CHANGE OF NAME!!!

NEW NAME:

MIDDLE CHASE RIVER DAM

Previously called:

- Upper Colliery Dam
- Howard Reservoir No. 3 Dam
- Upper Harewood Dam
<table>
<thead>
<tr>
<th>Structure</th>
<th>Type</th>
<th>Height</th>
<th>Crest Length</th>
<th>Slopes Upstream</th>
<th>Armour Protection</th>
<th>Full Supply Elevation</th>
<th>Design Flood Elevation</th>
<th>Operating Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Earthfill</td>
<td>13m</td>
<td>46m</td>
<td></td>
<td>Concrete wall upstream</td>
<td>Crest Protection Walkway</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**POWER FACILITIES**

<table>
<thead>
<tr>
<th>Number and Size of Units</th>
<th>Capacity (cfs)</th>
<th>Turbine Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**SLUICE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
<th>Elevation</th>
<th>Control U/S</th>
<th>D/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SPILLWAY**

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Sill Elevation</th>
<th>Capacity</th>
<th>At Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Overflow</td>
<td>15m. W x 1m. H</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Log Boom Across Spillway**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Protection**

<table>
<thead>
<tr>
<th>Apron</th>
<th>Entrance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Concrete-rock</td>
</tr>
</tbody>
</table>

**Gross Freeboard**

<table>
<thead>
<tr>
<th>1m</th>
<th>Net Freeboard</th>
</tr>
</thead>
</table>

**REMARKS OR SPECIAL CONSIDERATIONS**

Was unlicenced until November 23, 1984.
**Water Resources Service**  
**Dam Information Sheet**  
**D 720 002**  
**File: D355097**

**Completed by:** S. G. Reynolds  
**Date:** June 6, 1985

---

**DAM CLASSIFICATION:**  
DISASTER POTENTIAL CLASSIFICATION

---

**BACKGROUND**

<table>
<thead>
<tr>
<th>Name of Dam</th>
<th>Howard Dam #3</th>
<th>Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>City of Nanaimo</td>
<td></td>
</tr>
<tr>
<td>Latitude</td>
<td>49° 08.8'</td>
<td>Longitude 123° 57.8'</td>
</tr>
<tr>
<td>Source</td>
<td>Chase River</td>
<td>Purpose Recreational</td>
</tr>
<tr>
<td>Tributary to</td>
<td>Ocean</td>
<td>Licenced Quantity 93 dam³</td>
</tr>
<tr>
<td>Owner</td>
<td>City of Nanaimo</td>
<td></td>
</tr>
<tr>
<td>Year of Completion</td>
<td>Approx. 1910</td>
<td></td>
</tr>
<tr>
<td>Water Licence Nos.</td>
<td>CL 59691</td>
<td></td>
</tr>
<tr>
<td>Plan Nos.</td>
<td>Microfilm No. 1980</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>Originally built by Wellington Collieries, major repairs in 1910.</td>
<td></td>
</tr>
</tbody>
</table>

**WATERSHED**

<table>
<thead>
<tr>
<th>Area</th>
<th>43 Km²</th>
<th>Forest Cover</th>
<th>% Agriculture</th>
<th>% Urban</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation: Range</td>
<td>Median</td>
<td>Soil Type</td>
<td>Exposure</td>
<td>Met. Records</td>
<td>Runoff Records</td>
</tr>
</tbody>
</table>

**RESERVOIR**

<table>
<thead>
<tr>
<th>Capacity: Live</th>
<th>Dead</th>
<th>Total 93 dam³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area: Sill Level</td>
<td>15 ha.</td>
<td>Outlet Level</td>
</tr>
<tr>
<td>Elevation: Sill Level</td>
<td>Outlet Level</td>
<td></td>
</tr>
<tr>
<td>Inflow: Diversions</td>
<td>Capacity</td>
<td>Records</td>
</tr>
<tr>
<td>Releases: Records</td>
<td>File</td>
<td></td>
</tr>
<tr>
<td>Fetch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3 MIDDLE CHASE RIVER DAM (3)

Static Data

Table of Static Data

The relevant static data for the Middle Chase River Dam is contained in Table 3.3-1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>Middle Chase River Dam</td>
<td>Also referred to as: Upper Colliery Dam, Upper Harewood Dam and Howard No. 3 Reservoir Dam, and Harewood No. 1 Dam</td>
</tr>
<tr>
<td>Hazard Classification:</td>
<td>B</td>
<td>M of E criteria, dam is considered to be &quot;major&quot;. &quot;Disaster Potential Classification&quot; estimated to be &quot;B&quot;</td>
</tr>
<tr>
<td>Co-Ordinates:</td>
<td>N 5446020 E 429778</td>
<td>As determined by Wright, Parry, Taylor &amp; Fuller in February 1992</td>
</tr>
<tr>
<td>Structure Type:</td>
<td>Earth and rock fill dam with 0.6m thick, vertical, concrete cut-off wall</td>
<td></td>
</tr>
<tr>
<td>Height of Dam at Crest:</td>
<td>12.5 ft</td>
<td>As measured by Wright, Parry, Taylor &amp; Fuller, February 1992</td>
</tr>
<tr>
<td>Width of Dam at Crest:</td>
<td>50m</td>
<td>As measured by Wright, Parry, Taylor &amp; Fuller in February 1992</td>
</tr>
<tr>
<td>Storage Capacity for Reservoir:</td>
<td>9.26 Ha-m</td>
<td>Quantity of water stored is 9.26 Ha-m (75 acre-feet), per water license. Note: this should be confirmed.</td>
</tr>
<tr>
<td>Owner Information:</td>
<td>The City of Nanaimo</td>
<td></td>
</tr>
<tr>
<td>Year of Construction:</td>
<td>1810</td>
<td>Believed to have been completed in about 1910 by Wellington Collieries.</td>
</tr>
</tbody>
</table>
INSPECTION REQUIREMENTS

The inspection requirements for the Middle Chase River Dam are summarized in Table 3.3-2.

| TABLE 3.3-2 |
| RECOMMENDED INSPECTION AND MONITORING |

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NATURE OF INSPECTION/MONITORING</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Monitoring</td>
<td>- seepage flow</td>
<td>weekly (at least daily during storms)</td>
</tr>
<tr>
<td></td>
<td>- reservoir level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- precipitation</td>
<td></td>
</tr>
<tr>
<td>2. Monitoring</td>
<td>- suspended soils in seepage flows</td>
<td>monthly</td>
</tr>
<tr>
<td>3. Detailed Inspections</td>
<td>- settlement or cracking of dam crest and associated concrete structure</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td>- debris impeding flow through spillway</td>
<td></td>
</tr>
<tr>
<td>4. Special Inspections</td>
<td>- as above with special attention to new disturbances, for example cracking and erosion</td>
<td>during and after major storms and seismic events</td>
</tr>
<tr>
<td>5. Major Inspections</td>
<td>- including dam, abutments, spillway, reservoir, etc.</td>
<td>every 2 years</td>
</tr>
</tbody>
</table>

Notes:

1. It has been noted that significant seepage is occurring on the downstream face of the dam. The seepage appears to be clear. Such seepage is generally a concern for dams. It is recommended that the seepage flows be monitored on a weekly basis, along with reservoir elevation and precipitation, in order to determine whether or not the seepage is a hazard to the stability of the structure. The frequency of monitoring should be at least daily during major storms, i.e. (10 year events or greater). The origin of this seepage is not currently known, but it is recommended that it should be determined.

2. In addition, samples of the seepage water should be collected near the toe of the dam and tested for suspended solids on a monthly basis to determine if internal erosion is occurring.

3. Monthly inspections should be made of the dam crest and associated concrete structures to detect settlements or cracking, and of the spillway entrance to detect build up of debris which could impede flow through the spillway.
The monitoring and monthly inspections could be carried out by City of Nanaimo staff and the resulting data provided as reference material for the field inspections.

4. Special inspections should be undertaken during and after major storms (10 year event or greater) and after significant seismic activity (50 year event or greater). Evidence of ground movement should be recorded any time it is observed.

5. This is an unattended, operational dam. On the basis of its Disaster Potential Classification it should have a major inspection carried out at least once every 2 years. The major inspections should include not only the dam proper but also the abutments, spillway, reservoir, downstream slopes and so on.

   Major inspections should be carried out by Professional Engineers with Dam Safety and Geotechnical experience.
SITE DESCRIPTION AND GENERAL RECENT HISTORY

The Middle Chase River Dam is located on the Chase River which is in the southwest part of the City of Nanaimo, and is accessible via Nanaimo Lakes Road. The co-ordinates of the dam are N 5446020 and E 429778.

Middle Chase River Dam reservoir is used largely for recreational purposes. The reservoir also has some flood control capabilities with the temporary storage to the spillway invert elevation. The watershed area contributory to the reservoir has been estimated to be approximately 2575 hectares. This should be confirmed as part of a hydrologic study of the reservoir.

Middle Chase River Dam is situated about 0.4 km downstream from Nanaimo City No. 1 Reservoir. The dam is also situated 0.3 km upstream from Lower Chase River Dam and discharges into its reservoir. The Greater Nanaimo Water District offices are about 1 km upstream on Nanaimo Lakes Road.

Middle Chase River Dam is also known as Upper Harewood Dam and the Upper Colliery Dam. The dam may have been at the end of an old railroad siding. The structure consists of a 0.6m thick vertical concrete core with end dumped soil and rock fill on both the upstream and downstream sides of the core.

The dam is situated in a steep sided ravine with both abutments apparently founded on bedrock which is Cretaceous sedimentary rock of the Nanaimo Group. Bedrock exposures on either abutment indicate a massive conglomerate formation with tight joints and fractures and some weathering. The right abutment contact between the bedrock and the concrete wall shows signs of deterioration.

Adjacent to the left abutment is a 14m wide unregulated spillway which is founded on bedrock. A concrete wall along the right side of the spillway channel separates the embankment fill from the spillway. Another concrete wall extends part way down the left side. Below the wall, the dense sandy silt forming the left side of the spillway was noted to be eroded.

Based on local information, there is an abandoned, wood stave conduit under the dam. The intake and outlet to the conduit are not visible. Attempts were made in 1980 to locate this conduit but were unsuccessful. The remains of what may be the control valve structure is situated a few meters upstream of the concrete wall.

There was an opening in the concrete wall at or just below the reservoir level near the centre of the dam. This hole was made in about 1950 to increase the discharge capacity of the reservoir during a period of heavy rainfall which caused concern that the dam might be overtopped. At that time, additional fill was end-dumped on the downstream side of the wall and the hole was left covered by a wood panel for several years.
Improvement and remedial reconstruction of the Middle Chase River Dam was carried out in 1980. Tree and brush cover over the downstream face of the dam was removed and the slope was regraded. The concrete core was raised by 300mm and the wood cover over the concrete core opening was removed and replaced by a concrete plug. The discharge conduit believed to exist under the dam was proposed to be plugged but could not be located.

The downstream slope of the dam was excavated for some depth below its present crest to partly expose the natural subgrade of the dam. The origin of seepage could not be identified and the wood stave conduit could not be located. The dam slope was reconstructed using sand and gravel filter materials and coarse granular fill. Seepage rates were not improved by the reconstruction effort. However, the discharge water appears to be clear and the seepage occurs through the relatively clean granular material and drain rock blanket. A drainage trench was installed to intercept seepage.

