



Snare Hydro

Emergency Preparedness Plan

February 2014

Snare Hydro Emergency Preparedness Plan

DOCUMENT HISTORY				
Revision #	Revised Section(s)	Description of Revision	Prepared by	Issue Date
1	1.2, 11	Contact information update and addition of Snare Dyke Breach Report	NTPC	Nov 2013
2	1.2, 7.0, 8.0, Document History, 4.9	Updates per WLWB Board Directive January 17, 2014	David Dewar	Feb 2014
3	8.0, 6.1	Added external agencies to distribution list and added AANDC and DFO to contacts	David Dewar	Feb 2014

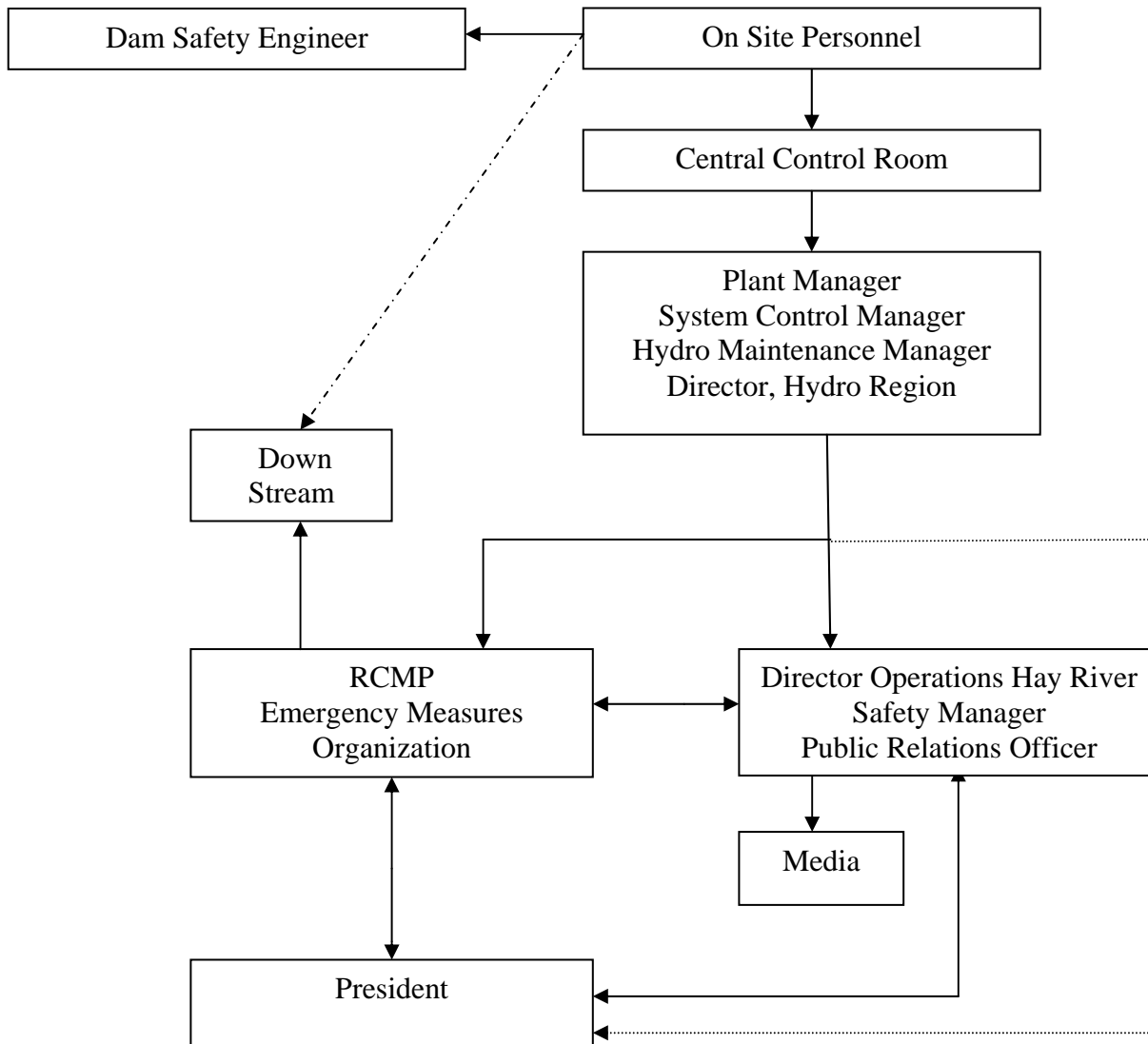
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Snare Emergency Preparedness Plan

1.0 Emergency Notification

1.1 Emergency Notification Flowchart Organizational Communication Plan



If any individual cannot contact the next person on the list that position should be skipped and immediately go to the next position.

