



Nanaimo Forest Products Ltd.
HARMAC PACIFIC Division

Fourth Nanaimo Lake Dam Operation, Maintenance, Surveillance (OMS) and Emergency Preparedness Plan (EPP) Manual



Fourth Nanaimo Lake Dam Operation, Maintenance, Surveillance (OMS) and Emergency Preparedness Plan (EPP)

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Emergency Communications Chart

Observer

NFP Harmac Pacific Maintenance Supervisor

Gerry Turner

(Handles Emergency – Makes All Calls)

If not available call Engineering or General Maintenance Superintendent

Office: 250-722-4286 Home: 250-749-3370 Cell: 250-713-4348

NFP Harmac Pacific Engineering Superintendent

Ryan Prontack

Discuss Emergency situation and possible actions

Office: 250-722-4237 Home: 250-754-1979 Cell: 250-714-4787

or

NFP Harmac Pacific General Maintenance Superintendent

Dave Hooper

Discuss Emergency situation and possible actions

Office: 250-722-4346 Home: 250-716-1350 Cell: 250-713-0751

CEO and General Manager, NFP Harmac Pacific Division

Paul Sadler

Confirm proposed actions per Section 4.2

Office: 250-722-4200 Home: 250-758-4973 Cell: 250-618-6642

Royal Canadian Mounted Police

911 Emergency

Commence evacuation

RCMP Nanaimo Office: 250-754-2345

Regional District of Nanaimo 24 hour: 250-390-4111

Jani Drew

Emergency Coordinator – Regional District response

Office: 250-390-6526 Home: 250-753-8511 Cell: 250-713-2057

Alternate #1 **Jack Eubank** Cell: 250-713-4872

Alternate #2 **Brian Brack** Cell: 250-714-3987

City of Nanaimo

Karen Lindsay

Emergency Program Manager – City response

24 hour: 250-713-7708 Office: 250-755-4572 Cell: 250-713-7708

Alternate #1 **Toby Seward** Director Social and Protective Services

24 hour Cell: 250-713-6595

Alternate #2 **Craig Richardson** Fire Chief Office: 250-714-2196

Emergency Management British Columbia

1-800-663-3456 – Emergency ask for Duty Regional Manager

Coordinate Provincial Government response

Ralph Mohrmann

Vancouver Island / Victoria Office: 250-952-4895

Vancouver Island Regional Manager

Clare Fletcher

Office: 250-952-4904 Cell: 250-812-5682

Transport Canada

Nanaimo Airport

24 hour: 250-755-5791 Office: 250-245-2157

and

BC Ministry of Transportation & Infrastructure

Johnathon Tillie

Emcon Services: 1 866-353-3136 / Office: 250-751-3287



City of Nanaimo / Manager Water Resources

Bill Sims

24 hr: 250-758-5222 Office: 250-756-5302 Cell: 250-714-3568
Alternate #1 **Ritchie Fulla**, General Foreman – Waterworks
24 hr: 250-758-5222 Office: 250-756-5324 Cell: 250-751-5731
Alternate #2 **Geoff Goodall**, Director, Engineering and Public Works
24 hr: 250-758-5222 Office: 250-756-5301 Cell: 250-816-6599

and

Timberwest

Main Gate – Dam Access

Glen Waatainen, RFT - Contract Manager
Office: 1-250-716-3769 Cell: 1-250-709-5766
Patti Pearce, TimberWest Front Desk(South Island) 1-250-716-3700
Richard Stevens, RFT - TimberWest Engineer
Office: 1-250-716-3723 Cell: 1-250-709-1097
Haul Road Radio Frequencies:
Timber West Haul: 153.110 PL Tone 203.5
Island Timberlands: 172.3650 PL Tone 127.3

Head, Dam Safety Section, BC Ministry of FLNRO

Scott Morgan

Office: 250-387-3265 Home: 250-595-1993 Cell: 250-380-8849

Monty Miedreich – Senior Dam Safety Officer

Office: 250-387-3264 Home: 250-361-8526 Cell: 250-361-8526

or

Water Stewardship Officer (Nanaimo), BC Ministry of FLNRO

John Baldwin

Office: 250-751-3179 Home: 250-756-4977 Cell: 250-668-2450



Preface

This Operation, Maintenance, Surveillance (OMS) and Emergency Preparedness Plan (EPP) Manual was prepared to establish, in one central reference document (with associated supporting documents), comprehensive, accurate, current, structure-oriented operating instructions for each dam and reservoir and related structures. The purpose is to ensure adherence to approved operating procedures.

This manual is prepared primarily for the use of the person or persons (dam tenders) located at or nearest to the dam and immediate supervisors who are assigned responsibility for the physical operation and maintenance of the dam. Additionally, this manual contains information and instructions that will permit responsible persons who are knowledgeable in reservoir operation but are unfamiliar with the conditions at this particular dam to operate the dam and reservoir during emergency situations and at such times when the regular operator cannot perform their normal duties.

The dam tender for the Fourth Nanaimo Lake Dam is the Mill Water Attendant for the Nanaimo Forest Products Ltd., Harmac Pacific Division mill. The dam is unattended except during routine visits by the Mill Water Attendant. The Mill Water Attendant's copy of the manual is kept at the Primary Pumphouse on the Nanaimo River.

Background (see Section 3.1)

Up until 1995, the Province of BC completed yearly inspections of the dam. In addition, the Mill Water Attendant, the Maintenance Supervisor, and the Engineering Department have historically completed regular inspections to confirm the integrity of the dam and repaired the dam as needed. In February 2000, under the Water Act of BC, new Dam Safety Regulations were proclaimed, and these detail dam owner's responsibilities for operation and maintenance, alterations, inspections, reporting, safety reviews and dealing with hazardous conditions. (The Province of BC may still complete spot inspections of the dam at their discretion). This manual has been updated to address the new regulations, which are included in Appendix D. The Government of BC downstream consequence classification of the Fourth Nanaimo Lake Dam is "high."



Section 1 - General Information

1.1 General Description and Purpose of Fourth Nanaimo Lake Dam

Constructed in 1952, the Fourth Nanaimo Lake Dam is a 22 m (72 ft) high by 210 m (689 ft) long concrete faced, rockfill dam, located near the original outlet of Fourth Nanaimo Lake on Sadie Creek, a tributary of the Nanaimo River. The dam is 0.6 km upstream of the joining of Sadie Creek and the Nanaimo River. The general arrangement of the dam is shown on Figure 9 (Drawing B73540) with details provided on Figures 3 and 4. A 45 m (148 ft) wide un-gated concrete spillway is situated on the west abutment.

The purpose of the Fourth Nanaimo Lake Dam is to store water for dry season use by Nanaimo Forest Products Ltd., Harmac Pacific Division. In the summer and early fall months water is discharged from the reservoir to augment low flows in the Nanaimo River, which serves as a water supply source for the Mill. In addition, extra water is normally discharged up to twice per year for fisheries enhancement. The mill's river wells and intake pumps are located approximately 8 km south of the mill and approximately 40 km downstream (east) of the dam.

The Government of BC downstream consequence classification of the Fourth Nanaimo Lake Dam is "high."

1.2 Dam Access Information

1.2.1 Location

The Fourth Nanaimo Lake Dam location is shown on Figure 2 (in drawing pocket):

Latitude and Longitude: 49°05'N
 124°24'W
 Grid Zone Designation:..... 10 U CK 975367
 Map Sheet: 92 F/1 (1:50,000 scale)

1.2.2 Access Route

Travel south from Nanaimo on Highway 1 and take the Nanaimo Lakes exit (west). This exit is 3 km north of the Nanaimo (Cassidy) Airport. Follow this road for 45 km to reach the dam as shown on Figure 1. Alternatively, to reach the Valve House, stay on the main road at km 44 and continue 1 km.

Km	Feature Along Nanaimo Lakes Road	Km	Feature Along Nanaimo Lakes Road
0	Highway 1 exit - 2 lane paved road	30	Timberwest Forest Ltd. Gate #2
22	Start gravel road		(only open as indicated Sec. 1.2.4)
24	Timber West Forest Ltd. Gate #1 (start 1½ lane paved road)	40	Cross Nanaimo River "TP" Bridge Gate #3
28	Campsites	42	Green River junction – keep right
29	Nearest cabins to dam	44	Turn left
		45	Fourth Nanaimo Lake Dam

1.2.3 Alternative Road Routes

In an emergency, machinery could be brought to the site from Lake Cowichan and Nitinat on logging roads. From Nitinat the route follows the Nitinat River north to a point west of Fourth Nanaimo Lake. From here a secondary road, in good condition, connects to the Nanaimo Lakes access road as shown on Figure 2. This road has 2 gates that require different keys from Nanaimo Lakes Keys.