The concrete spillway discharge sill was repaired and the right spillway training wall was extended downstream to direct flows away from the toe of the dam.
<table>
<thead>
<tr>
<th>Item</th>
<th>Recommended Completion Date</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once the source of the seepage has been established, remedial measures to stop the flow should be undertaken</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>The concrete cut-off wall should be cored to determine the depth of deterioration which has occurred</td>
<td>September 1993</td>
<td>$1500.00</td>
</tr>
<tr>
<td>A seismic assessment of the embankment and spillway should be carried out</td>
<td>September 1993</td>
<td>$20,000.00, Cost will include 3 dams on Chase River</td>
</tr>
<tr>
<td>The hydrological data for the Chase River system should be updated.</td>
<td>September 1993</td>
<td>$40,000.00, Cost will include 3 dams on Chase River</td>
</tr>
<tr>
<td>Protection of the lower, left hand side of the spillway where erosion of the bank is evident. This can be accomplished by extending the concrete wall further down the spillway</td>
<td>September 1994</td>
<td>$8,000.00</td>
</tr>
<tr>
<td>The dead trees should be removed from the reservoir (or as funding permits prior to this)</td>
<td>September 1997</td>
<td>$20,000.00</td>
</tr>
</tbody>
</table>
Upstream Concerns

There are 3 other dams (No. 1 Reservoir Dam, Upper Chase River Dam, and Powerline Dam in the Morrell Bird Sanctuary) upstream of the Middle Chase River Dam. Uncontrolled release of any of these reservoirs would likely cause the Middle Chase River Dam to be overtopped.

Nanaimo Lakes Road crosses the Chase River approximately 1km upstream of the reservoir. Should a chemical or oil spill occur near this crossing, the reservoir could be affected.

Downstream Concerns

There is another dam (Lower Chase River Dam) downstream of this structure which would be adversely affected by the uncontrolled release of the Middle Chase River reservoir.

The Chase River flows through many residential areas downstream of the Chase River Dams. A large number of residences in the area bordered by Sixth Street, Ninth Street, Wakesiah Avenue and the E & N tracks would be affected as well as the utility, railway and Island Highway Chase River crossings.
Reservoir #3.

This Reservoir is above the Howard Res., and is also owned & operated by the City of Nanaimo.

- the dam is earth fill 25' high with a 3' thick concrete face on the u/s
- the concrete on the u/s face is quite badly deteriorated.
- the d/s slope is fairly steep 1:2.1
- serious piping noted on 1.8 d/s line.

- a flow of 2-3 cfs. (seepage) estimated.

On arrival we examined the embankment to check foundation for settlement & examined the concrete.

- the u/s slope is covered with small alders - this would indicate that the dam was kept clear up to 15 years ago, or so, - one 24" fir
- the fill on the d/s slope did not appear to be well compacted - debris & an old car body in fill

Spillway
- on the northern abutment - 50' wide
- concrete sill and natural channel on flt limestone - excellent shape, no erosion
Reservoir is relatively clear with a few snags around the perimeter.

Spillway entrance. Note provision for stop-logs.
Spillway seen from downstream. Concrete condition on several of the piers is very poor.
Downstream face of dam. Note growth covering entire face and deteriorating stumps in embankment. Significant seepage was noted along the right abutment.
Howard Dam #3

Inspected by: R. J. Bugslag and G. F. Cox September 1, 1976.

Howard Dam #3 is owned and operated by the City of Nanaimo as a recreational reservoir. Administration comes under the Parks and Recreation Commission. Photographs taken during the inspection are shown on the accompanying pages.

The reservoir is clear of debris but some dead trees were noted on the perimeter which should be removed. The reservoir appears to be quite deep and to have very steep sides. The upstream face of the dam from the spillway to the right abutment is an 18 inch wide by 90 foot long concrete wall in reasonable condition. The right abutment embankment is heavily treed and these plus the trees on the downstream face of the dam should be removed. The spillway bridge should be replaced and the spillway piers should have some work done on them at the same time. Seepage on the right abutment is atrocious (RJB estimated 3 to 5 CFS). The rock foundations appear to be good on both abutments and in the spillway channel. A good source of gravel was noted upstream on the left abutment.

We should do a hydrology study of this system of dams and have the City hire a consultant to do a study of the works necessary to rehabilitate this dam.

R. J. Bugslag,  
Engineer Technician.  

G. F. Cox,  
Dam Inspection Engineer.
Possible source of borrow on left abutment.

Howard Dam #3
Harewood Dam #1

September 1, 1976.
Concrete in piers on spillway bridge in very poor condition.
RESERVOIR #3           March 12, 1976
Upstream face of dam.  Note growth on dam crest and deterioration of concrete wall.
Left abutment. Note heavy tree removal required.

Note repairs needed to spillway bridge.
Howard Dam # 3

September 1, 1976.

Typical reinforcing used in dam - car springs
- railway rails
- drill steel

Seepage along right abutment contact note - scrap material in embankment.
Howard Reservoir #3

Inspected by: R. J. Bugszag and G. F. Cox         February 12, 1977

Howard Reservoir #3 is owned and used as a recreational reservoir by the City of Nanaimo Parks and Recreation Commission. The dam is unlicensed and the condition of the dam warrants immediate attention. The dam is a 35' high earthfill with a 3' thick concrete wall on the upstream face. The embankment is completely overgrown with trees up to 24" in diameter on or near the crest. Considerable volumes of seepage were noted at the downstream toe (2-3 c.f.s.). A serious situation may be developing with seepage at the right abutment contact. Additional fill material appears to have been added to the downstream face by enddumping with little or no compaction. Debris and parts of an old car body were present in this additional material. A serious piping may be present in the center of the embankment, although it may be that this flow is coming from an old low level outlet in the dam.

An underwater inspection was undertaken and heavy silt conditions were noted. An old 2" pipe was found that may have been a valve stem but snag conditions underwater at 45' prevented further investigation.

The spillway is founded entirely on solid rock and is located on the left abutment. The bridge over the spillway should be replaced and the center piers repaired or replaced. The wing wall on the south side of the spillway should be replaced or extended to better protect the embankment section.

The City should be required to licence this structure and propose an upgrading schedule on the dam as soon as possible.

R. J. Bugszag,
Dam Inspection Officer.
Upstream concrete wall on structure.
HOWARD DAM NUMBER THREE

5 August, 1980

Dam crest viewed from right abutment prior to clearing.

Crest viewed from spillway bridge prior to clearing.
Howard Number Three Dam is owned and operated by the City of Nanaimo Parks and Recreation Commission as a recreation reservoir. Pictures taken during the inspection are shown on the accompanying pages.

The contractor has removed all vegetative growth from the dam and by means of a twelve inch syphon has drawn the lake down about six to eight feet. The spillway bridge has been rebuilt and the concrete walls on the chute have been raised. A one foot high concrete addition was being placed on the upstream face concrete wall. The wooden cover over a six foot diameter hole in the concrete wall was being removed. The contractor hopes to fill the hole with concrete and thereby cut down considerably on seepage through the dam. Some work is also planned to cut down on seepage around the sluice pipe. The fill placed on the downstream face of the dam looked good but the weir placed at the downstream toe to measure seepage looked inadequate and should be replaced by a more substantial structure. This request should be passed on by letter to the City of Nanaimo.

G.F. Cox, P. Eng.,
Dam Safety Engineer.
Crest of dam from spillway bridge.

Reservoir shoreline.
Seepage weir, downstream face of dam and spillway.
Upstream face of dam showing one foot high concrete wall addition and concrete plug at old outlet area. Note also deterioration of existing concrete.

Spillway channel from crest of dam.
DAM INSPECTION REPORT

Howard Reservoir #3 (Upper Harewood)  22 August, 1980

Inspected By:  G. D. Smith and L. Carolan

Construction on Howard Reservoir #3 is still in progress. A hole in the concrete upstream face had been patched and the form work for a one foot extension of the concrete wall was in progress. The hole had apparently been blown in the dam some years before to prevent overtopping in heavy rains.

The reservoir level had recently been drawn down 8' - 10' pending investigation of the downstream toe seep. Total drawdown was not considered feasible as a trout stocking program had recently completed. What had initially begun as a simple excavation to locate a wood stave low level outlet had grown into a large excavation showing a considerable amount of poor quality fill. The seepage appeared to increase and divide as the size of the hole increased.

Mr. John Hall of Golder Associates was brought in the following morning to advise.

Mr. Hall felt as the dam was drawn down the 2' wide concrete face could effectively be cut down to the existing water level and the 2:1 slope maintained to original ground.

Saturated material was removed and a 3' drain rock bed was placed to provide a french drain and stable working base for the Finning 215 hoe. Digging continued until a log crib was exposed. Although the outlet was still not located yet, it was felt by following the crib base across 10 - 15' the outlet would be exposed. As the day was getting late, Mr. Douglas Anderson, Engineer for Willis, Cunliffe and Tait decided to stabilize the slope for the day and complete the operation the following morning.

Upon exposure of the low level outlet the intent was to pump the pipe full of concrete and plug it off.

Next a continuance of the gravel filter from the plugged outlet to the gravel base would be installed to provide adequate drainage.
It was noted the debris being placed as fill material behind the spillway wall was of inadequate quality. Mr. Art Hunter of Willis, Cunliffe and Taite required the contractor to remove the material and replace only with an acceptable quality fill.

This project has been in progress for approximately a month now.

G. D. Smith,
Dam Inspection Technician.

SMITH/ml
August, 1980

Upstream face of dam showing remains of low level outlet upstream gate. Diver had located the top of the valve.
Spillway channel during rehabilitation. Note green 12" siphon used to draw the lake down.
A concrete plug was used to patch a hole through the dam. Although no date was available the hole had been made several years ago for rapid drawdown during heavy rains.

Concrete plug from upstream face after stripping.
INSPECTION REPORT

Howard #3 Dam

29 August, 1980

Inspection By: G. D. Smith and K. Kinnersley

Inspection Date: 26 August, 1980

On 26 August, 1980, Mr. Kinnersley and myself travelled to Howard #3 Dam for an on site inspection.

The contractor, Upland Construction, was still on site with the lake level drawn down an additional 5 - 6'. The excavation to locate the wood stave low level outlet was still open but placement of fill had begun. The low level outlet, however, had not been located. The consultant had again been in contact with Mr. Hall of Golder Associates who was redesigning the embankment to accommodate the heavy seepages located at the toe. It was originally felt the wood stave low level outlet could be exposed by removal of the lower downstream toe material however when not found it was felt placement of additional filter material would be a suitable alternative. A small vibratory compactor was in use as the material was being replaced in 12 - 18" lifts. A nuclear density testor was in use on each lift at random points to monitor compaction and moisture content.

A larger hoe, a finning 225, was on site in use replacing the previous machine.

The additional one foot section to the concrete wall had been completed and the forms stripped. Old sand bags were noted at the upstream base of the old concrete wall.

Mr. Art Hunter of Willis, Cunliffe and Tait was on site overseeing the fill re-placement operation.

Powerline Dam fill placement was to resume within the next few days as a sheepfoot roller had been acquired. A site visit in the next week is recommended.

G. D. Smith,
Dam Inspection Technician.
HOWARD #3

August, 1980

Initial excavation showing heavy seepages encountered.

Seepages at downstream toe prior to excavation.
Heavy seepage noted passing through the original fill.

