FEDERAL-PROVINCIAL FLOODPLAIN MAPPING AGREEMENT

PROVINCE OF BRITISH COLUMBIA
Ministry of Environment, Lands and Parks
Water Management Division

A DESIGN BRIEF ON THE FLOODPLAIN MAPPING STUDY

Quatse River
District Municipality of Port Hardy

An Overview of the Study Undertaken
to Produce Floodplain Mapping
for the Quatse River
in the District Municipality of Port Hardy

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DESIGN BRIEF ON THE FLOODPLAIN MAPPING STUDY

QUATSE RIVER - PORT HARDY

PREFACE

The purpose of this Design Brief is to present a description of the methodologies used and the results of the study undertaken to produce the floodplain mapping sheet for the Quatse River in the District Municipality of Port Hardy, Drawing 89-7, Sheet 1 (Appendix 4).

1. LOCATION

The Quatse River is located in the Mount Waddington Regional District, District Municipality of Port Hardy, at the north end of Vancouver Island as shown in Figure 1. The District Municipality of Port Hardy has a population of about 5100 and is approximately 500 kilometres north of Victoria via Highway 19. Major industries are forestry, mining, fishing and tourism. The southern terminus for the ferry to Prince Rupert is located in the District. A "Port Hardy Overview 1992" obtained from the District Municipality (Appendix 1) summarizes general information for the District.

Figure 2 is a Key Plan of the study area which indicates the location of the floodplain mapping drawing produced for the study.

2. BACKGROUND TO STUDY

The District Municipality, in a letter dated May 31, 1982, requested the Water Management Branch to assess river bank protection and dyking requirements and to provide floodplain mapping of the Quatse River. On September 28, 1982, Mr. A. A. Brown of the Branch and the undersigned met with municipal officials in Port Hardy to discuss their request and to examine the Port Hardy area (Appendix 2.1).

Mr. J. K. Spanier, Administrator of the Port Hardy District Municipality in 1982, indicated that the existing industrial property, located between Highway 19 and Development Road in the Boyden Creek/Quatse River floodplain area, experiences flooding at high tide due to drainage constraints.

Information on previous flooding events was obtained from long term residents of Port Hardy. Mr. Prestwick of Port

Hardy Engineering indicated that his property, located upstream of the Highway 19 bridge adjacent to the Quatse River (Appendix 3, Photo 2), was flooded in 1975 and 1980.

Mr. Ian Anderson, formerly the owner of the Pioneer Inn (Appendix 3, Photo 1), reported that his property flooded in November, 1975. The Pioneer Inn is located on the west bank of the Quatse River upstream of the Byng Road bridge.

The Finning Tractor building (Appendix 3, Photo 3), which has been floodproofed pursuant to the subdivision approval requirements, is located between Spicer Creek and the Quatse River north of Byng Road.

In December, 1992, Mr. B. J. Board and the undersigned visited the study area to assess the floodplain delineation. The floodplain mapping project was briefly discussed with staff of the Municipal District including Ms. Phyllis Belaire, Principal Appointed Officer, Mr. J. A. Fernandez, Clerk/Treasurer and Mr. W. Bliss, Building Inspector.

3. PRESENT STUDY

The 1992 floodplain mapping study is based on a field survey of watercourses in the District of Port Hardy obtained in July, 1988 (Appendix 2.2). The cross sections cover approximately 3.7 kilometres of the Quatse River from the sea at Hardy Bay to the confluence of Dick Booth Creek, Boyden Creek from Hardy Bay upstream approximately 1.0 kilometre, and Spicer Creek upstream approximately 3.5 kilometres from Hardy Bay (Drawing No. 89-7, sheet 1).

Topographic mapping, based on air photos obtained during July and August, 1982, at 1:5000 scale with 2 metre contour intervals, was used in the study (Appendix 2.3). The mapping was made available under the Provincial Large Scale Mapping Program.

4. FLOOD MAGNITUDES

4.1 General

In accordance with the policy of the Ministry of Environment, Lands and Parks, the flood levels and floodplain limits shown on floodplain mapping sheets are based on a designated (1:200 year frequency) flow plus an allowance for hydraulic and hydrologic uncertainties. The sensitivity of flood levels to flows for the watercourses in the study area is discussed in Sections 5.3.2 and 5.3.3.

4.2 Peak Flow Estimates

A regional hydrology study carried out for the Quatse River Basin in December, 1989 (Appendix 2.4) is summarized below. Drainage areas were measured from 1:50,000 scale mapping at one location each along the Quatse River, Spicer Creek and Boyden Creek. The measured drainage areas at these locations are listed in the following discussion.