1.2.4 Evaluation of Route

From Gate #1 the road is on Timberwest Forest Ltd. property. The road beyond this gate may be open to the public weekdays between 7:00 am and 4:30 pm. During weekends and holidays, the Timberwest Gate Attendant can be contacted at the contact number shown in the Communications Directory (Section 5). Nanaimo Forest Products Ltd., Harmac Pacific Division' Mill Water Attendant and Maintenance Supervisor have keys that open all three of the gates on the way to the dam from the Nanaimo side and the Cowichan/Nitnat Side.

The road is paved except for a section between km 20 and km 22, and the last 0.7 km from the turnoff to the dam crest. The road is not always snowplowed in the winter. Timberwest has just installed a new bridge over Sadie Creek at the west end of Fourth Lake and will now be actively logging in that area.

1.2.5 Other Access Methods

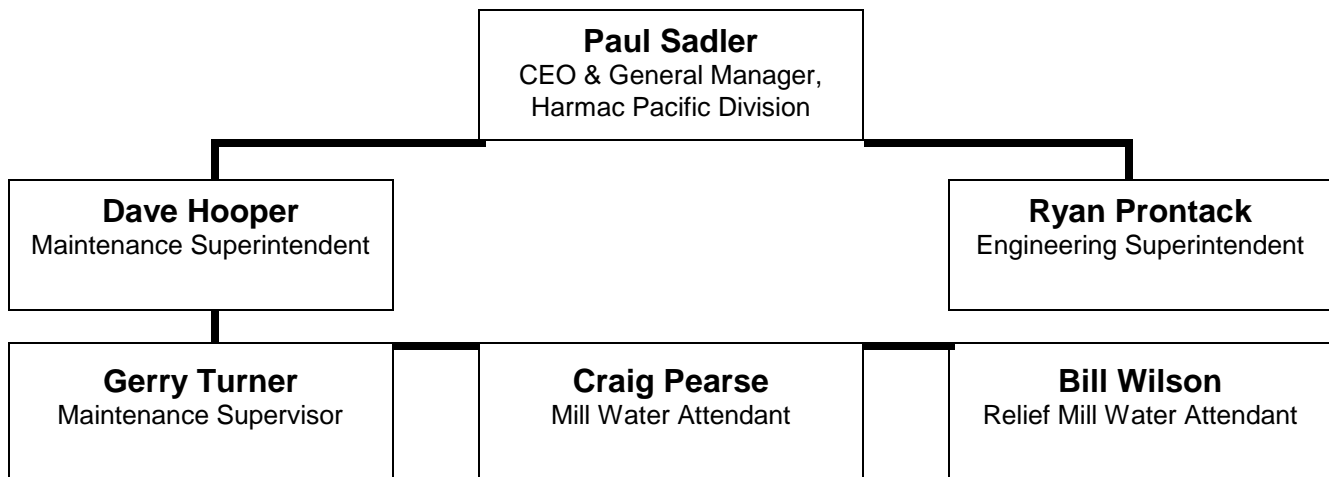
A helicopter or SnowCat could be used as alternative transportation, if necessary. The contact numbers are shown in the Communications Directory (Section 5). A helicopter can land on the dam or on the roads nearby and a floatplane can land on the reservoir, providing the reservoir is full.

1.2.6 Nearest Airport

Nanaimo (Cassidy) Airport located 3 km south of the Highway 1 exit to Nanaimo Lakes is the nearest airport to the dam site.

1.3 Assignment of Responsibility

An organization chart indicating the administrative structure as it applies to responsibility for the dam is illustrated below:





1.4 Dam Attendant

The dam is normally unattended, except for weekly inspection and operation visits by the Mill Water Attendant. Weekly visits are completed all year long except when the dam access roads are impassible due to snow or other obstacles.

Sections 2, 3 and 4 of this manual describe the Mill Water Attendant's duties in detail.

The Mill Water Attendant is normally stationed at the Nanaimo River Primary Pumphouse shown on Figure 1 attached (7:00 am – 3:30 pm weekdays only). *Note: No permanent telephone or radio facilities are located at or near the dam site; however, the Mill Water Attendant has a portable cellular/satellite telephone and VHF radio equipment as listed in Section 5 of this manual.*

1.5 Training

Relief and/or new personnel receive on-the-job training by the Mill Water Attendant under the supervision of the Maintenance Supervisor. This method is known as the "buddy system." The skills of existing personnel are maintained by a thorough annual review of the Operation, Maintenance, Surveillance and Emergency Preparedness Plan Manual for the Dam.

1.6 Data Reporting and Dam Records

The following sources of recorded information relate to operation and maintenance matters:

Title	Location	Update
Operating Log	Primary Pumphouse	Daily
Monthly Mill Water Usage	Primary Pumphouse	Daily
Nanaimo River Data	Maintenance Department	Monthly
Dynamic's System	Maintenance Department	As Required
Engineering/Maintenance Files	Engineering/Maintenance Departments	As Required

1.6.1 Operating Log

The Operating Log covers all Mill Water operations and is maintained by the Mill Water Attendant at the Primary Pumphouse. Records pertaining to the dam are entered whenever the dam is visited. The following items are recorded:

- Lake (reservoir) elevation.
- Spillway discharge.
- Valve settings and release rates.
- Dam seepage rate.

1.6.2 Monthly Mill Water Use

Table 1 is a facsimile of the form that is used to summarize and monitor mill water use. The tabulated data includes:

- Lake (reservoir) elevation.
- Fourth Nanaimo Lake valves settings.
- Controlled lake release rate.
- Nanaimo River flow at Granby Gauge (upstream of the pumphouse).
- Nanaimo River use.
- Nanaimo River residual flow.
- Nanaimo River temperature.
- Total mill water use.
- Groundwater pumping rate.



1.6.3 Nanaimo River Data

Every month during the period that Fourth Nanaimo Lake water is being released through the tunnel, the Maintenance Supervisor normally updates a graph that illustrates the following data:

- Actual lake elevation (recorded weekly).
- Days of mill water reserve at present rate of draw down (recorded weekly).
- River flow at Granby Gauge (recorded daily).
- Residual Nanaimo River flow (recorded daily).
- Mill usage (recorded daily).
- Target for residual Nanaimo River flow (recorded daily).
- Release from Fourth Nanaimo Lake (recorded daily).

1.6.4 Dynamic's System

The Dynamic System is host for maintenance work orders and mill procurement functions. Information stored in dynamics includes:

- Periodic Preventive Maintenance (PM) work orders.
- Work orders for substantial repairs.
- Materials or services procured as part of work orders.

1.6.5 Engineering and Maintenance Files

Records of major inspections and project work are kept in the Engineering Department. Records of weekly and monthly inspections and minor repairs are kept in the Maintenance Department.

1.7 **Safety**

In the interests of public safety the tunnel, the valve house and dam sluice outlet works are kept locked. A log boom is maintained immediately upstream of the spillway to keep boaters and swimmers a safe distance away and to capture debris before being washed into the spillway.

Bears frequent the area surrounding the reservoir and all personnel working in the area must be reminded to take appropriate precautions.

The RCMP are responsible for responding to drowning and major accidents. Any suspected drowning or major accidents shall be reported to the RCMP.

The Mill Water Attendant will also report any other hazardous situations.

1.8 **Restricted Areas**

There are no restricted areas, except as noted in Section 1.7.

1.9 **Revision/Distribution of Fourth Nanaimo Lake Dam Manual**

The Engineering Superintendent or delegate is responsible for updating, revising and distributing the Fourth Nanaimo Lake Dam OMS and EPP Manual and recording the location of each copy. The Communications Directory should be reviewed on a semiannual basis and updated if required. Each recipient of the Manual should receive dated revision sheets as they are produced. The Distribution List is provided in Appendix A.



1.10 Reference Material

The following documents, also located in the Nanaimo Forest Products Ltd., Harmac Pacific Division Engineering records, provide additional historical information about the dam:

1.10.1 Construction Drawings

Entitled Mill Water Supply, HA Simons, Consulting Engineer, dated 1951 – A list of these and other drawings is provided in Appendix B.

1.10.2 Construction Photographs

Black and White, 8" x 10" size.

1.10.3 Comments and Letters

By Karl Terzaghi regarding the plans and specifications for the Dam, dated 1951.

1.10.4 Report

Entitled “Geology of Fourth Nanaimo Lake Tunnel and Dam Site,” by Victor Dolmage, Consulting Geologist, dated November 28, 1950.