Excavation while attempting to locate wood stave low level outlet.
HOWARD #3

August, 1980

Beginning of excavation after drain rock placement was complete.
HOWARD #3

August, 1980

Downstream face of dam from crest during excavation.
HOWARD #3

August, 1980

Left abutment wing wall added to spillway was completed.
Beginning of original log crib dam was exposed - note log protruding from fill.

Original log crib dam exposed - logs were still intact.
A 12" high lift was added to the upstream concrete wall after construction. Note old sand bags on upstream face.
Replacement of fill in 12-18" lifts. A nuclear density tester was used to monitor compaction and moisture content after compaction on each lift.

Downstream toe during construction showing edge of drain rock and impervious cover.
HOWARD #3

August, 1980

Beginning of fill replacement - note, vibratory compaction on left of photo.
HOWARD #3

16 September, 1980

Recently repaired dam - note coarse drainrock at base to accommodate heavy seepages.
HOWARD #3

16 September, 1980

Trout re-stocking at Howard #3 Dam.
Upstream face of completed renovations. Note concrete plug repairing hole through concrete face.

Temporary weir monitoring heavy seepages.
February 24, 1981

HOWARD #3 DAM

Seepage at downstream toe.
City of Nanaimo,
455 Wallace Street,
Nanaimo, British Columbia.
V9R 5J6

Dear Sir:

Re: Howard Dams 3 and 4 - Application 0355097 and 0355174

The Dam Safety Section of Water Management Branch, Ministry of Environment recently inspected your Chase River Dams, Howard 3 and 4. The structures are currently under application for the purpose of land improvement.

Howard Dam 3

This dam appears to be operating as designed. A significant seepage is noted in the downstream toe area however. The source of this seepage was investigated during the 1980 remedial repairs but could not be isolated. A poorly constructed plywood weir was installed at that time. Monitoring the quantities exiting from this seepage is of interest to you as increased uncontrollable flows could cause serious downstream problems. Your existing weir is not effective enough to decipher spillway flows from embankment seepage.

The improvements recommended are:

(1) Extend the spillway wing-wall to ensure spillway flows are kept separate from your seepage flows until after a monitoring weir.

(2) Replace the plywood weir with a properly constructed permanent weir capable of measuring existing seepage flows only.

(3) Record the seepage results on a regular basis and maintain for historical records.

Please notify myself or Mr. G. Cox, Dam Safety Engineer at 387-1181 when these recommendations will be completed by.
Howard #4

This dam, located downstream of Howard #3, has also had remedial repairs carried out in 1980. The only area requiring your attention on this structure is the removal of new deciduous growth. This should be a regular maintenance consideration and set up to be carried out on an appropriate frequency.

If you have any questions please do not hesitate to call Mr. Cox, Dam Safety Engineer or myself at the above phone number.

Sincerely,

G. D. Smith,
Dam Inspection Technician.
Howard Dam #3 is a 35 foot earthfill structure located on the Chase River as part of a system of older dams apparently built around 1900 as part of the local collery operation. The dam is currently owned by the City of Nanaimo Parks and Recreation Commission and is under application for licensing for the purpose of land improvement.

The structure appeared very attractive with lawns, an arched walkway over the concrete spillway and a crushed rock path over the dam crest.

The spillway is placed on a bedrock base with concrete side walls and sill in place. It was noted some flow from the spillway was entering the seepage monitoring weir at the base of the dam.

The earthfill embankment has been effectively cleared of all growth and debris in the summer of 1980.

Heavy seepage still exited from the lower portion of the downstream face where a rock drain had been installed during remedial works in 1980.

As this seepage source could not be located during remedial works, the rock drain and weir were required to maintain safe operation. It appears the weir is not being utilized effectively however.

Evidence of new concrete in the form of a patch existed on the concrete wall on the upstream face. A city inspector during construction had said several years ago drawdown had been required because of heavy rains and the possibility of overtopping.

No records or dates were available to confirm this however.
Recommendations:

(1) Insist owner extend the spillway wall to ensure spillway flows are not allowed to interfere with the monitoring of seepage weir flows.

(2) Replace poor quality plywood weir with a properly constructed weir.

(3) Record the seepage results on a regular basis and keep for historical records.

S. Reynolds, Technician.

G. D. Smith, Dam Inspection Technician.
DAM INSPECTION REPORT

Howard Dam #3 RESERVOIR

Application

DATE October 6, 1982

LICENSSEE City of Nanaimo

FILE NO. D_720 002

WATERSHED AND RESERVOIR CONDITIONS

1. Saturated 6. Outlet Discharge N/A m³/s
2. Wet 7. Spillway Discharge 1 m³/s
3. Dry 8. Reservoir Debris H M
4. Freeboard 9. Reservoir Bank Stability 0 H L
5. Water Level Full meters

NOTE: Items marked X require attention - See Remarks

EMBANKMENTS

10. Growth
11. Upstream Slope
12. Crest
13. Downstream Slope
14. Downstream Toe
15. Rip Rap
16. Seepage
17. Erosion
18. Sloughing
19. Boils

OUTLET WORKS

30. Gate
31. Sluice
32. Submerged
33. Walls
34. Stilling Basin
35. Toe Drain
36. Channel
37. Hes
38. Erosion
39. Seepage

GATE WORKS

20. Accessibility
21. Wheel
22. Threads
23. Pedestral
24. Stem Guides
25. Stem
26. Gate
27. Grill
28. Boom
29. Gauge

SPILLWAY

40. Boom
41. Entrance
42. Walls
43. Spill
44. Apron
45. Channel
46. Growth
47. Erosion
48. Seepage
49. Debris

REMARKS: (Refer Above)

15. Concrete upstream face.
16. Heavy seepage - weir requires replacement.
40. None
42. Right wall requires extension to separate spillway flows from seepage.

INSPECTED WITH S. Reynolds SIGNED G. D. Smith

Dam Inspector

NOTE TO LICENSEE: Section 18(1) of the Water Act states:
"Every licensee and person who has obtained approval under Section 7 shall exercise reasonable care to avoid damaging any land, works, trees, or other property, and shall make full compensation to the owners for any damage or loss resulting from the construction, maintenance, use of operation of the licensee's works."
HOWARD DAM #3

Upstream face of dam.

October 6, 1982
HOWARD DAM #3

Downstream face.

October 6, 1982
Crest view from left abutment.

Seepage path to wier.
Lake level at full pool elevation.

Spillway channel seen from walkway.
Spillway flowing at right of photo into monitoring weir.

Water flowing from sillway into monitoring weir.
1983-Feb-28

Mr. G.D. Smith,
Dam Inspection Technician,
Ministry of the Environment,
Water Management Branch,
Parliament Buildings,
Victoria, B.C.
V8V 1X5

Dear Mr. Smith:

Thank you very much for your letter of 4 November 1982, regarding the Harewood Dams.

Since receiving your letter we have done considerable review and there have been several questions that have come up that we would like to discuss with you. Those being seepage problems as well as the maintenance of the particular sites. I have met with our Manager of Engineering Services and we would both appreciate very much if you could come to Nanaimo and visit the sites with us and perhaps expand on our knowledge of the responsibilities for maintenance and possible seepage problems.

I would appreciate it if you could get back to me as soon as possible, with a date that I could confirm for this meeting.

Yours truly,

F. Michael Patton,
Manager of Maintenance and Construction Services

cc R. Martin, Manager of Engineering Services
H.R. Wipper, Director, Parks and Recreation
File: 0270545
April 19, 1983

City of Nanaimo,
455 Wallace Street,
NANAIMO, British Columbia.
V9R 5J6

ATTENTION: Mr. Martin.

Dear Sirs:

Re: Howard Dam #4 - Application #0355097
    Howard Dam #3 - Application #0355174
    Westwood Lake Dam -- CL7001i-242622

Thank you for your prompt attention to our November 4, 1982, letter.

Included for your information is a copy of the Notes To File prepared after our joint inspection and discussions on March 25, 1983, regarding the above mentioned dams.

Your improvement proposals should be submitted to this office as soon as possible with construction dates included. If you have any further questions please do not hesitate to call Mr. Cox or myself at 387-1181.

Yours very truly,

G. D. Smith,
Dam Inspection Technician,
Power & Special Projects.

Enclosure.
On March 25, 1983 a joint inspection was carried out with four City of Nanaimo representatives; Mr. Bob Martin, Manager, Mr. Lyle Bangah, Design Engineer, Mr. John Snook, Maintenance Superintendent and Mr. Mike Patton, Manager of Maintenance and Construction Services.

The joint inspection was requested by Mr. Martin as a result of a November 4, 1982 letter prepared by the undersigned. The letter indicated required improvements and suggested improved maintenance procedures for both Howard #3 and Howard #4 Dams.

The March 25, 1983 inspection also included a quick look at Powerline (Morrel) Dam and a complete familiarization with Westwood Lake Saddle and Main Dam.

The areas covered in the discussions are categorized under their dam names in point form.

**Howard #4**

**Topics Discussed:**

1) Establish a regular maintenance program.
2) Raise and extend spillway walls.
3) Reseal spillway base.

The first topic discussed, which applied to all dams, was the need for a regular maintenance program to keep the structures free of deciduous and evergreen growth.

Mr. Martin indicated this would be carried out including the repair of minor erosion located on the left downstream abutment.

While inspecting the spillway a minor seep was noted on the left side. Mr. Snook indicated that the quantity of seepage seemed to vary in proportion with the quantity of spillway flows. He also pointed out that spillway flows had been very high in recent years on occasion to a point where sandbagging had been required at the intake to prevent overtopping the spillway walls which could cause seepage erosion.

Mr. Martin did not appear to be aware of the situation but said they would consider raising the spillway walls and resurfacing the spillway bed to increase flow capacity and decrease seepage problems.
Howard #3

Topics Discussed:

1) Extend spillway wingwall.
2) Replace wooden weir with a concrete weir of adequate capacity.
3) Monitor and record the flows for historical value.

On mentioning the spillway wingwall extension, Mr. Patton produced a sketch of a proposed replacement including a concrete spillway extension and an included concrete weir appearing to be very satisfactory. While discussing this proposal Mr. Martin suggested this structure could be monitored and recorded on a weekly basis by maintenance personnel in the area regularly.

Powerline (Morrel) Dam

This structure was visited only briefly for Mr. Martin's benefit as he had not seen the dam before.

Westwood Dam

Topics Discussed:

1) Point out need for regular clearing on both the main and saddle dams.
2) Discuss poor condition of the saddle dam and potential hazard.

The main dam discussions were general and included clearing growth only.

The saddle dam's poor condition was shown and the need for prompt attention was emphasized. Mr. Martin felt budgeting restrictions would make any funding for this area difficult. He did feel growth removal might be possible this year, however.

G. D. Smith,
Dam Inspection Officer.
Proposed improvements to seepage weir include extension of wing wall and replacement of wooden weir with concrete.

Spillway channel seen from dam crest.
Right abutment contact still seeping heavily.

Eroded concrete on spillway sill.
Howard Dam #3

Inspected By: R.J. Bugslag, G.F. Cox, W. Jolley

Inspection Date: May 28, 1984

Howard Dam #3 is owned and operated by the City of Nanaimo as a recreation dam. No guide was requested or provided. No photographs were taken during the inspection.

The reservoir was completely free of debris. The concrete on the upstream face appears sound. The dam crest appeared well maintained and the downstream face also. Very little seepage was noted at the abutment contacts.