The hydrology study was initiated with a review of the historical flood flow information for gauged basins in close proximity to the study area. Peak flow events on Vancouver Island are generally caused by late fall and winter westerly frontal rainstorms of low intensity but prolonged duration. Occasionally frontal storms become unstable and remain stationary over a watershed for several days, producing thunderstorms and heavy showers which could cause severe flooding and damage.

Estimates of regional peak flow were based on annual maximum discharges from a number of nearby Water Survey of Canada (WSC) hydrometric stations with adequate records. Record lengths vary from six to 28 years (including 1988); only two stations (08HE006 and 08HF004) are active and three (08HE006, 08HF003 and 08HF004) have recorders (instantaneous discharges).

The results of the regional peak flow estimates used in the hydraulic studies are listed as follows:

REGIONAL PEAK FLOW ESTIMATES

STREAM SITE	DRAINAGE AREA (km2)	RATIO OF MAXIMUM INSTANTANEOUS TO DAILY DISCHARGE	ESTIMATED PEAK DISCHARGE							
			20-year				200-year			
			Daily		Instantaneous		Daily		Instantaneous	
			L/s/km2	m3/s	L/s/km2	m3/s	L/s/km2	m3/s	L/s/km2	m3/s
Quatse River below Dick Booth Creek	74.1	1.50	1160	86	1740	129	1910	140	2900	210
Spicer Creek at Byng Road	8.56	2.07	2000	17	4000	34	3300	28	6800	58
Boyden Creek at Hwy. 19	10.0	2.00	1920	19	3800	38	3200	32	6300	63

5. FLOOD HAZARDS

5.1 Tsunamis

A tsunami is a long period wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Based on the available data for Alert Bay, it is not expected that there will be a significant tsunami wave at Port Hardy, assuming a distant underwater disturbance on the Pacific Rim (Appendix 2.5).

A review of the data available for the tsunami of March 27-29, 1964, on the west coast of Canada indicates there is no record of tsumani action for this event at Port Hardy. At Alert Bay, located 40 kilometres east of Hardy Bay, the 1964 tsunami had a level of 1.1 metres below Higher High Water Large Tide (HHWLT).

5.2 Ocean Flood Level

The flood level for the ocean for the purposes of floodplain mapping is based on HHWLT plus an allowance for storm surge and wave runup.

The Institute of Ocean Sciences (I.O.S.) supplied tidal information for the gauge installed at Port Hardy. The HHWLT is 2.7 metres, GSC datum. The recorded extreme ocean water level is 3.1 metres. The largest recorded storm surge based on the difference between the extreme observed and the predicted tide level, is 0.40 metres. It is estimated (Appendix 2.6) that a total of storm surge plus wind setup of about 0.6 metres is possible resulting in an ocean flood level of (2.7 + 0.6) 3.3 metres.

An analysis of wind and wave setup and storm surge was carried out by Mr. B. J. Holden, P. Eng., of the Flood Hazard Identification Section (Appendix 2.6). The relative low wind and wave components listed below reflect the sheltering of Port Hardy from prevailing winds. Results of this analysis, which utilized standard methodologies, are summarized below:

HHWLT	2.70 metres
Pressure Uplift	0.46 "
Wind Setup	0.03 "
Wave Setup	0.15 "
Ocean Flood Level	3.34 metres

Based on the above two methods of assessment, the recommended ocean flood level is 3.3 metres, GSC datum.

The ocean flood level adopted for Hardy Bay governs the

designated flood level for the Quatse River up to between cross sections 2 and 3 as indicated on the mapping sheet. For Boyden Creek, the ocean flood level dominates up to the area between cross sections 6 and 7. The minimum elevation of Development Road, which provides some protection from ocean flood levels to the existing industrial buildings to the south, is approximately 3.0 metres.

5.3 RIVER FLOOD LEVELS

5.3.1 General

Information sources listed in Appendix 2 were utilized in the HEC-2 water surface profile computer program, Version 6.4, developed by the Hydrologic Engineering Centre, U. S. Army Corps of Engineers in Davis, California. The flood profile calculations assume open water flow conditions.

Flood profiles were calculated for the Quatse River a distance of 3.7 km and for Boyden Creek a distance of 1.0 km, both measurements being from their outlets to the sea.