1.2 Emergency Notification Information

Calls that must be made:

1. On Site Personnel / Control Center Operator shall report to:

Manager, System Control Ken Dies	867-669-3327(O) 867-873-8034 (H) 867-445-6515 (cell)
Mech. Services Manager Sergio Catlyn	867-669-6881 (O) 867-445-3389 (cell)
Elec. Services Manager Robert Burgin	867-669-3308 (O) 867-766-3328 (H) 867-444-8424 (cell)
Director, Hydro Region Jay Pickett	867-669-3326 (O) 867-445-3988 (cell)
Dam Safety Engineer Gamini Hettiarachchige	867-669-3312 (O) 867-446-9581 (cell)
Sr. Mech. Eng. Lal Jayatilleka	867-669-3313 (O) 867-445-3061 (cell)

2. Regional Director shall report to the following:

President & CEO Emanuel DaRosa	867-874-5276 (O) 867-874-4202 (H) 867-875-7694 (cell)
Manager Safety & Envir – Edward Smith	867-874-5327 (O) 867-874-2491 (H) 867-875-7737 (cell)

3. Local Agencies (Yellowknife):

Fire Department/Ambulance	867-873-2222
Hospital	867-669-4111
RCMP	867-669-1111
City Hall	867-920-5600
Public Works	867-920-5670
Public Works (After Hours Emergency)	867-920-5699

4. Downstream Water Users:

RCMP – Behchoko	867-392-1111
Hamlet of Behchoko	867-392-6500
Chief Leon Lafferty - Behchoko	867-392-6412
Tlichon Lands Protection Department	867-392-6406

Other important phone numbers:

GNWT Emergency Measure Organization	867-873-7554
South Mackenzie District Office – AANDC	867-669-2720
Environment and Conservation – AANDC	867-669-2701
Water Resources Division – AANDC	867-669-2716
Environment Canada 24-hour emergency line	867-669-4729
Fisheries and Oceans Canada	867-669-4940

2.0 Statement of Purpose

2.1 Purpose

This Emergency Preparedness Plan (EPP) has been prepared to assist NTPC personnel, the Territorial Emergency Coordinating Committee, the RCMP, and other responsible local and regional officials in responding swiftly and effectively to emergencies at the four Snare River Dams. It facilitates efficient mobilization of NTPC manpower and equipment to deal with any developing emergency condition. It allows the non-NTPC emergency officials to establish timely warning procedures for the protection and security of property downstream.

This document is the Emergency Preparedness Plan for all of the NTPC hydro facilities - Snare Rapids, Snare Falls, and Snare Forks. Snare Cascades, although under a separate water license held by the Dogrib Power Corporation, is included due to location and for completeness. Rather than producing nearly identical EPPs for each dam, the differences in EPP for each dam are clearly noted where necessary in sections 3.1 (Dam Locations) and 7.0 (Inundation mapping).

Inclusion in the EPP of procedures dealing with the safety of the dam itself does not in any way reflect upon the integrity of the dam.

2.2 Scope

The EPP sets out initial instructions for the Hydro Region Director (HRD) and his staff to follow during emergencies at the dam. It describes:

5. Initial actions and observations to be taken;
6. Organizations and persons to be notified;
7. Remedial or deviating actions to be initiated; and
8. Resources available.

The procedures are designed to prevent or minimize loss of life and/or damage of property resulting from an emergency at a dam. In case of an emergency affecting the safety of the dam, procedures for initiating warning of downstream users are specified, consisting essentially of notification of local emergency agencies. Detailed public warning procedures are the responsibility of the RCMP and local and territorial emergency programs, agencies, and authorities.

Emergencies not specifically identified in the EPP shall be handled by the HRD and his staff using procedures appropriate to the degree of threat to life and property posed by the emergency, based on the procedures outlined in the Plan for emergencies of similar severity.