Section 2 – Reservoir Operations

2.1 Description of Hydraulic Structures

Regulated flow is released directly to the Nanaimo River via a tunnel from the lake bottom. The flow rate is regulated at the Tunnel Valve House and control is achieved by throttling a battery of manually operated gate valves. The tunnel plan and profile are shown on Figure 4. A tunnel sluice gate is located at the edge of the reservoir. Between mid-November and mid-May the tunnel is drained for frost protection.

The only other flow control is a dam sluice (low level outlet through the dam) that can be used to draw down the lake to the base of the dam. This valve is usually left slightly open to maintain a nominal flow in Sadie Creek. Details of the dam sluice are shown on Figure 5.

Floating debris that finds its way to the spillway is caught by boom-sticks and held until removed and trucked away. Note that burning debris on the downstream bank of the dam is prohibited – the intense heat generated by slash piles will degrade the rock face.

2.2 Reservoir Operating Procedures

Under consultation and direction of the Maintenance Supervisor, the Mill Water Attendant is responsible for controlling dam releases through the tunnel and dam sluice. The tunnel discharge is estimated using the method described in Figure 6, from the discharge pressure and tunnel valve openings. The dam sluice discharge is estimated by measuring the depth of water in the discharge conduit. The overall Nanaimo River flow is measured at the Granby Gauge, about 1 km upstream of the Nanaimo River pumphouse. The flow below the pumphouse is calculated by subtracting the mill river water consumption from the Granby Gauge reading.

There are some restrictions and guidelines on reservoir operation. As both Harmac Pacific and the City of Nanaimo maintain reservoirs on the Nanaimo River system, both are responsible for maintaining minimum flow guidelines set out by government agencies. The Department of Fisheries and Oceans Canada requires that the residual flow below the Nanaimo River pumphouse must be at or above 1.38 cms (49 cfs) at all times. As Harmac's portion of this is 1.10 cms (39 cfs), the tunnel discharge must be adjusted accordingly. In addition, if Fourth Nanaimo Lake storage is ample, the 1993 Province of BC Nanaimo River Water Management Plan guidelines require that Harmac Pacific's summer and early fall discharges are increased to meet fisheries flow targets. Discharges to the Nanaimo River are only required when the residual flows drop below the specified amounts – typically between July and October. Refer to Appendix C for *Provisional Operation Guidelines – Fourth Nanaimo Lake Reservoir*. Note: Actual increased discharges are mutually decided on and may differ somewhat from the Provisional Operation Guidelines. As well as controlling the tunnel discharge to meet mill and fisheries requirements, a flow of about 0.14 cms (4.9 cfs) is released from the dam sluice to maintain a flow in lower Sadie Creek.

The lake is normally kept as full as possible, but by late summer or early fall it can be as low as elevation 305 m (1,000 feet). The lowest possible lake elevation is 285.3 m (936.0 feet), equal to the tunnel invert. The bottom of the lake is approximately 2.0 m (6.6 feet) below this point. The spillway elevation is 316.7 m (1039 feet). If the lake elevation is known, the stored water volume may be read from the graph on Figure 7. During years of low precipitation and water shortage, the Water Forecast Procedure (1983 - Engineering file 69-1), may be used to determine the "mill operating days remaining" based on the reservoir level. The settings of the outlet valves would have a negligible effect on maximum reservoir levels during extreme floods and therefore there is no need for inflow forecasting or attendance at the dam during flood events.



2.3 Detailed Operating Instructions

There are three sets of control valves at the dam but only the valves located at the Tunnel Valve House are regularly manipulated. All valves are manually operated plus the tunnel sluice gate can also be operated with a portable power wrench.

2.2.1 Operation of Tunnel Discharge Valves

When Nanaimo River flows are approaching the minimum levels permitted by the Provisional Operation Guidelines described above, water is released from Fourth Nanaimo Lake. The control valves are located in a locked valve house situated on the south bank of the Nanaimo River just north of the dam.

A copy of the valve rating table, giving valve combinations to produce the desired release for various pressures (reservoir elevations) is reproduced in Figure 6. Water pressure in psi is indicated by the gauge in the tunnel sluice valve house. All of the gate valves on the tunnel discharge manifold, except for the 30-inch valve, are operated in a fully open or fully closed position. The latter valve has a mechanical pointer that indicates approximate flow through this valve when it is partially open. There are six valves:

- one.....6 inch (150 mm) diameter
- two.....12 inch (300 mm) diameter
- two.....18 inch (450 mm) diameter
- one.....30 inch (750 mm) diameter

2.2.2 Operation of Dam Sluice (low level outlet)

The dam sluice valve is located at the base of the dam on the downstream side. The valve house is locked. It contains a single 30-inch (750 mm) diameter gate valve that is normally slightly open to permit the nominal flow of 0.14 cms (4.9 cfs) in Sadie Creek.

2.2.3 Operation of Tunnel Sluice Gate

The tunnel gate is operated from a housing situated on the northwest edge of Fourth Nanaimo Lake. This gate is normally closed once per year in the fall for the purposes of draining the tunnel and the wood stave tail pipe. This prevents damage due to freezing. The gate is opened in the spring after the danger of frost is past. The tunnel sluice would also be closed for maintenance on the tunnel discharge valves or in the case of a failure in the wood stave tail pipe.

Opening of the tunnel sluice gate must be completed in two stages due to the high water pressure on it. A small wicket gate on the surface of the main gate facilitates the two-stage operation. To open the main sluice gate the single 6" control valve at the tunnel discharge is opened to release air (and prevent water hammer) and then the tunnel is flooded by closing the downstream discharge valves and opening the small wicket gate. When flooding is complete the main sluice gate can be opened and the 6" control valve closed. The hand crank for this sluice is also operated with a portable, electric wrench. This equipment is also in the care of the Mill Water Attendant.

2.4 Flood Study (by Ker, Priestman and Associates, 1986)

The Probable Maximum Flood (PMF) is an estimate of a hypothetical flood that is considered to be the most severe “reasonably possible” at a particular location based on relatively comprehensive hydrometeorological analysis of critical runoff-producing precipitation and hydrologic factors. The 200 Year Frequency Flood is a smaller flood that, on average, would occur once every 200 years. The probability of the 200 Year Frequency Flood being exceeded in any given year is 0.005. Both the PMF and 200 Year Frequency Flood were evaluated in the flood study in order to assess spillway capacity.



As there are no gauges at the dam site the flood study relied on analysis of data from surrounding gauged creeks and rivers, including the following Water Survey of Canada (WSC) stream gauging stations.

Station #	WSC Station Name	Catchment Area (Km ²)
08HB041	Jump Creek at the mouth	62.2
08HB003	Haslam Creek near Cassidy	95.6
08HB024	Tsable River near Fanny Bay	113.0
08HB027	Millstone River near Wellington	46.1
08HB034	Nanaimo River near Cassidy	684.0
08HB048	Carnation Creek at the mouth	10.1
08HB022	Nile Creek near Bowser	15.0
08HB009	Stamp River near Alberni	456.0
08HB008	Sproat River near Alberni	347.0
08HB016	Bings Creek near the mouth	15.5
08HB002	Englishman River near Parksville	324.0

Probable Maximum Flood and 200-Year Return Flood values were estimated for the above stations then transposed to the 28.0 km² catchment of the Fourth Nanaimo Lake Dam. Appropriate PMF and 200 Year Frequency Flood inflows to Fourth Nanaimo Lake were selected from the above range of estimates by comparing geographic settings of the studied catchment with the Fourth Nanaimo Lake catchment. These inflows were then routed through Fourth Nanaimo Lake to determine spillway discharge rates and maximum flood levels in the lake.

The maximum useful lake volume for flow augmentation purposes is 38,600,000 m³ (31,250 acre feet) which corresponds to the spillway crest elevation of 316.7 m (1,039 feet). Live storage above this point is required for flood routing. At the dam crest the total storage volume is 43,500,000 m³ (35,250 acre feet). A summary of the assumptions and results of the flood study follows.

Assumptions	PMF	200 Year
• Flood Duration hr.	120	105
• Initial lake elevation m (ft.)	317.0 (1,040)	317.0 (1,040)
• Outlet Works Valves	Closed	Closed
Results	PMF	200 Year
• Peak Instantaneous Inflow m ³ /s	348	139
• Peak Daily Inflow m ³ /s	196	78
• Peak Instantaneous Routed Outflow m ³ /s	284	105
• Maximum Lake Elevation m (ft.)	318.7 (1,045.6)	317.8 (1,042.36)
• Freeboard to Dam Crest m (ft.)	0.4 (1.4)	1.3 (4.4)

Figure 8 illustrates the above flood hydrographs and indicates the attenuating effects of routing through the lake. The design flood could be expected to occur during the fall and winter period, as a result of very intense precipitation on snow-pack.