Messrs. Bugslag and Jolley carried out an underwater inspection and no unusual conditions were noted. Two Datsun B210 cars were found and recovered.

G.F. Cox
Dam Safety Eng.

GC/tp
Concrete wall extension and weir completed.
Debris noted passing over spillway sill.

Concrete rectangular weir replacing plywood structure.
Howard Dam #3 is owned and operated by the City of Nanaimo for recreational use.

Since the last inspection of this dam, the wall on the right side of the spillway channel has been extended to protect the toe of the dam from being eroded. The new wall has been continued across the toe and incorporates a rectangular broad-crested weir for seepage measurement. A minor amount of seepage was noted coming from the contact area between the old and new walls of the spillway. Concrete spallling was noted on the upper portions of the old spillway walls. This should have been patched when the other work was being done on the spillway. Continued erosion and undercutting of the hillside on the left side of the spillway below the side wall is evident. This area should be monitored and action taken if erosion continues.

The downstream face of the dam is "grassed" but some erosion has occurred near the toe and along the right abutment contact. Eroded areas should be repaired and care taken along the abutment contact so that fine material isn't washed away. A properly graded combined rock drain filter could be employed along the abutment contact.

Stuart Reynolds
S. G. Reynolds
Dam Safety Technician

SGR: eh
HATERSHED AND RESERVOIR CONDITIONS

1. Saturated
2. Wet
3. Dry
4. Freeboard
5. Water Level
6. Outlet Discharge
7. Spillway Discharge
8. Reservoir Debris
9. Reservoir Bank Stability

NOTE: Items marked X require attention - See Remarks

EMBANKMENTS

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DATE WORKS

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REM科RS: (Refer Above)

16. Seepage at toe and along right abutment contact.
17. Above toe area and along right abutment contact.
42. Spalling of old concrete.
47. Along left side of channel beyond concrete wall.
48. Between old concrete wall and new wall that wraps around toe.
49. Some small logs in channel.

* Right side spillway channel wall has been extended and now protects the toe of the dam.

INSPECTED WITH: [Signature]

NOTE TO LICENSEE: Section 18(1) of the Water Act states:

"Every licensee and person who has obtained approval under Section 7 shall exercise reasonable care to avoid damaging any land, works, trees, or other property, and shall take full compensation to the owners for any damage or loss resulting from the construction, maintenance, use of operation of the licensee's works."

Page 69
FNR-2013-00173
Upstream face of dam as viewed from spillway entrance. The arrows point to the top corners of a large rectangular concrete patch.

Lower right side of concrete patch on upstream face.
DAM INSPECTION REPORT

HOWARD RESERVOIR #3
INSPECTED BY: S. Reynolds, S. Morgan
INSPECTION DATE: December 1, 1992

Howard Reservoir #3 Dam is owned and operated by the Parks and Recreational Department, City of Nanaimo, for recreational purpose. The dam was originally constructed in the early 1900s as a water storage reservoir for mining purposes. This dam is also known as Middle Chase River Dam.

The dam was rehabilitated in 1980; the downstream embankment material was removed and replaced with well compacted material, the upstream concrete face was raised, new concrete spillway channel walls were constructed and a new walkway was constructed over the spillway. The initial reason to excavate the downstream embankment was to search for the old low level outlet since it was felt that this was the source of high seepage flows. While excavating, poor quality fill and an old log crib dam were discovered and removed. The low level outlet was not located, therefore, a filter blanket was placed at the bottom of the fill to provide adequate drainage.

The dam appears in satisfactory condition, however, there is still a high level of seepage flow along the right groin of the downstream embankment. On the day of the inspection the flow through the seepage weir was estimated to be 0.3 cubic feet per second. The seepage weir that was constructed at the toe of the dam is not level and, should be reconstructed. A record should be kept of the seepage flows.

The spillway appears in satisfactory condition, however, there is some seepage through the right channel wall that contributes flow into the seepage weir at the toe of the dam.
There are several small trees growing near the right downstream groin contact of the dam which should be removed.

The start of the seepage path, along the right downstream groin contact is 2-3 feet above the top of the rock drain filter. The properly graded rock drain filter should be extended up to include the start of the seepage path.

**Recommendations:**

1. Reconstruct seepage weir and ensure an accurate record of seepage flows is maintained.

2. Remove small trees from right groin contact.

3. Ensure the rock filter drain along the right groin contact is adequate to reduce seepage erosion.

S. Morgan, A.Sc.T.
Dam Inspection Officer

SM:slj
View of upstream face from right abutment.

View upstream of spillway sill and pedestrian walkway.
Top picture:
Upstream view of seepage weir. Note approximately 0.3 cfs flow. Seepage weir needs to be reconstructed.

Bottom picture:
View upstream of right groin contact. Note seepage first appears where inspector is standing, approximately 2-3 fee above start of drainage rock.
The inspector is standing beside the location of the seepage exiting on the downstream slope. A permanent marker should be placed at this location so we can tell if the phreatic level is moving up the embankment. It does not appear that regular measurements of the seepage are being recorded by the owner.
Dear Mr. Hansen:

Enclosed are copies of the Dam Inspection Reports for Jump Creek, Howard #3 & #4, and Reservoir No. 1. The inspections were made December 1st and 2nd of 1992.

I took the liberty of enclosing the reports for Howard #3 and #4. If they are still being looked after by the Parks Section, could you forward them to Mike Patton.

Thank you for the copy of the Dam Safety Program Phase 1 Summary Report (September 1992).

I have also enclosed a copy of the summary we put together on the Training Aids for Dam Safety (TADS). We have copies of the 19 volumes (some with accompanying video tapes), that we will lend to interested dam owners on a limited basis. The City of Nanaimo may wish to purchase a set through Bureau in the U.S.A. We paid approximately US $3000 for the set which included the written volumes plus video tapes on 8 of the modules.

Yours Truly,

Stuart G. Reynolds, A.Sc.T.
Dam Inspection Officer
DAM INSPECTION REPORT

HOWARD RESERVOIR #3 D720002
INSPECTED BY: S. Reynolds, S. Morgan
INSPECTION DATE: December 1, 1992

Howard Reservoir #3 Dam is owned and operated by the Parks and Recreational Department, City of Nanaimo, for recreational purpose. The dam was originally constructed in the early 1900s as a water storage reservoir for mining purposes. This dam is also known as Middle Chase River Dam.

The dam was rehabilitated in 1980; the downstream embankment material was removed and replaced with well compacted material, the upstream concrete face was raised, new concrete spillway channel walls were constructed and a new walkway was constructed over the spillway. The initial reason to excavate the downstream embankment was to search for the old low level outlet since it was felt that this was the source of high seepage flows. While excavating, poor quality fill and an old log crib dam were discovered and removed. The low level outlet was not located, therefore, a filter blanket was placed at the bottom of the fill to provide adequate drainage.

The dam appears in satisfactory condition, however, there is still a high level of seepage flow along the right groin of the downstream embankment. On the day of the inspection the flow through the seepage weir was estimated to be 0.3 cubic feet per second. The seepage weir that was constructed at the toe of the dam is not level and, should be reconstructed. A record should be kept of the seepage flows.

The spillway appears in satisfactory condition, however, there is some seepage through the right channel wall that contributes flow into the seepage weir at the toe of the dam.
There are several small trees growing near the right downstream groin contact of the dam which should be removed.

The start of the seepage path, along the right downstream groin contact is 2-3 feet above the top of the rock drain filter. The properly graded rock drain filter should be extended up to include the start of the seepage path.

Recommendations:

1. Reconstruct seepage weir and ensure an accurate record of seepage flows is maintained.

2. Remove small trees from right groin contact.

3. Ensure the rock filter drain along the right groin contact is adequate to reduce seepage erosion.

S. Morgan, A.Sc.T.
Dam Inspection Officer

SM:slj
HOWARD DAM #3
(Upper Colliery Park Dam)

September 29, 1994
Howard Dam #3
(Upper Colliery Park Dam)

Spillway channel looking upstream.
HOWARD DAM
(Upper Colliery Park Dam)

Seepage measuring weir at the toe of the dam.

Small PVC grating located midway up the right abutment contact. The seepage used to surface at this location and now is piped downstream.
Concrete deterioration at right pier.

spillway sill and right pier - wing wall.
Drain pipes along the right abutment. These 2 pipes collect seepage from the abutment so it can be measured. The plastic containers are designed to collect and measure any fines that may be carried by the seepage.
September 20/95

Upper Colliery Dam (Howard #3) Spillway and upstream face.
The meeting was called at my request to discuss the operation and maintenance (O&M) manuals for the Colliery Dams on the Chase River and Westwood Lake. Scott showed us the O&M manuals that were prepared in 1992 by EBA Engineering. Geoff Evans was in charge of the City of Nanaimo dam assessment project of which the O&M manuals were a part. These O&Ms were not sent to our office in 1992 and I requested copies for our office and the Nanaimo Water Management office. Scott Crane and Geoff Evans will review the manuals for revisions and will send the copies out in the next few weeks. I requested that they be in a 3-ring binder to allow for replacement of pages for regular revisions. Our office will review the manuals and make recommendations. One recommendation that was made is to create one single binder for the Emergency Plan for all of the dams. This plan should have links to the City of Nanaimo emergency plan.

Al Boom discussed the McGarrigle Dam (Witchcraft Lake) and reviewed past discussions with the City regarding removal or rehabilitation. There has been no further work in this regard. Geoff Evans provided an inspection report by EBA engineering in 1992. Al Boom has other information in this office which he will send to our office.

DAM SITE ASSESSMENTS

McGarrigle Creek Dam

Access to this dam is off Jingle Pot Road on Kilpatrick (left after the hydro station) and right on Benson View Road. A short trail walk northward from the end of Benson View Road leads to the old dam. For details on the dam see the attached information. The old log crib dam is partially breached near the right side. The breach consists of the top 4 or 5 logs being removed by overtopping flow. The remaining log crib
embankment is about 3 metres high. The reservoir is fed by a diversion ditch from the north-west which enters the reservoir near the left abutment of the dam. We followed the diversion ditch for about 1 km. We saw only one very small creek crossing the diversion ditch has now cut down to about 3 m below the creek so that no diversion ditch is necessary. Most of the ditch is well established being eroded down into the slope 2-6 m deep. This eroded material has been washed into the reservoir and now has filled up most of the forebay to approximately 50 m upstream of the dam. For this reason, if the dam was to breach suddenly, the reservoir would not empty immediately but would erode over time through this large sediment deposit. A more likely cause of flooding would be if a large flood flow were to erode out of the diversion ditch and flow unrestricted down the side hill.

Removal or rehabilitation of this dam will require a considerable amount of planning, design and funding. I recommend that this dam be added to the list of abandoned dams and be included in the abandoned dams task of the Dam Safety Renewal Project being co-ordinated by Scott Morgan of this office.

Wednesday, July 22, 1998

Westwood Lake Dam

Main Dam
• clearing along left abutment required;
• small sinkhole 2 m to right of d/s outlet valve (in drainage blanket) about 1 foot deep sloping toward the outlet pipe;
• seepage flow (minor) in wet area d/s of drainage blanket.

Saddle Dam
• some clearing of alders required - this year’s growth;
• toe area nearly dry - no flowing water.