2.3 Abbreviations

The following abbreviations are used throughout this document:

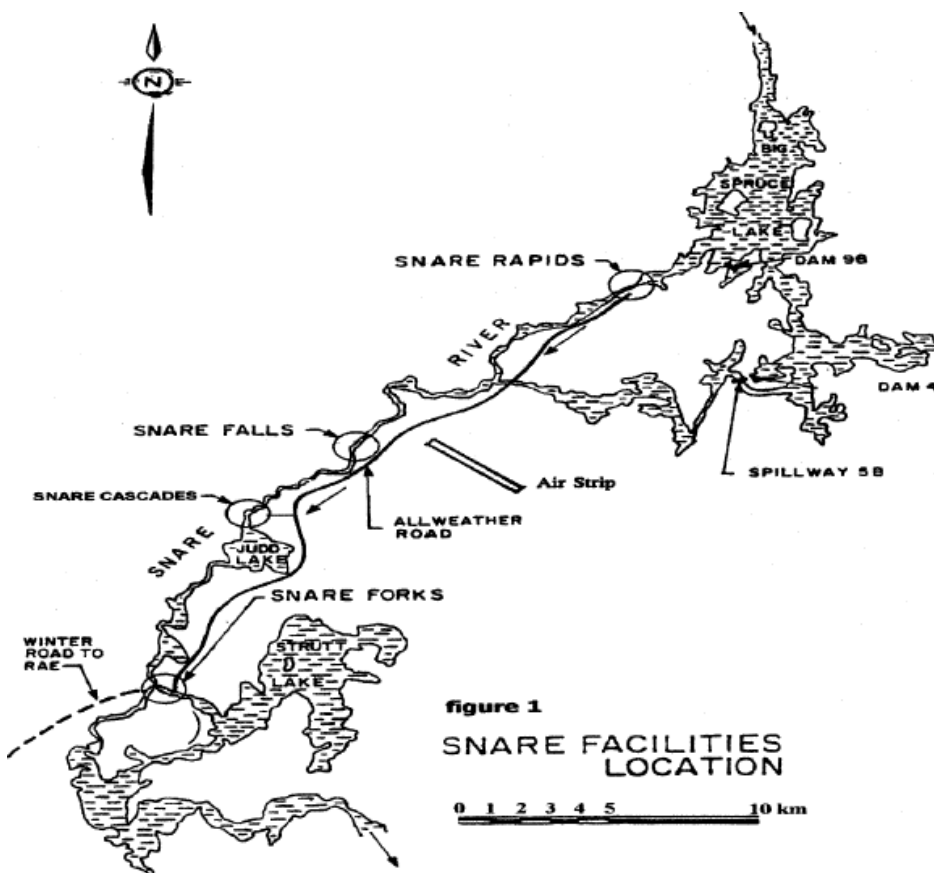
HRD Hydro Region Director
EPP Emergency Preparedness Plan
CC System Control Centre (at Yellowknife)

3.0 Project Description

3.1 Location of Dams and Downstream Areas

The location of the four Snare River Hydro Facilities is shown on figure 1. The main Snare Rapids dam with power plant and the 5B spillway are the furthest upstream on the Snare River. These components control outflow from the major storage reservoir, a combination of Big Spruce and Kwejinne Lakes called Big Spruce Reservoir. Next in line downstream is the Snare Falls dam with associated power plant and spillway. The Snare Falls forebay, although very small in storage capacity, backs up water to the toe of the Snare Rapids plant. Closely downstream to Snare Falls is the Snare Cascades plant and spillway. Furthest downstream is the Snare Forks dam with associated spillway, power plant, and small forebay.

