

# Hardy BBT Limited

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

APPENDIX "D"

**ASSESSMENT OF  
FLOODING AND EROSION POTENTIAL  
OF  
COWICHAN RIVER  
NEAR RIVER BOTTOM ROAD**

Prepared For:

Cowichan Valley Regional District  
137 Evans Street  
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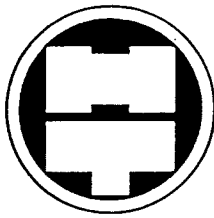
Attention: Mr. Tom R. Anderson  
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File No: NX00206

April 1989

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GEOTECHNICAL AND MATERIALS ENGINEERING — ENVIRONMENTAL MATERIALS AND CHEMICAL SCIENCES  
BONNYVILLE CALGARY EDMONTON FORT McMURRAY LETHBRIDGE LLOYDMINSTER MEDICINE HAT PEACE RIVER  
NANAIMO PRINCE ALBERT RED DEER REGINA SASKATOON VANCOUVER VICTORIA



# Hardy BBT Limited

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

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### ATTACHMENTS

COWICHAN RIVER FLOODING  
AND EROSION POTENTIAL .....Sheet 1 & Sheet 2

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## 1.0 INTRODUCTION

### 1.1 Purpose of This Study

The Cowichan Valley Regional District (CVRD) regulates zoning and building within their jurisdiction, which includes the River Bottom Road area along the Cowichan River upstream of Duncan, B.C. Local information, including the location of highwater marks on legal plans, indicates that the Cowichan River has changed its position substantially at various locations.

This historical evidence of erosion has raised the possibility that continued erosion and flooding of the Cowichan River in the River Bottom Road area may jeopardize construction and developments now being considered. The purpose of this study, therefore, is to assist the CVRD in regulating development by assessing the risk of erosion and flooding on this section of the Cowichan River.

### 1.2 Scope of Study

The proposed study is divided into two stages, namely:

1. The establishment of a hazard map showing areas where river erosion and flooding are likely to occur.
2. The establishment of flood levels along the valley suitable for stipulating building elevations.

This report addresses the Stage 1 portion of the overall study. Based on work conducted in Stage 1, recommendations for Stage 2 are presented (see Section 5.0).

In detail, the following items formed the terms of reference for this study:

- Carry out a study of river shifting, using available aerial photographs and maps for this section of the river. The aerial photographs shall extend back approximately thirty years from the present. Legal plans dating back to the early part of the century shall also be examined, and compared to the data provided by the aerial photographs.



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- Undertake a field reconnaissance to supplement data obtained from the aerial photographs/map study. The site visit will emphasize in particular those portions of the river that appear to have been active over the years.
- Assemble the information in the form of a plan or a series of plans of this portion of the river. The plan will identify areas considered to be high risk and areas considered to be low risk.

### 1.3 Study Area

The study area is located along a 13.6 kilometre reach of the Cowichan River upstream of Duncan, B.C. (Figure #1). The downstream end of the study area is situated where the boundary line between the Sahtlam District and the Quamichan District crosses the Cowichan River.

The upstream end of the study area is located at the western end of Block 2A in the Cowichan Lake Land District, immediately upstream of Marie Canyon.

## 2.0 METHODOLOGY

### 2.1 Office Investigation

Sets of aerial photographs were obtained and reviewed, as summarized in Table 2.1.

TABLE 2.1  
AERIAL PHOTOGRAPHY

DATE	SCALE	SOURCE
1958	1:26 000	National Air Photo Library (NAPL)
1972 07 03	1:18 300	B.C. Ministry of Environment
1986 05 30	1:10 800	B.C. Ministry of Environment



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These aerial photographs were used to delineate river channel changes with time, and locate topographic and vegetative indications of historical river locations. The aerial photographs were also examined stereoscopically to define lowland areas that may be subject to flooding, as well as high points of land such as the river valley wall or terraces which would likely constrain lateral movement of the river.

