falls to horse trail	2 - 4 m		3	0		release)
	Horse trail to 240 Bridge	2 - 4 m		0	1		large schools (50-250) of peamouth chub in this section (~600 total)
			Total	**5**	**1**		

Seymour River - Historical Winter Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge	Wild SH	Hatch. SH	Unk. SH	Total SH	CT	DV	RB	CO	Comments
March 26, 1987	Dam to Pats Pool	?	?	1			1	1				BCIT students
	Pats Pool to Spur 4			13	1		14					1 red spaghetti tag this section
	Spur 4 to Rice Lake Creek			14			14	1				pre-float tagging:
	Rice Lake Ck. to Twin Bridges			23	7		30					red d/s Spur 4, yellow u/s
	Twin Bridges to Ledge			4	2	5	11					
	Ledge Pool					10	10					
	Pipes Pool					45	45					
	Pipes to 88			1	1	1	3					
				56	11	61	128	2	0	0	0	1 red tag
April 3, 1987	Dam to Pats Pool	?	?	1	4		5	1 (dead)				more experienced floaters
	Pats Pool to Spur 4			2	6	6	14					2 yellow spaghetti tags this section
	Spur 4 to Rice Lake Creek			6	5	12	23					2 red spaghetti tags this section
	Rice Lake Ck. to Twin Bridges			23	12	16	51					3 red spaghetti tags this section
	Twin Bridges to Ledge			27	11		38					pre-float tagging:
	Ledge Pool					1	1					red d/s Spur 4, yellow u/s
	Pipes Pool					30	30					
	Pipes to 88			2		2	4					
				61	38	67	166	0	0	0	0	5 red tags, 2 yellow tags
April 7, 2001	Seymour Falls Dam to Train Bridge	2 - 8 m		10	6	36	52	0	0	0	0	21 ST were identified as winter fish and 3 ST were identified as summer fish

Seymour River - Historical Summer Steelhead Snorkel Float data

Date	Reach	Visibility	Discharge	Wild SH	Hatch. SH	Unk. SH	Total SH	CT	DV	RB	CO	Comments
July 2, 1980	Dam to Spur 7	> 5 m	low			9	9					2.5 hours to float
	Spur 7 to Spur 4	> 5 m	low			1	1					4.0 hours
	Spur 4 to Twin Bridges	> 5 m	low			6	6				3	2.75 hours
July 3, 1980	Twin Bridges to Pipeline	-	-									not floated due to water conditions; rain
July 10, 1980	Twin Bridges to Pipeline	clear	low			4	4		2		17	totals assume no fish movement b/w July 2/3 and July 10
July 3, 1980	Pipeline to Burrard Inlet	5	rising			1	1				1	2.0 hours
			Total			21	21	0	2	0	21	numerous CT and resident RB SH juveniles throughout
June 29, 1988	Pat's Pool to Spur 4	?	?	16	5	10	31				50	coho approx.; fewer juv. than in d/s section (June 28)
June 28, 1988	Spur 4 to Islands	clear	falling	2	12	8	22				12	few juveniles u/s of islands
	Islands to Cribbing			3	4	1	8			1	1	many juveniles (some hatchery) d/s of islands
	Cribbing to Twin Bridges			0	0	0	0				4	
			Total	21	21	19	61	0	0	1	67	
July 29, 2001	Dam to Pat's Pool	~6 m				10	10	11			48	
	Pat's Pool to Spur 4 Bridge	~6 m				10	10	2			51	
	Spur 4 Bridge to Twin Bridges	~6 m				6	6	5			11	
	Twin Bridges to Pipes Pool 88	~6 m				7	7	2			69	61 pink salmon also counted
			Total			33	33	20			179	