A plot run of each watercourse was obtained to assess the ground survey data and the extensions of surveyed cross sections obtained from the existing topographic mapping. Output from the plot runs was used to review other data such as flow regime, loss coefficients, bridge and culvert information, reach lengths, overbank data and relative Manning's "n" values. Photo 4, Appendix 3, shows the Quatse River looking downstream from Byng Road bridge.

Highwater data corresponding to measured flows from a specific flood occurence was not available in order to calibrate Manning's "n" values in the study area. The roughness characteristics at each cross section were estimated using the colour photographs provided by the Surveys Section, site visits, experience gained in other studies and a review of the information available in a book published by the U. S. Department of the Interior entitled "Roughness Characteristics of Natural Channels." Following is an overview of the computer runs for the above-noted watercourses.

5.3.2 Quatse River

A total of 28 river cross sections were obtained along the 3.7 km thalweg distance of the Quatse River from the sea at Hardy Bay to the confluence of Dick Booth Creek. There are two road bridges in the study area as shown on Drawing 89-7-1 and Figure 3.

The thalweg profile has an average slope of 0.5% in the

mapped section upstream of the Highway 19 bridge.

Manning's "n" value for the Quatse River channel was conservatively estimated to be 0.047 in the study area. Overbank areas were estimated to have an "n" value of 0.10. Flows used in the backwater analysis are listed in Section 4.

The designated flood levels were equal to the 1:200 year instantaneous flood level plus 0.3 metres.

Sensitivity studies indicate that for the 1:200 year instanteous flow, a change in Manning's "n" values of ±30% results in an average flood level change of ±0.24 metres. A 30% increase in the 1:200 year instantaneous flow results in an average flood level increase of 0.35 metres which is slightly above the allowance for uncertainties of 0.3 metres.

During the December, 1992 visit to the study area by staff of the Flood Hazard Identification Section, it was noted that there is a potential for Spicer Creek to enter the Quatse River system upstream of Byng Road due to culvert hydraulics and blockages during high flow events. Based on the peak flow analysis, combining the drainage areas of Quatse River and Spicer Creek results in a flow increase of 5% during a 1:200 year instanteous flood (2700 L/s/km2 for the 82.7 sq.km area) over the Quatse River (74.1 sq.km area) flow estimate of 210 m3/s. Flood levels would rise as a result of the combined flow approximately 0.06 metres which is less than the 0.3 metre allowance for uncertainties noted above.

5.3.3 Boyden Creek

A total of 10 river cross sections were obtained along the 1.2 km thalweg distance of Boyden Creek upstream from the sea at Hardy Bay. Two road bridges span the creek in the study area as shown on Drawing 89-7-1 and Figure 4.

Boyden Creek has a flat thalweg profile averaging 0.2% in the subject area. Photo 5 shows the creek in the tidal area.

The designated flood levels are equal to the 1:200 year daily flood level plus 0.6 metres or the 1:200 year instantaneous flood level plus 0.3 metres, whichever is the greater.

Sensitivity studies indicate that when the 1:200 year daily flow is increased by 30%, the flood level rises an average of 0.13 metres. An average increase of 0.10 metres occurs

when the Manning's "n" value is increased by 30% in the study area.

6. FLOODPLAIN MAPPING

6.1 General

The flood levels determined in the study were used to delineate floodplain limits onto the existing 2 metre contour mapping of the study area. The floodplain mapping for the Port Hardy District Municipality, Drawing No. 89-7, Sheet 1, indicates the location of river cross sections and survey monuments, the floodplain limits and the flood levels determined in the study.

The river survey data requested in January, 1988 (Appendix 2.2), included extensions of the cross section data over the entire floodplain where feasible. In addition, profile information was obtained along all roads in the study area to assist in hydraulic calculation and floodplain delineation. As indicated on the mapping sheet, the detailed ground survey information along with field observations undertaken in December, 1992, were used to delineate the floodplain limits in the study area.

Highway 19 and Byng Road (minimun crest elevation 4.6 metres and 8.4 metres, respectively) pose a potential barrier to flood flows. The flood level isograms indicated on the map sheet have been located to exceed potential flood ponding levels behind these transportation fills.

6.2 Conclusions

1. This design brief presents an overview of the studies undertaken to produce the floodplain mapping sheets for the Quatse River and Boyden Creek, distances upstream of approximately 3.7 and 1.2 km respectively, from their outlets to the sea at Hardy Bay.

2. The floodplain mapping is deemed to be preliminary as it is based on 2 metre contour interval mapping within the floodplain areas of both watercourses.