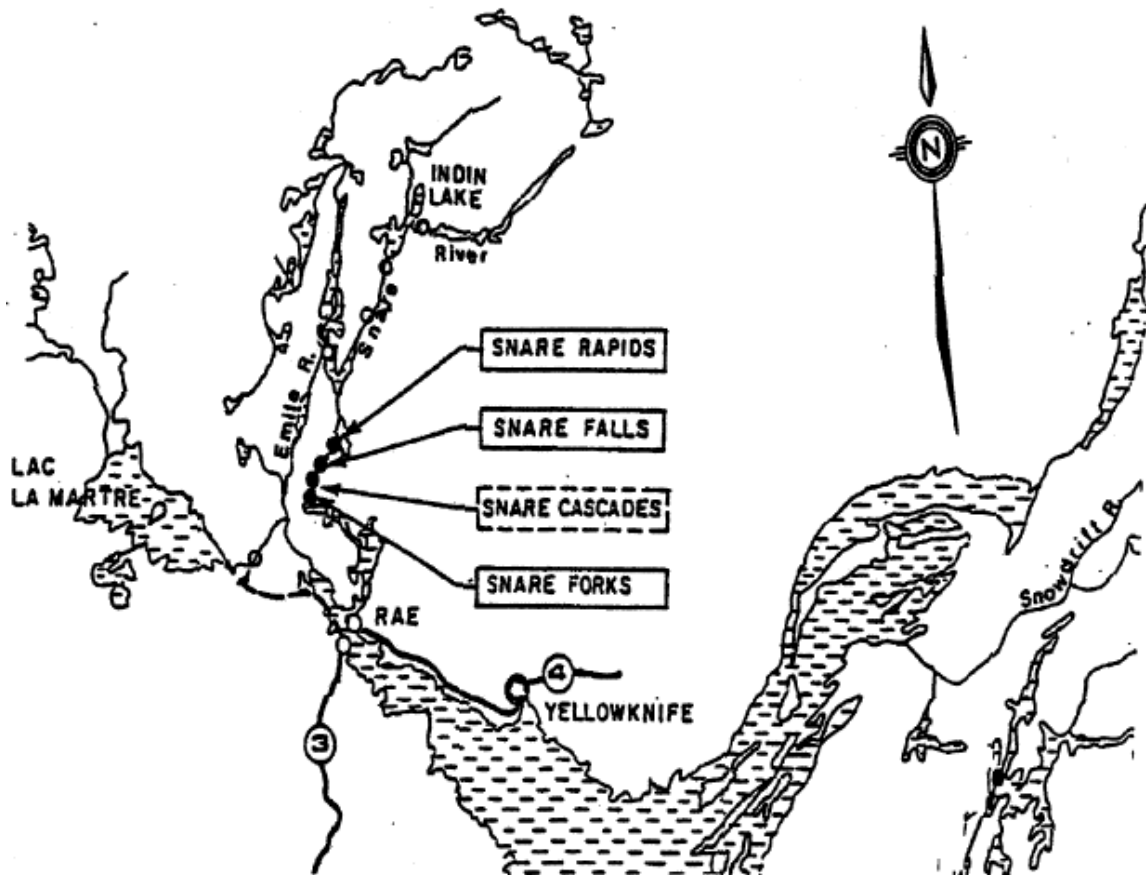
Figure 1: Snare River Hydro Facilities



Outflows from the Forks forebay immediately enter a small lake (Strutt Lake) and then pass into Slemon Lake. Outflows from here enter Russell Lake (which is essentially part of Marian Lake) within 5 km. The closest permanently inhabited

communities of Rae and Edzo are located on the south-east corner of Marian Lake. Marian Lake, joined to the North Arm of Great Slave Lake by the Frank Channel, can be considered part of this huge body of water.

Figure 2: Downstream Communities



A) Snare Rapids

Hazard Classification: High
Location and Access: 150 km by air northeast of Yellowknife, NT
115 km by water north of Rae/Edzo, NT
Latitude: 63031'N **Longitude:** 1160 00' W
River/Stream: Snare River **Nearest City/Town:** Rae/Edzo, NT
Height: 22 m **Normal Surface:** 130,203,559 m²
Length: 233 m **Normal Capacity:** 546,177,502 m³
Dam Type: rock-fill with impermeable core **Max Capacity:** 1,944,624,000 m³
Spillway: 8 controlled stoplog weirs **Spillway Capacity:** 528 m³
Dikes: (3) #4, #5B, #9B **Drainage Area:** 14,020 km²
Outlet other than spillway: Powerhouse Unit # 1, Unit #2, draw #8 at high levels
Purpose/Operation of Dam: Hydroelectric **Instrumentation:** core temperature
Significant upstream dams: None
Significant downstream dams: Snare Falls, Snare Cascades, Snare Forks
Overview of Inundation Area: Snare River downstream to Marion Lake
Method of emergency drawdown: breach freeboard dyke #9

B) Snare Falls

Hazard Classification: Low
Location and Access: 145 km by air northeast of Yellowknife, NT
103 km by water north of Rae/Edzo, NT
Latitude: 63026'N **Longitude:** 1160 11' W
River/Stream: Snare River **Nearest City/Town:** Rae/Edzo, NT
Height: 23 m **Normal Surface:** 5,640,147 m²
Length: 152 m **Normal Capacity:** 3,384,013 m³
Dam Type: Rock-fill with impermeable core **Max Capacity:** 87,306,912 m³
Spillway: 2 controlled underflow gates **Spillway Capacity:** 442 m³
Dikes: (2) North, South **Drainage Area:** 153 km²
Outlet other than spillway: Powerhouse Unit # 1, uncontrolled weir
Purpose/Operation of Dam: Hydroelectric **Instrumentation:** none
Significant upstream dams: Snare Rapids
Significant downstream dams: Snare Cascades, Snare Forks
Overview of Inundation Area: Judd Lake, Strutt Lake
Method of emergency drawdown: breach north saddle dam