PMF and 200 Year Frequency Flood estimates were determined by the Herschfield formula and Gumbel extrapolations, respectively. The Herschfield formula is frequently used by BC Hydro engineers to obtain approximate estimations of PMF. In our applications we have found it to provide reasonable estimates. Gumbel is a well-respected method of extreme value frequency analysis, satisfactory for the present application. The above techniques were utilized to determine flood flows simply for the purposes of evaluating the existing spillway capacity. Minimum freeboard during a PMF would be approximately 0.4 m (1.4 feet). Minimum freeboard remaining during a 200-year return period event would be approximately 1.3 m (4.4 feet).



Section 3 – Inspections and Maintenance

3.1 Background

Up until 1995, the Province of BC completed yearly inspections of the dam. In addition, the Mill Water Attendants, the Maintenance Supervisor, and Engineering Department personnel have historically completed regular inspections to confirm the integrity of the dam and repaired the dam as needed.

In February 2000, under the Water Act of BC, new Dam Safety Regulations were proclaimed, and these detail dam owner’s responsibilities for operation and maintenance, alterations, inspections, reporting, safety reviews and dealing with hazardous conditions. (The Province of BC may still complete spot inspections of the dam at their discretion). This manual has been updated to address the new regulations (included as Appendix D). The Government of BC downstream consequence classification of the Fourth Nanaimo Lake Dam is “high” – the required inspection activities and frequencies are summarized in the table below.

BC Dam Safety Regulation Minimum Frequency of Safety Activities

“EPP” means the emergency preparedness plan for a dam; “formal inspection” means a thorough on-site inspection performed by the representative of the dam owner who is responsible for dam safety; “OMS manual” means the operation, maintenance and surveillance manual for a dam; “site surveillance” means the close monitoring of dam behavior through visual inspections and, in addition, may include the systematic collection, analysis and interpretation of data obtained through automated instrumentation.

Column 1 sets out an activity that must be carried out by a dam owner under a provision in this regulation and columns 2, 3, 4 and 5 set out the minimum frequency with which the activity must be carried out for each classification.

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	Activity	Frequency of activity			
		Extreme classification	Very high and high classifications	Significant classification	Low classification
1	Site surveillance	Weekly ¹	Weekly ¹	Monthly ¹	Quarterly
2	Formal inspection	Semi-annually	Annually	Annually	Annually
3	Monitor instrumentation	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	If and when required by a dam safety officer
4	Test operation of outlet facilities, spillway gates and other mechanical components	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually
5	Update the emergency contact information in the EPP	Annually	Annually	Annually	Not applicable
6	Review, and revise if necessary, the OMS manual and the EPP	Every 7 years	Every 10 years	Every 10 years	Not applicable
7	Conduct dam safety review and submit dam safety report	Every 7 years	Every 10 years	Not applicable	Not applicable
8	Review downstream conditions, as set out in section 6.1, and notify a dam safety officer of any change in classification	Annually	Annually	Annually	Annually

¹ The frequency of visual inspections may be reduced if provided for in the OMS manual.



3.2 Inspections

The Mill Water Attendant completes weekly site surveillance checks all year except when the dam is inaccessible due to snow or other such conditions. The results of these checks are recorded on checklist sheets for each month and kept in the Maintenance Supervisor's office. See Section 6 for an example checklist sheet. The Mill Water Attendant also completes semi-annual inspections of the concrete dam face panel seals by boat.

Every year, the Maintenance Supervisor initiates a formal inspection. This exercise includes inspection items as well as test operation of all mechanical dam components. As with the weekly site surveillance checks, the formal inspection results, including photos, are recorded and kept in the Maintenance Supervisor's office. See Section 6 for an example checklist sheet.

In addition to the preceding inspections, the Maintenance Supervisor initiates underwater (diving) inspection of the concrete dam face, tunnel inlet, tunnel inlet works and sluice inlet at intervals of approximately five years or sooner if there is reason to believe a problem exists.

There are currently no piezometers or other instruments for measurement of settlement or movement at the dam. The Province of BC installed settlement-measuring instruments in 1977 to watch for settlement, but this practice was discontinued in 1985. While dam settlement was also measured by Harmac personnel in the distant past, the datum points no longer exist. A settlement survey was performed for Harmac in 2000 by AMEC Earth and Environmental Limited using limited historical data, and new datum points for future monitoring were established. Based on the minimal settlement experienced from 1952 to 2000, settlement surveys need only be completed at five-year intervals, or after major events such as earthquakes. These surveys will be initiated by the Engineering Superintendent, and records will be kept in the Engineering Department vault.

3.3 Dam Safety Review

A thorough Dam Safety Review (DSR) is completed at ten-year intervals per Schedule 2 of the BC Dam Safety Regulations. In addition, a Dam Safety Review shall also be carried out in the event of any of the following:

- major modification to the original design or design criteria;
- discovery of an extremely unusual condition;
- decommissioning;
- after an extreme hydrological or extreme seismic event.

A typical Dam Safety Review includes reviews of historical records, field inspections, laboratory testing, engineering evaluation, and safety evaluation. See Appendix D for DSR guidelines. A DSR was completed through AMEC Earth and Environmental in 2002, and The Engineering Superintendent is responsible for initiating the next DSR in 2012. DSR records are kept in the Engineering department vault.

3.4 Maintenance and Repairs

The Mill Water Attendant and Maintenance Supervisor are responsible for routine dam maintenance and repair tasks. When the scope of these tasks becomes large or complex, the Engineering Department or outside consultants may be involved.

Deficiencies identified by weekly site surveillance or yearly formal inspections may be addressed as described in Appendix E – *Identifying Problems and Solutions: A Self Help Guide (BC Dam Safety Guidelines)*.



3.5 Construction Materials, Equipment, Labour and Engineering Expertise

Nanaimo Forest Products Ltd., Harmac Pacific Division employs skilled workmen, technicians and engineers who will respond quickly in the event of an emergency at Fourth Nanaimo Lake Dam. Outside consultants and contractors (listed in Section 5 – Communications Directory) may also be retained as necessary and appropriate.

3.5.1 Materials, Equipment and Contractors

A source of sand and gravel near the dam is shown on Figure 1. There is no equipment located at the dam site. Heavy excavation equipment and supplies may be obtained by contacting the companies listed in the Communications Directory, or others as may be required.

3.5.2 Engineering Expertise

Qualified engineering consultants are listed in the Communications Directory.

3.6 Fish Stream Considerations

Any changes in and about a stream are subject to the Water Act and must conform to Section 9 of the Water Act, and Part 7 of the Water Act Regulations. Please refer to Appendix F – *Standard Operating Procedures for Works In or About a Stream*.



Section 4 - Emergency Response

4.1 Emergency Communications Chart for Dam Breach

In case of emergency, notification of personnel and agencies will proceed according to the chart on Page 1.

4.2 Emergency Procedures

The following emergency plan sets out instructions to Nanaimo Forest Products Ltd., Harmac Pacific Division' personnel in the event of an emergency at the dam. It describes:

- initial actions and observations to be taken;
- organizations and persons to be notified;
- remedial or alleviating actions to be initiated, and
- resources available.

The procedures are designed to prevent or minimize loss of life and/or property damage resulting from an emergency at the dam. In case of an emergency affecting the safety of the dam, procedures for initiating warning of endangered downstream populations are specified, consisting essentially of notification of local emergency agencies.

This subsection describes possible emergency situations and response procedures.

4.2.1 Dam Breach, Incipient Dam Breach or Potential Dam Breach

A dam breach is defined as a dam failure that results in large or rapidly increasing uncontrolled releases of water from the reservoir. An *incipient dam breach* is a dam breach that is just beginning to exist. A *potential dam breach* is defined as any condition that poses an immediate threat to the integrity of the dam, which could result in a dam breach.

If the Mill Water Attendant believes that a breach may form or has formed and that the worst of the flood wave is to follow, the Attendant shall, as soon as possible, contact the Maintenance Supervisor. The Supervisor shall ascertain and verify details of the threat from the Attendant as follows:

- description of slides, sloughs, subsidence, movement, cracking, seeps, drainage, etc.
- location and extent
- likelihood of deterioration
- reservoir elevation
- weather conditions
- in the case of a developing breach the Supervisor shall ascertain its size, rate of enlargement and, if possible, an estimate of the rate of increase in flow.

