Final Report

Salmon & White Rivers Flood Frequency Analysis

Project No. 2221-49200-07
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1 INTRODUCTION

1.1 GOALS AND OBJECTIVES FOR THE FLOOD FREQENCY ANALYSIS

The goal of the Flood Frequency Analysis is to provide current 20 & 200-year storm event flow rates in the Salmon and White Rivers for the Strathcona Regional district and the Village of Sayward. Updated estimates of flood discharges are required because the last assessment occurred in 1995. Since then, more data has been collected and the Salmon River diversion has been decommissioned. The Salmon River is now receiving all runoff from its watershed, and as such, estimated peak flows will understandably be greater than those calculated in past studies. The updated rates can be applied to future floodplain maps, hazard maps, and risk assessments should they be undertaken.

Specific objectives and deliverables of the study included:

1. Review of past hydrologic studies to be used as a comparison to the results of this study.
2. Review of past reports to establish historic diversion dam peak flows
3. Hydrologic analysis based on historic recorded data collected within the Salmon River watershed.
4. Results of the hydrologic analysis at given locations along both the Salmon and White Rivers.
5. Recommendations regarding potential floodplain and hazard mapping in the future

2 THE STUDY AREA

The last comprehensive floodplain study covering the Salmon and White Rivers Floodplains was completed in 1995 (BC Ministry of Environment, 1995). That study reviewed 1980 floodplain maps with the intention of updating data and providing a design brief as one was not included as part of the 1980 mapping project. In the 1995 study, 200-year flood extents and elevations for the two rivers were confirmed based on sensitivity analyses performed using hydraulic modeling software. As part of the 1995 study, floodplain maps were updated with current aerial imaging and topographic data. The previous study area, see Figure 1, covered the floodplain of the Salmon River up to 25km from the tidewaters at Kelsey Bay to above the confluence of Memekay River. The 200-year peak flow rates discussed in the 1995 study where compared to the resulting peak flow rates in this assessment.

Subsequent draft reports from 2016 (McMillan Jacobs Associates, 2016) and 2017 (Klohn Crippen Berger Ltd., 2017) regarding the diversion dam rehabilitation and final decommissioning projects respectively consisted of frequency analyses of the watershed on the Salmon River at the diversion dam. These reports where used as references to establish peak flow rates at the diversion dam and as comparisons to the frequency analysis results of this assessment.

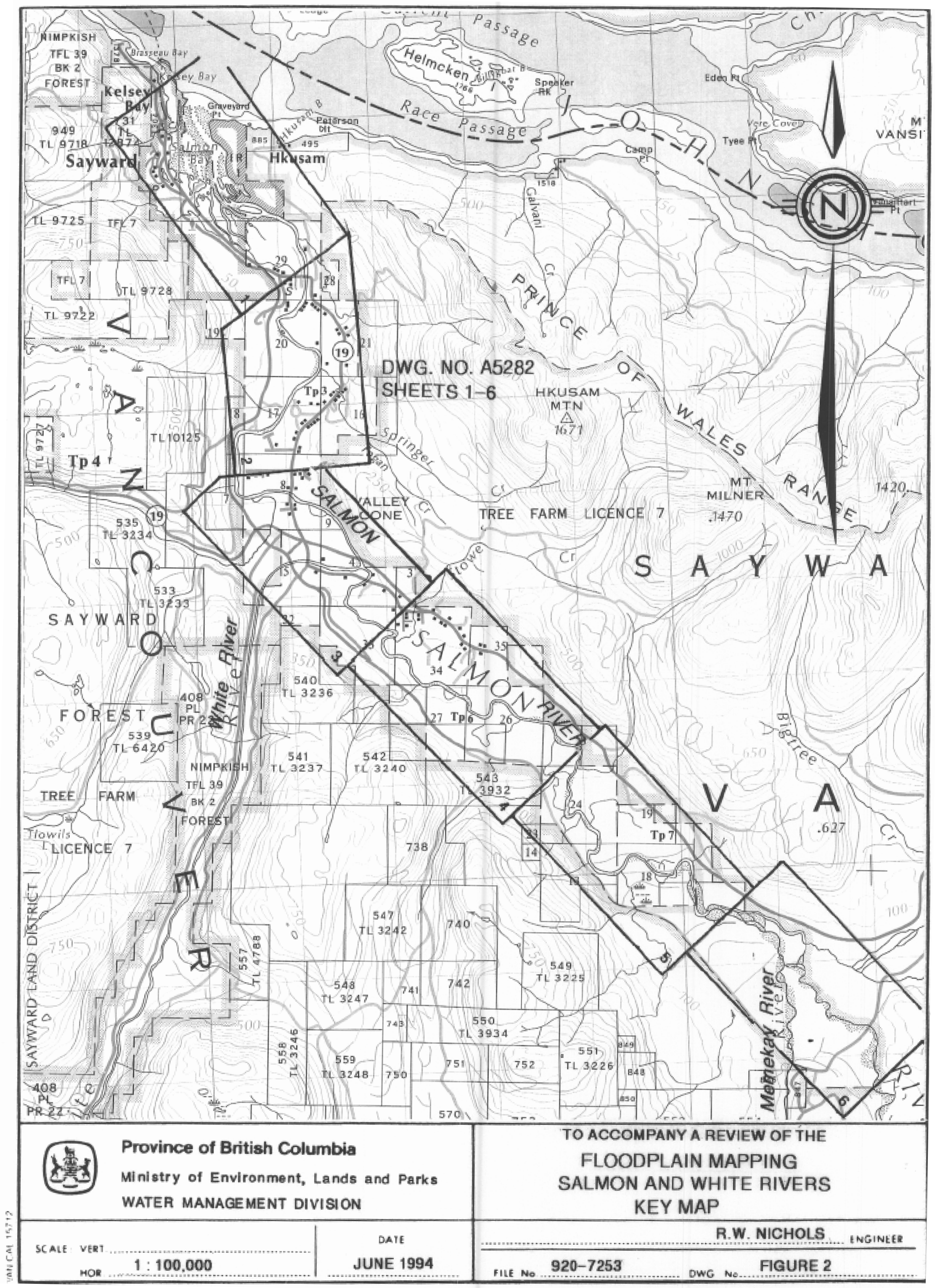

Figure 1: 1995 Salmon and White Rivers Floodplain Mapping Study Area

2.1 THE WATERSHEDS

The Salmon River extends from the Village of Sayward from its mouth in Kelsey Bay at the Johnstone Stait for 78 km to its headwaters. The total drainage area of the Salmon River is 1323.6 km^2, including the 366.7 km^2 White River catchment area, which has its confluence with the Salmon River just upstream of the Salmon River Bridge on Highway 19. The Salmon River watershed ranges from sea level up to 1,849m at the peak of Crown Mountain which is within Strathcona Provincial Park.

The White River flows for 45.4 km from its confluence with the Salmon River. The White River watershed topography ranges from about sea level up to 2,163m at Victoria Peak. An overview of both watersheds is shown on Figure 2.

Significant snowpack can accumulate in both the Salmon and White River watersheds at higher elevations during the winter months. However, peak discharges, resulting from spring snowmelt, are generally smaller than those peak flows associated with heavy rainfall events, during large frontal storms from the Pacific Ocean in late fall and/or early winter. As a result, peak flows in the Salmon and White River system occurs most frequently between October and February when higher precipitation is prevalent.

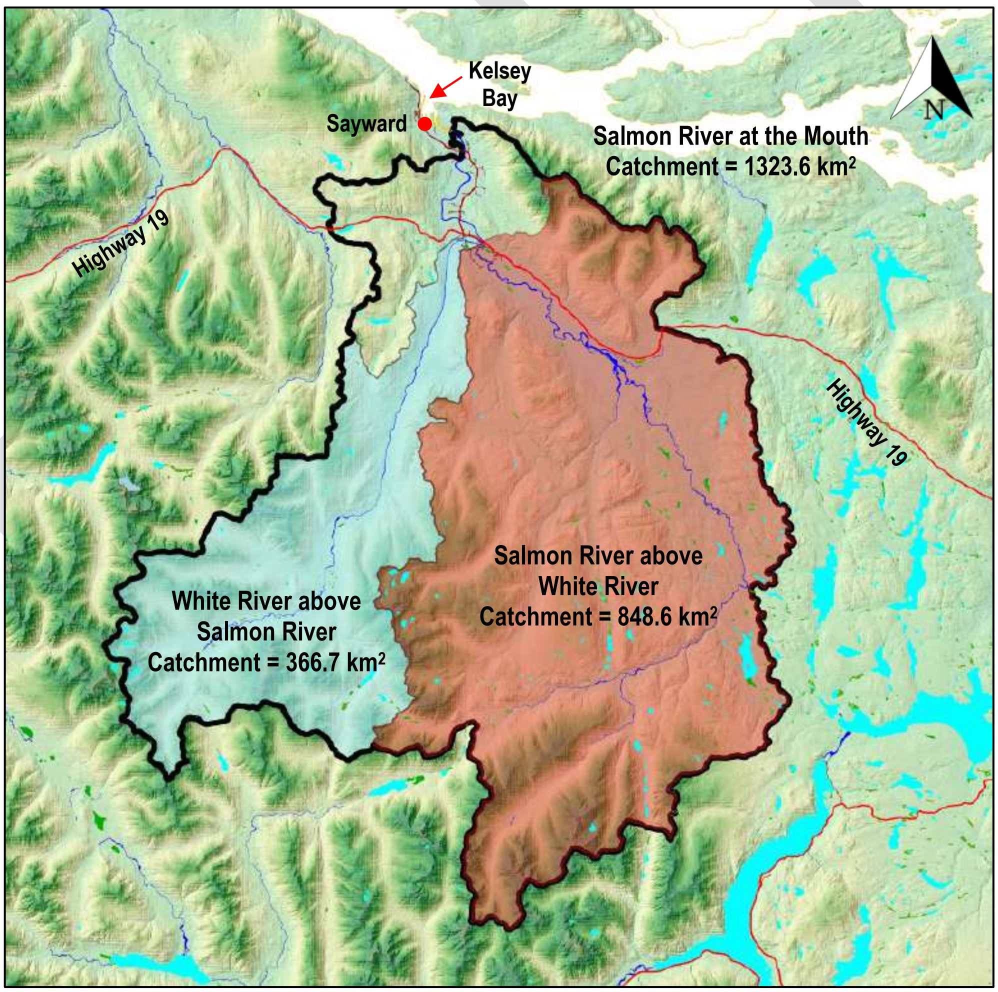

Figure 2: Salmon and White Rivers Catchment Areas

3 HYDROLOGIC ANALYSIS

3.1 AVAILABLE HYDROLOGIC DATA

There are four (4) Water Survey of Canada (WSC) hydrometric stations that are located within or the same hydrologic region as the Salmon and White River basins. These stations provide the flow data that is required to complete the complex statistical analysis to estimate peak flow rates. These stations are listed below in Table 1, and their locations are shown on Figure 3.

Table 1: Water Survey of Canada Hydrometric Stations used in Frequency Analysis for the Salmon River Watershed

WSC Station ID	Description	Catchment Area (km^2)
08HD006	Salmon River near Sayward	1210
08HD007	Salmon River above Memekay River	783
08HD020	Salmon River Diversion near Campbell River	439
08HD015	Salmon River Above Campbell Lake Diversion	268

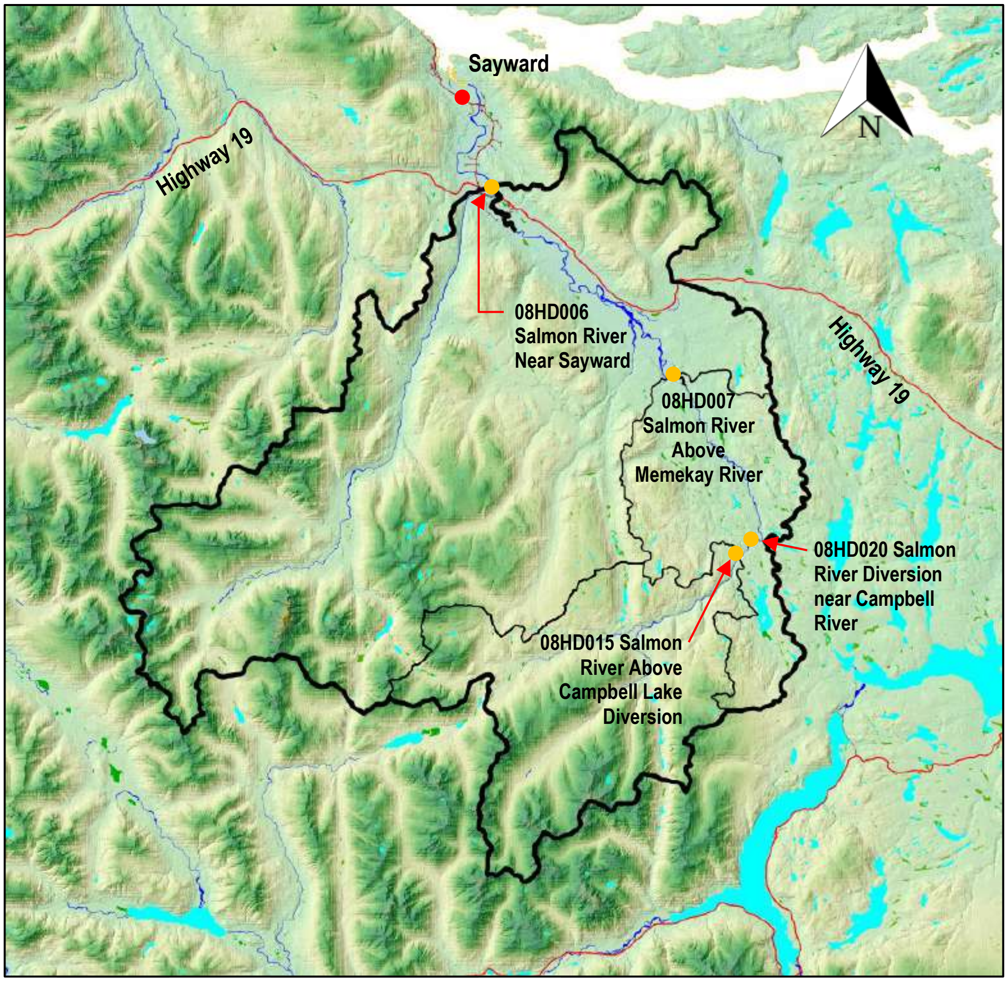

Figure 3: Water Survey of Canada Hydrometric Station Locations Considered in the Study

3.2 PREVIOUS HYDROLOGIC ESTIMATES

A previous study from February 1995 titled A Review of the Floodplain Mapping Study for the Salmon and White Rivers near Sayward BC presented a hydrologic assessment for the 200-year peak daily and instantaneous flow rates. The peak instantaneous results from the 1995 study are presented in Table 2 below.

Table 2: Summary of Estimated Instantaneous Discharge from 1995 Report

Location	Catchment Area (km²)	200-Year Return Period Peak Instantaneous Discharge (m³/s)
White River at the Confluence with Salmon River (XS-57)*	367	1060
Salmon River at the Confluence with White River (XS-26)*	849	1515
Salmon River near Sayward (08HB006)**	1210	2140
Salmon River near Sayward (XS-1)*	1324	2329

**Cross sections referenced on 1995 floodplain map (See Appendix A)*

*** Water Survey of Canada hydrometric station*

3.3 2019 HYDROLOGIC ASSESSMENT

The magnitude of the peak instantaneous design flows for the Salmon and White Rivers, for this study, have been estimated through a flood frequency analysis. This analysis utilizes peak flood records from hydrometric stations within the Salmon watershed. Due to the decommissioning of the Campbell River diversion in 2017, historic flows for the diverted water must be accounted for in the analysis to appropriately estimate flow rates. Based on data from BC Hydro (British Columbia Hydro and Power Authority, 2017) and the Water Survey of Canada (WSC), diverted peak instantaneous discharge values were add to those recorded at the Salmon River above Memekay River (08HD007) and the Salmon River near Sayward (08HD006). The peak diverted flow rates and their corresponding dates are outlined in Table 3 below.

Table 3: Historic Peak Instantaneous Flows on the Salmon River Diversion near Campbell River (08HD020)

Dates	Peak Instantaneous Discharge (m³/s)
1958- October 2010	43
October 2010 - 2011	15
2011 - December 2013	0
December 2013 – April 2014	5
April 2014 – May 2017	15
May 2017 - Present	0 (Decommissioned)

Irregularities in the data were discovered when comparing the peak instantaneous flows between station 08HD007 (Salmon River above Memekay River) and 08HD 015 (Salmon River above Campbell Lake Diversion). As evident in ??, upstream discharges were at times, significantly exceeding downstream discharge magnitudes despite there being no lakes or low gradient areas between the stations which could attenuate the flow and no diverted flow to Campbell Lake during such instances. This resulted in inconsistent results in the frequency analyses with lower than anticipated peak estimates for station 08HD007.

Table 4: Flow and Date Comparison Between WSC Stations 08HD007 & 08HD015

Salmon River above Memekay River (08HD007)		Salmon River above Campbell Lake Diversion (08HD015)		Percent Difference
Date	Peak Instantaneous (m3/s)	Date	Peak Instantaneous (m3/s)	
31Oct1981	363.0	31Oct1981	239.0	34%
25Oct1982	257.0	25Oct1982	161.0	37%
11Feb1983	398.0	NA	NA	
04Jan1984	349.0	04Jan1984	233.2	33%
02Apr1985	126.2	19Oct1985	76.0	
10Jan1986	313.0	24Feb1986	207.0	
11Jan1987	433.0	11Jan1987	249.0	42%
05Nov1988	306.0	05Nov1988	195.0	36%
04Dec1989	311.0	09Nov1989	203.0	
23Nov1990	532.0	NA	NA	
19Nov1991	335.0	02Feb1991	170.3	
30Jan1992	386.0	23Oct1992	274.0	
03Dec1993	437.0	03Dec1993	249.0	43%
02Mar1994	306.0	02Mar1994	255.0	17%
08Nov1995	484.0	08Nov1995	471.0	3%
11Jan1996	390.0	05Apr1996	408.0	
03Nov1997	370.0	03Nov1997	263.0	29%
23Jan1998	284.0	13Nov1998	206.0	
09Nov1999	285.0	09Nov1999	193.0	32%
20Oct2000	183.0	20Oct2000	145.0	21%
15Nov2001	320.0	15Nov2001	250.0	22%
07Jan2002	310.0	12Dec2002	224.0	
18Oct2003	410.0	18Oct2003	301.0	27%
15Nov2004	506.0	15Nov2004	410.0	19%
24Dec2005	332.0	10Nov2005	268.0	
15Nov2006	458.0	15Nov2006	425.0	7%
12Nov2007	431.0	12Nov2007	297.0	31%
05Jan2008	211.9	17May2008	115.0	
16Nov2009	535.0	16Nov2009	546.0	
11Jan2010	439.0	11Jan2010	390.0	11%
27Nov2011	482.0	27Nov2011	515.0	
04Jan2012	321.0	04Jan2012	401.0	
30Sep2013	152.0	30Sep2013	124.0	18%
			Average	25.7%

Grey cells represent flows on coinciding dates
Red text represents upstream flows that exceed those downstream.

To deal with the inconsistency, an averaged percent difference of 25.7% between the two stations flows on coinciding dates was calculated and used to factor the peak recorded flows for all years at the Salmon River station above Memekay River. This resulted in a consistent relationship between flow magnitudes and areas within the watershed.

To assess flood discharges in the both the Salmon and White Rivers, peak flood estimates from each WSC station within the basin were plotted against their respective net drainage areas. The resulting discharge-area relationships for the 20 & 200-year return periods peak instantaneous discharges were developed using a Log Pearson III distribution which is consistent with previous analyses. Figures 4 and 5 show the 20 & 200-year frequency curves developed from the frequency analysis for each WSC hydrometric station, the best fit line for the data points, and the predicted discharges for the study areas.

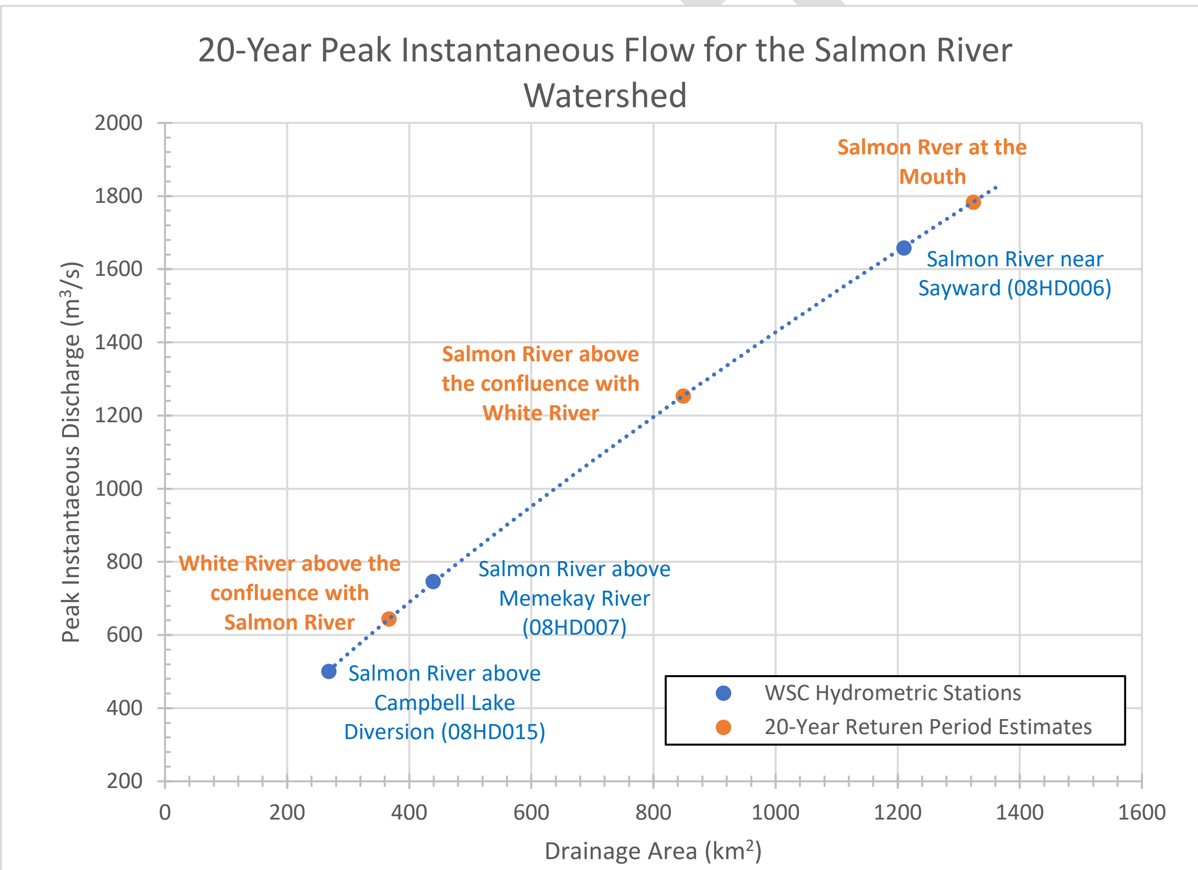

Figure 4: 20-Year Frequency Curve for the Salmon River Watershed

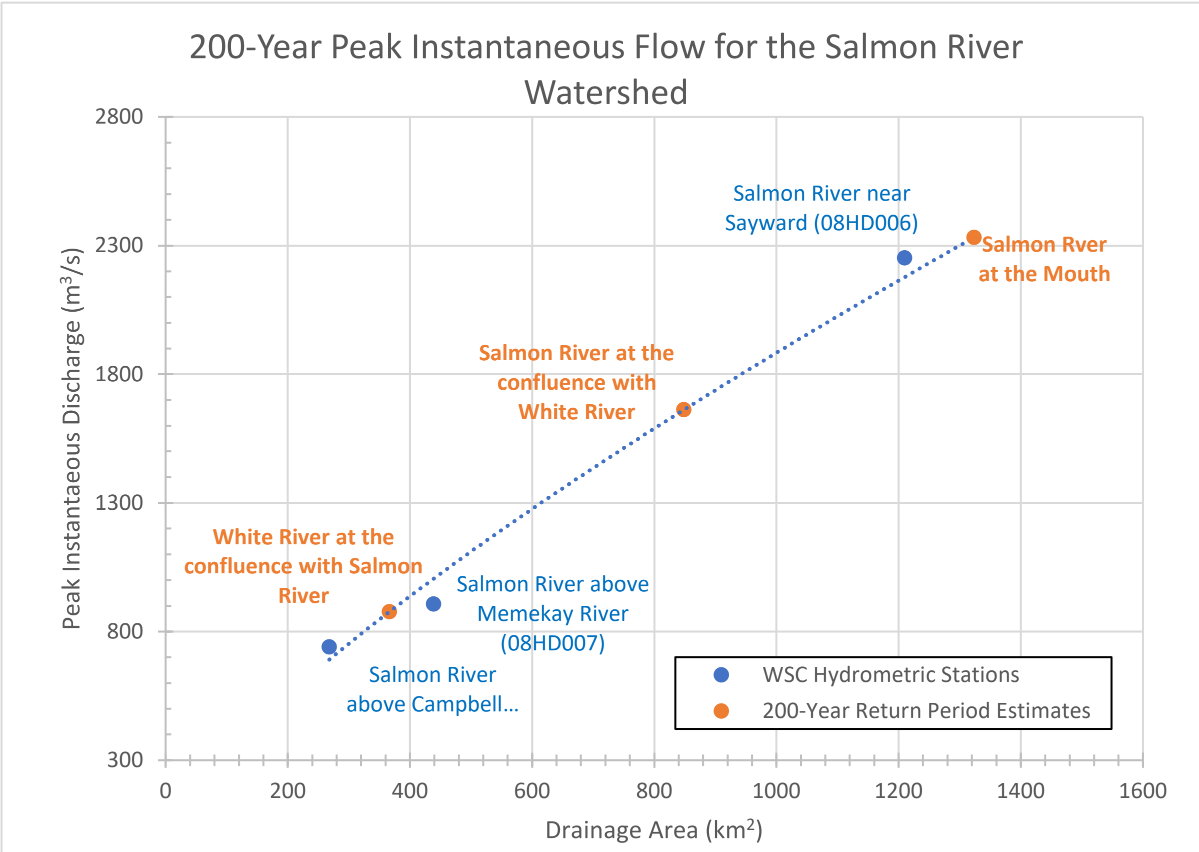

Figure 5: 200-Year Frequency Curve for the Salmon River Watershed

Instantaneous peak flows for each of the drainages in the study have been estimated using the results of the flood frequency curve's line of best fit equation. The equation is a power function as shown below:

20-Year Return Period: $Q_{20} = 5.92A^{0.79}$, in m³/s

200-Year Return Period: $Q_{200} = 9.78A^{0.76}$, in m³/s

Where: A = Catchment area, in km².