3. The Port Hardy District Municipality 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 gauging station on the Quatse River. In addition, assistance of other Ministries concerned with utilizing water resource data of this nature (i.e. fisheries resource, water supply, etc.) should be obtained to assist in

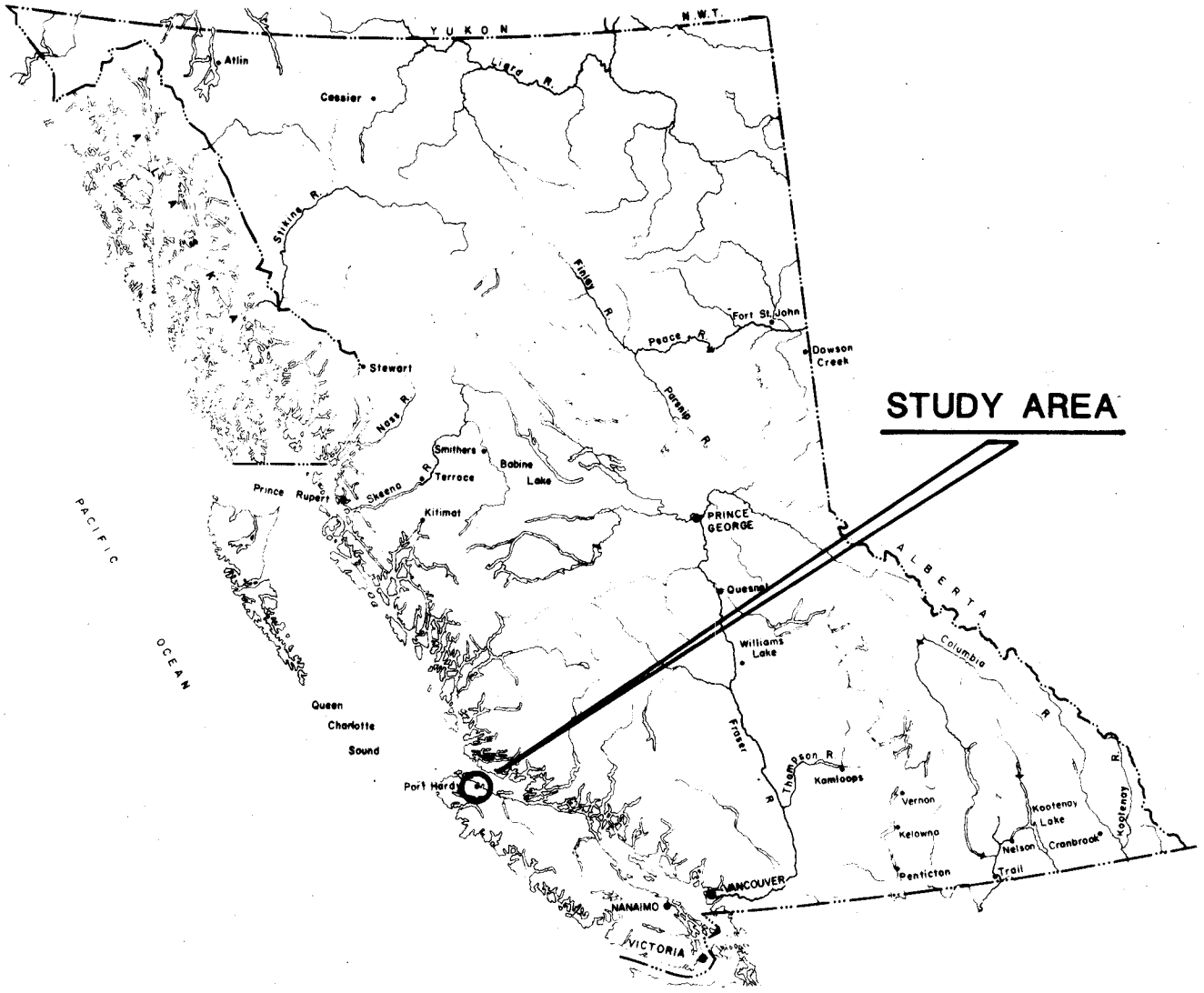
the necessary funding of a gauging station.

6.3 Recommendations

1. It is recommended that the floodplains delineated on Drawing 89-7, Sheet 1, be Interim Designated under the terms of the Federal Provincial Floodplain Mapping Agreement.