C) Snare Cascade

Hazard Classification: Low
Location and Access: 150 km by air north-east of Yellowknife, NT
100 km by water north of Rae/Edzo, NT
Latitude: 63° 25.3' N **Longitude:** 116° 13.2' W
River/Stream: Snare River **Nearest City/Town:** Rae/Edzo, NT
Height: 7 m **Normal Surface:** 220,000 m²
Length: 162 m **Normal Capacity:** 220,000 m³
Dam Type: rock-fill with impermeable core **Maximum Capacity:** 1,261,834 m³
Spillway: uncontrolled labyrinth weir **Spillway Capacity:** 434 m³
Dikes: none **Drainage Area:** 28 km²
Outlet other than spillway: Powerhouse Unit #1
Purpose/Operation of Dam: Hydroelectric **Instrumentation:** none
Significant upstream dams: Snare Rapids, Snare Falls
Significant downstream dams: Snare Forks
Overview of Inundation Area: Judd Lake
Method of emergency drawdown: breach right abutment

D) Strutt Lake & Snare Forks

Hazard Classification: Low
Location and Access: 140 km by air north-east of Yellowknife, NT
90 km by water north of Rae/Edzo, NT
Latitude: 63° 20' N **Longitude:** 116° 20' W
River/Stream: Snare River **Nearest City/Town:** Rae/Edzo, NT
Height: 18 m, 10 m **Normal Surface:** 10,900,205 m²
Length: 160 m, 105 m **Normal Capacity:** 6,540,018 m³
Dam Type: rock-fill with impermeable core **Max Capacity:** 77,449,680 m³
Spillway: uncontrolled weir **Spillway Capacity:** 364 m³
Dike: (3) #1, #2, #3 **Drainage Area:** 73 km²
Outlet other than spillway: Powerhouse Unit #1, Unit #2
Purpose/Operation of Dam: Hydroelectric **Instrumentation:** none
Significant upstream dams: Snare Rapids, Snare Falls, Snare Cascades
Significant downstream dams: None
Overview of Inundation Area: Strutt Lake
Method of emergency drawdown: breach freeboard dyke #1

4.0 Emergency Detection, Evaluation and Classification

4.1 Potential Dam Breach

4.1.1 Definitions

There are two classifications of Potential Dam Breach:

i. Dam Advisory Condition

A Dam Advisory Condition is a situation where an unusual problem or situation has occurred, but a failure of the dam is not imminent. Examples of a Dam Advisory Condition are:

- Instrumentation readings reach pre-determined numerical limits;
- Any undocumented or unusual spring;
- Any sign of piping;
- Any sign of slumping;
- Any sinkhole;
- Any unusual crack;
- Any unusual wet spot or boggy area;
- Any seismic event regardless of how slight;
- Any obstruction in the spillway;
- Evidence of damage due to vandalism at any structure(s);
- Bomb threat;
- A civil disorder near the reservoir structure(s); and
- Any aircraft accident near the reservoir structure.

ii. Dam Warning Condition

A Dam Warning Condition is any developing or occurring event or circumstance which is or may adversely affect the integrity of the dam but is considered controllable. The Dam Warning Condition has the potential of evolving into a Dam Emergency or Dam Breach condition. Examples of a Dam Warning Condition are:

- Water level of the reservoir is at an unsafe level and is rising threatening to overtop the dam; and
- Any developing erosion, settlement or upheaval occurring on the downstream slope or at the toe of the dam and is considered to be controllable.

4.1.2 Hazard

A potential dam breach may require the controlled release of unusually large flows causing downstream flooding and/or requiring action at downstream dams and reservoirs.

4.1.3 Response

Any observer who learns or suspects for good reason that potential breach condition exists in the dam shall immediately **report the situation to the System Control & Hydro Planning Manager**. Phone numbers are given in Section "Communications Directory."

(See also Section 3.0 for telephone locations, radio, and back-up systems.)

The System Control & Hydro Planning Manager shall:

1. Ascertain and verify details of failure threat;
 - a. Description of sloughs, subsidence, movement, cracking, seepage, drainage disturbances, etc.
 - b. Location and extent
 - c. Likelihood of deterioration
 - d. Effects on adjoining structures
 - e. Reservoir and tail water elevations (if available)
 - f. Prevailing weather conditions
 - g. Other facts believed to be pertinent
2. Initiate notifications procedures shown on Fig. 2-1. Make certain all officials understand the nature of a potential breach condition and the possibility of eventual dam breach;
3. Evaluate threat;
4. Determine and implement the immediate actions which must be taken to reduce or eliminate risk of a breach;
5. Take action to minimize potential for downstream flooding; and
6. If the situation deteriorates markedly and a breach occurs or becomes imminent, implement "Dam Breach" procedures set out in Section 4.2.