The resulting estimated peak instantaneous flow rates are summarized in Table 5 below along with the results from the 1995 study and the percent differences between the two.

Table 5: Summary of Estimated Peak Instantaneous Discharges

Catchment	Catchment Area (km^2)	2019 Peak Instantaneous Discharge (m^3/s)		1995 Peak Instantaneous Discharge (m^3/s)	Percent Difference Between 1995 and 2019 200-Year Estimates
		20-Year	200-Year	200-Year	
White River at the confluence with Salmon River	367	644	877	1060	18.8%
Salmon River at the confluence with White River	849	1253	1662	1515	9.3%
Salmon River at the Mouth	1324	1783	2331	2329	0.1%

4 CONCLUSION

The frequency analysis for the Salmon and White Rivers has provided estimated peak flow rates comparable to the results of previous studies, including consideration of the recent 2017 decommissioning of the Salmon River diversion dam. Current estimates, which account for the historically diverted flows, are within 0.1 – 18.8% of those estimated in 1995. The Salmon River sees high flows due in part to the watershed experiencing large magnitude rainfall events coupled with runoff from high elevation snowpack. The reintroduction of previously diverted flows, though not insignificant, does not appear have a substantial impact on the watershed in terms of peak flow rate estimates. Larger and additional available flow data sets have resulted in an updated discharge-area relationship which has led to different current peak flow predictions than those in 1995, but results are similar, as expected.

As more hydrometric data becomes available and with ongoing climate change impacts, frequency analyses should be revisited to ensure predictions remain relevant and accurate. At the same time, floodplain maps should be amended with updated frequency results and topographic data.

REFERENCES

BC Ministry of Environment. (1995). *A Review of Floodplain Mapping Study fro the Salmon and White Rivers near Sayward, BC.* Hydrology Branch. Victoria BC: Hydrology Branch.

British Columbia Hydro and Power Authority. (2017). *Salmon River Diversion Ceasing of Operations Application.* BC Hydro).

Klohn Crippen Berger Ltd. (2017). *Salmon River Diversion Decommissioning.* Vancouver BC.

McMillan Jacobs Associates. (2016). *Salmon River Canal Referbishment and Fish Passage Improvement (Draft Closeout Documentation).*

APPENDIX A: RECORD INFORMATION

CANADA/BRITISH COLUMBIA
FLOODPLAIN MAPPING AGREEMENT
Ministry of Environment, Lands and Parks
Water Management Division

A Review of the Floodplain Mapping Study for the Salmon and White Rivers near Sayward, B.C.

Hydrology Branch
Victoria, British Columbia
February 1995

File: 35100-30/920-7253

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Figures

Tables

FLOODPLAIN MAPPING STUDY
SALMON AND WHITE RIVERS

PREFACE

This review has been undertaken by the writer under the direction of Mr. R.W. Nichols, P.Eng., Head Floodplain Mapping, Flood Hazard Identification Section.

The purpose of this review is to present a description of the methodologies used and the results of the studies undertaken to review the December 1980 floodplain mapping for the Salmon and White Rivers, Drawing No. A5282 Sheets 1 through 6 (Appendix 5). As no design brief was produced for the 1980 studies this review will also provide background information to those studies.

The process used in this review is as follows:

1) Selection of 1990 high water marks which were deemed appropriate for the calibration of the HEC-2 model;

2) Review of the 1980 study model to ensure selected channel and overbank distances and "n" values are appropriate for use with the current data;

3) Calibration of the HEC-2 models to November 11, 1990 flood level data based upon flow estimates provided by the Hydrology Section;

4) Determination of the 1:200 year frequency flood levels including allowances for hydrologic and hydraulic uncertainties;

5) Comparison of the results of the 1993 studies to those of the 1980 studies;

6) Undertake field visits to the study area to view and assess the new bridges and other areas of concern within the watersheds;

7) Obtain current bridge data and road alignments from Ministry of Transportation and Highways;

8) Review the existing mapping with regards to revising the title block and accompanying notes and/or assessing the fan hazard areas that occur within the mapping project area; and,

9) Prepare drawings based upon the existing floodplain mapping and using updated air photography to indicate the 1990 High Water Marks, 1991 channel locations and current highway locations.

1. LOCATION

The Salmon and White River floodplains are located on north eastern Vancouver Island near the community of Sayward, some 70 km north of Campbell River (Figure 1). The majority of the study area lies within the jurisdiction of the Regional District of Comox-Strathcona with only the tidal portion within the boundaries of the Village of Sayward (Figure 2). The local economy of the area is primarily forest industry dependant with MacMillan Bloedel having major holdings in TFL 7. As with many areas on the island, recreation opportunities in the Sayward Valley are abundant.

2. BACKGROUND TO STUDY

2.1 1980 Studies

In the fall of 1975 heavy rainstorms blanketed the north end of Vancouver Island. Flooding was widespread, with communities such as Courtenay, Campbell River and Sayward affected. Major flooding of the Sayward Valley occurred when the Salmon and White Rivers overtopped their banks. Many residents were evacuated by Coast Guard Search and Rescue helicopters (Appendix 1.5).

Following this flood event, high water mark locations were identified and river surveys undertaken by the Technical Support Section for the preparation of floodplain mapping. Using the data obtained, river modelling was undertaken employing the water surface profile computer program HEC-2 (written by the U.S. Army Corps of Engineers) and the results transferred to 1:5000 scale orthophoto mapping (May 1976 photography). The floodplain mapping (Drawing No. A5282, Sheets 1 to 6, Appendix 5) extends from tidewater at Salmon Bay upstream approximately 25 km to above the confluence of the Memekay River. The White River portion of the floodplain mapping project extends from the confluence of the Salmon River upstream to just above the MacMillan Bloedel logging bridge, a distance of under 2 km. The completed mapping was released for public distribution in December of 1980.

The floodplain mapping was subsequently designated under the terms of the Canada/British Columbia Floodplain Mapping Agreement in December 1987. The Comox-Strathcona Regional District, electoral area

"H", within whose jurisdiction the floodplain mapping lies, has not incorporated the floodplain mapping into land use bylaws in this electoral area to date. New home construction on existing floodplain properties within the study area has not necessarily been flood proofed except in instances involving subdivision of lands pursuant to Section 82.1 of the Land Title Act. As discussed in Section 2.4, recent (1990) floods have motivated some home owners to elevate their homes to minimize future flood damages (see photographs Appendix 2).

2.2 Litigation

On January 15, 1987 a minor flood was reported on the Salmon River in the vicinity XS 79/80 (Drawing No. A5282 Sheet 5, Appendix 5 and photos Appendix 1.5). This area, known locally as the "Foort Farm", was being developed as a fish hatchery by Sea Farms Canada Ltd. Federal Fisheries approval, required for the hatchery development, was contingent on the site being not subject to flooding for a 1:30 year frequency flood event. A local engineering firm had been engaged to determine the suitability of the site. During the flood, lands adjacent to the buildings under construction were flooded however the buildings themselves were not inundated (Refer to photos on the 1980 design file, Appendix 1.5).

Following the report of the site being inundated, staff from the Nanaimo Water Management regional office viewed the site by helicopter to assess the situation. From this inspection it was determined that a debris blockage in the main channel of the Salmon River upstream of the hatchery site directed flow along an overflow channel adjacent to the site. As this was an isolated occurrence and no other reports of flooding in the valley were received or noted, flooding at this site was deemed to be "nuisance flooding" by the ministry. It should be noted that flood levels did not exceed the designated flood level for this location.

As a result of the inundation of the hatchery site property, the owners abandoned their plans for the site. As a result of these circumstances, the owners of the property embarked upon legal recourse which resulted in third party action against the Crown (File 35100-30/920-7253, Appendix 1.5). The basis of their action was that the ministry had been negligent in the preparation and issuance of the floodplain mapping. In their action they claimed that the mapping contained errors in the location of the flood level isograms, and in doing so the flood level designated for this location was too low. The litigation lasted almost 3 years, during which both sides engaged expert witnesses to comment on the validity of the mapping.

As the litigation was drawing to a conclusion, repeated heavy rainstorms struck the north end of the island and the Sayward Valley was severely flooded. This occurred not once but three times during the course of a four week period. The flood levels were of a similar magnitude to that of the October 1975 flood event upon which the December 1980 floodplain mapping was based.

Due to the circumstances of these events, the court case was continued and the data that had been obtained from the 1990 flood events was presented. The ministry's position during the case was that the floodplain maps depict the **1:200 year flood levels** assuming open channel flow conditions. The levels indicated on the mapping depict the recommended level for administrative purposes designed to **minimize** flood damages. The January 1987 event was considered to be **nuisance flooding**. Although overland flow was evident at the site during this event, the designated flood level was not exceeded. This was an isolated, localized occurrence with only a small percentage of the floodplain inundated. Given the broadness of the floodplain the potential is there for the floodplain to attenuate a much greater increase in flow with little increase in water level (See Figure 3 "Typical Floodplain Cross Section). The three subsequent events in November 1990 had a greater magnitude than the January 1987 event but did not incur flooding of the lands at the hatchery site. Thus the nuisance concept (debris blockage) of the Ministry was validated

The outcome of the litigation found in favour of the Crown. The findings of the judge, Honourable Justice Murray, concluded that the production of floodplain maps is similar to predicting the weather. It is with a combination of judgement, experience and available data, that the predictions are made, and that the flood levels are only **predictions**. In making his decision, the judge referred to Genesis 7:19 of the Bible and decided that Noah required the benefit of divine intervention for his **accurate prediction** of the coming floods.

2.3 Flooding - 1990

As stated previously, flooding again occurred in the Sayward Valley during the fall of 1990. The first reports were received in late October, when minor floods resulted in a debris jam at the new Sachts and Hammond bridges which were under construction (XS 5 Drawing 5282 - sheet 2 and photos Appendix 1.8). At this location a temporary low level work bridge platform built to facilitate construction of the main bridge was destroyed by the debris build up. Ponding from the debris jam resulted in a construction shack and adjacent lands being flooded. Backwater effects were evident upstream of XS 6 which resulted in a home located adjacent to the left bank being nearly flooded.

Some overland flow also occurred upstream at the "Duncan Bridge" (XS 22, Drawing A5282 - Sheet 3). Portions of the Sayward Road either side of the bridge were flooded to a depth of about 0.2 metres. Minor scouring of the shouldering occurred. Local highway maintenance personnel indicated that flooding of this section of the road was quite common during periods of heavy rainfall.

Inspection at the "Foort Farm" hatchery site indicated the overflow channel to be active although it did not reach bank full conditions. High water mark data (Appendix 1.9) was obtained both upstream and downstream of this site as well as the area in the vicinity of the bridges under construction.

Major flooding next occurred on November 11, 1990 when many parts of the Sayward Valley were inundated (Appendix 4). Numerous homes throughout the valley were flooded and the residents evacuated, the Sayward school heavily inundated (see videotape on file by Campbell River Community Television, Appendix 1.10). The White River highway bridge was destroyed. Much of the road and bridge network in the MacMillan Bloedel logging area was damaged. Staff from the Flood Hazard Identification Section (FHIS) in Victoria attended the area, conducted investigations and made observations, and obtained high water marks throughout the mapping area of the valley. A site inspection was made of the "Foort Farm" by FHIS staff and it was noted that flooding of the hatchery site had not occurred. General consensus among the local residences indicated this flood to be nearly equal to that of 1975. This was subsequently confirmed by high water mark comparisons of these flood events.

On November 23, 1990 flooding once again inundated the Sayward Valley. This flood was again of a similar magnitude to that of

November 11, 1990 and October 1975 with many areas again requiring evacuation. On December 4, 1990, as staff from Flood Hazard Identification and Technical Support Sections were conducting field surveys to establish flood levels for the November 11 event, yet another flood occurred. Similar to the previous floods of November, many areas of the valley were once again inundated. Additional high water mark data was acquired from this event. Neither of these 1990 flood events produced flooding at the "Foort Farm" hatchery site.

2.4 Photographs

Photograph 1 (Appendix 2) shows a home situated in the vicinity of XS 57 - White River (Drawing A5282 - Sheet 3). Note the high water mark location. This home was inundated during the November 11 and 23, 1990 floods. Photograph 2 is of the same home but subsequently raised between the November 23 and December 4, 1990 floods. Floodproofing was undertaken by the landowner without the benefit of public funding. Unfortunately the floodplain mapping was not consulted and therefore the home does not appear to elevated to the flood level (1:200 year) shown on Sheet 2. Had a bylaw been in place by the Regional District, the structure may have been floodproofed to Ministry standards at only slightly greater cost.

Photograph 3 and 4 (Appendix 2) is a home in the vicinity of XS 17,18 Salmon River (Drawing A5282 - Sheet 3). This home was flooded during the 1975 event. Following this flood the landowner raised the house approximately 2 feet. Note that at this location the homes are located in a low swale approximately 1.5 metres below the average ground level. During the November 1990 events, flood levels reached the underside of the floor joists. Calculated flood levels for this location indicate this home to be in excess of 2 metres too low to meet Ministry Standards.

Photograph 5 (Appendix 2) is a home in the vicinity of XS 14/15 (Drawing A5282 - Sheet 3). This home was also flooded during the November 1990 events. This home also has been raised since these events (see photograph 6). It is not known if the floodplain mapping had been consulted but it is estimated that the main floor of the home is now at, or nearly at, the flood level (1:200 year) shown on sheet 3.

Photograph 7 (Appendix 2) indicates H.W.M. 15 and 16. At this location inundation of the floodplain was caused by overland flow from upstream.

The high water mark at this location was just 0.1 m below the flood level (1:200 year). River levels adjacent to this location (photograph 8) were approximately 0.7m below the 1980 1:200 year flood level (this location is within the influence of backwater effects caused by debris jamming at the construction platform at "Sachts" bridge). From the above evidence it appears that the Ministry needs to review its policies regarding floodproofing. Floodproofing requirements to the flood level (1:200 year) or 1 metre above the adjacent ground, whichever is the greater elevation to account for topographic/flow conditions in the floodplain fringe should be considered.

2.5 High Water Mark Data

Following the November 11, 1990 flooding, high water marks were identified at 57 different locations throughout the mapping project area. A determined effort was made to ensure that as many of these were located at or near the locations of the 1975 high water marks wherever possible. This was done to assist in resolving the relationship of the magnitudes of the 1990 event and the 1975 event. The 1990 high water marks were photographed and surveyed geodetic elevations obtained in most cases. At some locations ground evidence was either destroyed by the successive flooding events or dismissed for other reasons.

This data was later compiled in a 3 ring binder and includes copies of the floodplain maps and mosaics indicating high water mark locations. Also included is a table which indicates the 1990 and 1975 flood levels relative to the 1980 1:200 year flood levels (Appendix 1.9).

Duplicate mylar copies of the floodplain mapping were obtained for use as a base to create a permanent record of the high water mark locations and elevations. These drawings are entitled "1990 Flood Data - Salmon and White Rivers" Drawing No. 94-14, Sheets 1 to 6 (Appendix 6). The drawings include data obtained from updated air photography of the mapping areas obtained in 1991. The air photography was used to create an uncontrolled mosaic of the study area which allowed the transfer of changes in channel location, topographic features and highway alignments to the drawings.

3. REVIEW OF THE 1980 FLOODPLAIN MAPPING

The 1990 flooding events provided the opportunity to make use of the data obtained to review and evaluate the 1980 floodplain mapping.

3.1 1980 Studies - General

The 1980 flood profile calculations used high water mark data obtained from the October 1975 flood event. Some difficulty was encountered during calibration of the models. Due to hydrologic uncertainties between daily and instantaneous discharge relationships (memo dated February 3, 1976 and April 9, 1980 - file 0323545 & design file), a conservative approach to modelling was employed using higher than normal Mannings "n" values. To determine flood levels, a 0.61 metre freeboard allowance was added to the calculated 200 year daily water surface elevation and compared to the corresponding calculated 200 year instantaneous water surface elevation. The highest of the two levels was selected as the flood level. In view of the high estimated instantaneous discharge and Manning's "n" values employed and in consideration of the broad floodplain it was decided to not add an additional 0.3 metres to the instantaneous calculated level as experience indicated that this would result in unrealistically high levels. This 1980 decision is validated by recent data. For example, Table 3 indicates that at XS 13, the 1980 selected flood level is 10.64 metres GSC or 1.43 metres above the 1990 observed flood level. The calculated 1990 (1:200 year) flood level at this section is 10.24 metres GSC or 1.03 metres above the 1990 observed level.

3.2 1993 Studies - General

As stated previously, following the November 1990 floods high water marks were identified and geodetic elevations obtained for use in calibration of the HEC-2 models. Revised hydrology estimates were obtained (Appendix 3) for the Q200 daily and instantaneous discharges. In keeping with Ministry practice, the addition of 0.61 metres to the calculated 1:200 year daily level and 0.3 metres to the calculated 1:200 year instantaneous level was applied to take into consideration hydraulic and hydrological uncertainties. The results were then compared to the existing (1980) flood levels as shown in Table 3. The table provides details such as selected Manning's "n" values, discharges, calculated flood levels and model calibration results.

Sensitivity studies were undertaken to determine the effects of various changes in discharge factors and relative Manning's "n" values. The studies took cognizance of such factors as changes in river regime, new bridge designs and approach fills to reflect existing conditions. Table 4 is a summary of the results of the "n" value sensitivity studies. Additional studies were undertaken to determine the effects of changes in discharge. The results of these studies are outlined in Table 5.

Studies were also undertaken to determine the meteorological effects on tide level predictions and the ocean flood level for Salmon Bay at the mouth of the Salmon River (Appendix 1.6).

4. FLOOD MAGNITUDES - 1993

Peak flow events on Vancouver Island as with other coastal areas in British Columbia usually occur during the late fall and early winter periods when warm, heavy rainfall is combined with an early snowpack and result in a rise in freezing level.

Water Survey of Canada (WSC) provided discharge estimates for the three major events of November 11, 23 and December 4, 1990. Initial reviews of these estimates indicated a discrepancy when compared with the 1975 event. Even though the flood levels were similar, the discharge estimates that had been provided for November 11, 1990 were considerably lower than October 1975. This discrepancy was pointed out to Water Survey of Canada who then undertook a review of their original estimates for the events. WSC determined that an error had been made in establishing the rating curve for the gauge. The curve had been erroneously made as a simple straight line extension of the metered flows and did not take into consideration overbank flows above and beyond bank full stages. After determining this, Water Survey of Canada recalibrated their rating curve and have revised the published discharges for these events (see letter on file 920-7253 dated April 12, 1991).

Gauge 08HD006 - Salmon River near Sayward, located just downstream of the White River confluence, is one of three active hydrometric stations in the study area. Prior to 1981 the station was located further downstream in the vicinity of the "Duncan Bridge" near XS 22. The station has been providing maximum and minimum daily discharge records since 1956 with maximum instantaneous records being available since 1982 only. According to the Water Survey of Canada publication "Surface Water Data - British Columbia" reliability of the records for the maximum daily discharges for the earlier periods of record are considered to be only fair. Maximum instantaneous discharge recorded occurred on November 11, 1990 at 1560 m^3/s. Maximum daily discharge recorded since 1981 occurred on November 23, 1990 at 1280 m^3/s.

Gauge 08HD007 - Salmon River above Memekay has been in operation providing instantaneous and daily discharge records since 1960. As with Gauge 08HD006, reliability of high flow records are considered to be only fair. Published peak flows for the November 1990 events are 489 m^3/s instantaneous on November 23 and 320 m^3/s daily on November 11.

Gauge 08HD015 - Salmon River above Campbell Lake Diversion has been in operation since 1981. Peak daily and instantaneous flows were recorded on Jan 11, 1987 at 207 m^3/s and 249 m^3/s respectively. Peak flows for the November 1990 events are not available.

Updated hydrology studies were requested following the 1990 floods. Final estimates were received from the Hydrology Section in a memo dated July 23, 1992 (Appendix 3). The study utilized a frequency analysis of updated stream flow records to 1991 and a modified procedure for estimating instantaneous peaks from manual gauges. In support of these estimates, the individual drainage basins and sub-basins areas were digitized from 1:50,000 scale topographic mapping and unit runoff estimates produced. These estimates compared favourably with the discharge estimates provided by the Hydrology Section. The results are listed on Table 1.

5. HYDRAULIC ANALYSIS - 1993

Information sources listed in Appendix 1 were utilized in the HEC-2 water surface profile computer program developed by the Hydrologic Engineering Centre, U.S. Army Corp of Engineers in Davis, California. The flood profile studies assumed open channel flow conditions. The 1980 studies utilized BC Systems Corporation's IBM mainframe computer. The 1993 studies utilized the 1980 models converted to PC format for use with the "Haestad Methods" (version 6.4) of the HEC-2 program which is the current format in use by the Ministry.

5.1 Salmon River

The Salmon River was divided into two reaches for ease of modelling. This was due to the length of river, number of cross sections, and the White River tributary influence. Reach 1 extends from tidewater at XS 0.1 upstream to XS 32 above the White River confluence. Reach 2 continues upstream starting at XS 32 extending to XS 97 above the Memekay confluence which is the upstream limit of the study. Flood levels for a number of named tributary streams including the Memekay River were not calculated during the study. These are noted on the mapping as "Limit of Study". The calculations for the Salmon and White Rivers do take into consideration the contributing discharge by these tributaries (Table 1).

A plot run of each model was made using the November 11, 1990 flows to review flow regimes, loss coefficients, reach lengths, overbank data and relative Manning's "n" values. The purpose of this was to review and update the models to reflect current conditions.

Data for the new "Sachts" and "Hammond" bridges and the approaches was obtained from Ministry of Transportation and Highways (MOTH) (Appendix 1.7) and the cross sections at XS 4.1, 4.2 were recoded. The coding for the bridge crossing at XS 27.1 and 27.2 on the Salmon River was deleted from the model as the structure was removed due to its derelict condition by MOTH in 1992. It should be noted that due to deck failure, the "Duncan" bridge located at XS 20.1, 20.2 is slated for replacement in the near future. MOTH indicates that the preliminary design calls for a more hydraulically efficient centre support pier although foundation conditions may not allow for this design. It is anticipated that some modification to the bridge approaches will be required.

High water mark elevations from the November 11, 1990 event, were coded at the appropriate cross sections to facilitate calibration of the models. Use of the high water mark data and revised flow estimate for calibration resulted in a reduction to the conservative "n" values used in the 1980 model to reflect this new data.

Runs were made using both the Q200 year and Q20 year daily and instantaneous revised flows. Comparisons of the results of these runs indicate the sensitivity of models to various discharges (Table 5).

Additional runs were made concentrating on the "Foort Farm" hatchery area as some channel avulsion has been experienced in this area. Cross sections in this area were modified to reflect current conditions. Adjustments were also made to channel and overbank reach lengths and Mannings "n" values. Results of these runs indicate that the broadness of the floodplain (in excess of 1km) provides sufficient capacity to compensate for channel processes with little change in water level. It was noted from the instantaneous and daily runs that a 25% increase in discharge resulted in an increase in water levels of less than 0.3 metres.

Sensitivity to "n" value increases were also studied. The studies determined that for Reach 1, an increase in "n" values in excess of 20%, can be accommodated by the selected flood levels. For Reach 2, the flood levels selected can withstand a 40% increase in "n" value. This would again confirm that the broadness of the floodplain, especially in the upper reaches contributes a significant attenuation to flood level increases (Table 4).

Sensitivity studies were also undertaken to determine the effects of sediment deposition in the channel area. A portion of reach 2 of the Salmon River from XS 79 to XS 86 was chosen for this test as channel aggradation is active in this area and also in question during the legal proceedings. Numerous models were made in which up to 2.5 metres (in 0.5 metre increments) of the lower elevations of these selected channel cross sections were removed. The flood levels derived from these runs were used for comparison to the Q200 daily run. These studies indicate the ability of the floodplain to attenuate the rise in water levels should channel capacity be reduced in isolated areas (Table 6).

Table 3 indicates the 1993 flood levels based on adopted Ministry criteria of Q200 daily flows + 0.61m freeboard and Q200 instantaneous flows + 0.3m freeboard allowances. The table also includes the 1980 selected flood levels and the difference between the 1993 flood levels and 1980 flood levels, which have been summarized in Table 7.

5.2 White River

The original 1980 White River model contains 16 cross sections starting at XS 57, approximately 400 metres upstream of the confluence with the Salmon River, and extending to XS 68, a distance of about 2000 metres upstream. As was the case with the 1980 Salmon River model, the White River models also used high "n" values for the channel and overbank roughness characteristics to compensate for limited streamflow and calibration data. The 1993 study calibration run was made using the 1990 high water mark elevation at XS 57 for the starting water surface level. This provided a good match to the observed elevations upstream.

An additional model was made using XS 25.2 on the Salmon River for the starting cross section. The cross section was modified by removing the bridge piers as there was no surveyed cross section immediately upstream of the bridge. The calibrated level and corresponding flow determined from the Salmon River - Reach 1 was used as the starting water surface elevation. This run provided an additional check on the calibration of the White River model as the reach is relatively short with limited high water mark data available. It also confirmed the calibration of the first model by allowing the use of the levels determined from the various Salmon River models to be used as the starting water levels. Bridge geometry provided by MOTH (Appendix 1.8) was also coded to reflect the newly constructed White River bridge at XS 60.1, 60.2.

Updated hydrology estimates have revised the Q200 instantaneous flow downward from the 1980 estimate of 1388 m^3/s to 1060 m^3/s. Although there is no gauge on the White River, flow estimates are based on Salmon River gauge observations above and below the White River. The new Q200 daily discharge of 684 m^3/s remains virtually unchanged from the 1980 estimate (694 m^3/s). As was the case in the 1980 studies, the instantaneous "Q" provides the dominant flood levels.

As was the case in the Salmon River models, sensitivity to "n" value increases were also undertaken to evaluate the model. Model runs were made using the selected "n" values multiplied by factors of 1.1, 1.2, 1.3 and 1.4. The studies indicated that the 0.3m freeboard allowance was sufficient to contain a 40% increase in "n" values up to XS 66 then the model becomes less tolerable (Table 4).

Sensitivity to discharge changes were also investigated. These studies indicate the model to be relatively sensitive to "Q" increases with the 1993 flood levels sufficient to withstand an increase in discharge of about 10% (Table 5).