Spillway
• clear - no floating debris
• recent removal of beaver debris;
• no logs in forebay (spillway entrance)
• no flow - W/L approx. 5 - 10 cm below spillway sill
• check Arbot Road access to the north-east on next visit;

Upper Colliery Dam (Howard #3)
• res. level 2 cm below sill, approx. 2 cfs through notch at left side of spillway;
• dam and spillway condition unchanged
• no flow from the two upper drain pipes (ones that have the silt catching containers);
• large flow coming from usual location near toe - cold water (much cooler than spillway flow). Gauge at concrete notch (V notch steel plate) 4" (10 cm);
• note: seepage tastes like hard well water, this may indicate that the "seepage" is a spring in the abutment

Lower Colliery Dam (Howard #4)

• clearing required along the top d/s slope (maples);
• 2 x 10 double barriers across both spillway entrances - space under barriers is about 1 ft.;
• spillway concrete unchanged - no major problems;
• spillway terminus - no erosion, good condition except for minor undermining at the left side toe of concrete;
• seepage - minor flow in older riverbed downstream, appears unchanged;
• clearing at toe required;
• should have weir at toe and regular inspection.

Will Jolley, A.ScT.
Senior Dam Safety Officer
Public Safety Section

WJ:khh

Attachment
CHANGE OF NAME!!!

NEW NAME:

LOWER CHASE RIVER DAM

Previously called:

- Lower Colliery Dam
- Howard Reservoir No. 4 Dam
- Lower Harewood Dam
Completed by: S. G. Reynolds
Date: June 6, 1985

DAM CLASSIFICATION
DISASTER POTENTIAL CLASSIFICATION

BACKGROUND
Name of Dam: Howard No. 4
Location: City of Nanaimo
Latitude: 49° 09.0' Longitude: 123° 57.6'
Source: Chase River
Tributary to: Ocean
Purpose: Recreation
Licenced Quantity: 173 dam³

Owner: City of Nanaimo
Year of Completion: Approximately 1910.

Water Licence Nos.: CL 59690
Plan Nos.: Microfilm No.
History: Originally built by Wellington Colliers, major repairs in 1980.

WATERSHED
Area: 43 Km²
Forest Cover: % Agriculture: % Urban: %
Elevation: Range: Median
Soil Type: Exposure
Met. Records
Runoff Records

RESERVOIR
Capacity: Live: Dead: Total: 173 dam³
Area: Sill Level: 15 ha: Outlet Level:
Elevation: Sill Level: Outlet Level:
Inflow: Diversions: Capacity: File
Records: File
Releases: Records: File
Fetch: --

Page 89
FNR-2013-00173
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<tr>
<td><strong>Number and Size of Units</strong></td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capacity (cfs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Turbine Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sluice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sill Elevation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Log Boom Across Spillway</strong></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td>Apron Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gross Freeboard</strong></td>
<td>1m</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net Freeboard</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Remarks or Special Considerations</strong></td>
<td>Was unlicenced until November 23, 1984.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.4 LOWER CHASE RIVER DAM (4)

Static Data

Table of Static Data

The relevant static data for the Lower Chase River Dam is contained in Table 3.4-1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>Lower Chase River Dam</td>
<td>Also referred to as: Lower Colliery Dam, Lower Harewood Colliery Dam Howard No. 4 Dam and Harewood No. 2 Dam</td>
</tr>
<tr>
<td>Hazard Classification:</td>
<td>B</td>
<td>M of E criteria, dam is considered to be &quot;major&quot;. &quot;Disaster Potential Classification&quot; estimated to be &quot;B&quot;</td>
</tr>
<tr>
<td>Co-Ordinates:</td>
<td>N 5446292 E 430138</td>
<td>As determined by Wright, Parry, Taylor &amp; Fuller in February 1992</td>
</tr>
<tr>
<td>Structure Type:</td>
<td>Earth fill, rock fill and mine waste dam with 1.2m thick vertical, concrete cut-off wall</td>
<td></td>
</tr>
<tr>
<td>Height of Dam at Crest:</td>
<td>23.3m</td>
<td>As determined by Wright, Parry, Taylor &amp; Fuller in February 1992</td>
</tr>
<tr>
<td>Width of Dam at Crest:</td>
<td>77m</td>
<td>As determined by Wright, Parry, Taylor &amp; Fuller in February 1992</td>
</tr>
<tr>
<td>Storage Capacity for Reservoir:</td>
<td>17.3 Ha-m</td>
<td>Quantity of water stored is 17.3 Ha-m (140 acre-feet), as per water license. Note: this should be confirmed.</td>
</tr>
<tr>
<td>Owner Information:</td>
<td>The City of Nanaimo</td>
<td></td>
</tr>
<tr>
<td>Year of Construction:</td>
<td>1910 to 1920</td>
<td>Believed to have been completed in about 1910 by Wakesiah Colliery.</td>
</tr>
</tbody>
</table>
INSPECTION REQUIREMENTS

The inspection requirements for the Lower Chase River Dam are summarized in Table 3.4-2.

**TABLE 3.4-2**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NATURE OF INSPECTION/MONITORING</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Monitoring</td>
<td>- seepage flow</td>
<td>weekly (at least daily during storms)</td>
</tr>
<tr>
<td></td>
<td>- reservoir level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- precipitation</td>
<td></td>
</tr>
<tr>
<td>2. Monitoring</td>
<td>- suspended soils in seepage flows</td>
<td>monthly</td>
</tr>
<tr>
<td>3. Detailed Inspections</td>
<td>- settlement or cracking of dam crest and associated concrete structure</td>
<td>monthly</td>
</tr>
<tr>
<td></td>
<td>- debris impeding flow through spillway</td>
<td></td>
</tr>
<tr>
<td>4. Special Inspections</td>
<td>- as above with special attention to new disturbances, for example cracking and erosion, or slope movements</td>
<td>during and after major storms and seismic events</td>
</tr>
<tr>
<td>5. Major Inspections</td>
<td>- including dam, abutments, spillway, reservoir, etc.</td>
<td>every 2 years</td>
</tr>
</tbody>
</table>

**Notes:**

1. It has been noted that minor seepage has occurred and is continuing to occur immediately downstream of the dam. The seepage appears to be clear. Such seepage is generally a concern for dams. It is recommended that a V-notch weir be constructed and that the seepage flows be monitored on a weekly basis, along with reservoir elevation and precipitation, in order to determine whether or not the seepage is a hazard to the stability of the structure. A staff gauge should be installed in a readily accessible location to allow the reservoir level to be measured. The frequency of monitoring should be at least daily during major storms, i.e. (10 year events or greater). The origin of this seepage is not currently known, but it is recommended that it should be investigated.

2. In addition, samples of the seepage water should be collected near the toe of the dam and tested for suspended solids on a monthly basis to determine if internal erosion is occurring.
3. Monthly inspections should be made of the dam crest and associated concrete structures to detect settlements or cracking, and of the spillway entrance to detect build up of debris which could impede flow through the spillway.

The monitoring and monthly inspections could be carried out by City of Nanaimo staff and the resulting data provided as reference material for the field inspections.

4. Special inspections should be undertaken during and after major storms (10 year event or greater) and after significant seismic activity (50 year event or greater) of the Dam, reservoir and related facilities. Evidence of ground movement should be recorded any time it is observed.

5. This is an unattended, operational dam. On the basis of its Disaster Potential Classification it should have a major inspection carried out at least once every 2 years. The major inspections should include not only the dam proper but also the abutments, spillway, reservoir, downstream slopes and so on.

Major inspections including summary reports should be carried out by Professional Engineers with Dam Safety and Geotechnical experience.
SITE DESCRIPTION AND GENERAL RECENT HISTORY

The Lower Chase River Dam is located on the Chase River which is in the southwest part of the City of Nanaimo, and is accessible via Nanaimo Lakes Road. The co-ordinates of the dam are N 5446292 and E 430138.

Lower Chase River Dam reservoir is used largely for recreational purposes. The reservoir also has some flood control capabilities with the temporary storage to the spillway invert elevation. The watershed area contributory to the reservoir has been estimated to be approximately 2625 hectares. This should be confirmed as part of a hydrologic study of the reservoir.

Lower Chase River Dam is situated about 0.3 km downstream from Middle Chase River Dam and discharges into the Chase River. The Greater Nanaimo Water District offices are about 1.3 km upstream on Nanaimo Lakes Road.

Lower Chase River Dam is also known as Lower Harewood Colliery Dam and the Lower Colliery Dam. The dam may have been at the end of an old railroad spur from the Harewood Mine. The structure consists of a thick vertical concrete core wall which is 0.3m thick from the top to 0.6m below the crest and then increases in thickness to 1.2m. End dumped soil and rock fill including mine waste form both the upstream and downstream shoulders of the dam.

The dam is situated in a steep sided ravine with both abutments believed to be comprised of silty overburden. The dam foundation material is believed to be dense sandy silt with some gravel. Some weathered siltstone is exposed on the lower portions of the right abutment.

The uncontrolled 2 bay spillway is located in the right abutment. The 2 bays join approximately 15m from the intake. At this point an open channel extends approximately 25m to a steep chute formed by the bedrock surface. A log jam has formed in the pool at the base of the chute.

Concrete walls line both sides of the spillway down to the open rock chute.

There is some erosion of the overburden evident on both sides of the chute, however, due to the limited thickness of overburden this poses no threat to the performance of the spillway.

When this dam was in service as a water supply reservoir, there were two conduits passing through the embankment. The outlet of the pipes, which projected out of the downstream face of the dam at about midheight, have been removed and the pipes blocked upstream. The control valves for the pipes were located on the upstream side of the dam.
Improvement and remedial construction of the Lower Chase River Dam was carried out in 1980. Tree and brush cover over the downstream face of the dam was removed and the lower half of the slope was regraded to 2 horizontal to 1 vertical. A berm drain was constructed about half way up to the dam face, at the top of the regraded portion. A seepage trench was also constructed at the contact with the right abutment.

In addition, the pipe conduits through the dam were filled with concrete to within 5m of the outlet end. The last 5m of downstream pipe section was filled with granular filter material. The spillway wall and floor was repaired and the south spillway wall was raised. Grouted rock rip rap was provided at the spillway discharge. There is minor continued seepage downstream of the dam, however visually noticeable suspended solids and evidence of piping has not been noted during periodic observation over several years.

Periodic observations have been made of the dam and related facilities since 1980.

The most significant note with respect to past observations of the dam was the appearance of a crack in the berm material added in 1980. This was monitored for at least 2 years after initial observation without any indication of change.
**ACTION PLAN**

The remedial works recommended at the Lower Chase River Dam are listed in Table 3.4-3.

**TABLE 3.4-3**

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommended Completion Date</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A weir should be constructed at the toe of the dam and fitted with a stilling basin to collect any fines being carried in the seepage water</td>
<td>June 1992</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>A staff gauge should be installed to measure the reservoir level along with a precipitation gauge</td>
<td>June 1992</td>
<td>$500.00</td>
</tr>
<tr>
<td>Installation of a log boom across the spillway inlet for the safety of swimmers and boaters. This boom will also catch debris floating toward the spillway and this material will require periodic removal</td>
<td>June 1992</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>The trees leaning over the reservoir must be removed prior to toppling</td>
<td>Ongoing</td>
<td>—</td>
</tr>
<tr>
<td>Erosion due to path on upper portion of downstream slope of dam should be repaired</td>
<td>September 1992</td>
<td>$500.00</td>
</tr>
<tr>
<td>Upper slope should be cleared of existing vegetation, regraded and hydroseeded.</td>
<td>September 1992</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>Surface water which flows down left abutment should be collected at top of slope and channelled away</td>
<td>September 1992</td>
<td>$500.00</td>
</tr>
</tbody>
</table>
The source of the existing seepage must be determined. This may include: review of historic information, underwater inspection, dye testing and boreholes.