If the Maintenance Supervisor concurs that a threat of dam breach exists, the Supervisor shall proceed to the site as quickly as possible with portable communications equipment. In the case of incipient breach the Supervisor shall determine and implement actions that reduce or eliminate the risk of full breach by contacting the General Maintenance Superintendent or the Engineering Superintendent to discuss findings and possible alternative actions.



If a breach or incipient breach situation is confirmed the Supervisor shall inform the Nanaimo Forest Products Ltd. General Manager, Harmac Pacific Division of the situation and contact the RCMP and Emergency Management British Columbia (EMBC) to request an evacuation of the low-lying areas of the Nanaimo River. The Emergency Communications Chart (Page 1) is to be followed for contacting individuals and agencies. A full inundation study, defining the limits of flooding in case of a dam breach, has not been completed at this time; however, the 200 Year Frequency floodplain maps 84-29-1, -2, and -3 (Figure 10) may be used to prioritize evacuation areas downstream of the Nanaimo River highway bridge.

4.2.2 Earthquake

When there has been a report of a significant earthquake the Maintenance Supervisor and/or the Engineering Superintendent shall immediately conduct a general overall inspection of the dam and proceed as follows:

- **Major Damage:** If damage has occurred such that there is a large or rapidly increasing uncontrolled flow passing downstream or there is an immediate threat to the integrity of the dam (e.g., significant increases in seepage, cracking or slumping of dam fill or major cracks in the spillway), implement Response to Dam Breach or Potential Dam Breach described in Section 4.2.1.
- **Minor Damage:** If damage has occurred which does not present an immediate threat to the safety of the dam (e.g., small cracks or displacements, small increase in seepage flow or small rockslides) the Supervisor shall:
 - ✓ conduct a thorough re-inspection of the dam with the Engineering Superintendent
 - ✓ develop an action plan with input from Engineering personnel
 - ✓ continue inspection and close monitoring of the facilities for 48 hours
 - ✓ conduct a secondary inspection two weeks to a month after the initial inspection.
- **No Damage:** Even if no damage is evident in an initial inspection the Maintenance Supervisor may wish to continue inspection and close monitoring of the facilities having regard to the recorded intensity of the earthquake.

4.2.3 Landslides

If the Mill Water Attendant observes any landslide movement or evidence of recent landslide the Attendant shall notify the Maintenance Supervisor who shall determine:

- exact location
- estimated size
- possible effect on operation of dam

and decide whether the Potential Dam Breach procedure set out in Section 4.2.1 should be implemented. In addition, the Supervisor shall notify Government of BC authorities as described in Appendix G – *Notification of Landslides or Debris Flow*.

4.2.4 Sabotage and Bomb Threat

- **Sabotage:** If there are indications that an act of sabotage has been committed, the Mill Water Attendant shall:
 - ✓ ensure safety of the public at or near the dam
 - ✓ determine if saboteur is still at the dam; assess potential for further sabotage
 - ✓ notify the RCMP.
 - ✓ if the saboteur has left, check the area for evidence that might aid in apprehending the culprit.



- **Bomb Threat:** If a telephoned bomb threat is received, the person receiving the call shall:
 - ✓ Keep the caller on line as long as possible. Ask the caller to repeat the message. Try to record every word spoken by the caller.
 - ✓ If the caller does not indicate the location of the bomb or time of detonation, ask the caller for this information.
 - ✓ Listen closely to the voice to identify gender, voice quality, and accent.
 - ✓ Pay particular attention to background noises such as motors running or music that could give a clue to the location from which call is being made.
 - ✓ Notify the Mill Water Attendant who shall then notify the RCMP.
 - ✓ If a bomb threat is received by mail or is relayed through the media, the recipient shall notify the Mill Water Attendant who shall notify the RCMP.
 - ✓ If a search is conducted for a bomb, the use of radios during the search should be avoided as they could cause premature detonation of a blasting cap. If during the search a suspicious package or object is found, **DO NOT TOUCH**. It should be left for trained personnel to remove or disarm.

4.2.5 Floods

The normal level of Fourth Nanaimo Lake is at or near the spillway crest elevation 316.7 m (1039.0 ft). This level will be exceeded during floods. The maximum flood level that would be achieved during the largest conceivable flood (PMF) is approximately Elevation. 318.7 m (1045.6 ft) or a freeboard to the dam crest of 0.4 m (1.4 ft). If the lake level is observed near such high levels or it becomes apparent that over-topping of the dam will occur the Mill Water Attendant shall contact the Maintenance Supervisor who shall implement the potential dam breach procedures set out in Section 4.2.1.

4.2.6 Slumping or Cracking of Dam

If slumping or cracking is observed anywhere on the dam or on the slopes adjacent to the abutments the Mill Water Attendant shall record the observations on the weekly inspection checklist and notify the Maintenance Supervisor with the following information:

- location and size of affected area
- rate of discharge of any water from the area and whether discharge is clear or muddy
- reservoir level
- precipitation amount prior to the discovery of the slump or crack.

If warranted the Supervisor shall proceed on the basis of potential dam breach as set out in Section 4.2.1.

4.2.7 Springs and Seeps

If new springs or seeps are observed within the dam, on its downstream face, on the abutments or on the valley floor immediately downstream, or existing ones increase abnormally, the Mill Water Attendant shall note the following observations on the weekly inspection report and notify the Maintenance Supervisor:

- location and size of springs or seeps
- estimated discharge or change of discharge
- nature of flow – clear or muddy
- reservoir elevations, and
- amount of precipitation at the time of and preceding discovery.

If warranted the Supervisor shall proceed on the basis of potential dam breach as set out in Section 4.2.1.



4.2.8 Severe Storms

Heavy rainfall or snowfall, high winds and/or heavy icing conditions can result in damage at the dam site or road washouts. If severe weather conditions are forecast or experienced the Mill Water Attendant shall:

- keep abreast of forecasts and storm developments
- make a dam inspection if warranted by weather conditions
- report damage to the Maintenance Supervisor.

The Supervisor shall have damage repaired and any lost services restored.

4.2.9 Forest Fires

If the Mill Water Attendant learns of a forest fire in the vicinity of the dam he shall notify Mill Central Control and BC Forest Service at the numbers listed in the Communications Directory.

After the fire is controlled the Attendant shall report the location and severity and any damage to equipment or structure.

4.3 **Warning Systems**

There are no warning systems of any kind in the vicinity of the dam site.

4.4 **Emergency Repairs**

Mill Maintenance and Engineering personnel and mobile equipment can respond for emergency repairs at the Fourth Nanaimo Lake Reservoir. In case extra assistance is required, refer to the Communications Directory in Section 5 for a list of Excavation Contractors, Material Suppliers, General Contractors and Engineering Consultants.

A source of sand and gravel near the dam is shown on Figure 1.



Section 5 – Communications Directory

Company/Department/Title	Name	Office Phone	Home Phone	Other Phone/Notes
Nanaimo Forest Products Ltd.	Harmac Pacific Office	250-722-3211		
	Central Control Room	250-722-4440		
- CEO & General Manager	Paul Sadler	250-722-4200	250-758-4973	250-618-6642
- Maintenance Supervisor	Gerry Turner	250-722-4285	250-749-3370	250-713-4348
- Engineering Superintendent	Ryan Prontack	250-722-4237	250-754-1979	250-714-4787
- Maintenance Superintendent	Dave Hooper	250-722-4346	250-716-1350	250-713-0751
- Mill Water Attendant	Office Phone	250-245-3924		
- Mill Water Attendant	Craig Pearse	Cell 250-668-4574	250-754-7497	Satellite 403-997-0071
- Relief Mill Water Attendant	Bill Wilson	Cell 250-714-5972	250-758-5961	Satellite 403-997-0071
RCMP	911 Emergency	250-754-2345		
Nanaimo Fire Department	911 Emergency	250-753-7311		
Ambulance Service	911 Emergency	250-758-8181		
Regional District of Nanaimo	Jani Drew	250-390-6526	250-753-8511	250-713-2057
City of Nanaimo	Karen Lindsay	24 hour 250-758-5222	Office 250-755-4572	250-713-7708
Emergency Management BC	(800) 663-3456			
EMBC Regional Manager	Ralph Mohrmann	250-952-4895		
Transport Canada	Nanaimo Airport	24 hour 250-755-5791	Office 250-245-2157	
BC Ministry of Transportation & Infrastructure	Johnathon Tillie	24 hour 1-866-707-7862	Office 250-751-3287	
City of Nanaimo		24 hour 250-758-5222		
- Director, Eng & Public Works	Geoff Goodall	250-756-5301	250-816-6599	250-758-5222
- Manager, Water Supply	Bill Sims	250-756-5302	250-245-8366	250-714-3568
- Manager, Utilities	John Elliot	250-756-5305	250-756-0784	250-755-5186
- General Foreman, Waterworks	Ritchie Fulla	250-756-5324	250-756-4534	250-751-5731
BC Senior Dam Safety Officer	Scott Morgan	250-387-3265	250-595-1993	250-380-8849
BC Regional Dam Safety Officer	John Baldwin	250-751-3179	250-756-4977	250-668-2450
BC Forest Service	Forest Fire Notification	800-663-5555		
Timberwest Access Gates	Main Office	250-716-3700		
Helicopters	Helijet Helicopters	1-800-665-4354		
	SunWest Helicopters	250-752-0707		
SnowCats	Cercomm Electronics	250-758-2652		
	BC Hydro	250-755-4775		
Excavation Contractors	Copcan Contracting	250-754-7260		Cell 250-755-6523
	Graf Excavation	250-245-8762	250-741-6505	Cell 250-714-6505
	D. Stalker Excavating	250-741-6510	Cell 250-739-9020	Cell 250-616-6675
Concrete Supplies	Bedrock Mix	250-245-0240		
Construction Companies	Yellow Cedar	250-713-1448	Carlson Construction	250-753-6481
Engineering Consultants	Acres International	604-683-9141	EBA Engineering	250-756-2256
	Allnorth Consultants	250-753-7472	Golder Associates	250-881-7372
	AMEC Earth & Env.	250-758-1887	Klohn Crippen	604-273-0311