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

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Flood Hazard Identification



Province of British Columbia
Ministry of Environment, Lands & Parks
Water Management Division

TO ACCOMPANY REPORT ON

FLOODPLAIN MAPPING
QUATSE RIVER
STUDY AREA LOCATION

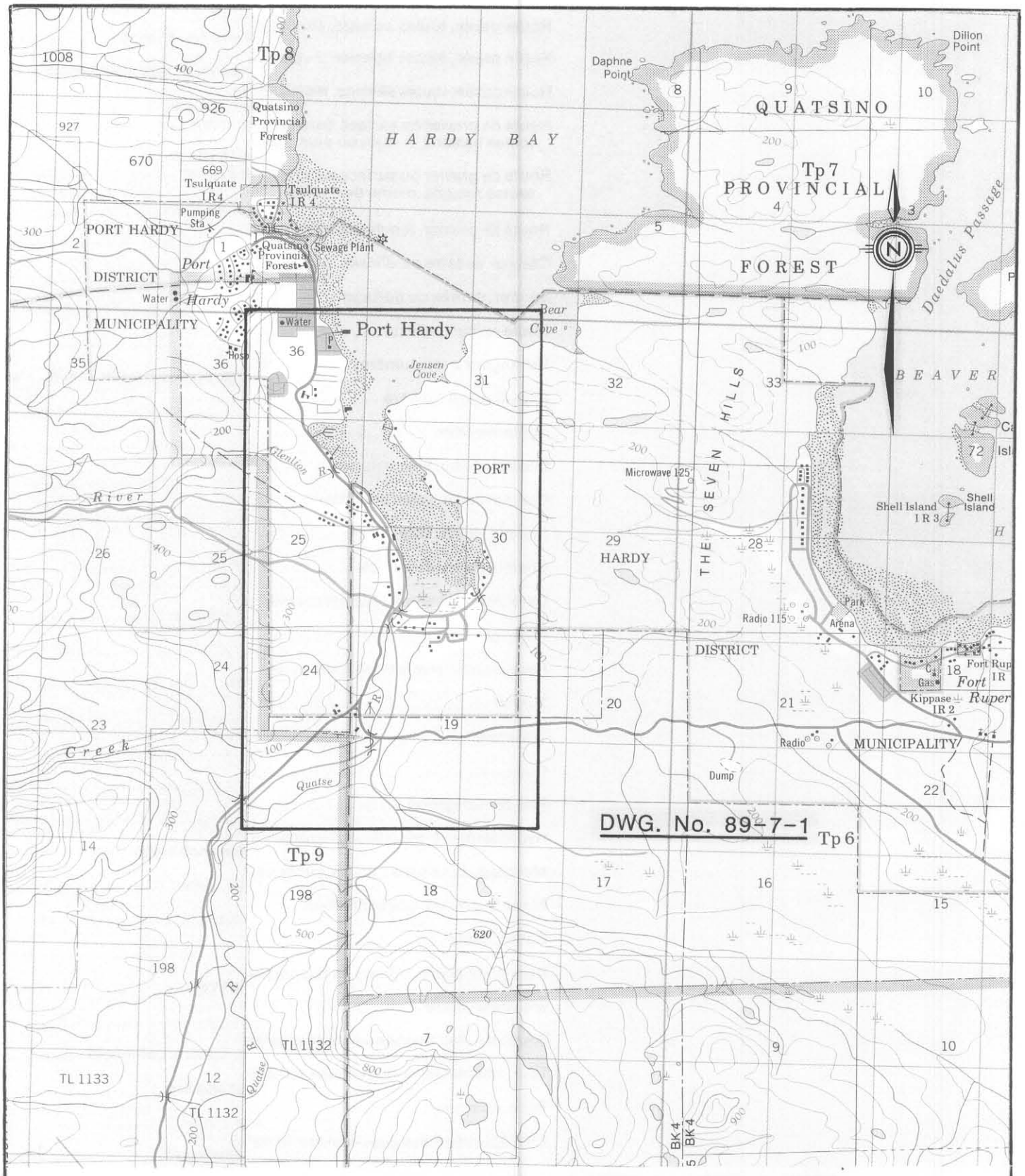
SCALE: VERT .....
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R.W. NICHOLS ENGINEER

FILE No. 35100-30/920-9982 DWG No. FIGURE 1

BCIL 7673-M E



Province of British Columbia
Ministry of Environment, Lands & Parks
Water Management Division