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Sensitivity to discharge changes were also investigated. These studies indicate the model to be relatively sensitive to "Q" increases with the 1993 flood levels sufficient to withstand an increase in discharge of about 10% (Table 5).

6. OCEAN WATER LEVELS

The ocean water level for floodplain mapping purposes is based on the sum of the astronomical high tide or higher high water large tide (HHWLT), storm surge and an allowance for wave run up. Salmon Bay is located on Johnstone Strait and is sheltered from direct exposure to Pacific Ocean storms and therefore only exposed to local wind and waves from the north across Johnstone Strait. An analysis of storm surge was carried out by B.J. Holden, P. Eng. of the Flood Hazard Identification Section (Appendix 1.6). Results of this analysis, which utilized standard methodologies, are summarized below:

HHWLT	2.5 metres GSC
Storm Surge	1.0 metres GSC
Ocean Still Water Flood Level	3.5 metres GSC

For administrative purposes, an allowance of 0.3 metres has been added for wind chop, wave run up and local drainage resulting in an ocean flood level for Salmon Bay of 3.8 metres GSC.

7. FLOODPLAIN MAPPING

7.1 Comparison of 1980 and 1993 Flood Levels

The flood levels determined in the 1980 studies were used to delineate the floodplain limits on the existing 1 metre contour orthophoto mapping. The floodplain mapping for the Salmon and White Rivers, Drawing No. A5282, Sheets 1 to 6, indicates the location of river cross sections and survey monuments, the floodplain limits and the flood levels determined in those studies.

The river survey data included cross section data across the entire floodplain wherever feasible and bridge geometry for the 3 locations on the Salmon River and 1 on the White R. In addition to the cross sections surveys, high water mark data was obtained for the 1975 flood and used in the assessment of flood levels during the modelling process. Subsequently, additional road profile data was obtained from MOTH for the new highway alignment and bridge.

The flood levels determined in the 1993 studies were used to check the validity of those established in the 1980 study and designated under the terms of the Canada/British Columbia Floodplain Mapping Agreement. The 1993 studies employ updated hydrology estimates, new road alignment and new bridge data but otherwise use the original cross section survey data as used in the 1980 studies. A field visit was made by Mr. R.W. Nichols and the writer to the study area between July 13 and 15, 1993 to review the area prior to completing the final hydraulic calculations concerning this project. The results of the 1993 studies confirm the flood levels derived during the 1980 studies and indicated on the floodplain mapping to be relatively conservative.

Analysis of the difference between the Salmon River 1993 flood levels and the 1980 flood levels is summarized in Table 7. As indicated, the average 1993 flood levels are 0.31 metres lower than the 1980 flood levels over the entire study area.

For the reach of the White River below the bridge at XS 60.1, 60.2 the flood levels are approximately 0.35 metres lower than the 1980 designated flood levels. Upstream of the bridge at XS 60.1, 60.2, the levels are significantly lower than those adopted in the 1980 studies, in excess of 1.5 metres in the upstream end. These lower levels are attributable to a combination of a lower "Q" and "n" values and a slightly more efficient bridge design.

Channel processes are ongoing in the upper reaches of the study area (Sheets 5 & 6). Significant quantities of debris are evident throughout this area which may serve to further compound these processes. As was evidenced during the minor 1987 event, debris build ups may result in temporary unexpected inundation of portions of the floodplain due to side channel activities during relatively minor flood events (Figure 3). Additional warning notes to the users in this area may be warranted. A further note regarding the Memekay River Fan may also be advisable (Sheet 6).

8. CONCLUSIONS

1. This review outlines the 1980 studies undertaken to produce the floodplain mapping sheets of the Salmon and White Rivers from tidewater to upstream of the Memekay River confluence. This document also describes the reasons for, and the results of, the 1993 review of the floodplain mapping project based on 1990 flood data.

2. The 1993 studies indicate that the 1:200 year flood levels, as designated on the floodplain mapping for the Salmon and White Rivers, Drawing No. A5282, Sheets 1 to 6 from the 1980 studies are relatively conservative.

3. Channel processes are active especially within the upper reaches of the Salmon River floodplain. Inundation of the floodplain through side channel activity can occur during minor events due to blockages within the main channel. Sensitivity studies on the White River, which is ungauged, indicate it to be relatively sensitive to "Q" increases. For these reasons the conservative flood levels determined in the 1980 studies should be retained until the uncertainties inherent in the study area, including the hydrology estimates, are satisfactoraly resolved.

4. The existing bridge on the Salmon River located at XS 20.1/20.2 is due to be replaced in the near future. When the design data is confirmed, it should be obtained from MOTH and the cross sections updated and modelled to determine the effects on flood levels near this location. Approvals under Section 7 of the Water Act which are required for bridge construction should stipulate that no increases in flood levels will be permitted.

5. The Comox-Strathcona Regional District and the Hydrology Section of the Ministry of Environment, Lands and Parks should actively seek the cooperation of Water Survey of Canada in the establishment of a hydrometric station on the White River.

6. The Planning and Standards Section, Floodplain Management Branch, should continue to seek the cooperation of the Comox-Strathcona Regional District in adopting floodproofing requirements in the designated floodplain areas in Electoral Area "H".

7. Ministry policy regarding minimum floodproofing requirements should be reviewed to include the statement "buildings shall be floodproofed to the flood level (1:200 year) or a minimum of 1 metre above the adjacent ground level, whichever is the greater". This will take into account overland flow conditions which may occur due to channel blockages and topographical changes

upstream and/or downstream of the subject property.

8. The Flood Damage Reduction Program should include options to provide financial assistance to home owners (when funding available) for floodproofing of existing homes as a viable alternative to dyking.

9. Flood disaster compensation claims paid by the Provincial Emergency Program (PEP) should stipulate and include floodproofing of claimants residence to reduce recurring future compensation payments.

9. RECOMMENDATIONS

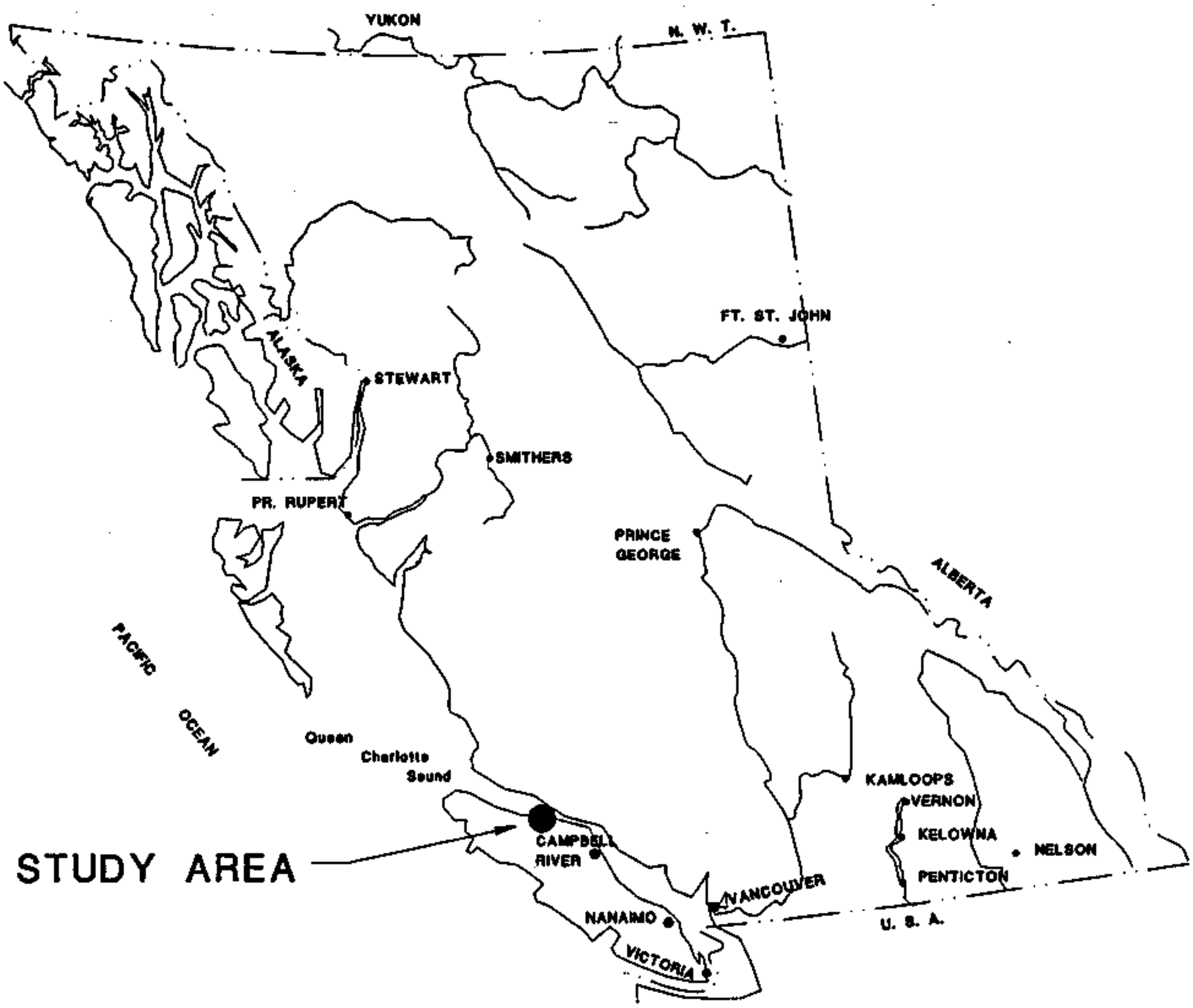
1. It is recommended that the flood levels and floodplain limits delineated on Drawing No. A5282, Sheets 1 to 6 be retained as shown.

2. The Drawings may be used for administrative purposes related to the preparation of hazard map schedules for official plans; floodproofing requirements in zoning and building bylaws; and the identification of floodable lands by Subdivision Approving Officers.

3. The Drawings should be modified to reflect the current topographical conditions and the results of the 1993 review. The changes should be duly noted in the revisions column on the drawings.

Steve Corner
Project Technician
Flood Hazard Identification

FIGURES



Province of British Columbia
Ministry of Environment, Lands and Parks
WATER MANAGEMENT DIVISION

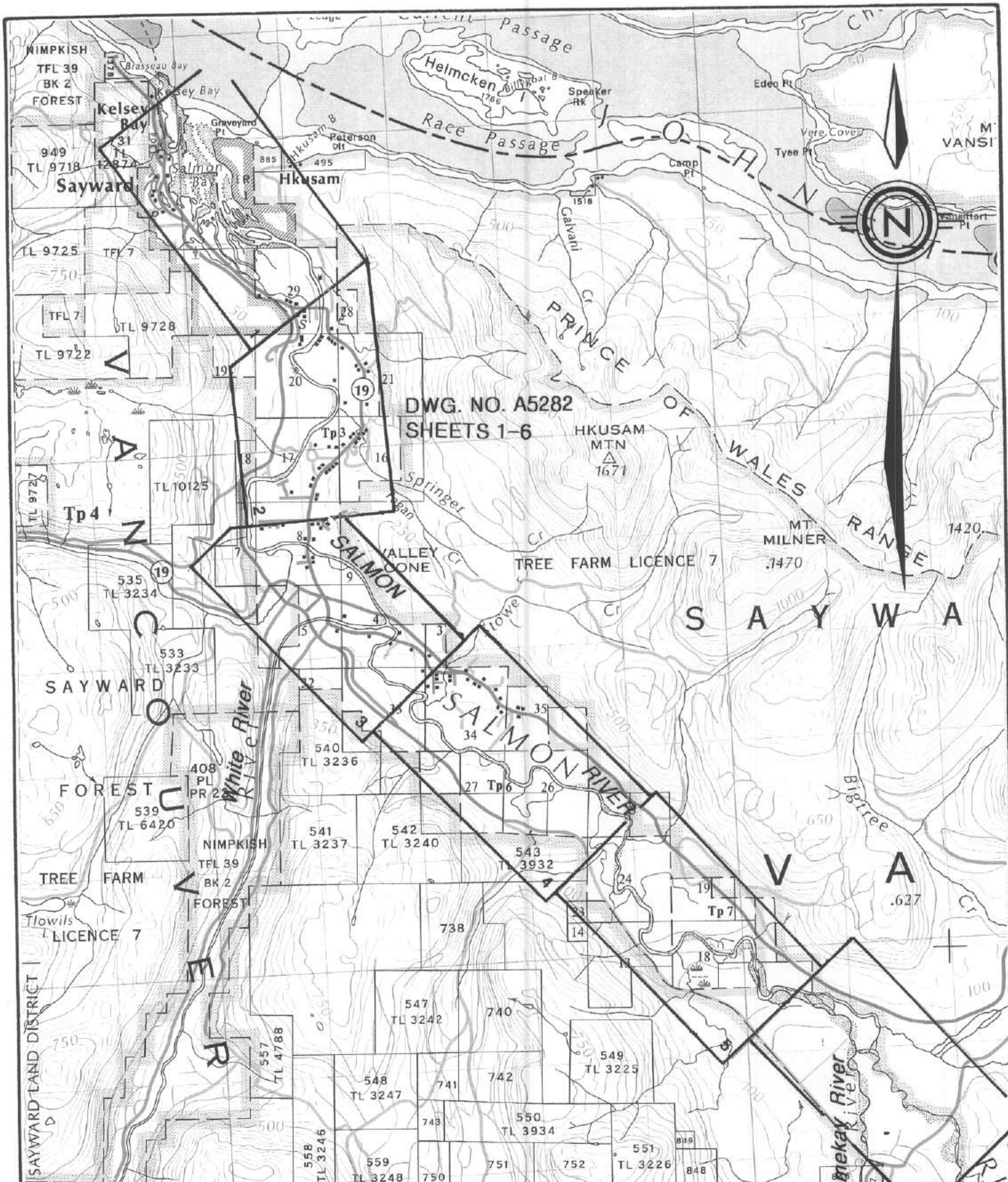
TO ACCOMPANY A REVIEW OF THE
FLOODPLAIN MAPPING
SALMON AND WHITE RIVERS
STUDY AREA LOCATION

R.W. NICHOLS ENGINEER

SCALE: VERT / HOR — NOT TO SCALE

DATE JUNE 1994

FILE No. 35100-30/920-7253 DWG. No. FIGURE 1



TO ACCOMPANY A REVIEW OF THE

FLOODPLAIN MAPPING
SALMON AND WHITE RIVERS
KEY MAP

Province of British Columbia

Ministry of Environment, Lands and Parks

WATER MANAGEMENT DIVISION

R.W. NICHOLS ENGINEER

SCALE VERT ....
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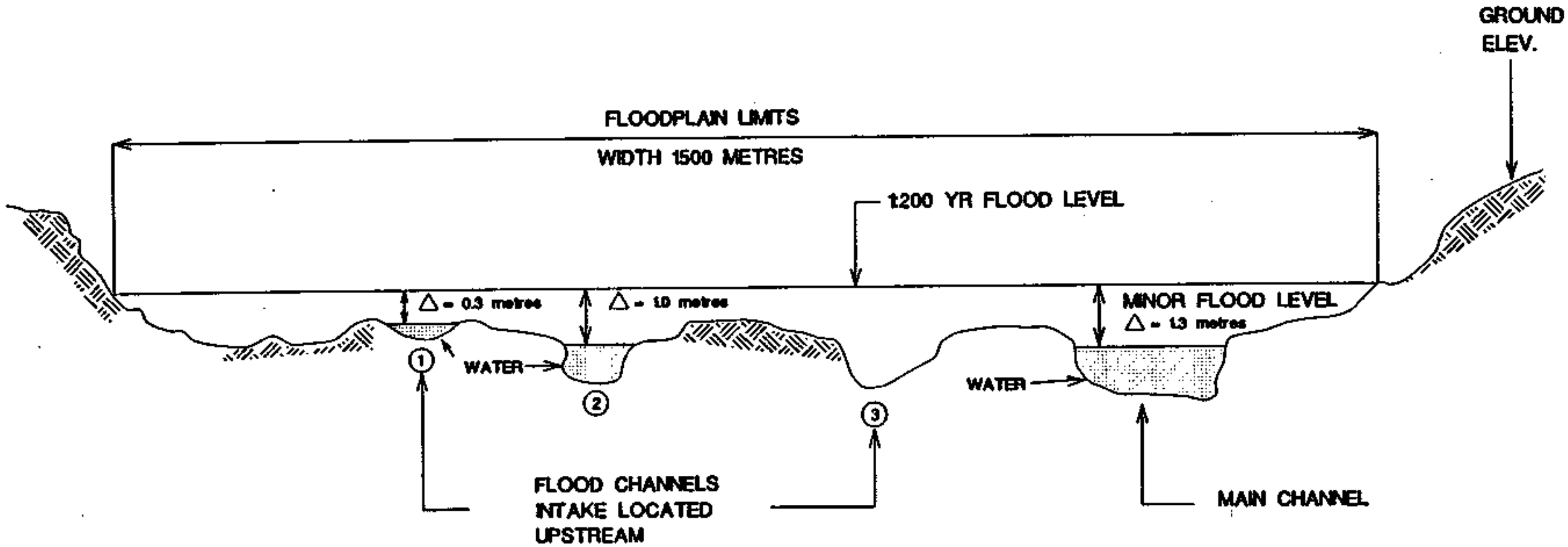
DATE JUNE 1994

FILE No. 920-7253 DWG No. FIGURE 2



1. Flood channels are typically separated from the main channel under minor flood conditions. These channels may or may not be active depending on "intake" conditions during minor floods. Flood channel 3 is depicted as having no flow under the minor flood condition.

2. The flood level rise varies across the floodplain (as above) from the minor flood to the 1:200 year event depending on the characteristics of the topography. Once the floodplain is completely inundated, equal flood levels are achieved in the cross section.

Province of British Columbia Ministry of Environment, Lands and Parks WATER MANAGEMENT DIVISION	TO ACCOMPANY A REVIEW OF THE FLOODPLAIN MAPPING FOR THE SALMON AND WHITE RIVERS TYPICAL FLOODPLAIN CROSS SECTION DEPICTING MINOR FLOOD LEVELS vs. 1:200 YEAR FLOOD LEVEL	SCALE: VERT. HOR. NOT TO SCALE	DATE JUNE 1994
		R.W. NICHOLS ENGINEER	
		FILE NO. 35100-30/920-7253	FIGURE 3

TABLES

TABLE 1

Salmon and White Rivers - 1993 Study			Nov. 11, 1990 Event			
"Q" Based on Unit Runoff Estimates			Q = 1560 cms at Gauge 08HD006 (Instantaneous)			
Summary of Drainage Basins						
		Calibration Run				
Area #	Name	Area in km2	Total Area	Unit Runoff (L/S/km2)	Computed Q	X-Sec
1	Upper Salmon River (Headwaters to above Grilse Cr.	112.85	112.85			
2	Grilse Creek	105.19	218.04	977	233	
3	Grilse Creek to Gauge 08HD015	52.08	270.12 (1)	1067	288	
4	Gauge 08HD015 to 08HD007	159.36	429.48 (2)	1067	459*	
5	Gauge 08HD007 to above Memekay	11.01	440.49	1067	469	89
6	Memekay River Basin & Salmon R. at Gauge 08HD007	211.21	651.7	1040	677	88
7	Big Tree Creek Basin	68.83	720.53	1025	738	86
	Foort Farm		749	1025	768**	
8	Big Tree Cr. to above D'Alrymple Cr.	43.9	764.43	1025	783	47
9	D'Alrymple Creek Basin	37.52	801.95	1025	822	46
10	Unnamed Creek Basin	10.67	812.62	1025	833	39
11	Unnamed Creek Basin	11.47	824.09	1025	845	34
12	Stowe Creek Basin	19.21	843.3	1023	863	33
13	Stowe Creek to above Gauge 08HD006	4.61	847.91	1023	869	26
14	White River Basin and Salmon R. at Gauge 08HD006	357.95	1205.86 (3)	1293	1560*	25
15	Gauge 08HD006 to above Springer Cr.	60.73	1266.59	1293	1638	17
17	Unnamed Cr. Basin	17.02				
16 & 17	Unnamed & Springer Cr. Basin	27.21	1293.8	1293	1673	10
18	Unnamed Cr. Basin	19.73	1313.53	1293	1699	1
NOTE:	(1) W.S.C. Published Area - 269 km2					
	(2) W.S.C. Published Area - 448 km2		*Hydrology Estimate (July 23, 1992)			
	(3) W.S.C. Published Area - 1200 km2		**Hydrology Median Estimate (July 23, 1992)			

TABLE 1

Salmon and White Rivers - 1993 Study			1:200 year Daily			
"Q" Based on D.A. Ratio to Gauge 08HD006 (D.A. 1206 km2)						
Summary of Drainage Basins			Q = 1970 cms at Gauge 08HD006			
Area #	Name	Area in km2	Total Area	Unit runoff (L/S/km2)	Computed Q	X-Sec
1	Upper Salmon River (Headwaters to above Grilse Cr.	112.85	112.85			
2	Grilse Creek	105.19	218.04			
3	Grilse Creek to Gauge 08HD015	52.08	270.12 (1)			
4	Gauge 08HD015 to 08HD007	159.36	429.48 (2)	1169	503*	
5	Gauge 08HD007 to above Memekay	11.01	440.49	1169	514	89
6	Memekay River Basin & Salmon R. at Gauge 08HD007	211.21	651.7	1364	888	88
7	Big Tree Creek Basin	68.83	720.53	1455	1047	86
	Foort Farm		749	1455	1090*	77
8	Big Tree Cr. to above D'Alrymple Cr.	43.9	764.43	1455	1112	47
9	D'Alrymple Creek Basin	37.52	801.95	1455	1165	46
10	Unnamed Creek Basin	10.67	812.62	1455	1181	39
11	Unnamed Creek Basin	11.47	824.09	1455	1199	34
12	Stowe Creek Basin	19.21	843.3	1455	1226	33
13	Stowe Creek to above Gauge 08HD006	4.61	847.91	1455	1232	26
14	White River Basin and Salmon R. at Gauge 08HD006	357.95	1205.86 (3)	1635	1970*	25
15	Gauge 08HD006 to above Springer Cr.	60.73	1266.59	1635	2070	17
17	Unnamed Cr. Basin	17.02				
16 & 17	Unnamed & Springer Cr. Basin	27.21	1293.8	1635	2116	10
18	Unnamed Cr. Basin	19.73	1313.53	1636	2146	1
NOTE:	(1) W.S.C. Published Area - 269 km2					
	(2) W.S.C. Published Area - 448 km2					
	(3) W.S.C. Published Area - 1200 km2					
	*Hydrology Estimate (July 23, 1992)					

TABLE 1

Salmon and White Rivers - 1993 Study			1:200 year Instantaneous			
"Q" Based on Unit Runoff Estimates						
Summary of Drainage Basins			Q =2140 cms at Gauge 08HD006			
Area #	Name	Area in km2	Total Area	Unit Runoff	Computed Q	X-Sec
				(L/S/km2)		
1	Upper Salmon River	112.85	112.85	1904		
	(Headwaters to above Grilse Cr.					
2	Grilse Creek	105.19	218.04	1904		
3	Grilse Creek to Gauge 08HD015	52.08	270.12 (1)	1904		
4	Gauge 08HD015 to 08HD007	159.36	429.48 (2)	1904	819*	
5	Gauge 08HD007 to above Memekay	11.01	440.49	1904	840	89
6	Memekay River Basin & Salmon R.	211.21	651.7	1826	1190	88
	at Gauge 08HD007					
7	Big Tree Creek Basin	68.83	720.53	1789	1288	86
	Foort Farm		749	1789	1340*	77
8	Big Tree Cr. to above D'Alrymple Cr.	43.9	764.43	1789	1366	47
9	D'Alrymple Creek Basin	37.52	801.95	1789	1433	46
10	Unnamed Creek Basin	10.67	812.62	1789	1452	39
11	Unnamed Creek Basin	11.47	824.09	1789	1474	34
12	Stowe Creek Basin	19.21	843.3	1789	1508	33
13	Stowe Creek to above Gauge 08HD006	4.61	847.91	1789	1515	26
14	White River Basin and Salmon R. at	357.95	1205.86 (3)	1774	2140*	25
	Gauge 08HD006					
15	Gauge 08HD006 to above Springer Cr.	60.73	1266.59	1774	2244	17
17	Unnamed Cr. Basin	17.02				
16 & 17	Unnamed & Springer Cr. Basin	27.21	1293.8	1774	2294	10
18	Unnamed Cr. Basin	19.73	1313.53	1774	2329	1
NOTE:	(1) W.S.C. Published Area - 269 km2					
	(2) W.S.C. Published Area - 448 km2					
	(3) W.S.C. Published Area - 1200 km2					
	*Hydrology Estimate (July 23, 1992)					

TABLE 1

Salmon and White Rivers - 1993 Study			1:20 year Daily			
"Q" Based on D.A. Ratio to Gauge 08HD006 (D.A. 1206 km2)						
Summary of Drainage Basins			Q = 1350 cms at Gauge 08HD006			
Area #	Name	Area in km2	Total Area	Unit runoff (L/S/km2)	Computed Q	X-Sec
1	Upper Salmon River (Headwaters to above Grilse Cr.	112.85	112.85			
2	Grilse Creek	105.19	218.04			
3	Grilse Creek to Gauge 08HD015	52.08	270.12 (1)			
4	Gauge 08HD015 to 08HD007	159.36	429.48 (2)	875	376*	
5	Gauge 08HD007 to above Memekay	11.01	440.49	875	385	89
6	Memekay River Basin & Salmon R. at Gauge 08HD007	211.21	651.7	988	643	88
7	Big Tree Creek Basin	68.83	720.53	1024	737	86
	Foort Farm		749	1024	767*	77
8	Big Tree Cr. to above D'Alrymple Cr.	43.9	764.43	1024	782	47
9	D'Alrymple Creek Basin	37.52	801.95	1024	820	46
10	Unnamed Creek Basin	10.67	812.62	1024	831	39
11	Unnamed Creek Basin	11.47	824.09	1024	843	34
12	Stowe Creek Basin	19.21	843.3	1024	863	33
13	Stowe Creek to above Gauge 08HD006	4.61	847.91	1024	867	26
14	White River Basin and Salmon R. at Gauge 08HD006	357.95	1205.86 (3)	1120	1350*	25
15	Gauge 08HD006 to above Springer Cr.	60.73	1266.59	1120	1422	17
17	Unnamed Cr. Basin	17.02				
16 & 17	Unnamed & Springer Cr. Basin	27.21	1293.8	1120	1448	10
18	Unnamed Cr. Basin	19.73	1313.53	1120	1470	1
NOTE:	(1) W.S.C. Published Area - 269 km2					
	(2) W.S.C. Published Area - 448 km2					
	(3) W.S.C. Published Area - 1200 km2					
	*Hydrology Estimate (July 23, 1992)					