Topographic maps of the area were obtained from Wright, Hillyard, Parry & Fuller of Duncan, B.C. These maps, which were compiled by the British Columbia Department of Lands and Forests, Surveys and Mapping Branch in 1959 at 1:6 000 scale from 1958 aerial photography, had contour intervals of 10', 20' and 100 feet (3.0, 6.1 and 30.5 meters). The topographic maps were used to confirm 1958 river locations and interpretations from the aerial photographs.

Maps that show river locations at the time lots or parcels of land were surveyed were also reviewed. These included 1:5 000 scale cadastral mapping from the B.C. Ministry of the Environment, Surveys and Mapping Branch, and from the CVRD Planning Department.

The CVRD also provided a 1:12 000 scale base plan entitled "Sahtlam and parts of Seymour and Cowichan Lake Districts, Vancouver Island, B.C.", which was originally compiled by J.B. Davenport in 1940. This plan showed the location of the Cowichan River in relation to land boundaries in the area. These river locations were related to the results of the aerial photograph interpretation.

## 2.2 Field Work

The study area was inspected on January 6, 1989 by Gary R.E. Beckstead, P. Eng. of Hardy BBT Limited (HBT) and on January 8, 1989 by Mr. Beckstead, P. Eng. and Mr. W. Doug Pelly, P. Eng. of HBT. During these visits the river was accessed via River Bottom Road and from there via public access points. Along the river, the following general observations were made and photographically documented:

- nature of river bed and bank materials. The river bed is comprised of gravel to cobble and boulder materials. Bank materials range from sand and silts to gravel.



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- lateral erosion processes of the river. To confirm the interpretation of aerial photographs, the direction and nature of erosion at key locations was observed. Lateral erosion processes observed included:
  - \* erosion of the outside of meander bends and point bar buildup on the inside of bends,
  - \* downstream meander progression,
  - \* short-circuiting of meander loops through creation of cutoffs,
  - \* deflection of the channel by debris (log) jams.
  
- elevation of floodplain and terrace areas. General heights of landforms adjacent to the river channel were noted. Floodplain areas varied from approximately 1 to 2 meters above river level at the time of the site visits. In most areas, local variations in the floodplain topography were observed, including channel scar remnants and occasional man-made disturbances including roads/ditches and gravel pit excavations. Terrace levels greater than 3 meters above the river level were also observed.

### 3.0 RESULTS

#### 3.1 River Movement

Information on historical river locations obtained from maps and aerial photographs has been used to assess the potential for lateral erosion along the Cowichan River. This assessment indicates that the Cowichan River in the 13.6 kilometres long study area is laterally unstable. The lower portion of the river, in the vicinity of the mouth of Holt Creek, is fairly stable. In this lower 2.7 kilometres long reach, the river is confined by a narrow valley, and lateral shifting is negligible.



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The upstream reach, which is approximately 10.9 kilometres long is characterized by significant lateral erosion and channel switching. This movement is indicated by meander scrolls on the floodplains and recently-abandoned meander loops or "oxbow lakes". Continuing lateral activity is in evidence, as indicated primarily by active point bar development. The future direction of anticipated channel movement can be estimated from the historical pattern of river changes.

### 3.2 Flooding Potential

A preliminary assessment of flooding potential for this stage of the study indicates that significant flooding of the floodplain areas adjacent to the Cowichan River is possible. These flood prone areas include both presently developed and undeveloped lands. This flooding potential has been defined by the edge of the low lying floodplain areas where they meet the higher terrace or valley wall areas.

This assessment of flooding potential does not prescribe detailed flood elevations for specific sites or a detailed delineation of flood prone lands. Further detailed hydrologic, hydraulic and mapping studies would be required to provide this information.

### 3.3 Hazard Maps

A hazard map has been prepared (Drawing #1) for use as a first resource in assessing the flooding and erosion potential of specific developments along the Cowichan River. The hazard map delineates zones having varying flood and erosion potentials, namely:

- ZONE "A": represents lands which are UNCONDITIONALLY UNSUITABLE for development based upon the estimated potential for lateral erosion of the river with the CVRD's planning horizon (50 years).