TO ACCOMPANY REPORT ON
FLOODPLAIN MAPPING
QUATSE RIVER
KEY PLAN

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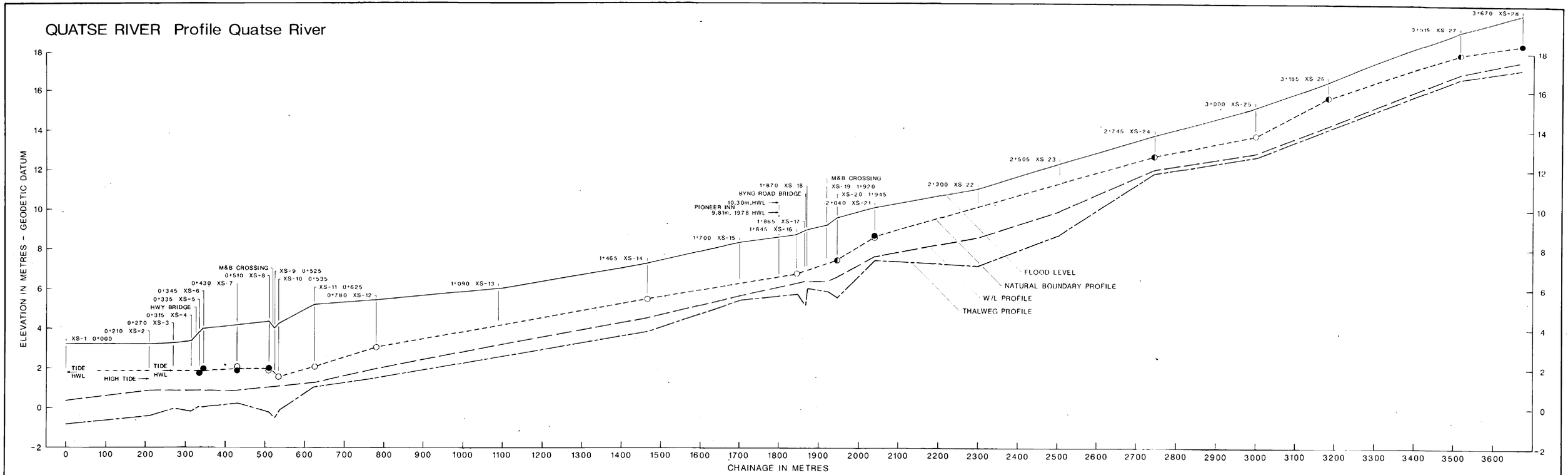
DATE

R.W. NICHOLS ENGINEER

FILE No. 35100-30/920-8962 DWG. No. FIGURE 2

BCIL 7673-M E

QUATSE RIVER Profile Quatse River



● NATURAL BOUNDARY R/B
○ NATURAL BOUNDARY L/B

Province of British Columbia
Ministry of Environment, Lands & Parks
Water Management Division