TABLE 1

Salmon and White Rivers - 1993 Study			1:20 year Instantaneous			
"Q" Based on Unit Runoff Estimates						
Summary of Drainage Basins			Q =1480 cms at Gauge 08HD006			
Area #	Name	Area in km2	Total Area	Unit runoff (L/S/km2)	Computed Q	X-Sec
1	Upper Salmon River (Headwaters to above Grilse Cr.	112.85	112.85			
2	Grilse Creek	105.19	218.04			
3	Grilse Creek to Gauge 08HD015	52.08	270.12 (1)	1399	316	
4	Gauge 08HD015 to 08HD007	159.36	429.48 (2)	1399	601*	
5	Gauge 08HD007 to above Memekay	11.01	440.49	1399	615	89
6	Memekay River Basin & Salmon R. at Gauge 08HD007	211.21	651.7	1312	855	88
7	Big Tree Creek Basin	68.83	720.53	1272	916	86
	Foort Farm		749	1272	953*	77
8	Big Tree Cr. to above D'Alrymple Cr.	43.9	764.43	1272	971	47
9	D'Alrymple Creek Basin	37.52	801.95	1272	1019	46
10	Unnamed Creek Basin	10.67	812.62	1272	1032	39
11	Unnamed Creek Basin	11.47	824.09	1272	1048	34
12	Stowe Creek Basin	19.21	843.3	1272	1072	33
13	Stowe Creek to above Gauge 08HD006	4.61	847.91	1272	1077	26
14	White River Basin and Salmon R. at Gauge 08HD006	357.95	1205.86 (3)	1228	1480	25
15	Gauge 08HD006 to above Springer Cr.	60.73	1266.59	1228	1610	17
17	Unnamed Cr. Basin	17.02				
16 & 17	Unnamed & Springer Cr. Basin	27.21	1293.8	1228	1645	10
18	Unnamed Cr. Basin	19.73	1313.53	1228	1670	1
NOTE:	(1) W.S.C. Published Area - 269 km2					
	(2) W.S.C. Published Area - 448 km2					
	(3) W.S.C. Published Area - 1200 km2					
	*Hydrology Estimate (July 23, 1992)					

Table 2

High Water Mark Elevations

(Pages 1 to 4)

TABLE 2

SALMON AND WHITE RIVERS - 1990 FLOODING							
PRELIMINARY ASSESSMENT - MARCH 1991							
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 1							
HWM #	DATE	1990	1975	200 YEAR	DIFF TO	20 YEAR	COMMENTS
		ELEV	ELEV	F.C.L.	F.C.L.	F.C.L.	
58			4.69	5.3		4.7	
	90/11/11	5.156					AS IDENTIFIED BY LANDOWNER
	90/11/23	4.961					NO VISUAL IDENTIFICATION FOUND
58A	NEW	4.454					IDENTIFIED 90/12/04
	NEW	4.229					"
	NEW	4.013					"
36	90/11/11	4.326	3.63 (I)	5.0	-0.7	4.4	
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 2							
13	90/11/11	4.849		5.9	-1.1	5.3	
12	90/11/11	5.433		6.1	-0.7	5.5	
12A	90/10/25	4.685		6.1		5.5	
11	90/10/25	5.41	5.181	6.2	-0.8	5.6	
10A	90/10/25	4.178		5.9		5.3	
10A	NEW	4.537		5.9		5.3	IDENTIFIED 90/12/04
10	90/11/11	5.419		5.9		5.3	
34	90/11/11	4.982		6.1		5.5	
35	90/11/11	5.775	5.67 (I)	7.2	-1.4		
35	90/11/23	5.321					
35	90/12/04	4.92					
14	90/11/11	5.929		6.6	-0.7	6.0	
14	90/10/25	5.137		6.6		6.0	DEBRIS JAM AT BRIDGE PLATFORM
14	90/12/04	4.369		6.6		6.0	
17	90/11/11	6.058	6.24	6.8	-0.7	6.4	
16	90/11/11						NOT SURVEYED
15	90/11/11	6.908*		7.0	-0.1	6.4	OVERLAND FLOW
18	90/11/11	6.596		8.1	-1.5	7.4	
19	90/11/11	7.439		8.0	-0.6	7.3	
19A	90/11/11	7.442		7.8	-0.4	7.1	
19A	90/11/23	7.212		7.8		7.1	
20	90/11/23	7.212	7.8	7.8	-1.0	7.1	
20A	NEW	7.297		8.7		8.0	IDENTIFIED 90/12/04
21*	90/11/11	7.929	7.86	9.3	-1.4	8.6	SEE NOTES
21	NEW	7.571		9.3		8.6	IDENTIFIED 90/12/04
22*	90/11/11	8.135		9.5	-1.4	8.6	
23	90/11/11	7.991?	8.5	9.9	-1.9	9.3	SEE NOTES
24	90/11/11	9.513	9.42	10.4	-0.9	9.8	
25	90/11/11	10.049	10.58	11.3	-1.3	10.7	
25A	90/11/11	10.086		11.3	-1.3	10.7	
25A	90/12/04?	9.577					
26							NOT SURVEYED
26A	NEW	9.662					IDENTIFIED 90/12/04
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 3							
HWM #	DATE	1990	1975	200 YEAR	DIFF TO	20 YEAR	COMMENTS
29	90/11/11	10.372	10.54	12.8	-2.3	12.2	
29	90/11/23	10.105					
29	90/12/04	9.834					
29	NEW	10.363					IDENTIFIED 90/12/04

TABLE 2

HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 3							
HWM #	DATE	1990	1975	200 YEAR	DIFF TO	20 YEAR	COMMENTS
29A	90/11/11	10.541		12.8	-2.3	12.2	
29B	90/11/11	9.991		12.9		12.3	
29C	90/11/11	10.492		13.0		12.4	
27	90/11/11	12.466		13.9	-1.4	13.1	
28	90/11/11	13.225	13.19	14.0	-0.8	13.2	
30	90/11/11	14.673	14.6	16.5	-1.9	15.9	
30A	90/12/04	13.191		14.1		13.3	
31	90/11/11	15.55		16.9	-1.3	16.3	
31A	NEW	15.467		17.0	-1.5	16.4	
31B	90/12/04	17.695		18.3		17.5	
32	90/11/11	14.871		16.6	-1.7	16.0	
32	NEW	15.234		16.6		16.0	
32A	90/12/04	15.156		16.6	-1.4	16.0	
33	90/11/11	16.309		18.0	-1.7	17.2	
52	90/11/11	17.671		19.4	-1.7	18.5	
52A	90/10/25	15.731					
53	90/11/11	18.476		20.0	-1.5	19.0	
50	90/11/11						NOT SURVEYED
54	90/11/11	18.683					
54A	90/11/11	18.587					DATA PROVIDED BY LANDOWNER
54A	90/11/23	18.464					DATA PROVIDED BY LANDOWNER
54A	90/12/04	18.236					DATA PROVIDED BY LANDOWNER
54A	1975	18.707					DATA PROVIDED BY LANDOWNER
51	90/11/11						
46	90/11/11	17.978	18.623	20.3	-2.3	19.3	DISTURBED
46	90/11/23	18.165		20.3		19.3	
46	90/12/04	18.531		20.3		19.3	
46A	NEW	18.56		20.4		19.4	
57	90/11/11	17.872	17.587	19.1	-1.5	18.5	
56	90/11/11	17.99	17.648	19.6	-1.6	19.0	
56A	90/10/25	16.547*		19.6		19.0	DISTURBED
47	90/11/11	18.914		21.0	-1.2	20.1	
47	90/12/04	18.732		21.0		20.1	
47	90/10/25	18.784*		21.0		20.1	DISTURBED
47A	90/12/04	18.666		20.8		20.0	
55	90/11/11	23.149(I)	20.48*	23.1	0.0	22.1	
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 4							
49	90/11/11	18.989		20.4	-1.4	19.4	
45A	NEW	18.872		20.8		19.8	IDENTIFIED 90/12/04
45A	NEW	18.651					IDENTIFIED 90/12/04
45	90/11/11	22.137		23.8	-1.7	23.2	
44	90/11/11	22.237		24.8	-2.6	24.3	
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 5							
HWM #	DATE	1990	1975	200 YEAR	DIFF TO	20 YEAR	COMMENTS
43	90/11/11	23.94		25.8	-1.9	25.3	
42	90/11/11	26.703		28.5	-1.8	28.1	
41	90/11/11	26.848		28.6	-1.8	28.2	
38	90/11/11	29.18		30.3	-1.1	30.0	
37	90/11/11	28.515		30.6	-2.1	30.3	
40	90/11/11	30.386		31.15	-0.8	30.85	
39	90/11/11	30.229		31.25	-1.0	30.95	
7	90/11/11	31.185		32.5	-1.3	32.15	

TABLE 2

HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 5							
HWM #	DATE	1990	1975	200 YEAR	DIFF TO	20 YEAR	COMMENTS
48A	NEW	31.161		33.0		32.7	IDENTIFIED 90/12/04
48	90/11/11	31.497		33.25	-1.8	32.95	
48	NEW	31.161		33.25		32.95	IDENTIFIED 90/12/04
1	90/11/11						
1	NEW	33.69		35.6		35.3	IDENTIFIED 90/12/04
1	NEW	33.663		35.6		35.3	IDENTIFIED 90/12/04
2	90/11/11	34.374		36.1	-1.7	35.8	
2	NEW	34.281		36.1		35.8	IDENTIFIED 90/12/04
3	90/11/11	35.189		36.5	-1.3	36.2	
4	90/11/11	35.761		37.5	-1.7	37.2	
HIGH WATER MARK ELEVATIONS - DWG A5282 SHEET 6							
5	90/11/11	35.986		39.0	-3.0	38.7	
5	NEW	36.36					IDENTIFIED 90/12/04
6	90/11/11	39.852		41.6	-1.7	41.3	
8	GONE						DESTROYED BY LATER EVENT
8	NEW	42.521		43.4		43.1	IDENTIFIED 90/12/04
9	GONE						DESTROYED BY LATER EVENT
9	NEW	42.67		43.4		43.1	IDENTIFIED 90/12/04

NOTES: GENERAL

1) A HIGH WATER MARK NUMBER FOLLOWED BY "NEW" INDICATES AN ELEVATION IDENTIFIED AT THE SAME LOCATION AS THE NOVEMBER 11, 1990 EVENT BUT THE DATE OF OCCURRENCE IS NOT KNOWN

2) A HIGH WATER MARK NUMBER FOLLOWED BY "A", "B", OR "C" INDICATES AN ELEVATION IN THE GENERAL LOCATION OF THE ORIGINALLY IDENTIFIED H.W.M. AND HAS BEEN VERIFIED AS OCCURRING ON NOVEMBER 11, 1990 UNLESS FOLLOWED BY "NEW"

3) A HIGH WATER MARK ELEVATION FOLLOWED BY (I) INDICATES THE POINT AS BEING INDEFINITE AND THE ELEVATION MAY NOT BE RELIABLE

4) A HIGH WATER MARK ELEVATION FOLLOWED BY "D" INDICATES THAT THE IDENTIFICATION POINT HAS BEEN DISTRUBED AND THEREFORE THE ELEVATION GIVEN MAY BE INACCURATE

NOTES: SPECIFIC

HWM 15 — FLOW AT THIS LOCATION WAS OBSERVED TO BE OVERLAND FROM THE SOUTHEAST AND FLOWING TOWARDS THE RIVER, THEREFORE THIS ELEVATION MAY NOT BE IDICATVE OF THE RIVER LEVEL AT THIS LOCATION SEE H.W.M. 17 FOR A MORE REPRESENTATIVE ELEVATION

HWM 21 — H.W.M. AT THIS LOCATION WAS REPORTED BY LOCAL RESIDENTS AS BEING 1 FOOT ABOVE THE ROAD LEVEL. NO VISUAL VERIFICATION COULD BE OBTAINED. ELEVATION GIVEN IS C/L OF ROAD PLUS 0.33 METRES

HWM 22 — ANOMALY AT THIS LOCATION MAY BE ATTRIBUTABLE TO FLOW FROM SPRINGER CREEK AS DEBRIS JAMMING AT THE BRIDGE WAS EXPERIENCED

HWM 46 — THE REFERENCE STAKE WAS REMOVED BY THE RESIDENT THEREFORE THE ELEVATION MAY BE ERONEOUS. H.W.M. FOR THE 90/11/23 AND 90/12/04 WERE PROVIDED BY THE RESIDENT HOWEVER THERE WAS SOME CONFUSION AS TO WHICH DATE APPLIED TO WHICH MARK

TABLE 2

NOTES: SPECIFIC (cont.)		
HWM 55		THE LOCATION (RIGHT BANK UPSTREAM SIDE OF THE BRIDGE) DIFFERS FROM
		THE 1975 LOCATION (LEFT BANK DOWNSTREAM OF THE BRIDGE) BECAUSE OF
		DEBRIS REMOVAL AT THE 1975 LOCATION DURING THE 1990 EVENTS
HWM 37		THE H.W.M. AT THIS LOCATION MAY BE RELATED TO TRIBUTARY FLOW AND NOT
		SALMON RIVER FLOW
HWM 39		THE H.W.M. IS LOCATED IN SIDE CHANNEL UPSTREAM OF THE OUTLET TO SALMON R.
HWM 40		THE H.W.M. IS LOCATED ON THE OUTSIDE BEND OF THE SALMON RIVER LEFT
		BANK MAIN CHANNEL
HWM 7		THE H.W.M. IS LOCATED 25m UPSTREAM OF THE UPSTREAM CORNER OF THE
		ELECTRICAL BUILDING. RELATIVE F.C.L. DERIVED FROM BUILDING LOCATION
		ESTABLISHED BY B. SCHUBERT OCTOBER 16, 1990

Table 3

Comparison of 1993 Flood Levels with 1980 Flood Levels

(Pages 1 to 3)

TABLE 3

Salmon River at Sayward - Summary Table															
Comparison of 1993 model results						to 1980 model results									
XS #	"Q"	"n"	1993 Flood Level		"Q"	"Q"	"n"	1980 Selected	Diff.	1980 criteria	Comments	"Q"	Calibration	Diff. to selected	
	Daily		daily + .61	inst. + .3	Inst.			Flood Level					1990 Flood	1993 Flood Level	
0.1	2146	0.032	**3.51 (3.8)**	3.30	2329.00		0.040	3.51 (4.1)		1980 level daily + 0.61	Sheet 1	1699	2.90		
1	•	•	**4.87**	4.70	•	2259.15	•	4.84	-0.03	1980 level inst + high "n"		•	3.93	0.94	
2	•	•	**5.22**	5.04	•	2250.77	0.035	5.30	0.08	•		•	4.27	0.95	
3	•	•	**5.96**	5.80	•	2241.26	•	5.84	-0.12	•	Sheet 2	•	4.94	1.02	
4	•	0.035	**6.02**	5.86	•	2235.16	•	5.87	-0.15	•		•	5.01	1.01	
4.1	•	•	**5.89**	5.72	•	•	0.050	6.06	0.17	•	bridge replaced 1991	•	4.91	0.98	
4.2	•	•	**5.92**	5.75	•	•	•	6.05	0.13	•	•	•	4.92	1.00	
5	•	•	**6.20**	5.96	•	•	0.040	5.93	-0.27	•		•	5.05	1.15	
6	•	•	**6.13**	5.99	•	•	0.060	6.01	-0.12	•		•	5.07	1.06	
7	•	•	**6.87**	6.74	•	•	•	7.54	0.67	•		•	5.78	1.09	
8	•	•	**7.45**	7.36	•	•	•	8.11	0.66	•		•	6.26	1.19	
9	•	•	**7.78**	7.69	•	•	•	8.61	0.83	•		•	6.59	1.19	
10	2116	•	**8.33**	8.21	*2294.00*	•	•	9.07	0.74	•		1673	7.17	1.16	
11	•	•	**8.73**	8.60	•	2214.24	•	9.55	0.82	•		•	7.62	1.11	
12	•	•	**9.11**	8.96	•	•	•	9.96	0.85	•		•	8.09	1.02	
13	•	•	**10.24**	10.06	•	•	•	10.64	0.40	•		•	9.21	1.03	
14	•	•	**10.43**	10.25	•	•	•	11.09	0.66	•		•	9.44	0.99	
15	•	•	**11.30**	11.16	•	•	•	11.91	0.61	•		•	10.21	1.09	
16	•	•	**12.05**	11.89	•	•	•	12.57	0.52	•	Sheet 3	•	11.01	1.04	
17	2070	•	**12.58**	12.41	*2244.00*	2197.51	0.050	13.09	0.51	•		1638	11.59	0.99	
18	•	•	**13.23**	13.05	•	•	•	13.54	0.31	•		•	12.28	0.95	
19	•	•	**13.58**	13.41	•	•	•	13.84	0.26	•		•	12.18	1.40	
20	*2070*	•	**13.61**	13.44	•	1407.30	•	13.47	-0.14	1980 level daily + 0.61	Backwater effects of	•	13.36	0.25	***
20.1	•	•	**13.63**	13.46	•	•	•	13.47	-0.16	•	"Duncan"bridge	•	13.38	0.25	***
20.2	•	•	**13.73**	13.57	*2244.00*	2109.60	•	13.68	-0.05	1980 level inst + high "n"	•	•	13.41	0.32	***
21	•	•	**13.73**	13.57	•	•	•	13.84	0.11	•	•	•	13.41	0.32	***
22	•	•	**13.59**	13.43	•	•	•	14.59	1.00	•		•	13.37	0.22	***
23	•	•	**15.09**	14.90	•	•	•	15.30	0.21	•		•	14.00	1.09	
24	•	•	**16.58**	16.45	•	•	•	16.60	0.02	•		•	15.47	1.11	
25	1970	•	**17.44**	17.29	*2140.00*	2104.26	•	17.77	0.33	•		1560	16.36	1.08	
25.1	1970	0.035	**17.87**	17.77	*2140.00*	2104.26	0.050			1980 level inst + high "n"	New Highway Bridge	1560	16.68	1.19	
25.2	•	•	**18.00**	17.93	•	•	•			•		•	16.76	1.24	
26	1232	•	**18.99**	18.98	*1515.00*	1376.72	0.060	19.39	0.40	:200 inst. with new bridge		869	17.59	1.40	
27	•	•	**19.00**	18.99	•	1371.39	0.050	19.41	0.41	1:200 inst. + high "n"		•	17.60	1.40	
27.1	•	•	19.13	**19.17**	•	•	0.060	19.45	0.28	•	Old Salmon Highway	•	17.68	1.49	
27.2	•	•	19.18	**19.23**	•	•	•	19.49	0.26	•	Bridge	•	17.72	1.51	
28	•	0.040	**18.93**	18.87	•	•	•	19.28	0.35	•		•	17.57	1.36	
29	•	•	19.19	**19.24**	•	•	•	19.60	0.36	•		•	17.74	1.50	
30	•	•	19.49	**19.64**	•	•	•	20.04	0.40	•		•	17.96	1.68	
31	•	•	19.63	**19.79**	•	•	•	20.24	0.45	•		•	18.08	1.71	

TABLE 3

Salmon River at Sayward - Summary Table															
Comparison of 1993 model results						to 1980 model results									
XS #	"Q"	"n"	1993 Flood Level		"Q"	"Q"	"n"	1980	Diff.	1980 criteria	Comments	"Q"	Calibration	Diff. to selected	
	Daily		daily + .61	inst. + .3	Inst.			Flood Level					1990 Flood	1993 Flood Level	
Reach 2															
32	1232	•	19.77	19.96	1515.00	1371.39	•	20.42	0.46	1:200 inst. + high "n"		869	18.22	1.74	
33	1226	•	19.81	20.00	1508.00	•	•	20.49	0.49	•	Sheet 4	863	18.44	1.56	
34	1199	•	19.85	20.04	1474.00	1340.95	•	20.57	0.53	•		845	18.47	1.57	
35	•	•	19.89	20.09	•	•	•	20.65	0.56	•		•	18.52	1.57	
36	•	•	19.99	20.18	•	•	•	20.75	0.57	•		•	18.63	1.55	
37	•	•	20.05	20.24	•	•	•	20.84	0.60	•		•	18.70	1.54	
38	•	•	20.15	20.33	•	1318.12	•	20.97	0.64	•		•	18.82	1.51	
39	1181	•	20.25	20.42	1452.00	•	•	21.09	0.67	•		833	18.96	1.46	
40	•	•	20.32	20.48	•	•	•	21.17	0.69	•		•	19.04	1.44	
41	•	•	20.73	20.83	•	•	•	21.45	0.62	•		•	19.58	1.25	
42	•	•	21.38	21.36	•	•	•	21.87	0.49	•		•	20.72	0.66	***
43	•	•	21.88	21.85	•	•	•	22.26	0.38	1:200 inst. + high "n"		•	20.70	1.18	
44	•	•	22.80	22.79	•	•	•	23.15	0.35	•		•	22.38	0.42	
45	•	•	23.95	23.99	•	•	•	24.23	0.24	•		•	22.95	1.04	
46	1165	•	24.40	24.45	1433.00	•	•	24.78	0.33	•		822	23.31	1.14	
47	1112	•	24.88	24.92	1366.00	•	•	25.32	0.40	•	Sheet 5	783	23.77	1.15	
48	•	•	25.39	25.42	•	1257.62	•	25.91	0.49	•		•	24.28	1.14	
49	•	•	25.82	25.84	•	1250.00	•	26.29	0.45	•		•	24.70	1.14	
50	•	•	26.51	26.51	•	•	•	26.89	0.38	•		•	25.44	1.07	
51	1112	0.040	27.21	27.19	1366.00	1250.00	0.060	27.54	0.33	1:200 inst. + high "n"	Sheet 5	783	26.17	1.04	
52	1112	•	27.77	27.71	•	833.87	•	27.99	0.22	1:200 daily + 0.61m		•	26.77	1.00	
53	•	•	28.17	28.09	•	•	•	28.48	0.31	•		•	27.20	0.97	
54	•	•	28.23	28.15	•	•	•	28.56	0.33	•		•	27.24	0.99	
55	•	•	28.24	28.17	•	•	•	28.58	0.34	•		•	27.23	1.01	
56	•	•	28.48	28.40	•	•	•	28.70	0.22	•		•	27.49	0.99	
76	•	0.045	28.92	28.82	•	•	•	29.29	0.37	•		•	28.01	0.91	
77	1112	•	29.45	29.34	•	806.71	•	29.86	0.41	•		•	28.54	0.91	
78	•	•	29.76	29.65	•	•	•	30.14	0.38	•		•	28.83	0.93	
79	•	•	30.25	30.15	•	•	•	30.57	0.32	•		•	29.31	0.94	
80	•	•	31.48	31.40	•	•	•	31.92	0.44	•		•	30.52	0.96	
81	•	•	32.66	32.52	•	•	•	33.10	0.44	•		•	31.95	0.71	
82	•	•	33.58	33.46	•	•	•	34.10	0.52	•		•	33.05	0.53	***
83	•	•	34.66	34.57	•	•	•	35.32	0.66	•		•	34.29	0.37	***
84	•	•	36.34	36.22	•	•	•	36.75	0.41	•		•	35.73	0.61	
85	•	•	37.36	37.14	•	•	•	37.23	-0.13	•		•	36.44	0.92	
86	1047	•	39.07	38.99	1288.00	•	•	39.16	0.09	•	Sheet 6	738	38.19	0.88	
87	•	•	40.50	40.37	•	•	•	40.67	0.17	•		•	39.56	0.94	

TABLE 3

Salmon River at Sayward - Summary Table

Comparison of 1993 model results						to 1980 model results									
XS #	"Q"	"n"	1993 Flood Level		"Q"	"Q"	"n"	1980	Diff.	1980 criteria	Comments	"Q"	Calibration	Diff. to selected	
	Daily		daily + .61	inst. + .3	Inst.			Flood Level					1990 Flood	1993 Flood Level	
88	888	0.050	43.05	43.00	1190.00	746.80	"	43.06	0.01	"		677	42.28	0.77	
89	514	"	44.78	44.84	840.00	746.80	"	44.97	0.13	"		469	44.06	0.78	
90	514	"	51.79	51.52	"	505.40	"	51.57	-0.22	"		"	50.66	1.13	
92	"	"	56.16	56.58	"	"	"	57.06	0.48	"		"	56.07	0.51	***
93	"	"	59.12	58.95	840.00	757.62	"	58.81	-0.31	1:200 inst. + high "n"		"	57.72	1.40	
94	514	"	60.94	61.49	"	505.40	"	61.39	-0.10	1:200 daily + 0.61m		"	60.51	0.98	
95	"	"	61.24	61.45	"	"	"	61.62	0.17	"		"	60.67	0.78	
95.1	"	"	61.19	61.34	"	"	"	61.58	0.24	"		"	60.64	0.70	
95.2	"	"	61.25	61.44	"	"	"	61.60	0.16	"		"	60.68	0.76	
96	"	"	61.61	62.28	840.00	757.62	"	61.98	-0.30	1:200 inst. + high "n"		"	60.96	1.32	
97	"	"	61.98	62.81	"	"	"	62.44	-0.37	"		"	61.28	1.53	

White River at Sayward - Summary Table

Comparison of 1993 model results to 1980 model results														
XS#	"Q"	"n"	1993 Flood Level		"Q"	"Q"	"n"	1980	Diff.	1980 criteria		"Q"	Calibration	Diff to selected
	Daily		daily + .61	inst.+.3	Inst.			Flood Level					1990 Flood	1993 Flood Level
25.3	1970	0.035	17.99	17.93	1515		0.060	19.39	1.40	Q200 Inst	No Freeboard Allowance	869	17.59	0.40
57	684	0.038	19.08	19.12	1060	1388	0.050	19.02	-0.10	"		691	17.77	1.35
58	"	"	19.15	19.26	"	"	"	19.52	0.26	"		"	17.95	1.31
59	"	0.040	19.51	19.72	"	"	0.060	20.17	0.45	"		"	18.75	0.97
60	"	"	19.52	19.71	"	"	"	19.52	-0.19	Q200 Daily +0.61 Frbrd		"	18.78	0.93
60.1	"	0.045	19.61	19.85	"	"	0.050	20.25	0.40	Q200 Inst	No Freeboard Allowance	"	18.87	0.98
60.2	"	"	19.62	19.87	"	"	"	20.36	0.49	(Bridge replaced 1992)		"	18.89	0.98
61	"	"	19.65	19.90	"	"	0.065	20.91	1.01	"		"	18.93	0.97
62	"	"	19.78	20.02	"	"	"	22.15	2.13	"		"	19.09	0.93
63	"	"	20.50	20.53	"	"	"	22.33	1.83	"		"	19.97	0.56
64	"	"	20.26	20.60	"	"	"	21.94	1.34	"		"	19.71	0.89
64.1	"	"	20.39	20.84	"	"	0.050	22.10	1.26	"		"	19.77	1.07
64.2	"	"	20.88	20.91	"	"	"	22.10	1.19	"		"	20.33	0.58
65	"	"	21.10	21.85	"	"	0.065	22.74	0.89	"		"	20.53	1.32
66	"	"	21.24	22.11	"	"	"	23.33	1.22	"		"	20.67	1.44
67	"	"	22.63	23.27	"	"	"	24.06	0.79	"		"	22.04	1.23
68	"	"	25.11	25.49	"	"	"	27.06	1.57	"		"	24.52	0.97