6.1 – Fourth Nanaimo Lake Dam Annual Inspection Checklist

Inspection Date: _____

Water License #: **109740**

Inspector's Name: _____

Provincial Dam #: **D720000**

Weather conditions at time of inspection: _____

Was the spillway flowing? Yes No
If yes, what was the flow rate? _____

If no, how far was reservoir drawn down below spillway sill level (1,039 feet)? _____

Was the tunnel gate open? Yes No
If yes, what was the discharge rate? _____

Are the following components of your dam in SATISFACTORY CONDITION? Yes, No or N/A (not applicable), check one.
If the 'No' box is checked, please comment on deficiency at bottom of page.

	EMBANKMENT				TUNNEL				SPILLWAY		
	Yes	No	N/A		Yes	No	N/A		Yes	No	N/A
U/S Slope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Inlet Gate and Works	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Debris Boom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Outlet Pipe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Entrance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D/S Slope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Outlet Control Valves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D/S Toe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Energy Dissipation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Apron	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sluice Drain (toe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					Walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erosion Protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					Channel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Saddle Dam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					Channel Slopes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Were any of the following *POTENTIAL PROBLEM INDICATORS* found?

INDICATOR	EMBANKMENT		TUNNEL		SPILLWAY	
	Yes	No	Yes	No	Yes	No
a) Seepage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Cracks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Settlement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Sloughing/Slides	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Animal Activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Excessive Growth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Excessive Debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Evaluation of the conditions downstream of the dam must be undertaken at the same time as the formal inspection to ensure the consequence classification of the dam has not changed. Any changes must be reported to the Dam Safety Officer.

Please comment on Deficiency(s) Found:

- Note:
1. Please complete this report form annually. A copy may be requested by the Dam Safety Officer in your Region.
 2. Attach photos of dam site and any significant observations.



6.2 – Fourth Nanaimo Lake Dam Weekly Inspection Checklist

Year: _____	Month: _____	Week 1	Week 2	Week 3	Week 4	Week 5
Date of inspection during the month: _____						

Was the spillway flowing? Yes No
 Was the tunnel open? Yes No

Weather conditions at time of inspection: _____

Visually Inspected:	√ OK	⊗ Problem	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Comments
Embankment	U/S slope							
	Crest							
	D/S slope							
	D/S toe							
	Drains (toe, others)							
	Erosion Protection							
Tunnel	Outlet pipe							
	Outlet control							
Spillway	Debris boom							
	Entrance							
	Sill							
	Apron							
	Walls							
	Channel							
	Channel slopes							
Potential Problems:	√ OK	⊗ Problem	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Comments
Embankment	Seepage (<i>Section 4.2.7 of Manual</i>)							
	Erosion							
	Cracks							
	Settlement							
	Sloughing /slides							
	Animal Activity							
	Excessive Growth							
	Excessive Debris							
Tunnel	Seepage							
	Erosion							
	Cracks							
	Settlement							
	Sloughing /slides							
	Animal Activity							
	Excessive Growth							
	Excessive Debris							
Spillway	Seepage							
	Erosion							
	Cracks							
	Settlement							
	Sloughing /slides							
	Animal Activity							
	Excessive Growth							
	Excessive Debris							



6.3 – Monthly Mill Water Statistics

For the Month of _____

Day	Lake Level (feet)	Lake Release (cfs)	Granby Gauge (cfs)	Total River & Well Mill Use (USgpd)	Total All Wells (USgpm)	River Usage (cfs)	Residual Flow (cfs)	River Temp. a.m. (° C)	River Temp. p.m. (° C)	Valve Settings 4th Lake	Sadie Gauge Level
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
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31											



Figures

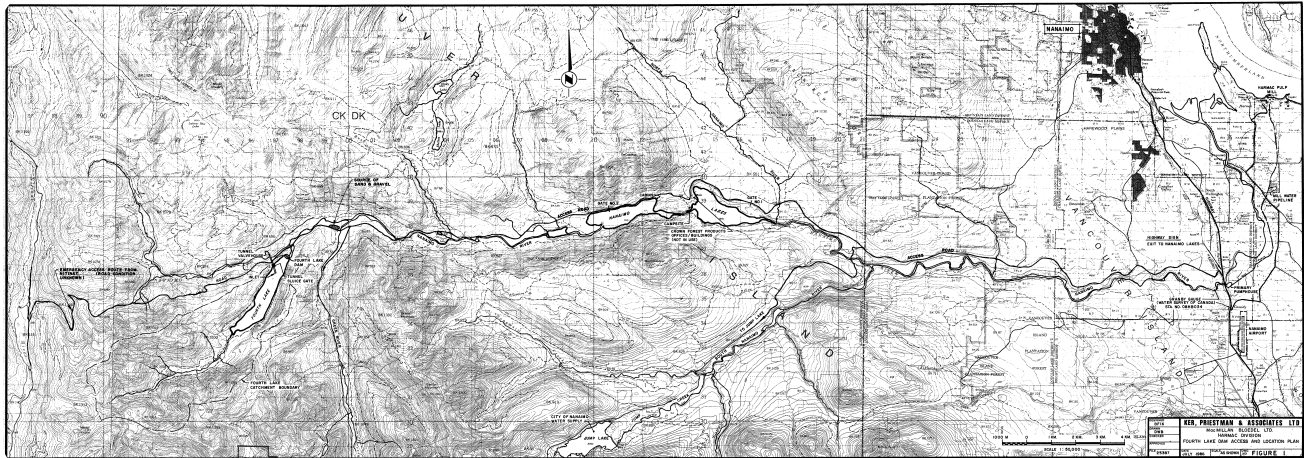
List of Figures

1. Ker, Priestman Drawing Dam Access and Location Plan
2. D5484 Rev D..... General Layout of Dam
3. D5485 Rev E.....Details of Dam
4. E5477 Rev E Water Supply Tunnel Plan and Profile
5. D6610 Rev D..... Details of Sluice Through Dam Base
6. E6614..... Rating Curves for Tunnel Discharge
7. Ker, Priestman GraphReservoir Volume vs. Lake Elevation
8. Ker, Priestman Design Hydrographs..Lake Inflow & Routed Outflow
9. B73540.....Key Plan – Fourth Lake Dam and Reservoir
10. BC Drawings 84-29-1/2/3.... Nanaimo River Floodplain Maps (1984)
11. D5486 Rev D.....General Topography Dam to Tunnel
12. D6502 Rev D..... Valve House GA and Concrete Details