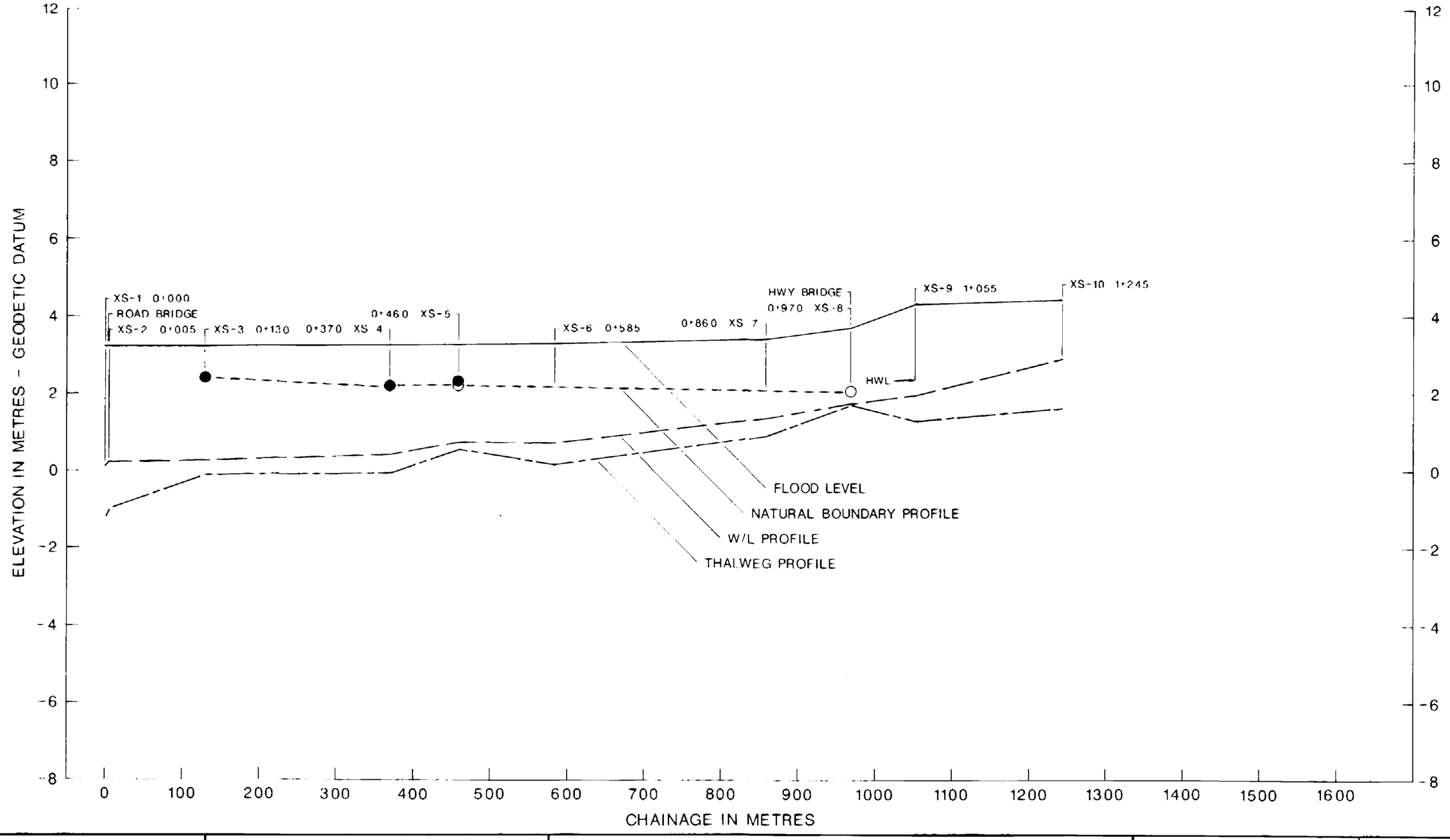
TO ACCOMPANY REPORT ON
FLOODPLAIN MAPPING
QUATSE RIVER
PROFILE

SCALE: VERT. 1 : 100
HOR. 1 : 5 000
DATE

R. W. NICHOLS ENGINEER

FILE No. 35100 30/920-8962 DWG No. FIGURE 3

BOYDEN CREEK Profile Boyden Creek



● NATURAL BOUNDARY R/B
○ NATURAL BOUNDARY L/B

Province of British Columbia
Ministry of Environment, Lands & Parks
Water Management Division

TO ACCOMPANY REPORT ON
FLOODPLAIN MAPPING
BOYDEN CREEK
PROFILE

SCALE: VERT. 1 : 100
HOR. 1 : 5 000

DATE

R. W. NICHOLS ENGINEER

FILE No. 35100-30/920-8962 DWG No. FIGURE 4

PORT HARDY OVERVIEW 1992

INTRODUCTION: The District Municipality of Port Hardy is located on the North East tip of Vancouver Island, 500 km north of Victoria. Port Hardy is an active community which serves as the regional center of Northern Vancouver Island and the mid-coast. The climate of Port Hardy is moderate with an average yearly temperature of a maximum of 11.7° C and 5.4° C minimum.

MUNICIPAL POPULATION: 1991 - 5,082
MARKET AREA POPULATION: 13,896

AREA: 4,731 hectares

ASSESSMENT:
1989- 24,495.00
1990- 27,074.00
1991- 31,241.00

BUILDING PERMIT VALUES:
1987- 1,737,964
1988- 645,480
1989- 4,961,519
1990- 3,557,951
1991- 3,839,932

HOUSING UNITS:
1,419- single residential
57- other units including apartment buildings

PER CAPITA INCOME: $19,400

ADMINISTRATION: Mayor Al Huddlestan, 6 Councillors

MAJOR INDUSTRIES:
FISHING Homeport fleet consists of 344 licensed commercial vessels and 420 commercial fishermen. 7,160 tonnes of salmon caught annually. Approximately 9.4 million dollars of seafood processed. Freezer plant.
FORESTRY Over 2,800 people employed in forest sector (1989) harvested by 9 major companies and 110 small contractors.
MINING Island Copper Mine. Second largest copper producer in B.C. 575 employees.
TOURISM
SAWMILL
SERVICE INDUSTRY

ACCOMMODATION: Hotels -7; 331 rooms
Bed and Breakfast - 24
R.V. Parks and Campsites - 4; 216 sites