Table 4

Sensitivity to "n" Value Increases

Salmon River (Pages 1 to 11)

White River (Pages 12 to 13)

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
0.1	0.032	2.90	2146	**3.51**	3.30	**4.10**	2.90	2329.00
0.1	0.035	2.90	2146				2.90	2329.00
0.1	0.038	2.90	2146				2.90	2329.00
0.1	0.042	2.90	2146				2.90	2329.00
0.1	0.045	2.90	2146				2.90	2329.00
1	0.032	4.26	2146	**4.87**	4.70	*4.84*	4.40	2329.00
1	0.035	4.42	2146				4.56	2329.00
1	0.038	4.56	2146				4.70	2329.00
1	0.042	4.69	2146				4.84	2329.00
1	0.045	4.82	2146				*4.97*	2329.00
2	0.032	4.61	2146	**5.22**	5.04	**5.30**	4.74	2329.00
2	0.035	4.78	2146				4.92	2329.00
2	0.038	4.93	2146				5.08	2329.00
2	0.042	5.07	2146				5.23	2329.00
2	0.045	5.21	2146				*5.37*	2329.00
3	0.032	5.35	2146	**5.96**	5.80	*5.84*	5.50	2329.00
3	0.035	5.53	2146				5.69	2329.00
3	0.038	5.70	2146				5.85	2329.00
3	0.042	5.85	2146				*6.01*	2329.00
3	0.045	6.00	2146				*6.16*	2329.00
4	0.035	5.41	2146	**6.02**	5.86	*5.87*	5.56	2329.00
4	0.039	5.58	2146				5.74	2329.00
4	0.042	5.74	2146				5.90	2329.00
4	0.046	5.89	2146				*6.06*	2329.00
4	0.049	6.04	2146				*6.21*	2329.00
4.1	0.035	5.28	2146	**5.89**	5.72	**6.06**	5.42	2329.00
4.1	0.039	5.47	2146				5.62	2329.00
4.1	0.042	5.65	2146				5.79	2329.00
4.1	0.046	5.81	2146				*5.97*	2329.00
4.1	0.049	5.97	2146				*6.13*	2329.00
4.2	0.035	5.31	2146	**5.92**	5.75	**6.06**	5.45	2329.00
4.2	0.039	5.50	2146				5.65	2329.00
4.2	0.042	5.67	2146				5.82	2329.00
4.2	0.046	5.83	2146				6.00	2329.00
4.2	0.049	*5.99*	2146				*6.16*	2329.00
5	0.035	5.49	2146	**6.10**	5.96	*5.93*	5.66	2329.00
5	0.039	5.66	2146				5.82	2329.00
5	0.042	5.81	2146				5.98	2329.00
5	0.046	5.96	2146				*6.13*	2329.00
5	0.049	6.10	2146				*6.27*	2329.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
6	0.035	5.52	2146	**6.13**	5.99	*6.01*	5.69	2329.00
6	0.039	5.70	2146				5.87	2329.00
6	0.042	5.87	2146				6.04	2329.00
6	0.046	6.03	2146				*6.20*	2329.00
6	0.049	*6.18*	2146				*6.36*	2329.00
7	0.035	6.26	2146	**6.87**	6.74	**7.54**	6.44	2329.00
7	0.039	6.46	2146				6.65	2329.00
7	0.042	6.66	2146				6.85	2329.00
7	0.046	6.84	2146				*7.03*	2329.00
7	0.049	*7.02*	2146				*7.21*	2329.00
8	0.035	6.84	2146	**7.45**	7.36	**8.11**	7.06	2329.00
8	0.039	7.04	2146				7.26	2329.00
8	0.042	7.23	2146				7.46	2329.00
8	0.046	7.41	2146				*7.64*	2329.00
8	0.049	*7.58*	2146				*7.80*	2329.00
9	0.035	7.17	2146	**7.78**	7.69	**8.61**	7.39	2329.00
9	0.039	7.39	2146				7.61	2329.00
9	0.042	7.59	2146				*7.81*	2329.00
9	0.046	7.78	2146				*8.00*	2329.00
9	0.049	*7.96*	2146				*8.17*	2329.00
10	0.035	7.72	2116	**8.33**	8.21	**9.07**	7.91	2294.00
10	0.039	7.90	2116				8.10	2294.00
10	0.042	8.08	2116				*8.28*	2294.00
10	0.046	8.25	2116				*8.45*	2294.00
10	0.049	*8.41*	2116				*8.61*	2294.00
11	0.035	8.12	2116	**8.73**	8.60	**9.55**	8.30	2294.00
11	0.039	8.32	2116				8.50	2294.00
11	0.042	8.50	2116				*8.69*	2294.00
11	0.046	8.67	2116				*8.87*	2294.00
11	0.049	*8.84*	2116				*9.03*	2294.00
12	0.035	8.50	2116	**9.11**	8.96	**9.96**	8.66	2294.00
12	0.039	8.74	2116				8.91	2294.00
12	0.042	8.95	2116				*9.12*	2294.00
12	0.046	*9.14*	2116				*9.32*	2294.00
12	0.049	*9.31*	2116				*9.49*	2294.00
13	0.035	9.63	2116	**10.24**	10.06	**10.64**	9.76	2294.00
13	0.039	9.73	2116				9.87	2294.00
13	0.042	9.85	2116				10.00	2294.00
13	0.046	9.98	2116				*10.14*	2294.00
13	0.049	10.11	2116				*10.27*	2294.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
14	0.035	9.82	2116	**10.43**	10.25	**11.09**	9.95	2294.00
14	0.039	10.00	2116				10.15	2294.00
14	0.042	10.18	2116				*10.34*	2294.00
14	0.046	10.35	2116				*10.51*	2294.00
14	0.049	*10.51*	2116				*10.68*	2294.00
15	0.035	10.69	2116	**11.30**	11.16	**11.91**	10.86	2294.00
15	0.039	10.83	2116				10.98	2294.00
15	0.042	10.96	2116				11.11	2294.00
15	0.046	11.09	2116				*11.24*	2294.00
15	0.049	11.21	2116				*11.37*	2294.00
16	0.035	11.44	2116	**12.05**	11.89	**12.57**	11.59	2294.00
16	0.039	11.58	2116				11.72	2294.00
16	0.042	11.71	2116				11.86	2294.00
16	0.046	11.84	2116				*11.99*	2294.00
16	0.049	11.97	2116				*12.12*	2294.00
17	0.035	11.97	2070	**12.58**	12.41	**13.09**	12.11	2244.00
17	0.039	12.13	2070				12.27	2244.00
17	0.042	12.27	2070				*12.42*	2244.00
17	0.046	12.41	2070				*12.56*	2244.00
17	0.049	12.54	2070				*12.69*	2244.00
18	0.035	12.62	2070	**13.23**	13.05	**13.54**	12.75	2244.00
18	0.039	12.76	2070				12.89	2244.00
18	0.042	12.89	2070				13.03	2244.00
18	0.046	13.01	2070				*13.16*	2244.00
18	0.049	13.14	2070				*13.29*	2244.00
19	0.035	12.97	2070	**13.58**	13.41	**13.84**	13.11	2244.00
19	0.039	13.14	2070				13.28	2244.00
19	0.042	13.30	2070				*13.44*	2244.00
19	0.046	13.44	2070				*13.59*	2244.00
19	0.049	13.58	2070				*13.74*	2244.00
20	0.035	13.00	2070	**13.61**	13.44	*13.47*	13.14	2244.00
20	0.039	13.18	2070				13.31	2244.00
20	0.042	13.33	2070				*13.48*	2244.00
20	0.046	13.48	2070				*13.63*	2244.00
20	0.049	*13.62*	2070				*13.78*	2244.00
20.1	0.035	13.02	2070	**13.63**	13.46	*13.47*	13.16	2244.00
20.1	0.039	13.21	2070				13.35	2244.00
20.1	0.042	13.37	2070				*13.54*	2244.00
20.1	0.046	13.53	2070				*13.76*	2244.00
20.1	0.049	*13.73*	2070				*13.92*	2244.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
20.2	0.035	13.12	2070	**13.73**	13.57	*13.68*	13.27	2244.00
20.2	0.039	13.28	2070				13.43	2244.00
20.2	0.042	13.43	2070				13.64	2244.00
20.2	0.046	13.61	2070				*13.81*	2244.00
20.2	0.049	*13.77*	2070				*13.95*	2244.00
21	0.035	13.12	2070	**13.73**	13.57	*13.68*	13.27	2244.00
21	0.039	13.28	2070				13.43	2244.00
21	0.042	13.43	2070				*13.61*	2244.00
21	0.046	13.59	2070				*13.76*	2244.00
21	0.049	13.73	2070				*13.91*	2244.00
22	0.035	12.98	2070	**13.59**	13.43	**13.84**	13.13	2244.00
22	0.039	13.19	2070				13.34	2244.00
22	0.042	13.37	2070				*13.56*	2244.00
22	0.046	13.55	2070				*13.73*	2244.00
22	0.049	*13.71*	2070				*13.89*	2244.00
23	0.035	14.48	2070	**15.09**	14.90	**15.30**	14.60	2244.00
23	0.039	14.64	2070				14.78	2244.00
23	0.042	14.81	2070				*14.95*	2244.00
23	0.046	14.97	2070				*15.12*	2244.00
23	0.049	*15.12*	2070				*15.28*	2244.00
24	0.035	15.97	2070	**16.58**	16.45	**16.58**	16.15	2244.00
24	0.039	16.13	2070				16.31	2244.00
24	0.042	16.29	2070				*16.47*	2244.00
24	0.046	16.44	2070				*16.62*	2244.00
24	0.049	*16.59*	2070				*16.77*	2244.00
25	0.035	16.83	1970	**17.44**	17.29	**17.77**	16.99	2140.00
25	0.039	17.07	1970				17.23	2140.00
25	0.042	17.29	1970				*17.46*	2140.00
25	0.046	*17.51*	1970				*17.68*	2140.00
25	0.049	*17.71*	1970				*17.89*	2140.00
25.1	0.035	17.26	1970	**17.87**	17.77		17.47	2140.00
25.1	0.039	17.52	1970				17.74	2140.00
25.1	0.042	17.77	1970				*17.98*	2140.00
25.1	0.046	*17.99*	1970				*18.22*	2140.00
25.1	0.049	*18.21*	1970				*18.44*	2140.00
25.2	0.035	17.39	1970	**18.00**	17.93		17.63	2140.00
25.2	0.039	17.64	1970				17.88	2140.00
25.2	0.042	17.88	1970				*18.12*	2140.00
25.2	0.046	18.10	1970				*18.34*	2140.00
25.2	0.049	18.32	1970				*18.56*	2140.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
26	0.035	18.38	1232	**18.99**	18.98	**19.39**	18.68	1515.00
26	0.039	18.60	1232				18.90	1515.00
26	0.042	18.80	1232				*19.11*	1515.00
26	0.046	18.99	1232				*19.31*	1515.00
26	0.049	*19.19*	1232				*19.50*	1515.00
27	0.035	18.39	1232	**19.00**	18.99	**19.41**	18.69	1515.00
27	0.039	18.61	1232				18.91	1515.00
27	0.042	18.81	1232				*19.12*	1515.00
27	0.046	*19.02*	1232				*19.33*	1515.00
27	0.049	*19.21*	1232				*19.53*	1515.00
27.1	0.035	18.52	1232	19.13	**19.17**	**19.45**	18.87	1515.00
27.1	0.039	18.73	1232				19.08	1515.00
27.1	0.042	18.93	1232				*19.28*	1515.00
27.1	0.046	19.12	1232				*19.47*	1515.00
27.1	0.049	*19.31*	1232				*19.66*	1515.00
27.2	0.035	18.57	1232	19.18	**19.23**	**19.49**	18.93	1515.00
27.2	0.039	18.77	1232				19.13	1515.00
27.2	0.042	18.96	1232				*19.33*	1515.00
27.2	0.046	19.16	1232				***19.52***	1515.00
27.2	0.049	*19.34*	1232				***19.70***	1515.00
28	0.040	18.32	1232	**18.93**	18.87	**19.28**	18.57	1515.00
28	0.044	18.53	1232				18.79	1515.00
28	0.048	18.74	1232				*19.01*	1515.00
28	0.052	*18.94*	1232				*19.22*	1515.00
28	0.056	*19.14*	1232				***19.42***	1515.00
29	0.040	18.58	1232	19.19	**19.24**	**19.60**	18.94	1515.00
29	0.044	18.79	1232				19.15	1515.00
29	0.048	18.99	1232				*19.35*	1515.00
29	0.052	19.18	1232				*19.55*	1515.00
29	0.056	*19.37*	1232				***19.74***	1515.00
30	0.040	18.88	1232	19.49	**19.64**	**20.04**	19.34	1515.00
30	0.044	19.10	1232				19.55	1515.00
30	0.048	19.30	1232				*19.76*	1515.00
30	0.052	19.50	1232				*19.97*	1515.00
30	0.056	19.70	1232				***20.17***	1515.00
31	0.040	19.02	1232	19.63	**19.79**	**20.24**	19.49	1515.00
31	0.044	19.24	1232				19.72	1515.00
31	0.048	19.45	1232				*19.94*	1515.00
31	0.052	*19.66*	1232				*20.15*	1515.00
31	0.056	*19.86*	1232				***20.36***	1515.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
32	0.040	19.16	1232	19.77	**19.96**	**20.42**	19.66	1515.00
32	0.044	19.38	1232				19.88	1515.00
32	0.048	19.59	1232				*20.10*	1515.00
32	0.052	*19.80*	1232				*20.31*	1515.00
32	0.056	*20.00*	1232				***20.52***	1515.00
33	0.040	19.20	1226	19.81	**20.00**	**20.49**	19.70	1508.00
33	0.044	19.42	1226				19.93	1508.00
33	0.048	19.63	1226				*20.15*	1508.00
33	0.052	*19.84*	1226				*20.36*	1508.00
33	0.056	*20.05*	1226				***20.57***	1508.00
34	0.040	19.24	1199	19.85	**20.04**	**20.57**	19.74	1474.00
34	0.044	19.46	1199				19.97	1474.00
34	0.048	19.67	1199				*20.19*	1474.00
34	0.052	*19.89*	1199				*20.40*	1474.00
34	0.056	*20.09*	1199				***20.61***	1474.00
35	0.040	19.28	1199	19.89	**20.09**	**20.65**	19.79	1474.00
35	0.044	19.51	1199				20.01	1474.00
35	0.048	19.72	1199				*20.24*	1474.00
35	0.052	*19.93*	1199				*20.45*	1474.00
35	0.056	*20.13*	1199				***20.66***	1474.00
36	0.040	19.38	1199	19.99	**20.18**	**20.75**	19.88	1474.00
36	0.044	19.60	1199				20.11	1474.00
36	0.048	19.82	1199				*20.33*	1474.00
36	0.052	*20.03*	1199				*20.55*	1474.00
36	0.056	*20.23*	1199				***20.76***	1474.00
37	0.040	19.44	1199	20.05	**20.24**	**20.84**	19.94	1474.00
37	0.044	19.66	1199				20.17	1474.00
37	0.048	19.87	1199				*20.39*	1474.00
37	0.052	*20.08*	1199				*20.60*	1474.00
37	0.056	*20.28*	1199				*20.81*	1474.00
38	0.040	19.54	1199	20.15	**20.33**	**20.97**	20.03	1474.00
38	0.044	19.76	1199				20.26	1474.00
38	0.048	19.97	1199				*20.48*	1474.00
38	0.052	*20.18*	1199				*20.69*	1474.00
38	0.056	*20.37*	1199				*20.90*	1474.00
39	0.040	19.64	1181	20.25	**20.42**	**21.09**	20.12	1452.00
39	0.044	19.85	1181				20.34	1452.00
39	0.048	20.05	1181				*20.56*	1452.00
39	0.052	20.25	1181				*20.76*	1452.00
39	0.056	*20.45*	1181				*20.97*	1452.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
40	0.040	19.71	1181	20.32	**20.48**	**21.17**	20.18	1452.00
40	0.044	19.92	1181				20.40	1452.00
40	0.048	20.12	1181				*20.62*	1452.00
40	0.052	20.32	1181				*20.82*	1452.00
40	0.056	*20.51*	1181				*21.03*	1452.00
41	0.040	20.12	1181	20.73	**20.83**	**21.45**	20.53	1452.00
41	0.044	20.30	1181				20.73	1452.00
41	0.048	20.48	1181				*20.92*	1452.00
41	0.052	20.65	1181				*21.12*	1452.00
41	0.056	*20.82*	1181				*21.31*	1452.00
42	0.040	20.77	1181	**21.38**	21.36	**21.87**	21.06	1452.00
42	0.044	20.90	1181				21.21	1452.00
42	0.048	21.02	1181				*21.37*	1452.00
42	0.052	21.15	1181				*21.53*	1452.00
42	0.056	21.28	1181				*21.69*	1452.00
43	0.040	21.27	1181	**21.88**	21.85	**22.26**	21.55	1452.00
43	0.044	21.42	1181				21.71	1452.00
43	0.048	21.55	1181				*21.86*	1452.00
43	0.052	21.67	1181				*22.01*	1452.00
43	0.056	21.80	1181				*22.15*	1452.00
44	0.040	22.19	1181	**22.80**	22.79	**23.15**	22.49	1452.00
44	0.044	22.36	1181				22.66	1452.00
44	0.048	22.51	1181				*22.82*	1452.00
44	0.052	22.65	1181				*22.97*	1452.00
44	0.056	22.77	1181				*23.11*	1452.00
45	0.040	23.34	1181	23.95	**23.99**	**24.23**	23.69	1452.00
45	0.044	23.45	1181				23.78	1452.00
45	0.048	23.55	1181				23.89	1452.00
45	0.052	23.65	1181				23.99	1452.00
45	0.056	23.74	1181				*24.09*	1452.00
46	0.040	23.79	1165	24.40	**24.45**	**24.78**	24.15	1433.00
46	0.044	23.93	1165				24.30	1433.00
46	0.048	24.07	1165				24.44	1433.00
46	0.052	24.20	1165				24.58	1433.00
46	0.056	24.33	1165				24.71	1433.00
47	0.040	24.27	1112	24.88	**24.92**	**25.32**	24.62	1366.00
47	0.044	24.39	1112				24.75	1366.00
47	0.048	24.52	1112				24.88	1366.00
47	0.052	24.63	1112				25.01	1366.00
47	0.056	24.75	1112				25.13	1366.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
48	0.040	24.78	1112	25.39	**25.42**	**25.91**	25.12	1366.00
48	0.044	24.93	1112				25.28	1366.00
48	0.048	25.07	1112				25.42	1366.00
48	0.052	25.20	1112				25.57	1366.00
48	0.056	25.33	1112				25.70	1366.00
49	0.040	25.21	1112	25.82	**25.84**	**26.29**	25.54	1366.00
49	0.044	25.35	1112				25.69	1366.00
49	0.048	25.49	1112				25.83	1366.00
49	0.052	25.61	1112				25.97	1366.00
49	0.056	25.73	1112				26.10	1366.00
50	0.040	25.90	1112	26.51	**26.51**	**26.89**	26.21	1366.00
50	0.044	26.04	1112				26.36	1366.00
50	0.048	26.17	1112				26.50	1366.00
50	0.052	26.29	1112				26.63	1366.00
50	0.056	26.41	1112				26.76	1366.00
51	0.040	26.60	1112	**27.21**	27.19	**27.54**	26.89	1366.00
51	0.044	26.73	1112				27.03	1366.00
51	0.048	26.86	1112				27.17	1366.00
51	0.052	26.98	1112				27.30	1366.00
51	0.056	27.09	1112				27.42	1366.00
52	0.040	27.16	1112	**27.77**	27.71	**27.99**	27.41	1366.00
52	0.044	27.26	1112				27.52	1366.00
52	0.048	27.36	1112				27.63	1366.00
52	0.052	27.45	1112				27.73	1366.00
52	0.056	27.54	1112				27.83	1366.00
53	0.040	27.56	1112	**28.17**	**28.17**	**28.48**	27.79	1366.00
53	0.044	27.66	1112				27.89	1366.00
53	0.048	27.75	1112				27.99	1366.00
53	0.052	27.84	1112				28.09	1366.00
53	0.056	27.92	1112				*28.18*	1366.00
54	0.040	27.62	1112	**28.23**	28.15	**28.56**	27.85	1366.00
54	0.044	27.73	1112				27.97	1366.00
54	0.048	27.84	1112				28.08	1366.00
54	0.052	27.94	1112				28.19	1366.00
54	0.056	28.03	1112				*28.29*	1366.00
55	0.040	27.63	1112	**28.24**	28.17	**28.58**	27.87	1366.00
55	0.044	27.75	1112				28.00	1366.00
55	0.048	27.86	1112				28.11	1366.00
55	0.052	27.96	1112				28.22	1366.00
55	0.056	28.05	1112				*28.32*	1366.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
56	0.040	27.87	1112	**28.48**	28.40	**28.70**	28.10	1366.00
56	0.044	27.96	1112				28.19	1366.00
56	0.048	28.04	1112				28.29	1366.00
56	0.052	28.13	1112				28.38	1366.00
56	0.056	28.21	1112				*28.47*	1366.00
76	0.045	28.31	1112	**28.92**	28.82	**29.29**	28.52	1366.00
76	0.050	28.40	1112				28.61	1366.00
76	0.054	28.48	1112				28.70	1366.00
76	0.059	28.56	1112				28.79	1366.00
76	0.063	28.64	1112				*28.88*	1366.00
77	0.045	28.84	1112	**29.45**	29.34	**29.86**	29.04	1366.00
77	0.050	28.92	1112				29.12	1366.00
77	0.054	28.99	1112				29.21	1366.00
77	0.059	29.07	1112				29.29	1366.00
77	0.063	29.14	1112				*29.37*	1366.00
78	0.045	29.15	1112	**29.76**	29.65	**30.14**	29.35	1366.00
78	0.050	29.24	1112				29.45	1366.00
78	0.054	29.33	1112				29.55	1366.00
78	0.059	29.41	1112				29.64	1366.00
78	0.063	29.49	1112				*29.72*	1366.00
79	0.045	29.64	1112	**30.25**	30.15	**30.57**	29.85	1366.00
79	0.050	29.74	1112				29.95	1366.00
79	0.054	29.83	1112				30.05	1366.00
79	0.059	29.91	1112				30.15	1366.00
79	0.063	30.00	1112				*30.23*	1366.00
80	0.045	30.87	1112	**31.48**	31.40	**31.92**	31.10	1366.00
80	0.050	30.98	1112				31.22	1366.00
80	0.054	31.08	1112				31.32	1366.00
80	0.059	31.18	1112				*31.42*	1366.00
80	0.063	31.26	1112				*31.52*	1366.00
81	0.045	32.05	1112	**32.66**	32.52	**33.10**	32.22	1366.00
81	0.050	32.13	1112				32.30	1366.00
81	0.054	32.20	1112				32.37	1366.00
81	0.059	32.26	1112				32.45	1366.00
81	0.063	32.33	1112				32.52	1366.00
82	0.045	32.97	1112	**33.58**	33.46	**34.10**	33.16	1366.00
82	0.050	33.04	1112				33.23	1366.00
82	0.054	33.10	1112				33.30	1366.00
82	0.059	33.17	1112				33.38	1366.00
82	0.063	33.23	1112				33.44	1366.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
83	0.045	34.05	1112	**34.66**	34.57	**35.32**	34.27	1366.00
83	0.050	34.17	1112				34.38	1366.00
83	0.054	34.27	1112				34.49	1366.00
83	0.059	34.36	1112				*34.58*	1366.00
83	0.063	34.44	1112				*34.68*	1366.00
84	0.045	35.73	1112	**36.34**	36.22	**36.75**	35.92	1366.00
84	0.050	35.80	1112				35.99	1366.00
84	0.054	35.87	1112				36.07	1366.00
84	0.059	35.94	1112				36.15	1366.00
84	0.063	36.00	1112				*36.23*	1366.00
85	0.045	36.75	1112	**37.36**	37.14	***37.23***	36.84	1366.00
85	0.050	36.75	1112				36.84	1366.00
85	0.054	36.72	1112				36.89	1366.00
85	0.059	36.72	1112				36.93	1366.00
85	0.063	36.82	1112				37.04	1366.00
86	0.045	38.46	1047	**39.07**	38.99	**39.16**	38.69	1288.00
86	0.050	38.55	1047				38.79	1288.00
86	0.054	38.66	1047				38.87	1288.00
86	0.059	38.74	1047				38.94	1288.00
86	0.063	38.78	1047				38.98	1288.00
87	0.045	39.89	1047	**40.50**	40.37	**40.67**	40.07	1288.00
87	0.050	39.98	1047				40.18	1288.00
87	0.054	40.06	1047				40.29	1288.00
87	0.059	40.14	1047				*40.39*	1288.00
87	0.063	40.24	1047				*40.49*	1288.00
88	0.050	42.44	888	**43.05**	43.00	**43.06**	42.70	1190.00
88	0.055	42.53	888				42.79	1190.00
88	0.060	42.61	888				42.88	1190.00
88	0.065	42.69	888				42.97	1190.00
88	0.070	42.76	888				*43.04*	1190.00
89	0.050	44.17	514	44.78	**44.84**	**44.97**	44.54	840.00
89	0.055	44.24	514				44.63	840.00
89	0.060	44.31	514				44.71	840.00
89	0.065	44.38	514				44.78	840.00
89	0.070	44.44	514				*44.85*	840.00
90	0.050	51.18	514	**51.79**	51.52	***51.57***	51.22	840.00
90	0.055	51.14	514				51.16	840.00
90	0.060	51.16	514				51.22	840.00
90	0.065	50.73	514				51.15	840.00
90	0.070	50.75	514				51.16	840.00