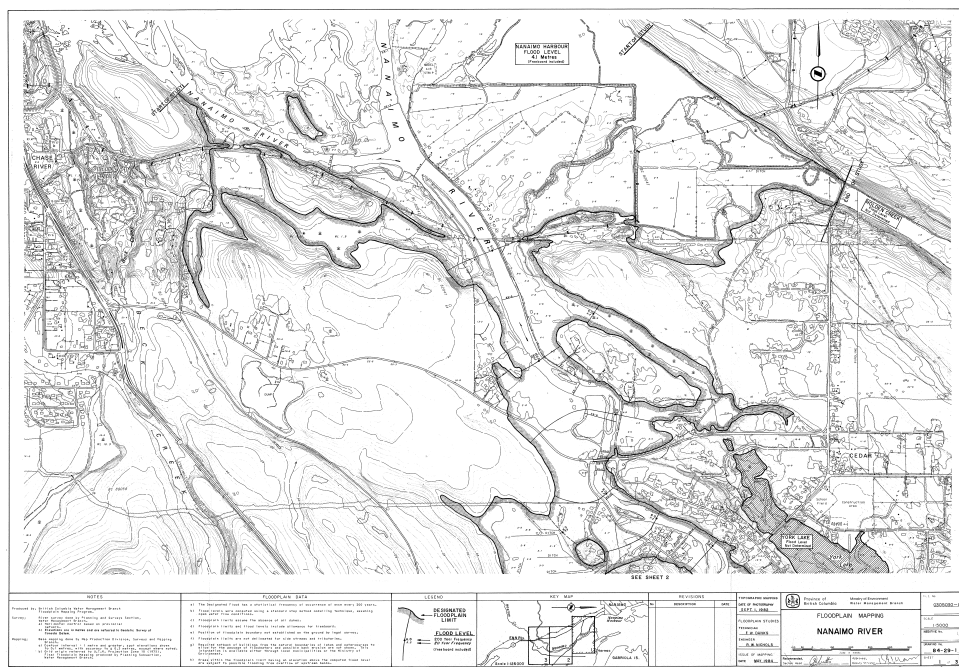


Key Figures

(Reduced size drawings – see originals)



Dam Access and Location Plan

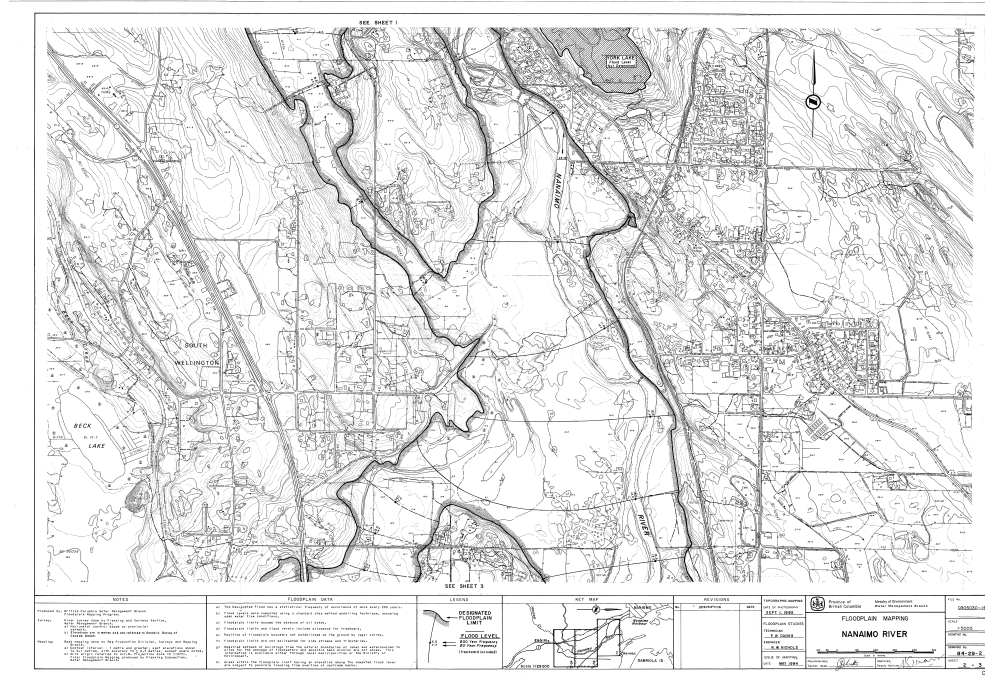


Nanaimo River Floodplain Map 1

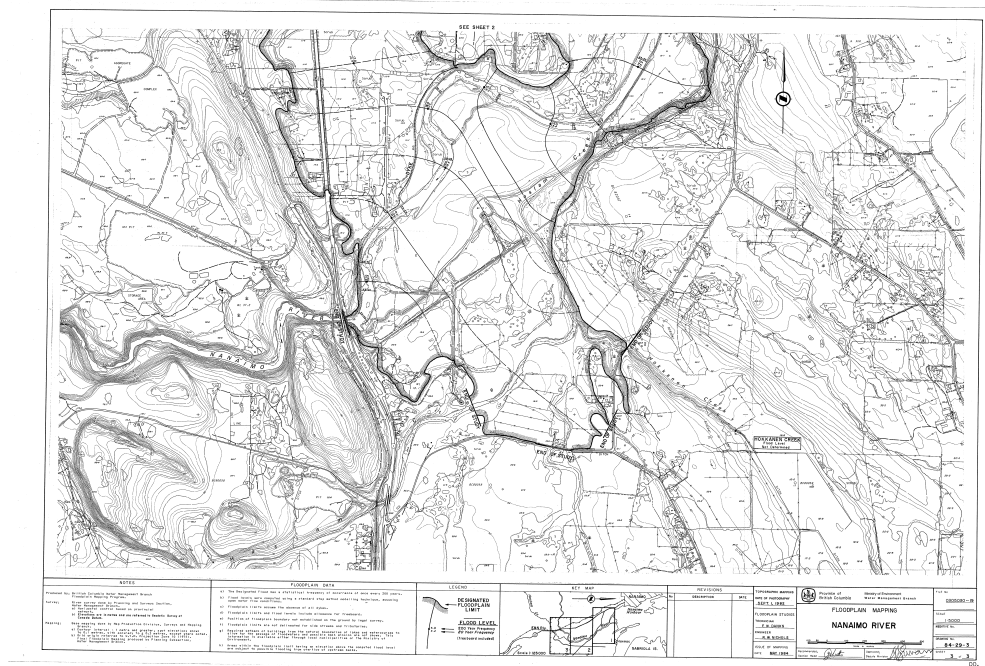


Key Figures

(Reduced size drawings – see originals)