EDUCATION: Public Schools- 4; Private- 2 and North Island College

POLICE: R.C.M.P. Detachment- 12 member

FIRE: 31 volunteers; 2 halls

HOSPITAL: 25 acute care beds; 7 basinettes; 4 doctors; 2 dentists

WATER SYSTEM: Capacity to service a population of 8,500

ELECTRICITY: B.C. Hydro and Power Authority

SEWAGE: Secondary Wastewater Treatment; 417,000 gal/day

STREETS AND ROADS:
Asphalt- 40.0 km
Unpaved- 3.0 km

PARKS AND PICNIC AREAS:
10 - Parks
3 - Ball Fields
2 - Boat Ramps

RECREATIONAL FACILITIES:
Facilities include an olympic-size indoor swimming pool, an ice skating arena which doubles as a roller skating rink in the spring/summer months, a four-sheet curling club, a racquet club with 3 racquet courts and one squash court, an outdoor tennis court with two nets, a motor speedway, a bowling alley, a professional nine-hole golf course approximately 20 minutes away, and a ski resort within 1 1/2 hours driving. Senior Centre Facility with recreational arts and crafts plus live-in suites.

GOVERNMENT OFFICES:
Federal - 5;
Provincial - 12;
Municipal - 6

DISTANCE FROM PORT HARDY TO:
Campbell River - 235 km
Nanaimo - 400 km
Victoria- 500 km
Port McNeill - 46 km
Port Alice - 48 km

HIGHWAYS: No. 19 - South to Campbell River, Nanaimo and Victoria

AIRPORT: 3 paved runways (longest 5,000'),an all weather ILS system, a flight service station and fuel facilities, weather office.

TRANSPORTATION/ AIR:
Time Air / Canadian Partners - 2 flights daily
Pacific Coastal - 3 flights daily
Vancouver Island Helicopters
Sea Plane Base

TRANSPORTATION/ MARINE: B.C. Ferries to Prince Rupert via Bella Bella

RECREATION: Quatse River Hatchery, Chain Saw Carvings, Museum & Library, Native Carvers (Copper Makers), Scuba Diving, Fishing, Eagle Watching, Harbour Tours, Hardy Bay Theatre, Port Hardy Rec. Center, Bowling (N.I. Lanes), Cape Scott & San Joseph Provincial Parks, Caving (Little Huston, Devils Bath), Bird Watching (Quatse River Estuary), Stream and Lake Fishing, Horseshoes, Killer Whale Watching (Telegraph Cove), Skiing (Mt.. Cain)

CHAMBER OF COMMERCE: Travel InfoCentre

NEWSPAPER: North Island Gazette

RADIO & TELEVISION: CFNI Radio, A-1 Cable Systems

May/1992

Appendix 2

Detailed Information Sources

1. "Floodplain Management - District of Port Hardy". A memo report to J. D. Watts dated October 28, 1982, Files P77-8/0305030-18, summarizing the results of a field visit to Port Hardy by R. W. Nichols and A. A. Brown, Water Management Branch.

2. Project 88FDC-1, Field Survey, carried out in July, 1988 by Surveys Section, Water Management Branch, involving: 28 cross sections (3 bridges) on the Quatse River; 10 cross sections (2 bridges) on Boyden Creek; 7 cross sections and 7 culvert profiles on Spicer Creek; road profiles.

3. Project 82-023T, mapsheets at 1:5000 horizontal scale, 2 metre contours, produced by Surveys and Resource Mapping Branch (sheets 92L.063.4.3 and 92L.073.2.1), based on air photos flown in July and August, 1982

4. Hydrology Section Report entitled "Quatse River Peak Flows", File S2105, dated December 22, 1989, by W. Obedkoff, P. Eng.

5. Notes in Quatse River Design File dated November 25, 1991, from D. Barlow, P. Eng., regarding tsunami effects at Port Hardy.

6. "Ocean Flood Levels, Hardy Bay" by B. J. Holden, P. Eng., file 35100-30 dated January, 1993.

Appendix 3

Photos of Study Area
(December, 1992)

PHOTO 1

View looking west towards Pioneer Inn. Byng Road bridge crossing the Quatse River in the left side of photo.



PHOTO 2



Looking towards Prestwich property, located on east bank (right side of photo) upstream of Highway 19 bridge.

PHOTO 3



Finning Tractor Building, floodproofed pursuant to approval of July 1978 under Land Regristry Act Section 93(3).

PHOTO 4



Quatse River looking downstream from Byng Road bridge. Erosion protection works can be seen at the river bend.

PHOTO 5



Boyden Creek looking upstream from Development Road in tidal area.