Once the source of the seepage has been established, remedial measures to stop the flow may be necessary.

A seismic assessment of the embankment and spillway should be carried out.

The hydrological data for the Chase River system should be updated.

Dead trees should be removed from the reservoir.

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommended Completion Date</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>The source of the existing seepage must be determined. This may include: review of historic information, underwater inspection, dye testing and boreholes.</td>
<td>September 1993</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>Once the source of the seepage has been established, remedial measures to stop the flow may be necessary.</td>
<td>N/A</td>
<td>—</td>
</tr>
<tr>
<td>A seismic assessment of the embankment and spillway should be carried out</td>
<td>September 1993</td>
<td>$20,000.00 Cost will include 3 dams on Chase River</td>
</tr>
<tr>
<td>The hydrological data for the Chase River system should be updated</td>
<td>September 1993</td>
<td>$40,000.00 Cost will include 3 dams on Chase River</td>
</tr>
<tr>
<td>Dead trees should be removed from the reservoir.</td>
<td>September 1997 (or as funding permits prior to this)</td>
<td>$10,000.00</td>
</tr>
</tbody>
</table>
TECHNICAL DATA

Hydrological Aspects

The hydrological aspects of the Chase River system were assessed and reported in the 1978 Storm Drainage Study. The inflow to the Lower Chase River reservoir was estimated to be 57.8 m$^3$/s, for a 100 year storm in the 1978 study. The spillway capacity with a 0.9 m discharge depth (determined by the top of the concrete wall) was estimated to be 53.8 m$^3$/sec, therefore the spillway may not be adequate to transmit the flow resulting from a 100 year storm.

Seismic and Geological Concerns

Geology

The bedrock underlying the Lower Chase River Dam is sedimentary rock of Cretaceous aged Nanaimo Group. Bedrock consisting of conglomerates of the Millstream Member, is exposed downstream of the Lower Chase River Dam. The bedrock, where exposed, dips 35 degrees downstream, suggestive of proximity to a fault. Drilling by Golder Associates in 1978 suggests that the Lower Chase River Dam is founded upon overburden. Their borehole No. 9 through the dam encountered dense but unlithified sandy silt with some gravel, which may represent alluvium or till. It appears that some weathered siltstone is exposed in places along the lower portion of the right abutment.

Seismic Concern

There is a fault associated with the Chase River valley, which runs west of the dam location. It should be determined if this fault is active and the impact of it on the safety of the dam should be assessed.

Upstream Concerns

There are 4 other dams (No. 1 Reservoir Dam, Upper Chase River Dam, Middle Chase River Dam, and Powerline Dam in the Morrell Bird Sanctuary) upstream of the Lower Chase River Dam. Uncontrolled release of any of these reservoirs would likely cause the Lower Chase River Dam to be overtopped.

Nanaimo Lakes Road crosses the Chase River approximately 1.3km upstream of the reservoir. Should a chemical or oil spill occur near this crossing, the reservoir could be affected.
Downstream Concerns

The Chase River flows through many residential areas downstream of the Chase River Dams. A large number of residences in the area bordered by Sixth Street, Ninth Street, Wakesiah Avenue and the E & N tracks would be affected as well as the utility, railway and Island Highway Chase River crossings.
The Howard Dam is owned and operated by the City of Nanaimo. We were unable to find a file or licence for the dam. We recommend that the City should be contacted soon by Gerry or Bob to discuss the status of the dam.

- It is about 80' high - earth fill with a thick concrete face on the U/S side.
- The dam appears in excellent shape and no seepage noted.
- There were large trees on the d/s face - c'mon.
- One intake with 2 gates on the U/S side of crest.
- Another intake with control @ 30' out in the reservoir.
- The area is used as a park - see lifeguard tower.

Spillway:
- A 10' wide channel joining into one.
- The channel is about 150' long ending in a 90' falls into the original channel.
- Concrete in good shape.
Concrete outlet structure on downstream face.

Downstream face of dam. W. Jolley standing on concrete outlet structure. The dam is approximately 70' in height.
Upstream face of dam presently being used as a park by the City of Nanaimo. The reservoir is clear and the upstream valve wheels have been removed. The pondage itself has silted in and at the concrete cut-off wall is only 10' deep.
Spillway channel is solid bedrock below dam.

Concrete spillway channel looking downstream from bridge on dam crest.
HOWARD DAM #4


Howard Dam #4 is owned and operated by the City of Nanaimo as a recreational reservoir. Administration comes under the Parks and Recreation Commission. Photographs taken during the inspection are shown on the accompanying pages.

The reservoir appears quite clear and the upstream face of the dam appears to be in fairly good condition except for some minor erosion taking place near the gate structure. The dam is approximately 75 feet high, has a 30 foot wide crest, has 1 to 1 slope on the downstream face and appears to have been constructed of coal mine waste or ballast. It has trees on the downstream face up to 2 feet in diameter which should be removed and a spillway on the right abutment which is founded on good bedrock. The spillway bridge should be replaced and the downstream end of the spillway should have some concrete work done to prevent further damage.

Since both this and Howard Dam #3 are unlicenced, a consultants' study of the rehabilitation work necessary should be a precondition for licencing. As-built plans should also be requested for both these dams and a hydrology study done of the whole system.

R. J. Bugslag, Engineer Technician.

G. F. Cox, Dam Inspection Engineer.
Spillway bridge. Note repairs needed.

Spillway bridge on Dam centreline.
Spillway chute downstream of bridge.
Sluice gates and area where dam crest fill has eroded away.

Crest of dam and reservoir. Note heavy growth on downstream face of dam.
Spillway chute and plunge pool from downstream.
End of spillway chute showing concrete erosion water falls on sound rock.
Howard Reservoir #4
HAREWOOD-DAM #2
September 1, 1976.

Two level sluice and plunge pool.

Typical overgrowth on downstream face of dam.
Howard Reservoir #4

Inspected by: R. J. Bugslag and G. F. Cox  
12 February 1977

Howard Reservoir #4 is owned and maintained as a recreational reservoir by the City of Nanaimo Parks and Recreation Commission. The dam is unlicensed and investigations could find no record of it ever being licensed since constructed in 1910-20 by the Collieris.

The dam is a 75' high earthfill with a 3' concrete slab on the upstream face. Materials evident at the site, and the steepness of the slopes indicate the dam may have been built from mine wastes. Old drawings substantiate this as an old rail spur from the Harewood Mine is shown terminating at the site. The dam appears to be in good condition with no seepage evident at the downstream toe. There was adequate freeboard on the dam at the time of inspection. The concrete spillway, although some of the slab has eroded off the downstream end, is founded on solid rock and appears to be adequate. There are some trees on the downstream face that should be cleared to facilitate future inspections. The are upstream valves on the low level outlet and it should be investigated if they are operational.

An underwater inspection was carried out and indicated that the upstream face of the dam was heavily silted in. The concrete valve housing in the reservoir was also investigated and appears to be in good condition.

The City should be requested to apply for a Water Licence on the structure and to carry out a clearing program on the downstream face.

R. J. Bugslag,
Dom Inspection Officer.
Re: Nanaimo Inspection

Inspection #1 - Howard #4 Dam

Howard #4 Dam was visited 24 June, 1980, to investigate the clearing and fill-placement contract being carried out by upland Construction. Mr. Art Hunter of Willis, Cunliffe and Tait was acting as site supervisor for the duration of the project. The growth on the downstream area had been cleared and grubbed however, stumps on the face were sawn off at ground level and filled over. The toe of the downstream face had been trenched and backfilled with drain rock, picking up seepages across the embankment.

The fill was approximately 50% in place and had been in progress for 10 days. No approved compaction units were in operation. Mr. Hunter estimated completion in another 10 days and the start of a similar contract on the next dam upstream also owned by the City of Nanaimo. The material placement was an imported granular berm approximately 10' wide and staked to extend about 2/3 up the back face and being placed in 1' - 2' lifts.

The old low level outlet works had been eliminated with valves removed and old lines plugged.

Some work had been started in the spillway removing poor concrete with air hammers. The bottom end of the spillway had eroded across the end. The intention of the contract was to trim the fractured concrete sill and pack a mixture of concrete and rocks between bedrock and original spillway concrete.

It was noted some trees remained in the embankment above the berm in the area of the right abutment, apparently for aesthetic reasons.

G. D. Smith,
Dam Inspection Technician.
Sign placed at entrance to fenced off work area.
Stabilizing berm viewed from left abutment area.

Filter material placed along abutment contact.
Diversion of spillway flows while undertaking spillway repairs.

Sandbagging employed to divert water through 2-12" C.M.D. culverts while spillway repairs are undertaken.
HAREWOOD RESERVOIR

15 July, 1980

Stabilizing berm viewed from the right abutment contact.
15 July, 1980

...in the right abutment contact.
Repairs to the end of the spillway chute.
Howard Number Four Dam is owned and operated as a recreational reservoir by the City of Nanaimo Parks and Recreation Commission. No guide was requested. Photographs taken during the inspection are shown on the accompanying pages.

No noticeable change has occurred on the upstream face or the crest of the dam since the last inspection but considerable work has been done on the downstream face and the spillway. The downstream face has been cleared of all vegetation, the pipes projecting from the downstream face have been removed, and a previous stabilizing fill has been added which terminates as a berm some twenty feet below crest level. A really good finishing job has been done on the stabilizing fill and berm which made even more noticeable the crack across the berm and down the downstream face. The spillway walls have been raised and the floor has been repaired. The lower part of the chute and the stilling basin, where undermining was noted on previous reports, has been filled in with hand placed rock covered and painted with a good concrete mix. The work appears to be well done. One seep was noted about halfway down the spillway which probably drains toward the dam.

The crack on the downstream berm should be instrumented and monitored to see if movement is occurring. No further action necessary at this time.

G.F. Cox, P. Eng.,
Dam Safety Engineer.
HOWARD #4

August, 1980

Downstream face of recent rehabilitation including a filter blanket and toe drain.
Tear face of recent rehabilitation including a blanket and toe drain.
Drain rock toe drain used to pick up embankment seepages.

Top of filter blanket berm from left abutment.
August, 1980

Toe of spillway patched during recent rehabilitation.

Repaired concrete spillway channel. Note right wing wall raised 8".
View of Downstream face from left abutment showing line of alignment points set to monitor cracking filter material.
Diversion of spillway flow while repairs are being carried out on the spillway slab.
INSPECTION REPORT

Howard #4 Dam

29 August, 1980

Inspection By: G. D. Smith and K. Kinnersley

Inspection Date: 26 August, 1980

A crack was noted in the downstream filter blanket located at the crest of the filter material recently placed and extending approximately 1/3 way down the face. The crack was measured to 18" deep and is felt to warrant monitoring.

Monitoring will be established and carried out by this office and should consist of points set on either side of the crack.

G. D. Smith,
Dam Inspection Technician.

SMITH/ml
Closeup of crack in downstream berm. Note - crack just below break is approximately 1/10' in width.
HOWARD DAM #4

August 1980

View of completed berm placed downstream of existing dam.
HOWARD DAM #4

View of completed berm plan.
February 24, 1981

HOWARD #4 DAM

Erosion on left abutment.