TABLE 4

SALMON RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
92	0.050	55.55	514	56.16	**56.58**	**57.06**	56.28	840.00
92	0.055	55.74	514				56.44	840.00
92	0.060	55.86	514				56.54	840.00
92	0.065	56.42	514				*56.69*	840.00
92	0.070	56.50	514				*56.79*	840.00
93	0.050	58.51	514	**59.12**	58.95	***58.81***	58.65	840.00
93	0.055	58.51	514				58.67	840.00
93	0.060	58.56	514				58.79	840.00
93	0.065	57.98	514				*58.84*	840.00
93	0.070	58.10	514				*58.92*	840.00
94	0.050	60.32	514	60.93	**61.49**	***61.39***	61.19	840.00
94	0.055	60.49	514				61.31	840.00
94	0.060	60.61	514				61.39	840.00
94	0.065	60.94	514				*61.49*	840.00
94	0.070	61.00	514				*61.56*	840.00
95	0.050	60.63	514	61.24	**61.45**	**61.62**	61.15	840.00
95	0.055	60.76	514				61.28	840.00
95	0.060	60.87	514				61.39	840.00
95	0.065	61.11	514				*61.50*	840.00
95	0.070	61.19	514				*61.59*	840.00
95.1	0.060	60.58	514	61.19	**61.34**	**61.58**	61.04	840.00
95.1	0.066	60.72	514				61.19	840.00
95.1	0.072	60.84	514				61.31	840.00
95.1	0.078	61.08	514				*61.43*	840.00
95.1	0.084	61.17	514				*61.54*	840.00
95.2	0.060	60.64	514	61.25	**61.44**	**61.60**	61.14	840.00
95.2	0.066	60.78	514				61.30	840.00
95.2	0.072	60.91	514				61.44	840.00
95.2	0.078	61.15	514				61.58	840.00
95.2	0.084	61.24	514				***61.70***	840.00
96	0.060	61.00	514	61.61	**62.28**	***61.98***	61.98	840.00
96	0.066	61.12	514				62.04	840.00
96	0.072	61.22	514				62.12	840.00
96	0.078	61.42	514				62.21	840.00
96	0.084	61.50	514				***62.29***	840.00
97	0.060	61.37	514	61.98	**62.81**	***62.44***	*62.51*	840.00
97	0.066	61.47	514				*62.56*	840.00
97	0.072	61.56	514				*62.63*	840.00
97	0.078	61.72	514				*62.70*	840.00
97	0.084	61.79	514				*62.76*	840.00

TABLE 4

WHITE RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
25.3	0.035	17.39	1970	**18.00**	17.93	**19.39**	17.63	2140
25.3	0.039	17.39	1232				17.63	2140
25.3	0.042	17.39	1232				17.63	2140
25.3	0.046	17.39	1232				17.63	2140
25.3	0.049	17.39	1232				17.63	2140
57	0.035	18.47	684	19.08	**19.10**	**19.02**	18.80	1060
57	0.039	17.94	684				18.87	1060
57	0.042	17.99	684				18.95	1060
57	0.046	18.05	684				19.03	1060
57	0.049	18.10	684				19.11	1060
58	0.038	18.54	684	19.15	**19.23**	**19.52**	18.93	1060
58	0.042	18.11	684				19.04	1060
58	0.046	18.21	684				19.15	1060
58	0.049	18.30	684				19.25	1060
58	0.053	18.39	684				19.36	1060
59	0.040	18.90	684	19.51	**19.71**	**20.17**	19.41	1060
59	0.044	18.83	684				19.52	1060
59	0.048	18.92	684				19.63	1060
59	0.052	19.01	684				19.74	1060
59	0.056	19.09	684				19.85	1060
60	0.040	18.91	684	19.52	**19.70**	***19.52***	19.40	1060
60	0.044	18.86	684				19.53	1060
60	0.048	18.96	684				19.65	1060
60	0.052	19.05	684				19.77	1060
60	0.056	19.13	684				19.88	1060
60.1	0.045	19.00	684	19.61	**19.84**	**20.25**	19.54	1060
60.1	0.050	18.96	684				19.65	1060
60.1	0.054	19.04	684				19.75	1060
60.1	0.059	19.13	684				19.86	1060
60.1	0.063	19.21	684				19.96	1060
60.2	0.045	19.01	684	19.62	**19.86**	**20.36**	19.56	1060
60.2	0.050	18.97	684				19.66	1060
60.2	0.054	19.06	684				19.77	1060
60.2	0.059	19.15	684				19.87	1060
60.2	0.063	19.23	684				19.97	1060
61	0.045	19.04	684	19.65	**19.89**	**20.91**	19.59	1060
61	0.050	19.01	684				19.69	1060
61	0.054	19.10	684				19.80	1060
61	0.059	19.18	684				19.90	1060
61	0.063	19.26	684				20.00	1060

TABLE 4

WHITE RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
62	0.045	19.17	684	19.78	**20.01**	**22.15**	19.71	1060
62	0.050	19.18	684				19.82	1060
62	0.054	19.27	684				19.94	1060
62	0.059	19.36	684				20.04	1060
62	0.063	19.45	684				20.15	1060
63	0.045	19.89	684	20.50	20.53	**22.33**	20.23	1060
63	0.050	19.63	684				20.36	1060
63	0.054	19.80	684				20.48	1060
63	0.059	19.97	684				20.60	1060
63	0.063	20.07	684				20.70	1060
64	0.045	19.65	684	20.26	**20.60**	**21.94**	20.30	1060
64	0.050	20.78	684				20.33	1060
64	0.054	20.88	684				20.31	1060
64	0.059	20.05	684				20.32	1060
64	0.063	20.19	684				20.42	1060
64.1	0.045	19.78	684	20.39	**20.84**	**22.10**	20.54	1060
64.1	0.050	20.77	684				20.54	1060
64.1	0.054	20.87	684				20.54	1060
64.1	0.059	20.06	684				20.54	1060
64.1	0.063	20.21	684				20.54	1060
64.2	0.045	20.27	684	20.88	**21.61**	**22.10**	21.31	1060
64.2	0.050	20.80	684				21.35	1060
64.2	0.054	20.91	684				21.40	1060
64.2	0.059	20.29	684				21.45	1060
64.2	0.063	20.38	684				21.49	1060
65	0.045	20.49	684	21.10	**21.85**	**22.74**	21.55	1060
65	0.050	20.89	684				21.61	1060
65	0.054	20.99	684				21.67	1060
65	0.059	20.53	684				21.73	1060
65	0.063	20.58	684				21.78	1060
66	0.045	20.63	684	21.24	**22.11**	**23.33**	21.81	1060
66	0.050	21.01	684				21.90	1060
66	0.054	21.12	684				21.98	1060
66	0.059	20.81	684				22.05	1060
66	0.063	20.89	684				22.13	1060
67	0.045	22.02	684	22.63	**23.27**	**24.06**	22.97	1060
67	0.050	22.20	684				23.11	1060
67	0.054	22.37	684				23.26	1060
67	0.059	22.47	684				23.38	1060
67	0.063	22.59	684				23.50	1060

TABLE 4

WHITE RIVER - SENSITIVITY TO "n" VALUE INCREASES								
SECNO	"n"	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
		DAILY		DAILY	INST	1980	INST	
68	0.045	24.50	684	25.11	**25.49**	**27.06**	25.19	1060
68	0.050	24.69	684				25.43	1060
68	0.054	24.86	684				25.64	1060
68	0.059	25.05	684				25.85	1060
68	0.063	25.21	684				26.05	1060

Table 5

Sensitivity to "Q" Increases

Salmon River (Pages 1 to 10)

White River (Pages 11 to 12)

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
0.1	2.9	2146	**3.51**	3.30	**4.10**	2.90	2329
0.1	2.9	2360.6				2.90	2561.9
0.1	2.9	2575.2				2.90	2794.8
0.1	2.9	2789.8				2.90	3027.7
1	4.26	2146	**4.87**	4.70	4.84	4.40	2329
1	4.42	2360.6				4.57	2561.9
1	4.57	2575.2				4.73	2794.8
1	4.72	2789.8				*4.88*	3027.7
2	4.61	2146	**5.22**	5.04	**5.30**	4.74	2329
2	4.77	2360.6				4.91	2561.9
2	4.92	2575.2				5.07	2794.8
2	5.07	2789.8				5.22	3027.7
3	5.35	2146	**5.96**	5.80	*5.84*	5.50	2329
3	5.53	2360.6				5.69	2561.9
3	5.7	2575.2				5.86	2794.8
3	5.86	2789.8				*6.02*	3027.7
4	5.41	2146	**6.02**	5.86	5.87	5.56	2329
4	5.59	2360.6				5.74	2561.9
4	5.75	2575.2				5.91	2794.8
4	5.9	2789.8				*6.07*	3027.7
4.1	5.28	2146	**5.89**	5.72	**6.06**	5.42	2329
4.1	5.45	2360.6				5.59	2561.9
4.1	5.6	2575.2				5.74	2794.8
4.1	5.74	2789.8				5.89	3027.7
4.2	5.31	2146	**5.92**	5.75	**6.06**	5.45	2329
4.2	5.48	2360.6				5.62	2561.9
4.2	5.63	2575.2				5.80	2794.8
4.2	5.79	2789.8				5.97	3027.7
5	5.49	2146	**6.10**	5.96	*5.93*	5.66	2329
5	5.69	2360.6				5.86	2561.9
5	5.86	2575.2				6.05	2794.8
5	6.04	2789.8				*6.22*	3027.7
6	5.52	2146	**6.13**	5.99	*6.01*	5.69	2329
6	5.72	2360.6				5.89	2561.9
6	5.9	2575.2				6.09	2794.8
6	6.09	2789.8				*6.27*	3027.7

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980.00	INST	
7	6.26	2146	**6.87**	6.74	**7.54**	6.44	2329
7	6.47	2360.6				6.65	2561.9
7	6.66	2575.2				6.85	2794.8
7	6.85	2789.8				7.03	3027.7
8	6.84	2146	**7.45**	7.36	**8.11**	7.06	2329
8	7.1	2360.6				7.33	2561.9
8	7.34	2575.2				*7.57*	2794.8
8	*7.57*	2789.8				*7.80*	3027.7
9	7.17	2146	**7.78**	7.69	**8.61**	7.39	2329
9	7.42	2360.6				7.65	2561.9
9	7.66	2575.2				*7.89*	2794.8
9	*7.88*	2789.8				*8.11*	3027.7
10	7.72	2116	**8.33**	8.21	**9.07**	7.91	2294
10	7.94	2327.6				8.14	2523.4
10	8.15	2539.2				*8.36*	2752.8
10	*8.35*	2750.8				*8.56*	2982.2
11	8.12	2116	**8.73**	8.60	**9.55**	8.30	2294
11	8.33	2327.6				8.52	2523.4
11	8.53	2539.2				8.73	2752.8
11	8.73	2750.8				*8.93*	2982.2
12	8.5	2116	**9.11**	8.96	**9.96**	8.66	2294
12	8.69	2327.6				8.86	2523.4
12	8.88	2539.2				9.06	2752.8
12	9.06	2750.8				*9.25*	2982.2
13	9.63	2116	**10.24**	10.06	**10.64**	9.76	2294
13	9.79	2327.6				9.93	2523.4
13	9.94	2539.2				10.08	2752.8
13	10.08	2750.8				10.23	2982.2
14	9.82	2116	**10.43**	10.25	**11.09**	9.95	2294
14	9.98	2327.6				10.12	2523.4
14	10.13	2539.2				10.28	2752.8
14	10.27	2750.8				10.43	2982.2
15	10.69	2116	**11.30**	11.16	**11.91**	10.86	2294
15	10.89	2327.6				11.05	2523.4
15	11.06	2539.2				11.22	2752.8
15	11.22	2750.8				*11.37*	2982.2

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
			DAILY	INST	1980		
16	11.44	2116	**12.05**	11.89	**12.57**	11.59	2294
16	11.61	2327.6				11.76	2523.4
16	11.77	2539.2				11.92	2752.8
16	11.92	2750.8				*12.08*	2982.2
17	11.97	2070	**12.58**	12.41	**13.09**	12.11	2244
17	12.14	2277				12.28	2468.4
17	12.29	2484				12.44	2692.8
17	12.44	2691				*12.59*	2917.2
18	12.62	2070	**13.23**	13.05	**13.54**	12.75	2244
18	12.77	2277				12.91	2468.4
18	12.92	2484				13.05	2692.8
18	13.05	2691				13.20	2917.2
19	12.97	2070	**13.58**	13.41	**13.84**	13.11	2244
19	13.13	2277				13.27	2468.4
19	13.28	2484				13.42	2692.8
19	13.42	2691				13.57	2917.2
20	13	2070	**13.61**	13.44	*13.47*	13.14	2244
20	13.16	2277				13.30	2468.4
20	13.31	2484				13.45	2692.8
20	13.45	2691				13.60	2917.2
20.1	13.02	2070	**13.63**	13.46	*13.47*	13.16	2244
20.1	13.2	2277				13.35	2468.4
20.1	13.36	2484				13.62	2692.8
20.1	13.61	2691				*13.90*	2917.2
20.2	13.12	2070	**13.73**	13.57	*13.68*	13.27	2244
20.2	13.3	2277				13.44	2468.4
20.2	13.46	2484				*13.75*	2692.8
20.2	*13.74*	2691				*13.95*	2917.2
21	13.12	2070	**13.73**	13.57	*13.68*	13.27	2244
21	13.29	2277				13.44	2468.4
21	13.45	2484				13.68	2692.8
21	13.67	2691				*13.86*	2917.2
22	12.98	2070	**13.59**	13.43	**13.84**	13.13	2244
22	13.16	2277				13.32	2468.4
22	13.33	2484				13.58	2692.8
22	13.57	2691				*13.77*	2917.2

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
			DAILY	INST	1980		
23	14.48	2070	**15.09**	14.90	**15.30**	14.60	2244
23	14.62	2277				14.75	2468.4
23	14.76	2484				14.88	2692.8
23	14.88	2691				15.02	2917.2
24	15.97	2070	**16.58**	16.45	**16.58**	16.15	2244
24	16.18	2277				16.37	2468.4
24	16.38	2484				16.57	2692.8
24	16.57	2691				*16.77*	2917.2
25	16.83	1970	**17.44**	17.29	**17.77**	16.99	2140
25	17.01	2167				17.16	2354
25	17.17	2364				17.31	2568
25	17.31	2561				17.44	2782
25.1	17.26	1970	17.87	17.77		17.47	2140
25.1	17.51	2167				17.74	2354
25.1	17.75	2364				17.97	2568
25.1	17.96	2561				18.22	2782
25.2	17.39	1970	18.00	17.93		17.63	2140
25.2	17.67	2167				17.91	2354
25.2	17.92	2364				18.18	2568
25.2	18.17	2561				18.47	2782
26	18.38	1232	**18.99**	18.98	**19.39**	18.68	1515
26	18.74	1355.2				19.05	1666.5
26	19.08	1478.4				*19.41*	1818
26	*19.41*	1601.6				*19.77*	1969.5
27	18.39	1232	**19.00**	18.99	**19.41**	18.69	1515
27	18.74	1355.2				19.05	1666.5
27	19.08	1478.4				*19.41*	1818
27	*19.40*	1601.6				*19.76*	1969.5
27.1	18.52	1232	19.13	**19.17**	**19.45**	18.87	1515
27.1	18.88	1355.2				19.24	1666.5
27.1	*19.23*	1478.4				*19.61*	1818
27.1	*19.56*	1601.6				*19.97*	1969.5
27.2	18.57	1232	19.18	**19.23**	**19.49**	18.93	1515
27.2	18.93	1355.2				19.30	1666.5
27.2	*19.27*	1478.4				*19.66*	1818
27.2	*19.60*	1601.6				*20.02*	1969.5

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
			DAILY	INST	1980		
28	18.32	1232	**18.93**	18.87	**19.28**	18.57	1515
28	18.65	1355.2				18.91	1666.5
28	*18.97*	1478.4				19.23	1818
28	*19.27*	1601.6				*19.56*	1969.5
29	18.58	1232	19.19	**19.24**	**19.60**	18.94	1515
29	18.93	1355.2				19.31	1666.5
29	19.27	1478.4				*19.67*	1818
29	19.6	1601.6				*20.02*	1969.5
30	18.88	1232	19.49	**19.64**	**20.04**	19.34	1515
30	19.26	1355.2				19.73	1666.5
30	19.61	1478.4				*20.11*	1818
30	*19.95*	1601.6				*20.49*	1969.5
31	19.02	1232	19.63	**19.79**	**20.24**	19.49	1515
31	19.38	1355.2				19.88	1666.5
31	19.73	1478.4				*20.26*	1818
31	*20.07*	1601.6				*20.63*	1969.5
32	19.16	1232	19.77	**19.96**	**20.42**	19.66	1515
32	19.53	1355.2				20.05	1666.5
32	19.88	1478.4				20.42	1818
32	*20.22*	1601.6				*20.79*	1969.5
33	19.20	1226	19.81	**20.00**	**20.49**	19.7	1508
33	19.57	1348.6				20.09	1658.8
33	19.92	1471.2				20.46	1809.6
33	*20.25*	1593.8				*20.83*	1960.4
34	19.24	1199	19.85	**20.04**	**20.57**	19.74	1474
34	19.6	1318.9				20.13	1621.4
34	19.95	1438.8				20.49	1768.8
34	*20.28*	1558.7				*20.86*	1916.2
35	19.28	1199	19.89	**20.09**	**20.65**	19.79	1474
35	19.64	1318.9				20.17	1621.4
35	19.98	1438.8				20.53	1768.8
35	*20.32*	1558.7				*20.89*	1916.2
36	19.38	1199	19.99	**20.18**	**20.75**	19.88	1474
36	19.73	1318.9				20.26	1621.4
36	20.06	1438.8				20.61	1768.8
36	*20.39*	1558.7				*20.97*	1916.2

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
37	19.44	1199	20.05	**20.24**	**20.84**	19.94	1474
37	19.78	1318.9				20.3	1621.4
37	20.11	1438.8				20.66	1768.8
37	*20.43*	1558.7				*21.01*	1916.2
38	19.54	1199	20.15	**20.33**	**20.97**	20.03	1474
38	19.87	1318.9				20.39	1621.4
38	20.19	1438.8				20.73	1768.8
38	*20.50*	1558.7				*21.07*	1916.2
39	19.64	1181	20.25	**20.42**	**21.09**	20.12	1452
39	19.95	1299.1				20.46	1597.2
39	20.26	1417.2				20.79	1742.4
39	*20.56*	1535.3				*21.13*	1887.6
40	19.71	1181	20.32	**20.48**	**21.17**	20.18	1452
40	20.01	1299.1				20.51	1597.2
40	20.31	1417.2				20.84	1742.4
40	*20.60*	1535.3				21.17	1887.6
41	20.12	1181	20.73	**20.83**	**21.45**	20.53	1452
41	20.35	1299.1				20.8	1597.2
41	20.59	1417.2				21.08	1742.4
41	*20.85*	1535.3				21.38	1887.6
42	20.77	1181	21.38	**21.36**	**21.87**	21.06	1452
42	20.91	1299.1				21.25	1597.2
42	21.07	1417.2				21.45	1742.4
42	21.24	1535.3				21.69	1887.6
43	21.27	1181	21.88	**21.85**	**22.26**	21.55	1452
43	21.4	1299.1				21.7	1597.2
43	21.53	1417.2				21.87	1742.4
43	21.67	1535.3				22.05	1887.6
44	22.19	1181	**22.80**	22.79	**23.15**	22.49	1452
44	22.33	1299.1				22.62	1597.2
44	22.45	1417.2				22.75	1742.4
44	22.56	1535.3				22.87	1887.6
45	23.34	1181	23.95	**23.99**	**24.23**	23.69	1452
45	23.5	1299.1				23.85	1597.2
45	23.65	1417.2				24.00	1742.4
45	23.78	1535.3				24.14	1887.6

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980.00	INST	
46	23.79	1165	24.40	**24.45**	**24.78**	24.15	1433
46	23.95	1281.5				24.32	1576.3
46	24.1	1398				24.47	1719.6
46	24.24	1514.5				24.63	1862.9
47	24.27	1112	24.88	**24.92**	**25.32**	24.62	1366
47	24.43	1223.2				24.79	1502.6
47	24.58	1334.4				24.95	1639.2
47	24.72	1445.6				25.10	1775.8
48	24.78	1112	25.39	**25.42**	**25.91**	25.12	1366
48	24.93	1223.2				25.28	1502.6
48	25.08	1334.4				25.44	1639.2
48	25.21	1445.6				25.59	1775.8
49	25.21	1112	25.82	**25.84**	**26.29**	25.54	1366
49	25.36	1223.2				25.71	1502.6
49	25.51	1334.4				25.86	1639.2
49	25.64	1445.6				26.01	1775.8
50	25.9	1112	26.51	**26.51**	**26.89**	26.21	1366
50	26.04	1223.2				26.36	1502.6
50	26.18	1334.4				26.51	1639.2
50	26.3	1445.6				26.65	1775.8
51	26.6	1112	**27.21**	27.19	**27.54**	26.89	1366
51	26.73	1223.2				27.03	1502.6
51	26.85	1334.4				27.16	1639.2
51	26.97	1445.6				27.29	1775.8
52	27.16	1112	**27.77**	27.71	**27.99**	27.41	1366
52	27.28	1223.2				27.53	1502.6
52	27.38	1334.4				27.65	1639.2
52	27.48	1445.6				27.76	1775.8
53	27.56	1112	**28.17**	**28.17**	**28.48**	27.79	1366
53	27.67	1223.2				27.89	1502.6
53	27.76	1334.4				28.00	1639.2
53	27.85	1445.6				28.10	1775.8
54	27.62	1112	**28.23**	28.15	**28.56**	27.85	1366
54	27.72	1223.2				27.96	1502.6
54	27.82	1334.4				28.06	1639.2
54	27.91	1445.6				28.17	1775.8

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
55	27.63	1112	**28.24**	28.17	**28.58**	27.87	1366
55	27.74	1223.2				28	1502.6
55	27.85	1334.4				28.11	1639.2
55	27.95	1445.6				28.21	1775.8
56	27.87	1112	**28.48**	28.40	**28.70**	28.1	1366
56	27.98	1223.2				28.21	1502.6
56	28.08	1334.4				28.32	1639.2
56	28.17	1445.6				28.42	1775.8
76	28.31	1112	**28.92**	28.82	**29.29**	28.52	1366
76	28.41	1223.2				28.62	1502.6
76	28.49	1334.4				28.72	1639.2
76	28.58	1445.6				28.81	1775.8
77	28.84	1112	**29.45**	29.34	**29.86**	29.04	1366
77	28.93	1223.2				29.13	1502.6
77	29.01	1334.4				29.23	1639.2
77	29.09	1445.6				29.31	1775.8
78	29.15	1112	**29.76**	29.65	**30.14**	29.35	1366
78	29.24	1223.2				29.45	1502.6
78	29.33	1334.4				29.55	1639.2
78	29.41	1445.6				29.64	1775.8
79	29.64	1112	**30.25**	30.15	**30.57**	29.85	1366
79	29.74	1223.2				29.95	1502.6
79	29.83	1334.4				30.05	1639.2
79	29.91	1445.6				30.14	1775.8
80	30.87	1112	**31.48**	31.40	**31.92**	31.1	1366
80	30.97	1223.2				31.21	1502.6
80	31.08	1334.4				31.32	1639.2
80	31.17	1445.6				31.41	1775.8
81	32.05	1112	**32.66**	32.52	**33.10**	32.22	1366
81	32.12	1223.2				32.29	1502.6
81	32.2	1334.4				32.37	1639.2
81	32.26	1445.6				32.44	1775.8
82	32.97	1112	**33.58**	33.46	**34.10**	33.16	1366
82	33.06	1223.2				33.25	1502.6
82	33.14	1334.4				33.34	1639.2
82	33.22	1445.6				33.42	1775.8

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980.00	INST	
83	34.05	1112	**34.66**	34.57	**35.32**	34.27	1366
83	34.15	1223.2				34.37	1502.6
83	34.24	1334.4				34.47	1639.2
83	34.33	1445.6				34.56	1775.8
84	35.73	1112	**36.34**	36.22	**36.75**	35.92	1366
84	35.82	1223.2				36.01	1502.6
84	35.9	1334.4				36.09	1639.2
84	35.98	1445.6				36.18	1775.8
85	36.75	1112	**37.36**	37.14	***37.23***	36.84	1366
85	36.83	1223.2				36.9	1502.6
85	36.82	1334.4				36.97	1639.2
85	36.87	1445.6				37.09	1775.8
86	38.46	1047	**39.07**	38.99	**39.16**	38.69	1288
86	38.54	1151.7				38.79	1416.8
86	38.66	1256.4				38.88	1545.6
86	38.75	1361.1				38.94	1674.4
87	39.89	1047	**40.50**	40.37	**40.67**	40.07	1288
87	39.98	1151.7				40.17	1416.8
87	40.05	1256.4				40.27	1545.6
87	40.13	1361.1				40.37	1674.4
88	42.44	888	**43.05**	43.00	**43.06**	42.7	1190
88	42.53	976.8				42.79	1309
88	42.61	1065.6				42.89	1428
88	42.69	1154.4				42.97	1547
89	44.17	514	44.78	**44.84**	**44.97**	44.54	840
89	44.26	565.4				44.64	924
89	44.33	616.8				44.73	1008
89	44.41	668.2				44.82	1092
90	51.18	514	**51.79**	51.52	***51.57***	51.22	840
90	51.15	565.4				51.18	924
90	51.19	616.8				51.15	1008
90	51.18	668.2				51.14	1092
92	55.55	514	56.16	**56.58**	**57.06**	56.28	840
92	55.74	565.4				56.44	924
92	55.83	616.8				56.59	1008
92	55.97	668.2				56.71	1092

TABLE 5

SALMON RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
93	58.51	514	**59.12**	58.95	***58.81***	58.65	840
93	58.5	565.4				58.71	924
93	58.56	616.8				*58.86*	1008
93	58.57	668.2				*59.03*	1092
94	60.32	514	60.93	**61.49**	***61.39***	61.19	840
94	60.49	565.4				61.34	924
94	60.63	616.8				61.45	1008
94	60.77	668.2				*61.54*	1092
95	60.63	514	61.24	**61.45**	**61.62**	61.15	840
95	60.74	565.4				61.19	924
95	60.84	616.8				61.18	1008
95	60.93	668.2				61.15	1092
95.1	60.58	514	61.19	**61.34**	**61.58**	61.04	840
95.1	60.69	565.4				61.05	924
95.1	60.78	616.8				60.99	1008
95.1	60.86	668.2				61.13	1092
95.2	60.64	514	61.25	**61.44**	**61.60**	61.14	840
95.2	60.75	565.4				61.18	924
95.2	60.84	616.8				61.18	1008
95.2	60.93	668.2				61.93	1092
96	61	514	61.61	**62.28**	***61.98***	61.98	840
96	61.17	565.4				62.22	924
96	61.33	616.8				*62.48*	1008
96	61.48	668.2				*62.82*	1092
97	61.37	514	61.98	**62.81**	**62.44**	62.51	840
97	61.57	565.4				62.78	924
97	61.75	616.8				63.07	1008
97	61.94	668.2				63.41	1092