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The actual river movement which will occur over a 50 year time span is dependent upon the sequence and magnitude of flood events and the occurrence of debris jams. Thus the delineation presented in Drawing #1 is a best estimate of future river movement based on historical patterns of movement and the present river configuration. The likely range in future river movement should be taken to fall within a band 30 meters each side of the Zone "A" boundary shown on Drawing #1.

It should be noted that river bank erosion control works would be required to prevent lateral movement of the river into these ZONE "A" areas. In general, however, placement of erosion control works on specific separate properties is not a desirable course of action for two reasons:

- a) control of lateral erosion at one point may result in shifting the attack on other adjacent properties. In a river as dynamic as the Cowichan, deflection of the river currents where bank protection works have been constructed may cause the river to shift its location and affect other properties. This is not to say that these other properties would not have been affected normally if the lateral movement of the river channel was allowed to continue. By restraining the movement at one point, however, the attack on an adjacent property may be accelerated.
- b) to be effective, control of lateral erosion may need to extend over a significant length of river bank. Therefore, where an individual property is affected, the required protection works may need to extend along other neighbouring properties to prevent outflanking of the erosion control works.





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- ZONE B: represents lands which are **CONDITIONALLY SUITABLE** for development based on an assessment of erosion and flooding potential.

Within this zone, lands are beyond the probable limits of river erosion within the 50 year planning horizon, but may be subject to flooding. In most instances, this flooding is expected to be characterized by low velocity or backwater areas, and not by fast-moving water. Additional detailed studies would be required to provide specific fill elevations for sites along the Cowichan River.

- ZONE C: represents lands which are **UNCONDITIONALLY SUITABLE** for development from a hydrological perspective. These lands lie beyond the zone of lateral erosion and flooding delineated on Drawing #1 and are not expected to be affected by these hazards within the 50 year planning horizon.

Site specific hydrologic and geotechnical studies may be required to define constraints or limitations on development, where the development is planned for areas within 30 meters of the boundaries shown in Figure #1.

### 3.4 Limitations of Hazard Maps

The hazard zones delineated on Drawing #1 are the result of a cursory study. Limitations of this mapping should be recognized, as follows:

1. ZONE "A" assumes no erosion protection is constructed to control river movement. The ZONE "A" boundary should be considered as a best estimate of future river movement.
2. ZONE "B" assumes no fill is added to limit flooding potential. The ZONE "B" boundary has been placed at the slope break between the low-lying floodplain and higher terraces or the valley wall. Thus the ZONE "B" boundary is not based upon a specified flood level for a designated flood discharge event.



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3. Given the limitations presented in 1 and 2 above, the hazard zones delineated on Drawing #1 should only be used as a preliminary guide to identify which areas are clearly subject to flooding and/or erosion and those which are not. It is not intended to replace detailed site-specific assessments or engineering investigations.

4. The zone boundaries shown on Drawing #1 have been established at various changes in topography and other physical features. No survey has been carried out to confirm that the legal boundaries shown are accurately located with respect to the physical features.

#### 4.0 CONCLUSIONS

4.1 Significant areas along the Cowichan River upstream of Duncan are subject to flooding and lateral movement (erosion and channel shifting).

4.2 Flooding and erosion potentials can be used as parameters to regulate development along the Cowichan River within the Cowichan Valley Regional District.

#### 5.0 RECOMMENDATIONS

5.1 It is recommended that the hazard zones delineated on Drawing #1 be used as a rough guide in regulating development along the Cowichan River. It should be used only to determine which land areas are clearly subject to flooding and erosion and those which are not.

5.2 It is recommended that Drawing #1 not be used to replace detailed site specific investigations or assessments. The delineations on Drawing #1 are based on a cursory assessment of flooding and erosion potentials.

5.3 It is recommended that residents along the Cowichan River be encouraged to observe and report changes in the river to the CVRD. If remedial actions become necessary in the future, such actions can be most economically carried out if they are planned and are undertaken in a non-crisis situation.