Seep causing sluff in area of left abutment.
HOWARD #4 DAM

Left abutment washout.

Infilling of toe drain from left abutment sluff.
Downstream toe.

Run-off pooling on filter blanket.
City of Nanaimo,
455 Wallace Street,
Nanaimo, British Columbia.
V9R 5J6

Dear Sir:

Re: Howard Dams 3 and 4 - Application #0355097 and #0355174

The Dam Safety Section of Water Management Branch, Ministry of Environment recently inspected your Chase River Dams, Howard #3 and #4. The structures are currently under application for the purpose of land improvement.

Howard Dam #3

This dam appears to be operating as designed. A significant seepage is noted in the downstream toe area however. The source of this seepage was investigated during the 1980 remedial repairs but could not be isolated. A poorly constructed plywood weir was installed at that time. Monitoring the quantities exiting from this seepage is of interest to you as increased uncontrollable flows could cause serious downstream problems. Your existing weir is not effective enough to decipher spillway flows from embankment seepage.

The improvements recommended are:

(1) Extend the spillway wing-wall to ensure spillway flows are kept separate from your seepage flows until after a monitoring weir.

(2) Replace the plywood weir with a properly constructed permanent weir capable of measuring existing seepage flows only.

(3) Record the seepage results on a regular basis and maintain for historical records.

Please notify myself or Mr. G. Cox, Dam Safety Engineer at 387-1181 when these recommendations will be completed by.
Howard #4

This dam, located downstream of Howard #3, has also had remedial repairs carried out in 1980. The only area requiring your attention on this structure is the removal of new deciduous growth. This should be a regular maintenance consideration and set up to be carried out on an appropriate frequency.

If you have any questions please do not hesitate to call Mr. Cox, Dam Safety Engineer or myself at the above phone number.

Sincerely,

G. D. Smith,
Dam Inspection Technician.
DAM INSPECTION REPORT

HOWARD (Collery) Dam #4

Inspected By: G. D. Smith and S. Reynolds

Inspection Date: October 6, 1982

Howard (Collery) Dam #4 is owned and operated by the City of Nanaimo Parks and Recreation Commission. The licence is currently under application for the purpose of land improvement.

Some new growth was evident on the downstream face, which should be removed on a regular basis, however the embankment appeared to be in good condition.

The crack on the downstream stabilizing berm has been monitored for over two years now and its condition does not appear to have changed in this time. Water was pooling at the top of this berm.

Minor erosion was showing as a result of surface run-off but does not appear to be a problem yet.

A clear flow of water was exiting from the downstream toe area. This seepage appeared to be following the right abutment contact. The amount of the flow was minor and did not warrant monitoring at this time.

The crest of the dam is grassed and in good condition.

The upstream face is a concrete wall, extending from the spillway channel to the left abutment.

The area is well maintained for recreational purposes.

Improvements made to the spillway area appear to be functioning well. The seepage spot located left of the spillway is still wet but doesn't appear to have changed in size.

No action necessary at this time.

S. Reynolds, Technician.

G. D. Smith, Dam Inspection Technician.
Province of British Columbia
Ministry of Environment

DAM INSPECTION REPORT

Howard (Collery) Dam #4 RESERVOIR

DATE October 6, 1982

Application

FILE NO. 720 003

LICENSEE City of Nanaimo

WATERSHED AND RESERVOIR CONDITIONS

1. Saturated
2. Wet
3. Dry
4. Freeboard 1.5 meters
5. Water Level Full
6. Outlet Discharge N/A m3/s
7. Spillway Discharge 1-2 m3/s
8. Reservoir Debris
9. Reservoir Bank Stability

NOTE: Items marked X require attention - See Remarks

EMBANKMENTS OUTLET WORKS

10. Growth X 30. Gate
11. Upstream Slope - 31. Sluice
12. Crest
13. Downstream Slope X 32. Submerged
14. Downstream Toe X 33. Walls
15. Rip Rap - 34. Stilling Basin
16. Seepage X 35. Toe Drain
17. Erosion X 36. Channel
18. Sleuling - 37. Wall

GATE WORKS SPILLWAY

20. Accessibility 40. Boom X
21. Wheel
22. Threads
23. Pedestal
24. Stem Guides
25. Stem
26. Gate
27. Grill
28. Boom
29. Gauge

REMARKS: (Refer Above)

10. Deciduous growth on downstream slope.
13. See #10 - ponding at stabilizing berm crest.
14. Minor seepage
16. Minor
17. Left abutment.
40. None

INSPECTED WITH S. Reynolds SIGNED G. D. Smith

Dan Inspector

NOTE TO LICENSEE: Section 18(1) of the Water Act states:
"Every licensee and person who has obtained approval under Section 7 shall
exercise reasonable care to avoid damaging any land, works, trees, or
other property, and shall make full compensation to the owners for any
damage or loss resulting from the construction, maintenance, use of
operation of the licensee's works."
HOWARD #4

October 5, 1982

Downstream face of dam showing stabilizing berm on lower portion.
Spillway intake in good condition.

Remains of low level outlet valve assembly.
Considerable growth on upper portion of downstream face. Note alder windfall across lower downstream face.

Log crib below downstream toe probably used as support for original pipeline.
Downstream portion of spillway over bedrock foundation.

Spillway channel free of debris.
Water ponding on top of stabilizing berm.
Dear Mr. Smith:

Thank you very much for your letter of 4 November 1982, regarding the Harewood Dams.

Since receiving your letter we have done considerable review and there have been several questions that have come up that we would like to discuss with you. Those being seepage problems as well as the maintenance of the particular sites. I have met with our Manager of Engineering Services and we would both appreciate very much if you could come to Nanaimo and visit the sites with us and perhaps expand on our knowledge of the responsibilities for maintenance and possible seepage problems.

I would appreciate it if you could get back to me as soon as possible, with a date that I could confirm for this meeting.

Yours truly,

F. Michael Patton,
Manager of Maintenance and Construction Services

cc R. Martin, Manager of Engineering Services
H.R. Wipper, Director, Parks and Recreation
CITY OF NANAIMO,
455 WALLACE STREET,
NANAIMO, BRITISH COLUMBIA.
V9R 5J6

ATTENTION: Mr. Martin.

Dear Sirs:

Re: Howard Dam #4 - Application #0355097
Howard Dam #3 - Application #0355174
Westwood Lake Dam - CL7001, 242622.

Thank you for your prompt attention to our November 4, 1982, letter.

Included for your information is a copy of the Notes To File prepared after our joint inspection and discussions on March 25, 1983, regarding the above mentioned dams.

Your improvement proposals should be submitted to this office as soon as possible with construction dates included. If you have any further questions please do not hesitate to call Mr. Cox or myself at 387-1181.

Yours very truly,

G. D. Smith,
Dam Inspection Technician,
Power & Special Projects.

Enclosure.

SMITH/hjg
On March 25, 1983 a joint inspection was carried out with four City of Nanaimo representatives; Mr. Bob Martin, Manager, Mr. Lyle Bangah, Design Engineer, Mr. John Snook, Maintenance Superintendent and Mr. Mike Patton, Manager of Maintenance and Construction Services.

The joint inspection was requested by Mr. Martin as a result of a November 4, 1982 letter prepared by the undersigned. The letter indicated required improvements and suggested improved maintenance procedures for both Howard #3 and Howard #4 Dams.

The March 25, 1983 inspection also included a quick look at Powerline (Morrel) Dam and a complete familiarization with Westwood Lake Saddle and Main Dam.

The areas covered in the discussions are categorized under their dam names in point form.

Howard #4

Topics Discussed:

1) Establish a regular maintenance program.
2) Raise and extend spillway walls.
3) Reseal spillway base.

The first topic discussed, which applied to all dams, was the need for a regular maintenance program to keep the structures free of deciduous and evergreen growth.

Mr. Martin indicated this would be carried out including the repair of minor erosion located on the left downstream abutment.

While inspecting the spillway a minor seep was noted on the left side. Mr. Snook indicated that the quantity of seepage seemed to vary in proportion with the quantity of spillway flows. He also pointed out that spillway flows had been very high in recent years on occasion to a point where sandbagging had been required at the intake to prevent overtopping the spillway walls which could cause seepage erosion.

Mr. Martin did not appear to be aware of the situation but said they would consider raising the spillway walls and resurfacing the spillway bed to increase flow capacity and decrease seepage problems.
Howard #3

Topics Discussed:
1) Extend spillway wingwall.
2) Replace wooden weir with a concrete weir of adequate capacity.
3) Monitor and record the flows for historical value.

On mentioning the spillway wingwall extension, Mr. Patton produced a sketch of a proposed replacement including a concrete spillway extension and an included concrete weir appearing to be very satisfactory. While discussing this proposal Mr. Martin suggested this structure could be monitored and recorded on a weekly basis by maintenance personnel in the area regularly.

Powerline (Morrel) Dam

This structure was visited only briefly for Mr. Martin's benefit as he had not seen the dam before.

Westwood Dam

Topics Discussed:
1) Point out need for regular clearing on both the main and saddle dams.
2) Discuss poor condition of the saddle dam and potential hazard.

The main dam discussions were general and included clearing growth only.

The saddle dam's poor condition was shown and the need for prompt attention was emphasized. Mr. Martin felt budgeting restrictions would make any funding for this area difficult. He did feel growth removal might be possible this year, however.

G. D. Smith,
Dam Inspection Officer.
Downstream face seen from left abutment.
Well maintained dam crest seen from right abutment.

Minor erosion due to run-off in left abutment area.
Spillway channel flowing heavily at time of inspection.
Howard Dam #4

Inspected By: R.J. Bugslag, G.F. Cox, W. Jolley

Inspection Date: May 28, 1984

Howard Dam #4 is owned and operated by the City of Nanaimo as a recreation dam. No guide was requested or provided. No photographs were taken during the inspection.

The reservoir was completely clear of debris. The concrete on the upstream face appears sound. The crest is well maintained as befits its use as a park and swimming area. The grass seeded on the downstream face appears to have taken very well. Standing water was noted on the downstream berm. There was about 6 inches of flow over the spillway. Messrs. Bugslag and Jolley carried out an underwater inspection but no unusual conditions were noted.

No action necessary at this time.

G.F. Cox
Dam Safety Eng.

GC/tp
March 20, 1985

Seepage at downstream toe.

Minor erosion noted at downstream toe.
HOWARD DAM #4

Inspected by: W. Jolley, R. J. Bugslag

Inspection Date: November 19, 1986

Howard Dam #4 is owned and operated by the City of Nanaimo for recreational use. No photographs were taken during the inspection due to a camera malfunction.

At the time of inspection the reservoir was full and the spillway was flowing 10 cm deep. The concrete repairs made to the spillway walls, slab and terminal structure in 1980 have held up well and the spillway remains in fair operating condition. There has been no work undertaken to raise the spillway wing walls as discussed with City of Nanaimo representatives in March, 1983.

There is no log boom across the forebay to keep floating debris from entering the spillway channel. There are a number of large snags around the perimeter of the reservoir which could float into the spillway mouth and block the outflow.

The embankment has been kept free of growth with the exception of the toe area where some alder brush should be removed. The erosion gullies down the face of the berm, which occurred shortly after construction, have been grassed over and no longer appear to be a problem. A small amount of clear seepage was noted at the downstream toe which appears unchanged from previous inspections.