4.1.4 Notifications

1. Immediate notifications shall be made as shown in Section 1-1. The HRD plays a larger role in initial notifications in the case of potential breach compared with an actual breach because he is the key coordinator in the evaluation of breach potential, possible remedial measures, impact reduction, etc.
2. If any individual or agency responsible for making further notifications cannot be reached, it shall be the responsibility of the initiating caller to make the next stage of notifications himself.
3. The HRD may specify additional people or agencies that should be notified and initiate actions which may reduce the downstream flooding hazard. Refer to Communications Directory in Section 6.0 for a full list of phone numbers.
4. Yellowknife System Control Centre shall be kept fully informed of any change affecting reported condition of the emergency.

4.1.5 Media Contacts

Formal media contacts with NTPC related specifically to a potential dam breach shall be handled in conjunction with NTPC's Public Relations Officer.

4.2 Dam Breach

4.2.1 Definition

There are two kinds of Dam Breach situations:

i. Dam Emergency Condition

A Dam Emergency Condition is defined as one or more of the following situations:

- Water has overtopped or will overtop any dam or dike.
- Any uncontrollable erosion, settlement, or upheaval occurring on the downstream slope or at the toe of the dam.
- Any uncontrollable leakage through any dam structure.

ii. Dam Breach Condition

A Dam Breach Condition is defined as:

- A dislocation or failure of any structure which allows for an expanding, uncontrollable discharge of water through the spillway, dam or dykes indicating a breach is occurring.

4.2.2 Downstream Hazard

Any building, road, bridge, powerhouse, dam, or settlement which could possibly be reached by flooding.

4.2.3 Response Checklist

1. Observe and report breach (see below)
2. Verify breach report
3. Notify people shown Section 1.1 to start warnings
4. Take action to stem or alleviate flooding downstream

4.2.4 Observations

Any observer who learns or suspects for good reason that a breach has formed in one of the dams shall immediately **report the situation to the System Control & Hydro Planning Manager**. If the System Control & Hydro Planning Manager is not available, the observer shall contact the alternate person. Phone numbers are given in Section 1-2 and in Section 6.0 "Communications Directory." (See also Section 3.0 for telephone locations and radio information.) In clear concise language the observer shall relate:

1. Name and position
2. Identification of the breached dam
3. Location of breach
4. Magnitude (size of cracks, gaps, erosion rate)
5. Rate of enlargement
6. Rate of uncontrolled flow
7. Rate of increase in flow
8. Time of commencement of breach

The observer must estimate the above to the best of his ability as measures taken by others will depend on the information supplied.

4.2.5 Verification

Before notifying others, the System Control & Hydro Planning Manager shall be satisfied that the failure report is genuine. Verification may include:

1. Recognition of caller;
2. Caller's demonstrated knowledge of NTPC procedures, personnel, systems, etc;
3. Corroborative evidence from instrumentation, current environmental conditions (e.g., weather, earthquake); and/or
4. Contacting another member of staff at or near the dam site for confirmation (but only if there is serious doubt about the veracity of the report. Remember, time may be of the essence).

4.2.6 Notification

1. Immediate notifications shall be made as shown on the chart in Section 1.1. The notifications are arranged to maximize the time available to allow site personnel to devote their time to remedial operations and actions to lessen flooding.
2. If any individual or agency responsible for making further notifications cannot be reached, it shall be the responsibility of the initiating caller to make the next stage of notifications himself.
3. Yellowknife System Control Centre shall be kept fully informed of any change affecting the reported condition of the emergency.
4. Staff residing at the Snare Rapids staff house may be aware of temporary hunting or fishing camps in the area. If an evacuation is planned and the camps are accessible by vehicle or boat, notification will be made. The Snare Falls spillway is equipped with a klaxon horn, which is sounded when the spill gates are opened. If camps are not easily accessible, the RCMP will be notified.

4.2.7 Media Contacts

In general, emergency announcements through the local media will be the responsibility of RCMP and/or local officials. The HRD may contact the local communications media as necessary to assist with any emergency announcements or to obtain information. However, formal contact by NTPC staff with the media should be handled in conjunction with the Public Relations Officer. Prior consultation between Territorial and NTPC Public Relations Officer is encouraged in dealing with media inquiries.

4.3 Earthquakes

An earthquake alert exists if an earthquake is felt in the Snare area.

In the case of an earthquake alert the System Control & Hydro Planning Manager shall immediately arrange for a general overall inspection of the dam and surrounding slopes.