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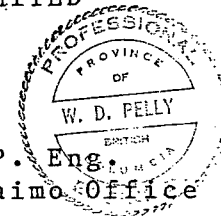
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5.4 Detailed hydrologic and hydraulic studies should be conducted to define 1:200 year flood water levels and resultant safe building/fill elevations for specific sites or reaches along the Cowichan River.

We trust this report contains the information required at this time. We look forward to being of further assistance on this project, and if there are any questions please contact us.

Yours truly  
HARDY BBT LIMITED

W.D. Pelly, P. Eng.  
Manager, Nanaimo Office

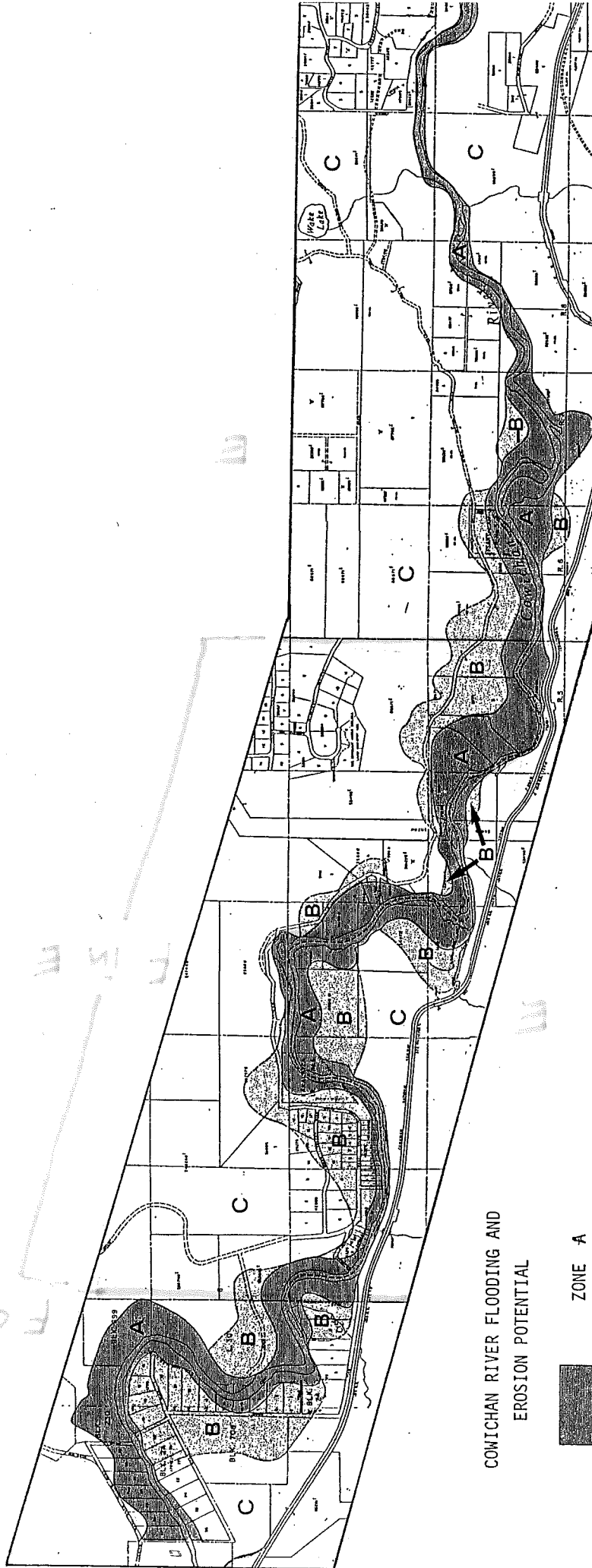


Reviewed by:

G.R.E. Beckstead, P. Eng.

WDP/GREB/djc  
Encls.

F G C P  
F I A E C P



COMICHAN RIVER FLOODING AND  
EROSION POTENTIAL

	ZONE A
	ZONE B
	ZONE C