Recommendations:

1. Construct a log boom across the forebay area to keep floating debris from entering the spillway.

2. Raise the spillway wing walls where required to stop any further overtopping.

3. Clear the brush from the toe and abutment contact area.

R. J. Bugslag
Dam Inspection Officer

William Jolley
Dam Inspection Technician
UNDERWATER DAM INSPECTION REPORT

DAM __________ Howard Dam #4 (lower Colliery Dam) __________

DATE __________ May 3, 1989 __________

FILE NO. __________ D 720003 __________

MAX. DEPTH __________ 10m __________

ELEVATION __________ 200 meters __________

RESERVOIR CONDITIONS

1. Water Level reservoir full - spillway 10 cm.
2. Outlet Discharge 0
3. Spillway Discharge approximately 0.5 cu.m/sec
4. Reservoir Debris Hazard some floating and sunken debris

OUTLET WORKS - See page 2

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<td>8. Trashrack Guides</td>
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<td>9. Screens</td>
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<td>10. Debris</td>
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<td>13. U/S Channel</td>
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SPILLWAY - Upstream sill only

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<td>19. Gate Guides</td>
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<td>24. Erosion</td>
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UPSTREAM FACE

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<td>26. Erosion</td>
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<td>27. Sloughing</td>
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<td>28. Sink Holes</td>
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<tr>
<td>29. Debris</td>
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<td></td>
<td>- deep silt layer</td>
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UPSTREAM FACE (con't.)

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<tr>
<td>34. Deterioration</td>
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</tbody>
</table>

REMARKS: (Refer Above)

Outlet Works refer to page 2.

DIVING INSPECTORS __________ R. J. Bugslag, W. Jolley, S. G. Reynolds __________

DIVER'S TENDER(S) __________ G. D. Smith __________
OUTLET WORKS - The outlet works have been plugged with concrete and are no longer in operation. The two entrances on the upstream side of the gate tower were covered with steel plate many years ago. The plate corroded completely through and has been pushed by the water pressure into the intake chamber. Only the outside edge of the steel plates remain. Divers did not enter the gate chamber because of the limited visibility (30 cm with lights) and danger of entrapment.

The underwater portion of the spillway entrance was inspected also. There is a minor amount of undermining of the slab which does not appear to be a structural problem or likely to deteriorate further.

Divers discovered an old tunnel entrance at the 7 meter depth. It is located in a vertical rock wall 10 meters from the intake tower in what was the right side valley wall. The entrance is partially blocked with debris and gravel that has been dumped down the upstream face to form a beach for swimmers.

William Jolley, A.Sc.T.
Dam Inspection Officer
Undermining of upstream end of concrete spillway sill. This is likely caused by wave action when the reservoir is drawn down below the spillway sill level.

Close-up view of old concrete at the upstream side of the spillway sill.
HOWARD RESERVOIR #4
INSPECTED BY: S. Reynolds, S. Morgan
INSPECTION DATE: December 1, 1992

Howard Reservoir #4 Dam is owned and operated by the Parks and Recreational Department, City of Nanaimo, for recreation purpose. The dam was originally constructed in the early 1900s as a water storage reservoir for mining purposes. This dam is also known as Lower Chase River Dam.

Howard Dam #4 was rehabilitated in 1980; a stabilizing berm was constructed on the downstream embankment, vegetation was cleared, the low level outlets were plugged off and the spillway walls and floor were upgraded.

The dam appears in satisfactory condition. There is minor vegetation growth on the downstream embankment which should be cleared. Minor seepage was observed at the downstream toe. The safety line across the spillway channel, just upstream of the falls, is no longer in place.

S. Morgan, A.Sc.T.
Dam Inspection Officer
View of upstream face from left abutment.
Howard Reservoir No. 4 Dam

December 1, 1992

View upstream from downstream toe.
Greater Nanaimo Water District  
Superintendent of Water Supply  
P.O. Box 748  
Nanaimo, B.C.  
V9R-5M2  

April 15, 1993  
File: D-720002  
D-720003  
D-720005  
D-720121

Dear Mr. Hansen:

Enclosed are copies of the Dam Inspection Reports for Jump Creek, Howard #3 & #4, and Reservoir No. 1. The inspections were made December 1st and 2nd of 1992.

I took the liberty of enclosing the reports for Howard #3 and #4. If they are still being looked after by the Parks Section, could you forward them to Mike Patton.

Thank you for the copy of the Dam Safety Program Phase 1 Summary Report (September 1992).

I have also enclosed a copy of the summary we put together on the Training Aids for Dam Safety (TADS). We have copies of the 19 volumes (some with accompanying video tapes), that we will lend to interested dam owners on a limited basis. The City of Nanaimo may wish to purchase a set through Burec in the U.S.A. We paid approximately US $3000 for the set which included the written volumes plus video tapes on 8 of the modules.

Yours Truly,

Stuart Reynolds  
Stuart G. Reynolds, A.Sc.T.  
Dam Inspection Officer
DAM INSPECTION REPORT

HOWARD RESERVOIR #4 D720003
INSPECTED BY: S. Reynolds, S. Morgan
INSPECTION DATE: December 1, 1992

Howard Reservoir #4 Dam is owned and operated by the Parks and Recreational Department, City of Nanaimo, for recreation purposes. The dam was originally constructed in the early 1900s as a water storage reservoir for mining purposes. This dam is also known as Lower Chase River Dam.

Howard Dam #4 was rehabilitated in 1980; a stabilizing berm was constructed on the downstream embankment, vegetation was cleared, the low level outlets were plugged off and the spillway walls and floor were upgraded.

The dam appears in satisfactory condition. There is minor vegetation growth on the downstream embankment which should be cleared. Minor seepage was observed at the downstream toe. The safety line across the spillway channel, just upstream of the falls, is no longer in place.

S. Morgan, A.Sc.T.
Dam Inspection Officer
Crest of the berm on the downstream side of the embankment.

Falls at the end of the spillway channel as seen from the river channel looking up.
Spillway entrance.

Spillway channel looking downstream from the bridge.
Date: Nov. 28, 1995
To: Wayne Hansen
From: Will Jolley
cc:
Subject: Spillway, Lower Colliery Dam

During an inspection of the Lower Colliery Dam (Howard #4 Dam on our records) last month, it was noted that some boards were still in place across the spillway entrance. We assume that these boards are placed here to stop swimmers from sliding down the spillway in the summer. Would you please check to see if the boards have been removed. There is a heavy rain warning up for this PM and tonight.

Below is a photo of the spillway entrance. Hopefully it will make it through the fax machine.

Dam Inspection Reports for Howard Dams #3&4 and Westwood Lake will be sent to you in the near future. The spillway boards are the only serious concern.

Will Jolley,
Dam Safety Officer
Lower Colliery Dam
(Howard # 4)

Spillway entrance. Note 2x10 boards placed across the entrance to keep swimmers out of the spillway chute.

Downstream face and grassed berm.
DAM ASSESSMENTS - CITY OF NANAIMO

Lower & Upper Colliery, Westwood and McGarrigle Dams

Meeting: July 22, 1998
City Public Works Yard

Attendees: Scott Crane and Dave Aitkinson (For Ritchie Fulla), City of Nanaimo
Geoff Evans, Evans Professional Engineering Services
Will Jolley, Dam Safety, Victoria
Alan Boom, Water Management Nanaimo

The meeting was called at my request to discuss the operation and maintenance (O&M) manuals for the Colliery Dams on the Chase River and Westwood Lake. Scott showed us the O&M manuals that were prepared in 1992 by EBA Engineering. Geoff Evans was in charge of the City of Nanaimo dam assessment project of which the O&M manuals were a part. These O&Ms were not sent to our office in 1992 and I requested copies for our office and the Nanaimo Water Management office. Scott Crane and Geoff Evans will review the manuals for revisions and will send the copies out in the next few weeks. I requested that they be in a 3-ring binder to allow for replacement of pages for regular revisions. Our office will review the manuals and make recommendations. One recommendation that was made is to create one single binder for the Emergency Plan for all of the dams. This plan should have links to the City of Nanaimo emergency plan.

Al Boom discussed the McGarrigle Dam (Witchcraft Lake) and reviewed past discussions with the City regarding removal or rehabilitation. There has been no further work in this regard. Geoff Evans provided an inspection report by EBA engineering in 1992. Al Boom has other information in this office which he will send to our office.

DAM SITE ASSESSMENTS

McGarrigle Creek Dam

Access to this dam is off Jingle Pot Road on Kilpatrick (left after the hydro station) and right on Benson View Road. A short trail walk northward from the end of Benson View Road leads to the old dam. For details on the dam see the attached information. The old log crib dam is partially breached near the right side. The breach consists of the top 4 or 5 logs being removed by overtopping flow. The remaining log crib
embankment is about 3 metres high. The reservoir is fed by a diversion ditch from the north-west which enters the reservoir near the left abutment of the dam. We followed the diversion ditch for about 1 km. We saw only one very small creek crossing the diversion ditch has now cut down to about 3 m below the creek so that no diversion ditch is necessary. Most of the ditch is well established being eroded down into the slope 2-6 m deep. This eroded material has been washed into the reservoir and now has filled up most of the forebay to approximately 50 m upstream of the dam. For this reason, if the dam was to breach suddenly, the reservoir would not empty immediately but would erode over time through this large sediment deposit. A more likely cause of flooding would be if a large flood flow were to erode out of the diversion ditch and flow unrestricted down the side hill.

Removal or rehabilitation of this dam will require a considerable amount of planning, design and funding. I recommend that this dam be added to the list of abandoned dams and be included in the abandoned dams task of the Dam Safety Renewal Project being co-ordinated by Scott Morgan of this office.

Wednesday, July 22, 1998

Westwood Lake Dam

Main Dam
- clearing along left abutment required;
- small sinkhole 2 m to right of d/s outlet valve (in drainage blanket) about 1 foot deep sloping toward the outlet pipe;
- seepage flow (minor) in wet area d/s of drainage blanket.

Saddle Dam
- some clearing of alders required - this year’s growth;
- toe area nearly dry - no flowing water.

Spillway
- clear - no floating debris
- recent removal of beaver debris;
- no logs in forebay (spillway entrance)
- no flow - W/L approx. 5 - 10 cm below spillway sill
- check Arbot Road access to the north-east on next visit;

Upper Colliery Dam (Howard #3)
- res. level 2 cm below sill, approx. 2 cfs through notch at left side of spillway;
- dam and spillway condition unchanged
- no flow from the two upper drain pipes (ones that have the silt catching containers);
• large flow coming from usual location near toe - cold water (much cooler than spillway flow). Gauge at concrete notch (V notch steel plate) 4" (10 cm);
• note: seepage tastes like hard well water, this may indicate that the "seepage" is a spring in the abutment

**Lower Colliery Dam (Howard #4)**

• clearing required along the top d/s slope (maples);
• 2 x 10 double barriers across both spillway entrances - space under barriers is about 1 ft.;
• spillway concrete unchanged - no major problems;
• spillway terminus - no erosion, good condition except for minor undermining at the left side toe of concrete;
• seepage - minor flow in older riverbed downstream, appears unchanged;
• clearing at toe required;
• should have weir at toe and regular inspection.

Will Jolley, A.ScT.
Senior Dam Safety Officer
Public Safety Section

WJ:khh

Attachment