The System Control & Hydro Planning Manager shall proceed as follows:

1. **Severe Damage** - If a dam is damaged to the extent that there is a rapidly increasing or large uncontrolled flow passing downstream, implement "dam breach" procedure set out in Section 4.2.
2. **Significant Damage** - If damage has occurred which has not caused a breach but which poses an immediate threat to the safety of the dam (e.g. significant

increases in drain flow, new seepage or boils, cracking or slumping of dam embankment or major cracks in concrete control structure), implement "Potential Dam Breach" set out in Section 4.1.

3. **Minor Damage** - If damage has occurred which does not present an immediate threat to the safety of the dam (e.g. small cracks or displacements, small increases in drain flow, small rock or earth slides), the following shall be implemented by the System Control & Hydro Planning Manager:
 - a. Conduct a thorough re inspection of both faces of dams and crests for cracking, slumping, offset or seepage.
 - b. Conduct a detailed inspection of areas in vicinity of abutments for possible landslides, displacements or seepage.
 - c. Inspect all drainage systems and note any changes in established drainage patterns and whether drainage flow is clear or cloudy.
 - d. Inspect powerhouse, power intakes and spillways to determine any damage.
 - e. Observe reservoir slopes and downstream areas visible from dam crest for landslides or ground ruptures.
 - f. Immediately upon discovery of any damage or upon completion of each detailed investigation, a report shall be made orally to the OS.
 - g. Some damage to structures may not be readily apparent during the inspection immediately following an earthquake. Inspection and close monitoring of the facilities should be continued for at least 48 hours. A secondary inspection shall then be made 2 weeks to a month after the initial inspection.
4. **No damage** - If no damage is evident, the OS shall notify the Vice-President of Operations who will decide whether a thorough inspection such as outlined in Item 3 above, should be made, having regard to the intensity of the earthquake.

4.4 Sabotage, Bomb Threat, Riot

4.4.1 Sabotage

If there are indications that an act of sabotage has been committed at the dam, local staff shall notify the HRD, who shall:

1. Ensure safety of members of public and NTPC employees at or near dam. This may include evacuation of the dam site.
2. Determine (if possible) whether saboteur is still at the dam site and assess sabotage potential and situation.
3. Notify:
 - a. RCMP
 - b. Director of Operations and Engineering
 - c. Manager Safety & Environment
4. If the saboteur has left, check the area for evidence that might aid in apprehending him/her.

4.4.2 Bomb Threat

If a telephone bomb threat is received, the person receiving the call should:

1. Keep the caller on line as long as possible. Ask caller to repeat message. Try to record every word spoken by caller.
2. If caller does not indicate the location of bomb or time of detonation, ask caller for this information.
3. Listen closely to voice: sex, voice quality, accent, or speech impediment.
4. Pay particular attention to background noises such as motors running or music that could give a clue to location from which the call is made.
5. Notify the HRD, who shall then notify:
 - a. RCMP
 - b. Director of Operations and Engineering
 - c. Manager Safety & Environment
6. Evacuate dam site under supervision of the HRD.

If a search is conducted for a bomb, use of radios during the search should be avoided; radio signals could cause premature detonation of a blasting cap. If during the search a suspicious package or object is found, **DO NOT TOUCH**. It should be left for trained personnel to remove or disarm.

4.4.3 Riot

If there is a riot or demonstration at the dam, the HRD shall:

1. Ensure safety of members of public and NTPC employees at or near dam. This may include evacuation of the dam site.
2. Lock all gates and doors.

3. Notify:
 - a. RCMP
 - b. Director of Operations and Engineering
 - c. Manager Safety & Environment

4.5 Floods

4.5.1 Early Warning

The area draining into Big Spruce reservoir contains a very high proportion of lakes. These act to hold back and slow down snowmelt and rainfall runoff before it reaches the Snare River and its main tributaries. Once reaching a major channel, numerous lakes hold runoff back still further. These include Winter Lake, Round Rock Lake, Snare Lake, and Indin Lake on the mainstem, and Ghost Lake on the Ghost River.

Consequently, it takes close to two months after a major storm event or after the start of snowmelt before the ensuing reservoir inflows reach a peak. If the forecasted peak inflow is very high, then a two month early warning period is available to organize a wide range of mitigative measures. Initially this would involve planning and organizing.

An even more accurate inflow forecast can be made about 4 weeks before the peak when complete flow information from the indicator basin on the Indin River is available from satellite. If, at this point, the forecast remains extremely high, the previously organized mitigative measures would be implemented. These would include, for example, early draw down of Big Spruce reservoir and the Falls and Forks forebays, heightening of major dams, removal of small very low head side dams, etc. as described subsequently.