TABLE 5

WHITE RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
25.3	17.39	1232	**18.00**	17.93	**19.39**	17.63	2140.00
25.3	17.67	1355.2				17.91	2354.00
25.3	17.92	1478.4				18.18	2568.00
25.3	18.17	1601.6				18.47	2782.00
57	17.88	684	18.49	**19.12**	**19.02**	18.80	1060.00
57	18.19	752.4				*19.14*	1166.00
57	18.46	820.8				*19.47*	1272.00
57	18.73	889.2				*19.80*	1378.00
58	18	684	18.61	**19.26**	**19.52**	18.93	1060.00
58	18.29	752.4				19.26	1166.00
58	18.56	820.8				*19.58*	1272.00
58	18.83	889.2				*19.90*	1378.00
59	18.74	684	19.35	**19.72**	**20.17**	19.41	1060.00
59	18.89	752.4				19.64	1166.00
59	19.05	820.8				*19.90*	1272.00
59	19.22	889.2				*20.17*	1378.00
60	18.76	684	19.37	**19.71**	***19.52***	19.40	1060.00
60	18.9	752.4				19.64	1166.00
60	19.05	820.8				*19.89*	1272.00
60	19.22	889.2				*20.17*	1378.00
60.1	18.86	684	19.47	**19.85**	**20.25**	19.54	1060.00
60.1	19.01	752.4				19.76	1166.00
60.1	19.17	820.8				20.00	1272.00
60.1	19.34	889.2				20.26	1378.00
60.2	18.88	684	19.49	**19.87**	**20.36**	19.56	1060.00
60.2	19.03	752.4				19.78	1166.00
60.2	19.19	820.8				*20.01*	1272.00
60.2	19.36	889.2				*20.27*	1378.00
61	18.92	684	19.53	**19.90**	**20.91**	19.59	1060.00
61	19.06	752.4				19.80	1166.00
61	19.22	820.8				*20.03*	1272.00
61	19.38	889.2				*20.29*	1378.00
62	19.08	684	19.69	**20.02**	**22.15**	19.71	1060.00
62	19.21	752.4				19.91	1166.00
62	19.35	820.8				*20.13*	1272.00
62	19.50	889.2				*20.36*	1378.00

TABLE 5

WHITE RIVER - SENSITIVITY TO "Q" INCREASES							
SECNO	CWSEL	Q	FLOOD LEVEL			CWSEL	Q
	DAILY		DAILY	INST	1980	INST	
63	19.95	684	**20.56**	20.53	**22.33**	20.23	1060.00
63	19.93	752.4				*20.38*	1166.00
63	19.91	820.8				*20.55*	1272.00
63	19.89	889.2				*20.73*	1378.00
64	19.71	684	20.32	**20.60**	**21.94**	20.30	1060.00
64	19.7	752.4				20.51	1166.00
64	19.84	820.8				*20.71*	1272.00
64	19.97	889.2				*20.90*	1378.00
64.1	19.78	684	20.39	**20.84**	**22.10**	20.54	1060.00
64.1	19.92	752.4				20.74	1166.00
64.1	20.07	820.8				*22.91*	1272.00
64.1	20.21	889.2				*23.23*	1378.00
64.2	20.27	684	20.88	**21.61**	**22.10**	21.31	1060.00
64.2	20.51	752.4				21.58	1166.00
64.2	20.68	820.8				*22.56*	1272.00
64.2	20.85	889.2				*22.82*	1378.00
65	20.49	684	21.10	**21.85**	**22.74**	21.55	1060.00
65	20.69	752.4				*21.95*	1166.00
65	20.87	820.8				*22.95*	1272.00
65	21.04	889.2				*23.36*	1378.00
66	20.63	684	21.24	**22.11**	**23.33**	21.81	1060.00
66	20.83	752.4				*22.19*	1166.00
66	21.01	820.8				*23.08*	1272.00
66	21.19	889.2				*23.49*	1378.00
67	22.02	684	22.63	**23.27**	**24.06**	22.97	1060.00
67	22.22	752.4				23.18	1166.00
67	22.42	820.8				*23.62*	1272.00
67	22.6	889.2				*23.96*	1378.00
68	24.5	684	25.11	**25.49**	**27.06**	25.19	1060.00
68	24.66	752.4				25.30	1166.00
68	24.8	820.8				25.18	1272.00
68	24.92	889.2				25.09	1378.00

Table 6

Sedimentation Tests

TABLE 6

SALMON RIVER AT SAYWARD - REACH 2											
SEDIMENTATION TESTS											
XS	Q	CWSEl. Q200D	CWSEl. 1.0m SED	DIFF TO Q200D	CWSEl. 1.5m SED	DIFF TO Q200D	CWSEl. 2.0m SED	DIFF TO Q200D	CWSEl. 2.5m SED	DIFF TO Q200D	COMMENTS
76	1112	28.31	28.31	0.00	28.31	0.00	28.31	0.00	28.31	0.00	
77	1112	28.84	28.84	0.00	28.84	0.00	28.84	0.00	28.84	0.00	
78	1112	29.15	29.15	0.00	29.15	0.00	29.15	0.00	29.15	0.00	
79	1112	29.64	29.65	0.01	29.70	0.06	29.78	0.14	29.88	0.24	SEDIMENTATION STARTS HERE
80	1112	30.87	30.94	0.07	31.06	0.19	31.21	0.34	31.36	0.49	
81	1112	32.05	32.08	0.03	32.10	0.05	32.11	0.06	32.13	0.08	
82	1112	32.97	32.99	0.02	33.03	0.06	33.12	0.15	33.19	0.22	
83	1112	34.05	34.12	0.07	34.18	0.13	34.29	0.24	34.37	0.32	
84	1112	35.73	35.77	0.04	35.81	0.08	35.92	0.19	36.14	0.41	
85	1112	36.75	36.74	-0.01	36.80	0.05	36.86	0.11	37.15	0.40	
86	1047	38.46	38.52	0.06	38.55	0.09	38.60	0.14	38.60	0.14	SEDIMENTATION ENDS HERE
87	1047	39.89	39.87	-0.02	39.89	0.00	39.91	0.02	40.01	0.12	
88	888	42.44	42.44	0.00	42.43	-0.01	42.42	-0.02	42.35	-0.09	
89	514	44.17	44.16	-0.01	44.17	0.00	44.17	0.00	44.72	0.55	
90	514	51.18	51.18	0.00	51.18	0.00	51.19	0.01	50.93	-0.25	*CRITICAL DEPTH
92	514	55.55	55.55	0.00	55.54	-0.01	55.54	-0.01	55.93	0.38	
93	514	58.51	58.51	0.00	58.51	0.00	58.51	0.00	57.82	-0.69	*CRITICAL DEPTH
94	514	60.32	60.32	0.00	60.31	-0.01	60.31	-0.01	60.63	0.31	
95	514	60.63	60.63	0.00	60.63	0.00	60.62	-0.01	60.78	0.15	
95.1	514	60.58	60.58	0.00	60.58	0.00	60.58	0.00	60.74	0.16	
95.2	514	60.64	60.64	0.00	60.64	0.00	60.63	-0.01	60.78	0.14	
96	514	61.00	61.01	0.01	61.00	0.00	61.00	0.00	61.10	0.10	
97	514	61.37	61.37	0.00	61.37	0.00	61.37	0.00	61.45	0.08	
AVERAGE				0.01		0.03		0.06		0.14	

Table 7

1993 Flood Levels
vs.
1980 Flood levels

(Pages 1 and 2)

Table 7

SALMON AND WHITE RIVERS
1994 REVIEW OF FLOOD LEVELS*
BASED ON NOVEMBER/DECEMBER 1990 FLOOD EVENTS

Salmon River

1. <u>Tidewater to Upstream of Sachts Bridge (Sheets 1 and 2)</u>
   XS 0.1 to XS 6
   Average 1993 FL - 1980 FL = -0.31/8 = -0.04
   Varies -0.27 to +0.17

   Comments
   •Coastal FL reduced from 4.1 to 3.8m (1993)
   •Area affected by new bridge, approach road

2. <u>Upstream of Sachts Bridge to Duncan Bridge (Sheets 2 and 3)</u>
   XS 7 to XS 19 (Sheet 3)
   Average 1993 FL - 1980 FL = 7.84/13 = 0.60 metres
   Max = +0.85; Min +0.26
   "n" values reduced from 0.060 and 0.050 to 0.035

   Comments
   •Using new FL's (1993), observed 1990 flood levels may equal or exceed 1993 isograms due to increases in levels attributable to overland flows/roads etc in the flood plain fringe.**

3. <u>Upstream of Duncan Bridge to Downstream of White/Salmon Confluence</u>
   XS 21 to XS 25
   Average 1993 Fl - 1980 Fl = 0.67/4 = 0.17m
   Varies 0.33 to 0.02
   "n" values reduced from 0.050 to 0.035

4. <u>Upstream of White/Salmon Confluence to Downstream of Foort Farm</u>
   XS 26 to XS 56 (Sheets 3 to 5)
   Average 1993 FL - 1980 FL = 14.09/33 = 0.43
   Varies 0.69 to 0.22

   Comments
   •Bridge removed across Salmon River upstream of White River confluence likely to have improved (reduced) Flood levels for a portion of this area (ie: XS 29 to XS 36)

* Source - Table 3
** Source - Section 2.4

5. Foort Farm Area
XS 76 to XS 85 (Sheet 5)
Average 1993 FL - 1980 FL = 3.82/10 = 0.38
Varies 0.66 to -0.13

6. Foort Farm Area to Memekay
XS 86 to XS 97 (Sheet 6)
Average 1993 FL - 1980 FL = 0.15/13 = 0.1
Varies 0.48 to -0.31

7. Total

Sheet 1	-0.31	8
Sheet 2	+7.84	13
Sheet 3	+0.67	4
Sheet 4	+14.09	33
Sheet 5	+3.82	10
Sheet 6	+0.15	13
	26.26	81

Average = 0.31 (entire project)

APPENDICES

APPENDIX 1
Detailed Information Sources

No.	Source	Contents
1.	Project No. 76-FDC-5 and 75-F-10, field survey carried out in the Sayward Valley during September, 1976 and November 1975.	78 cross sections on the Salmon River and 12 cross sections on the White River including bridge details, high water mark data and photos.
2.	Map Production Division, Surveys and Resource Mapping Branch, Project No. 77-109-TO	Orthophoto Base Mapping of the Sayward Valley (1:5000 scale, 1 metre contours - completed July 1979)
3.	Water Survey of Canada, Inland Waters Branch, Letter dated April 12, 1991, File 35100-30/920-7253 1993 - Design File	Updated stream flow information for the November 1990 floods
4.	Hydrology Division, Water Management Branch, Files 0256957, 0305030-7, Hydrology Study - Salmon, White and Memekay Rivers	Results of studies to predict the 1:200 year flood frequencies and November 1975 peak flow estimates.
5.	Flood Hazard Identification Section, Water Management Branch, File 35100-30/920-7253	Salmon River Floodplain Mapping correspondence file
6.	"Ocean Water Level Salmon Bay (Salmon River Mouth)", B. Holden, P.Eng, Flood Hazard Identification Branch, 1994	Results of studies to predict the ocean flood level for Salmon Bay

APPENDIX 1
Detailed Information Sources

No.	Source	Contents
7.	Ministry of Transportation and Highways, Bridge Engineering Branch	Bridge geometry and road alignment for the "Sachts and Hammond" bridges and the "White River" bridge
8.	"Salmon and White Rivers, November 11, 1990 Flooding, High Water Mark Locations, Ministry of Environment, Lands and Parks, Flood Hazard Identification Section	3 Ring binder containing uncontrolled mosaics indicating HWM locations, HWM photos and tables of flood level elevations
9.	"Campbell River and Sayward Flooding - December 1990", Hugh Smith, CRTV Campbell River	VHS Videotape of Flood Footage, Campbell River and Salmon River at Sayward

Appendix 2

Photos of Study Area

Photos 1 to 8

PHOTO 1: SALMON RIVER AT SAYWARD - HOME FLOODED NOVEMBER 11 AND 23, 1990
NOTE H.W.M. BETWEEN DECK RAILS

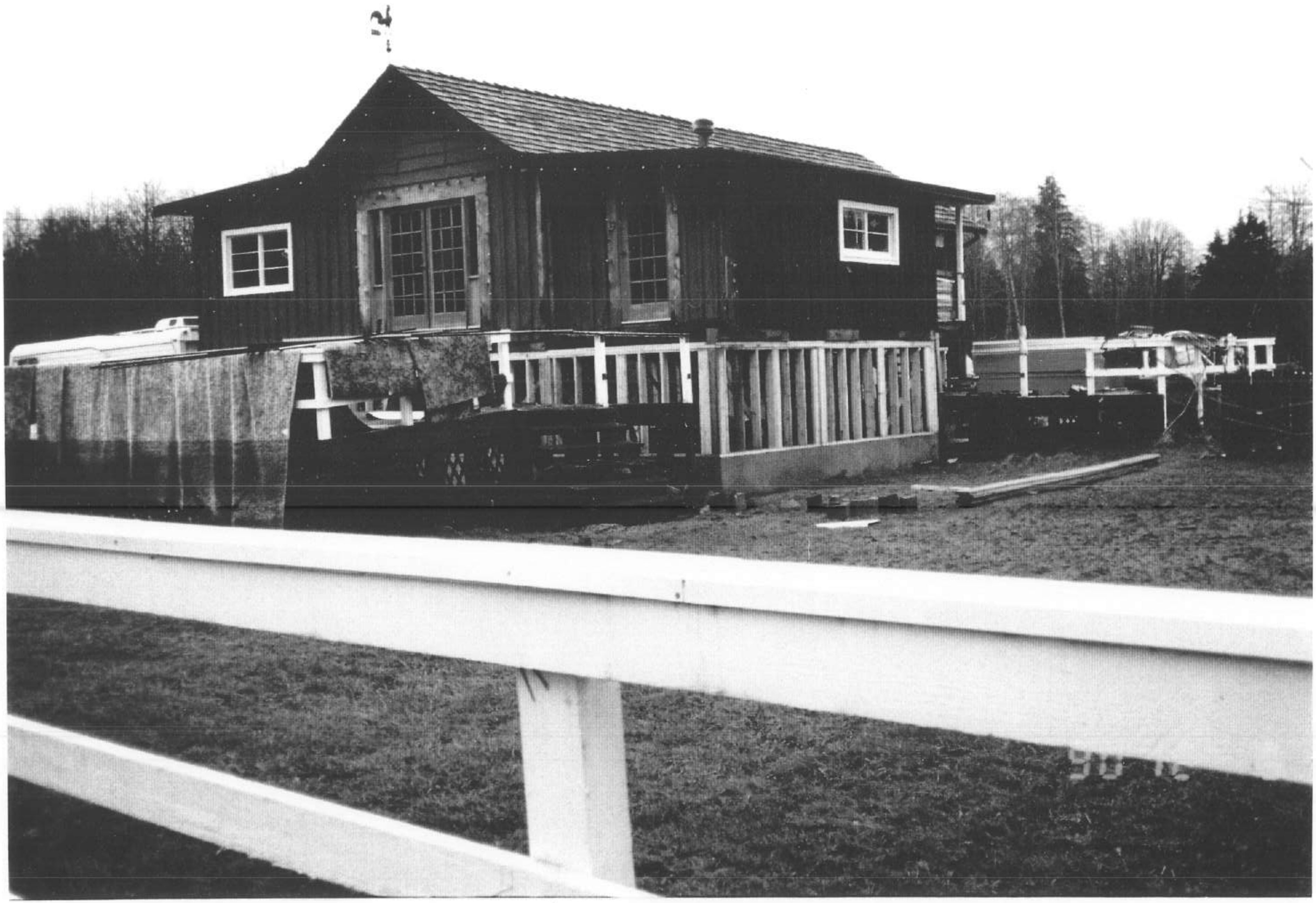


PHOTO 2: SALMON RIVER AT SAYWARD - FLOODED HOME RAISED BETWEEN NOVEMBER 23, 1990 AND DECEMBER 5, 1990 FLOODS

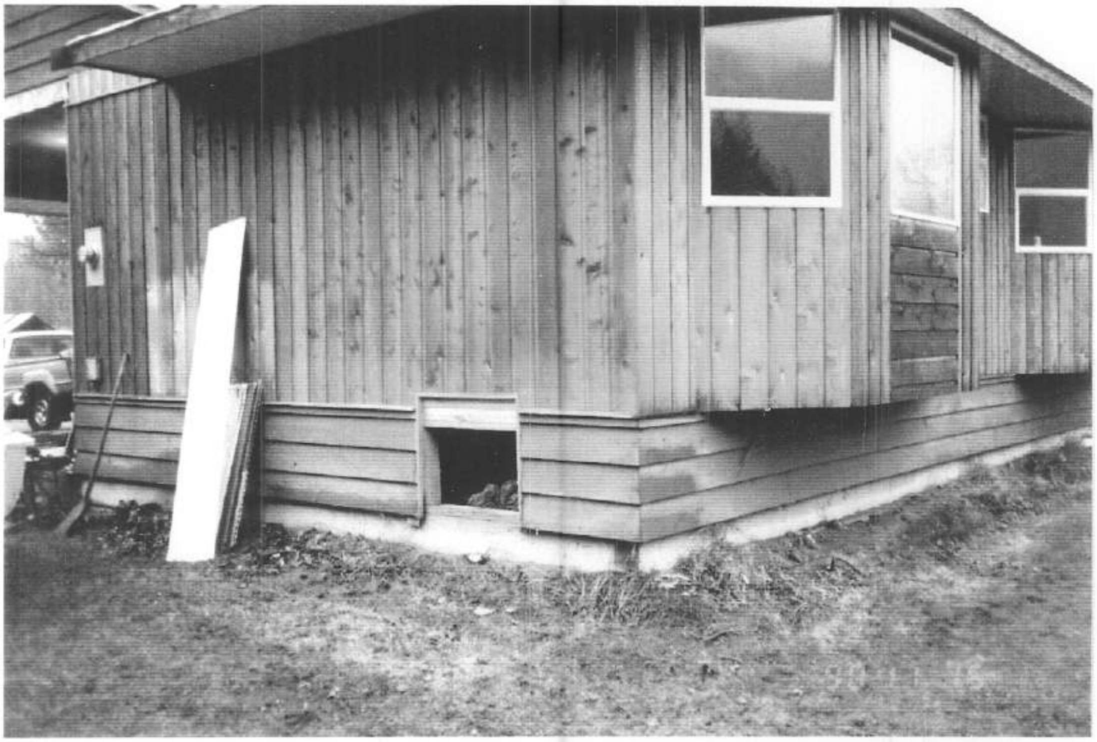


PHOTO 3: HWM 90-29 - TOP OF FRAME AROUND ACCESS DOOR - HOME LOCATED AT THE FOOT OF ARMISHAW ROAD (NOTE THIS HOME WAS FLOODED DURING THE 1975 EVENT AND SUBSEQUENTLY RAISED ABOUT 2 FEET

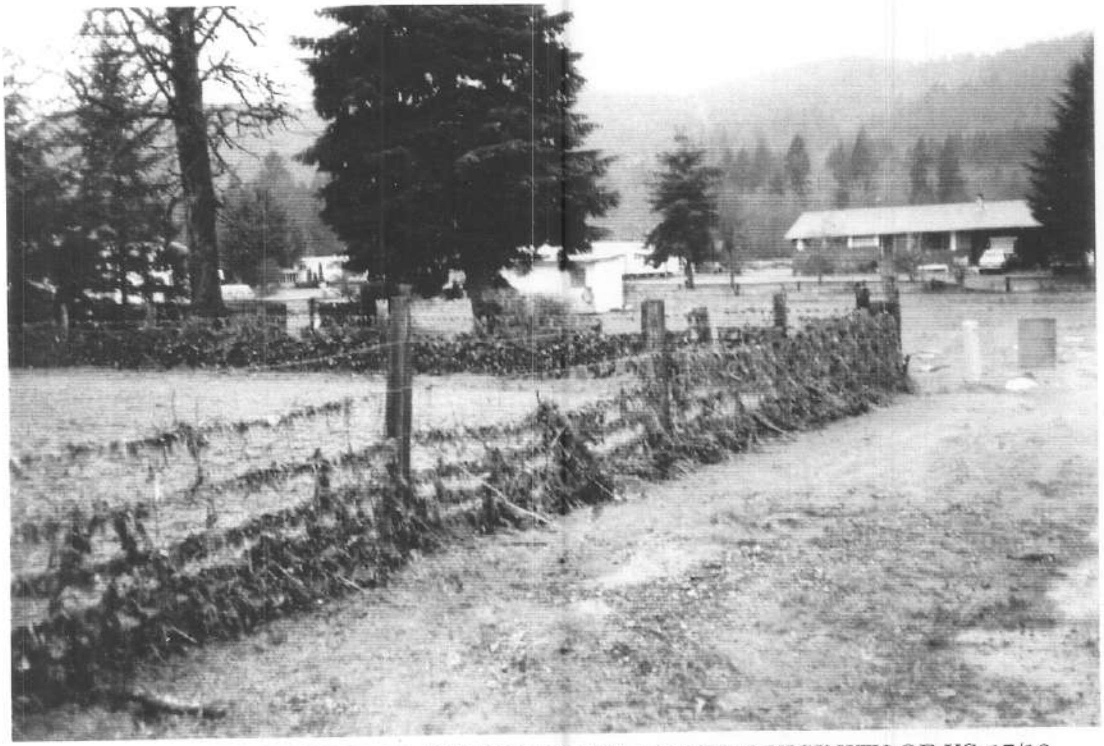


PHOTO 4: LOOKING TOWARD HWM 90-29 ARMISHAW ROAD IN THE VICINITY OF XS 17/18 NOTE DEBRIS ON FENCE

PHOTO 5: HWM 90-26 - KNUTSON HOME ON GLENROY ROAD

PHOTO 6: VIEW OF KNUTSON HOME ON GLENROY ROAD NOW FLOODPROOFED (REFER TO HWM 90-25/26)

PHOTO 7: HWM 15/16 - ADJACENT TO FCL 7.0m
HWM FROM OVERLAND FLOW

PHOTO 8: HWM 90-17 - VICINITY OF FCL 7.0 m
(HWM FROM RIVER FLOW)

Appendix 3

Hydrology Study Summary

Memo Dated July 23, 1992

Province of British Columbia

BC Environment
WATER MANAGEMENT DIVISION

MEMORANDUM

To: Peter Woods
Head
Flood Hazard Identification Section

Date: July 23, 1992

File: 42500-40/R1
Study 378

Re: **Salmon River**

In response to Mr. Nichols' request of June 2, I have completed a study to provide the required information. This memo summarizes the study and gives the results.

1. Frequency Analysis

With the additional years of peak flow data at Sayward and modification of the procedure for estimating instantaneous peaks from manual gauge observations has given better definition to the frequency analysis at this station. This in turn allows a reasonable estimate of the frequency curves for the Bigtree site and the White River. The following table provides the return period results utilizing data up to and including 1991.

Peak Flows - m3/s

Location	d.a. km^2	Instant. Peak Flow		Daily Peak Flow	
		20-yr	200-yr	20-yr	200-yr
Salmon above Memekay	448	601	819	376	503
Salmon below Bigtree	749	953	1,340	767	1,090
Salmon near Sayward	1,200	1,480	2,140	1,350	1,970
White River	358	758	1,060	488	684

2. Flood Flows of November 11, 1990

Using the revised and published flow data for this flood event and the updated frequency curves, the following results are obtained.

Location	Instant. Peak		Daily Peak	
	Flow m^3/s	R.P.-years	Flow m^3/s	RP-years
Salmon above Memkay	459	5	320	9
Salmon near Sayward	1,560	27	967	5

...2

S.C. - For. Design File

It is not possible to provide a definite estimate of the peak flow at the Bigtree site or for the White River as there is no information on relative contributions from various parts of the watershed. However, as there are gauges above and below it is possible to provide a range of possible peak flows. The following table provides this range and a median or most likely value.

Instantaneous Peak Flow (in^3/s) and Return Period (years)

Location	Extreme		Extreme		Median	
	Flow	R.P.	Flow	R.P.	Flow	R.P.
Salmon below Bigtree	890	13	640	4	768	7
White River	535	5	881	50	700	13

C. H. Coulson
Head
Hydrology Section

CHC:gg
HY8872

Appendix 4

Newspaper Articles of November 1990 Floods

Vancouver, B.C. Tuesday, November 13, 1990

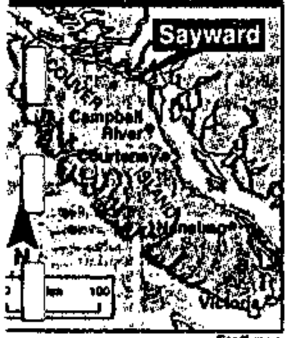
THE Province

50 cents
60 cents minimum outside Lower Mainland

LOTTO Page 60

Rain
Page 62

oded out



Staff map

NEW FLOODS LIKELY TODAY

Staff photo by Peter Hulbert

Canoe is the only way to traverse rising waters of Hatzic Lake, where adjacent cottages and trailers were awash.

Damage in millions already

By Suzanne Fournier
Staff Reporter

With a new storm on the way, Fraser Valley and northern Vancouver Island reeled yesterday from the effects of earlier storms and flooding.

B.C. Solicitor-General Russ Fraser completed a helicopter tour of the affected areas and estimated damage on the south coast at "millions and millions of dollars — a lot of money."

Claude Dailey, manager of policy and plans for the Provincial Emergency Program, said the cost of the PEP response alone so far is more than $3 million. He estimated damage in all parts of the south coast will total "more than $10 million."

Fraser said PEP will pay compensation for 80 per cent of the value of a principal residence, up to a maximum of $100,000.

Provincial adjusters will be sent to survey the damage once the floodwaters recede, said Fraser, who yesterday flew to Sayward on northern Vancouver Island with Highways Minister Rita Johnston.

Fraser noted there is no compensation for recreational property or vehicles.