Nanaimo River Floodplain Map 2

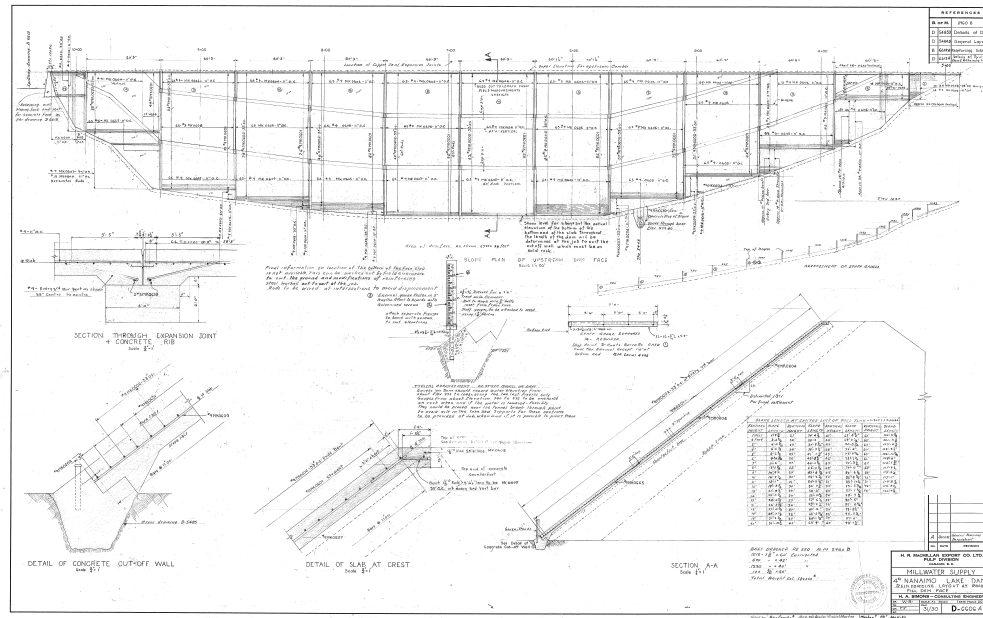


Nanaimo River Floodplain Map 3

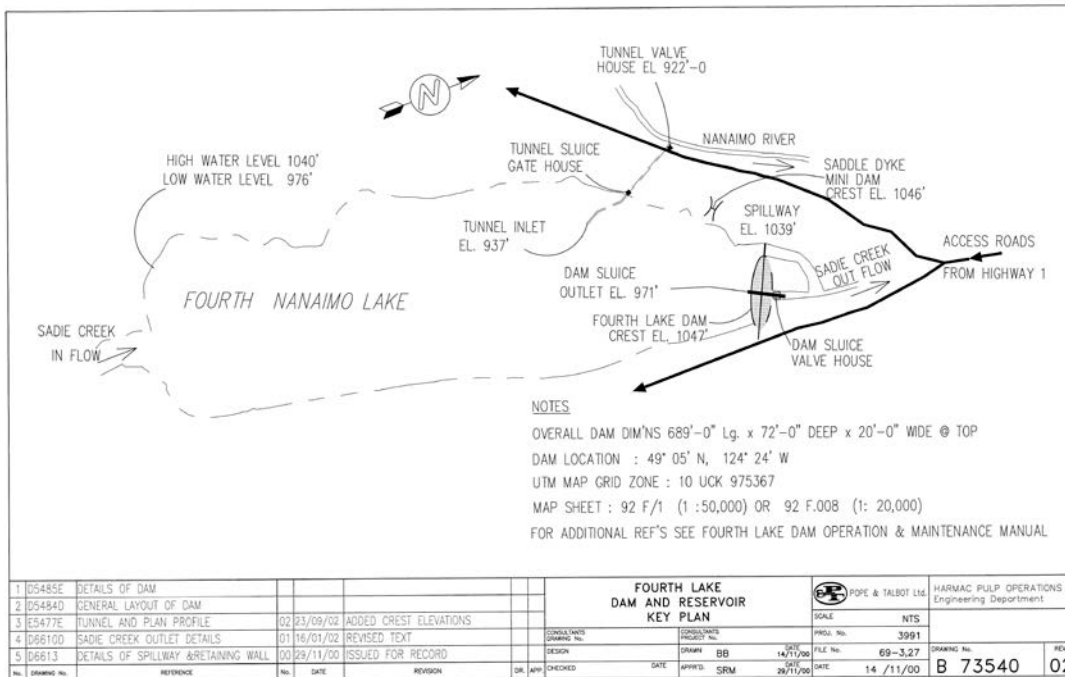


Key Figures

(Reduced size drawings – see originals)



Dam Face Layout



Fourth Nanaimo Lake Dam and Reservoir Key Plan



Photographs – September 20, 2002



① Upstream Dam Face



② Spillway Dam



③ Spillway Wingwall and Riprap



④ Spillway from end of Wingwall to Sadie Creek



⑤ Dam Sluice Valvehouse



⑥ Sluice and Toe Flows to Sadie Creek



Photographs – September 20, 2002



7 Tunnel Gatehouse



8 Tunnel Valvehouse



9 Saddle Dam



10 Saddle Dam



Photographs – September 24, 2003



1 - Dam Face



2 - Dam Face North



3 - Dam Face South



4 - Burnt caulking



5 - Dam Crest



6 – Dam Face – Side View



Photographs – September 24, 2003



7 - Downstream Slope



8 - North Dam Abutment



9 – Spillway Dam



10 – Spillway Dam Crest South



11 – Spillway Dam Crest North



12 - Spillway Control Joint



Photographs – September 24, 2003



13 - Spillway Control Joint Closeup



14 - Spillway Abutment RipRap



15 - Spillway Apron



16 – Spillway Wingwall



17 – Spillway #1



18 – Spillway #2



Photographs – September 24, 2003



19 – Spillway #3



20 – Spillway #4



21 – Spillway #5



22 – Spillway #6



23 - Sluice Valve House



24 - Sluice and Toe Flows



Photographs – September 24, 2003



25 - Saddle Dam - Front



26 - Saddle Dam - Back



27 - Saddle Dam - Top



28 - Saddle Dam – Old Crack



29 - Saddle Dam – Crack Closeup



Appendix A – Distribution List

Manual Distribution	Name	Address / Email	Phone #	Fax #
Nanaimo Forest Products Ltd. Harmac Pacific Division	PO Box 1800	1000 Wave Place	Nanaimo BC	V9X 1J2
(1) Original	Ryan Prontack	rprontack@harmacpacific.com	250-722-4237	250-722-4320
(2) Mill Water Attendant	Craig Pearse	cpearse@harmacpacific.com	250-668-4574	250-722-4350
(3) Relief Mill Water Attendants	Bill Wilson	bwilson@harmacpacific.com	250-714-5972	250-722-4350
(4) Maintenance Supervisor-1	Gerry Turner	gturner@harmacpacific.com	250-722-4285	250-722-4350
(6) Engineering Superintendent	Ryan Prontack	rprontack@harmacpacific.com	250-722-4237	250-722-4320
(7) General Maintenance Superintendent	Dave Hooper	dhooper@harmacpacific.com	250-722-4346	250-722-4350
BC Ministry of FLNRO	PO Box 9340	Stn Prov Govt	Victoria BC	V8W 9M1
(8) Head, Dam Safety Officer	Scott Morgan	scott.morgan@gov.bc.ca	250-387-3265	250-356-0605
(9) Senior Dam Safety Officer	Monty Miedreich	monty.miedreich@gov.bc.ca	250-361-8526	250-356-0605
BC Ministry of FLNRO		2080-A Labieux Road	Nanaimo BC	V9T 6E9
(10) Water Stewardship Officer	John Baldwin	john.baldwin@gov.bc.ca	250-668-2450	250-751-3103
Emergency Management BC	Headquarters	P.O. Box 9201 Stn. Prov. Gov't	Victoria BC	V8W 9J1
(11) Director	Ralph Mohrmann	ralph.mohrmann@gov.bc.ca	250-952-4895	250-952-4304
(E-file only) Manual Distribution	Name	Address / Email	Phone #	Fax #
Regional District of Nanaimo		6300 Hammond Bay Road	Nanaimo BC	V9T 6N2
(1) Emergency Coordinator	Jani Drew	jdrew@rdn.bc.ca	250-390-6526	
City of Nanaimo		580 Fitzwilliam Street	Nanaimo BC	V9R 6E2
(2) Emergency Program Manager	Karen Lindsay	karen.lindsay@nanaimo.ca	250-755-4572	250-753-5480



**Appendix B – List of Construction Drawings
Prepared by H.A. Simons, Consulting Engineer**

Drawing #	Description
E5477*	Water Supply Tunnel – Plan and Profile (Fig 4)
D5478	Fourth Lake Tunnel – Manifold and Pipe Details
D5484*	General Layout of Dam at Fourth Nanaimo Lake (Fig 2)
D5485*	Details of Dam – Fourth Nanaimo Lake (Fig 3)
D5486*	General Topography Dam to Tunnel (Fig 11)
E5487	Plan and Elevation Showing Test Holes
C5488	Fourth Lake Tunnel – Details of Concrete Nose at Junction of Tunnels
C5489	Fourth Lake Tunnel – Details of Pipe Installation and Concrete Plug
D6184	Fourth Lake Tunnel – Combined Sluice and Wicket Gates Tunnel Shaft Details
D6185	Fourth Lake Tunnel – Sluice Gate and Hoist Assembly and Stem Details
C6187	Fourth Lake Tunnel – Details for 48" diameter W.S. Line
D6368	Fourth Lake Tunnel – Details at Vertical Shaft and Sluice Gate
D6502*	Fourth Lake Tunnel – Valve House General Arrangement & Concrete Details (Fig 12)
D6503	Fourth Lake Tunnel – Valve House Walls and Beams Reinforcing Details
D6504	Fourth Lake Tunnel – Valve House Basement and Roof Slabs Reinforcing Details
D6606	Reinforcing Layout at Rock Fill Dam Face
B6607	Reinforcing Steel Schedule - Rock Fill Dam Face
D6610*	Details of Sluice through Dam Base (Fig 5)
D6612	Fourth Lake Tunnel – Entrance / Trash Racks and Supports Details
D6613	Details of Spillway Dam and Retaining Wall
E6614*	Rating Curves for Tunnel Discharge (Fig 6)
C28857	Fourth Lake Storage – Requirements for 175 cfs Flow
A30337	Fourth Lake Valve House – Correction Table for Discharge from 30" Valve

* Included in this Manual as a Figure



Appendix C – Provisional Operation Guidelines Fourth Nanaimo Lake Reservoir

Excerpt from Province of BC, Ministry of Environment, Lands & Parks
"Nanaimo River Water Management Plan," July 1993



Appendix D – Water Act: BC Dam Safety Regulation



Appendix E – Identifying Problems and Solutions: A Self Help Guide (BC Dam Safety Guidelines)



Appendix F – BC Standard Operating Procedures for Works In or About a Stream



Appendix G – BC Notification of Landslides or Debris Flow