Meanwhile, officials were concerned about a storm that was expected to drop at least 40 millimetres (1.6 inches) of rain on the Fraser Valley and up to 100 mm (four inches) on northern Vancouver Island overnight and today.

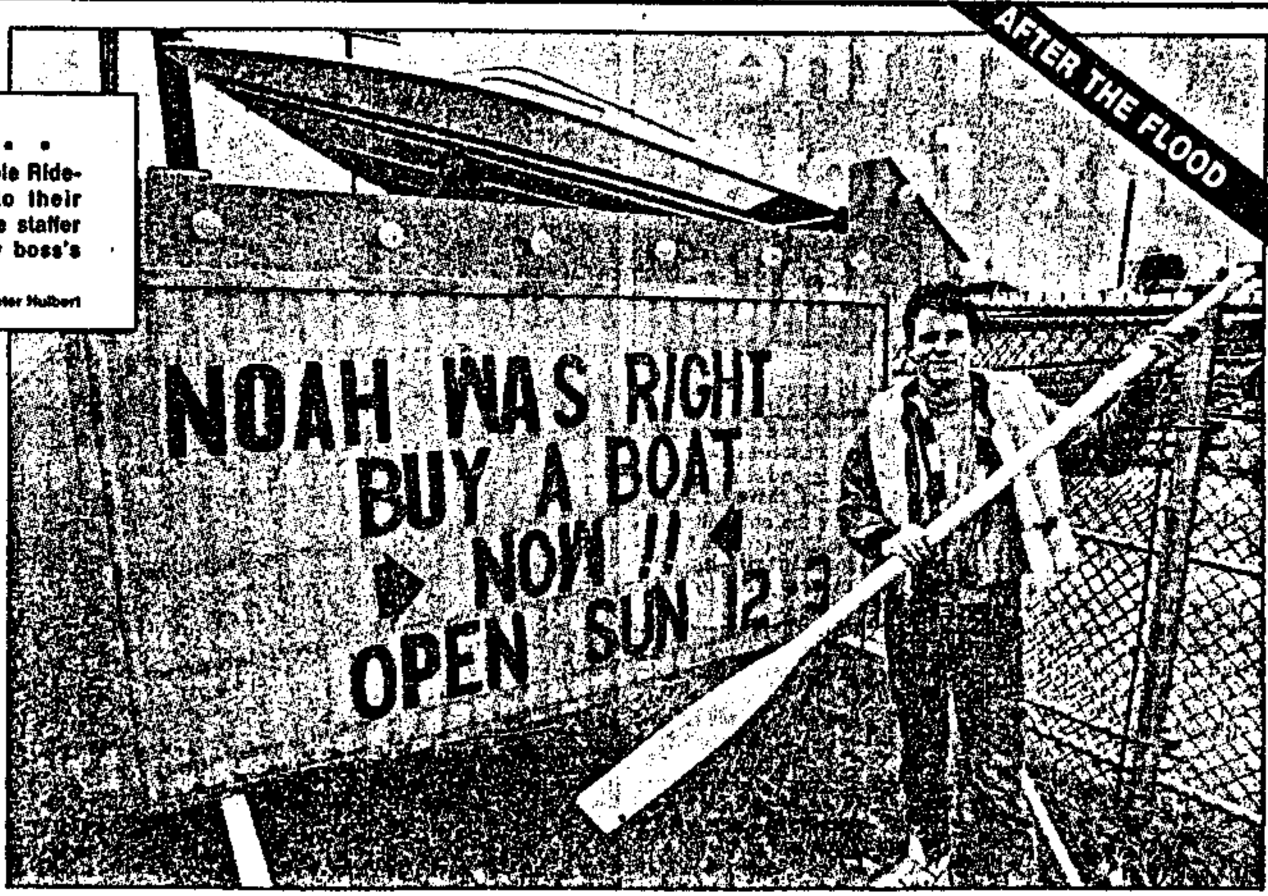
"It's going to aggravate an already bad situation," said Geoff ...oty, PEP's operations manager.

AFTER, Pages 4-5

LIVING Anne Garber's survival guide to holiday shopping, Page 41

MARKETPLACE

AFTER THE FLOOD



Oar else . . .

Oar sales are up as Maple Ridge-area residents take to their boats, and Ridge Marine staffer Jeffrey Allan stands by boss's sign that says it . . .

St by Peter Hulbert

)elays, :losures)lague ecovery efforts

, Tom Watt
ıff Reporter

he chaotic highway situation he Lower Mainland is ıdually returning to normal.

But there are still closures and ıys.

he ministry of highways ised yesterday that the ›quihalla and Trans-Canada ghways are open.

otorists, however, should ect periodic delays on the ıns-Canada at Laidlaw and ›nes Creek east of Chilliwack.

Southbound motorists on the uihalla should also expect rmittent closures.

On the Trans-Canada a 60-kph ›eed zone has been posted at ıtzic Bridge.

■ ■ ■

he Hope-Princeton and ighway 11 from Vye Road to the S. border at Sumas remain ›ed.

■ ■ ■

he Squamish Highway is open › Pemberton, but there are lays six-kms south of Whistler ause of alternating single-lane fic.

xpect closures north of Lions ıy from 9 a.m. to noon and 1 m. to 3 p.m.

Duffey Lake Road from berton to Lillooet is closed l further notice because of ›ding in the Lillooet Lake area.

■ ■ ■

he highways department says ill issue updated information 0 a.m. today.

For information, call the ›inistry's 24-hour road report at ›0-9775 for the Lower Mainland 1-800-663-4997 for outside Lower Mainland.

Floods ravage Sayward school

LIFE'S WORK OF TEACHING, LEARNING DOWN THE DRAIN

By Keith Fraser and Suzanne Fournier
Staff Reporters

SAYWARD — Kevin Kavanagh waded through "tons of bloody mud" and water only to watch "years of teaching and learning literally go down the drain."

Kavanagh, 41, is principal of Sayward Elementary and Junior Secondary School, which has 200 students from kindergarten through Grade 9.

The school serves the 1,500 people of the Sayward Valley on northern Vancouver Island, about half of whom live in the flooded valley area.

A total of 81 people were evacuated from the valley, 40 by land and 41 using four helicopters, which in some cases had to pluck people off their doorsteps.

Kavanagh saw the Salmon River course through his school during the weekend, and yesterday he surveyed the damage.

"It's sad — there's silt and mud everywhere, display cases full of trophies the kids won have fallen over, smashed and floated down the hall," he said.

"There's children's artwork, their gym strip and personal belongings lying all over.

"It's all bloody mud everywhere.

"For the teachers — two of whom have flooded homes — and for me, it's like watching an entire life's work of teaching literally go down the drain."

It took a week to repair the school after a flood of similar intensity in 1976.

Electrical, plumbing and heating systems must be checked. The furnace fuel supply was breached and contaminated the school's well, said Kavanagh, noting that a search is under way for temporary schooling sites.

Sayward is a rural community with a well-established emergency contact system and students will be told by telephone where and when to go to school, he said.

"This is an incredible community — there were 81 people evacuated and by early afternoon they were all billeted in private homes. Everyone pulled together."

Bedding was provided for six people at a local community centre on Sunday night. In the morning, when more evacuees arrived by helicopter, hot chili, sandwiches, cookies and cakes were served to about 50 people.

Sayward RCMP Cpl. Fred Miller confirmed that 81 people were flown out by four choppers from the RCMP, Coast Guard, Canadian Forces Base at Comox and Pacific Rim Helicopters.

"At this point most of the Sayward Valley homes are badly damaged but salvageable, but if the water gets higher, some homes will be totally lost," Miller said.

Crews continued to work on several bridges that were washed out by the deluge and the main road into Sayward remained cut.

Environmentalists promptly blamed clearcut logging as a factor in the flooding.

But B.C. Solicitor General Russ Fraser, who toured the area by helicopter yesterday, dismissed such claims.

"It's not my area of expertise, but I saw slides on mountains where no one had laid a finger — it's hard to blame anything but the rainfall," said Fraser.

■ B.C. Hydro yesterday warned Vancouver Island pulp mills their power could be endangered after flooding caused two towers carrying four 500,000-volt power lines to collapse into the Green River between Pemberton and Rainbow on the mainland.

Sayward's residents seek disaster reason

By Judith Lavoie
Times-Colonist staff

SAYWARD — As floodwaters began to recede throughout B.C. Tuesday, residents here were left looking for a reason for the disaster which befell the Sayward Valley.

Some pointed to a logjam behind a platform used to build a bridge over the Salmon River as one reason Sunday's floods were so devastating for this community 70 kilometres north of Campbell River.

The work platform was beside the partially completed bridge, adjacent to the school, which with homes in the valley took the brunt of the flooding when the Salmon and White rivers burst their banks.

Showers are forecast for today, though a repetition of the weekend's heavy rains is not expected.

Provincial Emergency Program spokesman Claude Dalley said Tuesday the flood threat on Vancouver Island has eased.

"The rain warnings were cancelled almost 24 hours ago," said Dalley.

"The waters are receding and people are cleaning up."

Sayward residents can expect some help from the provincial government. Dalley estimates there will be about $10 million in government aid from PEP to B.C.'s flood victims.

"People say that when the floods came in 1975 they weren't as bad as this and people had time to move stuff up and prepare," said Sayward resident Len Stefiuk. "I think it was the new bridge and the work platform jamming up the logs."

Beside the flood-damaged bridge project stands a Highways Ministry "Freedom to Move" sign.

Few people in this forestry-based community of 650 believe logging practices had anything to do with the floods.

"I don't think that was it, but no one can say for sure," said Ginger Gustafson, a valley resident.

Most people knew there was likely to be a flood, but they did not know how bad it was going to be, Gustafson said.

DAMAGE A3

Books, artwork engulfed in mud as school surveys nature's wrath

Times-Colonist staff

SAYWARD — Brown slime and silt covered the floors, carpets and furniture at the Sayward school on Tuesday.

A storeroom off the school's shop area remained under several metres of water and desks and chairs were piled outside to dry despite intermittent showers.

"They're certainly more likely to dry out there than in here. Just look at it as outdoor education," said principal Kevin Kavanagh.

Irreplaceable teaching plans, students' notes and artwork were lost when the Salmon River burst its banks and ran through the school on Sunday.

"The parking lot was pretty well wiped out," said vice-principal John Kerr. "It just took the pavement right off. It took 10-foot squares and just flipped them upside down. It was quite something."

Much of the gravel of the parking lot is now piled on what was once the lawn of a house that was across the road.

"We've lost hundreds of textbooks, but we did get most of the library books to safety," said Kerr, paddling through the mud to help one of the work crews sent by Campbell River school district.

The high-water mark is at least 50 centimetres up the doors and anything in the bottom two shelves of filing cabinets has been lost.

"These were the teachers' lessons that they had prepared for years. It's like watching your life's work going down the drain. They're not like ministry textbooks. I think it's Murphy's Law," Kavanagh said.

Some of the 190 students, ranging from kindergarten to Grade 9, have been in the school trying to salvage their belongings and others have offered to help with the cleanup, Kerr said.

Staff whose houses are intact have taken home children's clothes to wash. Where possible, items such as pencil boxes and a child's fossil collection have been saved from the all-engulfing mud, Kavanagh said.

Noreen Archer, a member of the janitorial staff, remembers the previous flood at the school in 1975.

"But this is so much worse. The kids are just going to be so sad when they see all this."

Kavanagh said a saving grace as the disaster unfolded was the response from the school board and the 650 residents of the community, which is about 70 kilometres north of Campbell River.

"People have come in and volunteered even though there's lots of stuff that needs to be done in the valley," he said.

About 20 people were working on the school cleanup Tuesday, including many of the 13 teachers. And despite the devastation, Kavanagh hopes to have the school back in operation by Monday.

"We have three contractors coming in tomorrow with heaters, fans and extractor units," he said.

Depite the hopes of some students that Mother Nature is on their side, report cards will go out as usual, Kavanagh said.

"We got the secondary report cards out on Friday, and the elementary report cards are being written at the moment at home."

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Colonist

DAMAGE

Continued from A1

The mountains surrounding Sayward were covered with snow prior to the weekend, and torrential rains and warm winds helped to rapidly melt the snowpack, causing large amounts of water to flow into the Salmon and White rivers.

As in 1975, the weather conditions were accompanied by a high tide which made matters worse, said another resident.

Three out of four bridges in the area remain impassable. Many of the 500 valley residents who live outside Sayward have not yet been able to return to their homes.

"I came for breakfast [Sunday] and I couldn't get home, so I've stayed here ever since," said valley resident Jeanette Stefiuk. "I'm a guest at the Salmon River Inn."

Eleanor Hurst, Salmon River Inn spokesman and one of Sayward's four aldermen, has offered free rooms for anyone unable to get home.

The entire community is pulling together trying to help those whose homes were flooded, Gustafson said.

"Everyone has somebody staying with them," she said.

As the flood waters recede the damage is being assessed but no cost figures are available, Hurst said.

Dalley said the $10 million in possible aid includes about $2.5 million spent on first-response efforts as of Tuesday.

Dalley said the $10-million estimate was based partly on PEP's $6-million experience with floods in and around Chilliwack last year.

PEP will be covering some uninsurable losses on principal residences up to a ceiling of $100,000 for individuals, and will cover certain uninsurable losses of farmers, small businessmen and municipalities.

"But it will be probably the middle of next week before we have a good idea of how much will be involved," he said.

The current provincial budget allows for $1,203,500 in first-response costs — down from more than $2 million budgeted last year. PEP can request extra money from Ottawa under the Flood Relief Act.

Finance Minister Mel Couvelier was unavailable Tuesday to say where the money would come from in light of millions of dollars in spending restraints he has ordered in attempts to make good on his pledge of a balanced budget.

Even with government help, the floods will affect Sayward, which is already suffering because of logging disputes in the Tsitika Valley, Gustafson said.

"There's already hardship here, people are starting to hurt financially," she said.

In several cases people who are already battling other problems have been hit hard by the flood, said Gustafson and Hurst.

A trailer owned by Bobby and Jack Toft has been badly damaged.

"She [Bobby] was visiting her husband in Vancouver when it happened. He was paralysed in a logging accident this summer," Gustafson said.

Another family whose home has been damaged were also in Vancouver with their seven-year-old daughter who is in hospital after being diagnosed two weeks with cancer, Hurst said.

Truck falls in washout, Gold River man escapes

Times-Colonist staff

A Gold River man escaped serious injury Monday when his pickup truck plunged into a washout.

Gerald Mark Hall, 30, was crossing the Oktwanch River bridge when his vehicle plunged into the washout. The rear portion of the truck stayed on the roadway.

Cpl. John Ollinger of the Gold River RCMP said the slow speed of the truck saved Hall from serious injury or death. A tow truck later retrieved the pickup.

Also in the Gold River area, about 30 people were transported in the buckets of front-end loaders Sunday when flood waters cut them off from the town.

Jerry Morgan, the area emergency program coordinator, said between 50 and 60 people helped in the rescue operation.

The water rose as high as 1.3 metres, cutting off workers at the Canadian Pacific Forest Products mill and an Indian reserve.

Morgan said those on high ground or not in immediate danger were left, but the remainder were moved by the front-end loaders.

Power was expected to be fully restored to the region Tuesday evening after a mud slide near Gold River knocked out the lights for 10:30 p.m., Rich Comer, a hydro service technician at Port Hardy, said Tuesday.

Power started to be slowly restored by midnight by a back-up generating system at Port Hardy, but it overloaded at 6:45 a.m. Tuesday and failed, plunging the communities back into darkness, he said.

The blackout occurred when a slide on a mountain about 20 kilometres north of Gold River swept over a Hydro transmission tower supporting a line that feeds electricity to the north Island, he said.

Heavy rains in the area are blamed for the slide, Comer said.

Hydro advised customers to take it easy on power consumption for the next day, he said.

Devastated Sayward homeowners await damage estimates

By Judy Lavoie
Times-Colonist staff

SAYWARD — Stories of heartbreak and hardship are pouring into Sayward Village office where the Provincial Emergency Program team has set up headquarters in the wake of devastating Remembrance Day weekend floods.

But so far no dollar figures can be put on the damage, says PEP spokesman Lloyd Rayment.

"We are talking about single-level houses which have had two feet of water inside. The walls are starting to bulge and the water was over the electrical sockets. And how do you score damage to the land?," said Rayment. *(Related coverage/A6)*

"We have about 17 names here of people who have had considerable damage or have been displaced. Some still can't get back and are staying with relatives or friends," he said.

So far, little concrete comfort can be given to Sayward homeowners. Adjusters are expected to be in Sayward by the end of the week and will distribute disaster financial-assistance guidelines and forms.

Those eligible will receive financial help with 80 per cent of the cost to a ceiling of $100,000, provided they put in the first $1,000.

But it is not as simple as adding up the damage.

"It covers the essential of everyday lifestyle. We cover the main living area items but nothing recreational," said Rayment.

In addition to devastated homes, soaked animal feed, smashed barns and wrecked fences, Sayward residents are also coping with contaminated wells and overflowing septic fields.

Sample bottles and instructions for cleaning wells are being distributed at the village office and residents are being advised to boil water.

The Victoria-based PEP team arrived Monday to help local emergency crews.

Meanwhile speculation about the cause of the flood continues.

"It was just perfect [flood] conditions. Snow and then warm weather and then rain," said Steven Sproul, a 31-year resident.

But different patterns of flooding from the last major flood on Remembrance Day weekend, 1975, have aroused some suspicions.

B.C. Hydro's insistence on opening some dams in Campbell River probably contributed, said a farmer who didn't want his name printed.

After the 1975 flood, B.C. Hydro agreed to keep the lake levels lower during flood season.

But Sandy Burpee, B.C. Hydro area manager for northern Vancouver Island, said the only change to the Salmon River flows was that B.C. Hydro stopped diverting a small amount of water.

"There are a lot of misconceptions," he said.

"We have a very small diversion dam several miles upstream from Sayward, and we shut off the diversion. If we had continued to take the water off it would have been a pretty small percentage of the flow of the Salmon River," Burpee said.

Residents are blaming extensive damage to Sayward school on construction of a new $4-million bridge adjacent to the school and a logjam against the work platform.

On Wednesday the logjam was again building up behind the wrecked work platform.

However, Rod Mochizuki, Courtenay District Highways Manager, said the department has no information that would lay the flood blame on the new bridge.

A report on Sayward's three damaged bridges is due shortly and until it has been studied no decisions will be taken on whether to replace them immediately.

The most badly-damaged bridge is the White River Bridge which has been cut off in the middle.

"We will definitely consider a temporary construction. That's for sure," said Mochizuki.

Sayward residents now have to drive through logging roads to reach the main town area.

'You've just got to get on with it'

SAYWARD — Lorne Brown's little girl has a brain tumor, he is out of work — and now his "dream house" has been wrecked by floodwater.

"I don't know what to do. I've just about given up. But you've just got to get on with it," Brown said Wednesday.

The Brown's house has one-metre high muddy waterlines around the inside walls. Sodden wallboard is already bulging.

During the Remembrance Day weekend, floodwaters nearly covered the Brown's car, overturned the deep-freeze and threatened to carry off the new washing machine. The appliances had only recently been paid for and the car carried no insurance.

"We just bought the house in September," Brown said.

But for the last month nothing has gone right for the Browns. Two weeks ago their seven-year-old daughter Tia was diagnosed as having a brain tumor. Her mother, Shawn, is now in Vancouver where Tia is in hospital.

When Lorne first heard about his daughter's illness he was forced out of work and on to stress leave. Now his neighbors have rallied to help him through the latest tragedy.

Two women who showed up to help Tuesday didn't know Brown and he didn't know them. They didn't even want credit from the media. They just came in with buckets and mops.

It was the third waterlogged home the two women had helped clean in the past two days.

Another Sayward resident, Lynn Hadley, spent Tuesday and Wednesday drying out the soaked antiques and carpets in her home beside the White River and surveying the wreckage of her new $6,000 fence.

Hadley, a diver, put on her scuba gear as the river started to rise and moved her horses to a barn on higher ground.

"I had only 15 or 20 minutes and then I knew I had to get out. You couldn't swim against the current. And when the fence went down you couldn't pull yourself along it," she said.

Hadley's boyfriend, Steve Dingwall, who owns the house, is currently diving in Chile.

"I phoned him and said 'You know that new house you wanted to build on the hill. Well you better start to build it,' " Hadley said.

Bobbi Toft was in Vancouver visiting her husband, paralysed in a log-

the flood hit her mobile home.

"I sure didn't think it was going to turn out this way. There was 32 inches of water in the trailer. It was right up to the counter top," said Toft.

SOOKE WATER OK'D

Sooke and East Sooke residents can drink their water from the tap again.

Regional medical health officer Dr. Shaun Peck has lifted a boil-water advisory for the two areas, ordered Friday after heavy rains stirred up sediment in Charters Creek.

Yellowish-brown coloring may continue for a few days but doesn't pres-

Judith Lavoie photo

Long road back

Sayward residents struggled Wednesday to come to terms with the devastation wreaked by the Remembrance Day weekend floods. Here, Steven Sproul, a 31-year resident of the community, stands by the Sacht's Bridge construction project, where some say a logjam in the Salmon River contributed to flooding of the community's school. *Related stories/A3*

Drenched communities dry out — again

By Katherine Dedyna
Times-Colonist staff

Mud-soaked up-Island communities are drying out and cleaning up after Friday's flooding — the second devastating onslaught in two weeks.

Sayward, hit hardest by the floods, is making its way back to normal, but the extent of the loss may not have fully sunk in yet, warned Phil Blanchard, area co-ordinator for the Provincial Emergency Program.

A public meeting Tuesday in the town is slated to deal with "critical incident stress" he said.

"I think there's going to be more of a backlash," he predicted, as people still reeling from the destruction and mess of two weeks ago realize they'll have to begin all over again.

But the threat of further damage and danger has pretty well dried up.

"There's nobody at this point under any personal risk," Blanchard said Saturday afternoon, and the town is once again accessible by road.

Unfortunately, some of the people hardest hit this time were the same ones who suffered the brunt of the damage during Remembrance Day weekend floods.

Lorne and Shawn Brown, whose seven-year-old daughter, Tia, was recently diagnosed as having a brain tumor, were not able to defend their "dream home."

Lorne rushed to Campbell River to stave off flooding at his mother's house. Shawn is in Vancouver for Tia's hospital treatments.

"I don't really want to think about it," Shawn said in a telephone interview. "I don't even know if I'm going to have a home to go to."

The last she heard, the house was under nearly a metre of water — just a bit less than the last time.

Everything the family had salvaged was already outside in the carport when the floods returned.

"They're probably the worst-case scenario," Blanchard said, adding that the heaters and vacuums brought in to clean up the previous mess were probably destroyed.

The second flood, deeper than the first, spelled disaster for Bunni Toft. Water rose over the countertops in her mobile home.

Saturday she headed for the mainland, taking the bad news to her husband who is in a Vancouver hospital because of a summer logging accident which left him paralysed.

"The mobile was completely flooded. It was worse than it was before," said family friend Bert Hadley.

"Just about everything will have to be replaced."

The Sayward elementary school, which still has more than a metre of water in its crawl space and about 15 mm on the floors, is not expected to reopen until Wednesday. Older students helped staff lug furniture to the gym to save it from water damage.

The havoc wreaked on logging roads is expected to put more than 300 forestry workers out of a job for at least two or three days, said MacMillan Bloedel foreman Mark Godard.

Blanchard said this time around, residents no longer resisted abandoning their homes at the onset of the flood threat — a major problem in the floods two weeks ago.

Many of them "learned the hard way" about the dangers of late-night rescues involving helicopters and boats in storm conditions.

This time, 12 people had to be rescued by vehicles. About 90 families temporarily stranded in their homes found refuge with friends and neighbors on higher ground.

Ed Waters, a spokesman for the Provincial Emergency Program located in Courtenay, said "no major structural damage" was registered, although it was touch-and-go moving one mobile home.

All major roads on the Island are believed to be "passable," he said.

About 900 Tahsis residents spent 1½ days without drinking water after the main broke in the river canyon.

Mayor Tom McCrae said said pipe repairs were dangerous and difficult, especially with the six-man public works crew being reduced to two because of holidays and illness.

The pipe break cut off water to the lower part of the town where the majority of people live.

McCrae said residents caught rain water and boiled it for drinking water Friday, and on Saturday were invited to the upper town to get water from homes served from a 2½-million litre storage tank.

The town was cut off from other parts of the Island by washouts for some parts of the day, and near the river some basements were flooded.

"There was some damage, but we live in an area that gets 12 to 14 feet of rain a year so we know what rain is about," he said.

A mudslide in Port Alice destroyed road repairs done after a flood last year.

And 28 residents of a mobile home park in Martindale, outside Parksville, had to leave their trailers after they were submerged metre-deep in water.

Best Selection

November 24, 1990

☐ Clutching salvaged [...]longings, flooded-out reside[...] are piggy-backed by resc[...] workers away from th[...] swamped homes. *Story/B1*
☐ It's hard to get a su[...] pump — or a plumber — [...]love or money. *Story/B1*
☐ CRD watchful for sewa[...] after spill into Gorg[...] *Story/D24*

Up-Island towns stranded by storms

By Richard Watts
Times-Colonist staff
and The Canadian Press

Floods stranded about 250 Sayw[...] residents Friday as rivers overflo[...] their banks there for the second [...] in two weeks.

Torrential rains that swelled cre[...] and rivers and high winds which [...] down trees temporarily cut off v[...]ous other up-Island communities.

Phil Blanchard, provincial em[...]gency program area co-ordinator [...] Sayward, said about 90 families w[...] stranded in their homes becaus[...] the floodwaters.

An RCMP power launch equip[...] with an inflatable rescue boat t[...]elled from Campbell River to [...] rescue the flood-isolated Sayw[...] residents.

"The only hope we've got is for [...] rain to settle down a little bit and the temperature to drop," Blanch[...] said.

"The flood level is higher than [...] Nov. 11 storm in some places, an[...] others it is lower," he said.

On Nov. 11, under almost-identi[...] conditions, warm weather melted [...] snow on the hills and mountains [...] teamed with heavy rain to cause [...] nearby Salmon and White rivers [...] top their banks and flood the town.

But this time, Blanchard said, [...] high country had accumulated m[...] snow cover which was melting to [...] to the flood.

Port Alberni was essentially cut [...] the better part of Friday. The M[...]istry of Highways shut down Highw[...] 4 when high winds and rain topp[...] trees in Cathedral Grove.

RCMP Const. Brock Clayards s[...] more than a dozen trees in the prov[...]cial park crashed over when the ra[...] turned the earth to mud and hi[...] winds pushed the giants over.

Clayards narrowly escaped de[...]

STRANDED A[...]