4.5.2 Mitigative Measures

1. **Big Spruce Reservoir** - Large amounts of water are stored in Big Spruce reservoir. The normal range of licensed water levels varies from 217.93 m (715.0 ft.) to 222.29 m (729.3 ft.). The impermeable core of the dam was constructed at elevation 222.50 m (730.0 ft.) and in 2002 the core was raised to an elevation of 223.0 m (731.66). Consequently, the maximum licensed operating level of the Snare Rapids dam, (valid only during periods of high flow) which is 222.50 m (730.0 ft.) is now 1.66 m below the top of the core.

Material above the core, a compacted mixture of large gravel, silt and clay is also fairly impermeable.

The Snare Rapids dam and powerhouse would be severely damaged and a gap would develop if reservoir levels exceeded the top of the dam at 224.03 m (735.0 ft.).

To prevent this from happening during flood periods, water is spilled from Big Spruce Reservoir through the 5B spillway, located about five kilometres away from the Snare Rapids dam. This two-man operation is accomplished by selectively withdrawing stop logs (12", 18" and 24" high), with a traveling, powered crane, from each of the eight 6.1 m (20 ft.) wide bays. Stop logs can be removed to elevation 216.41 m (710 ft.) in bays #3, and #4, and to elevation 219.76 m (721 ft.) in the other six bays. Stop log removal time is dependent upon several factors. Complete removal of all stop logs requires about 5 hours of time. To minimize the sudden rise in downstream water levels, spillage would begin well before the peak is reached.

If inflows were to exceed the spill capacity with the Rapids generator also passing maximum amounts of water, then a nearby borrow pit of till and heavy equipment on site could be used to raise the top of the dam by 0.3 to 0.6 meters and to repair small weaknesses that may develop. Gaps could also be dug by 4 men crews into several small side dams (i.e. #9B). Subsequently washouts would safely expand these gaps and thus the spill rate but would not deepen more than approximately 2 to 3 meters.

2. **Snare Falls Forebay** - Only small amounts of water are stored in the Falls forebay. Water levels are normally maintained between 202.08 m (663.0 ft.) and 202.39 m (664.0 ft.).

The Snare Falls dam and powerhouse would be severely damaged if forebay water levels exceed the top of the dam at elevation 20.574 m (675.0 ft.). The impervious core of the dam rises to elevation 204.83 m (672.0 ft.). To prevent a dam break from happening, water is spilled through two 5.79 m (19 ft.) wide motorized undershot gates that open from 195.38 m (641.0 ft.) to 202.39 m (664.0 ft.).

Small amounts of water also spill uncontrollably over a small 12.2 m (40 ft.) wide weir whenever water levels exceed 202.39 m (664.0 ft.). With both gates fully open, and with the forebay topped up, maximum Falls outflows would match maximum spill capacity from Big Spruce reservoir. If it were necessary to spill through gaps in the Big Spruce side dams, then (time permitting) gaps should be placed in the two right bank side dams near the Falls dam to increase spillage at the Falls too. This could easily be accomplished with heavy equipment. However, first priority would be directed towards saving the Rapids dam with its attendant large volume of stored water.

3. **Snare Forks Forebay** - Only small amounts of water are backed up behind the Forks dam. Water levels normally range between 173.43 m (569 ft.) and 173.74 m (570 ft.).

NTPC drawings show the top of the core of the dam at elevation 175.56 m (576 ft.). This is the maximum water level allowed by licence. The top of the dam is at elevation 176.78 m (580 ft.). The top of the right side dam is slightly lower at about elevation 175.3 m (575 ft.).

The Snare Forks plant would be severely damaged if the adjacent dam were breached. This is normally prevented by uncontrolled spillage over the concrete weir at elevation 173.74 m (570 ft.). However, if the forebay inflows were to become higher than combined spillway plus plant flows, water levels would rise until the low side dam failed. At that point outflow rates would increase substantially. This additional spill would be located far enough away from the power plant that it would not be damaged.

Even greater additional spill protection would, in fact, be provided because heavy equipment would be used to initiate wider areas of washout. This measure would have a lower priority, however, than mitigative measures to ensure the integrity of the Snare Rapids dam and the Snare Falls dam.

4.5.3 Downstream Flooding Hazards

1. Historical Peak Flows

No serious downstream flood damage has been reported in the over fifty year history of Snare hydroelectric development.

2. Spillway Design Discharge

In 1998 Dillon Consulting Limited determined that the 1:1000 AEP flood equal to 458 m³/s at Big Spruce Reservoir was attenuated to a maximum daily outflow of 424 m³/s. A confirming estimate of 434 m³/s for the 1:1000 AEP flood was determined by KGS Group in 1999. According to KGS Group at the normal operating level of elevation 222.29 m (729.3 ft), the total spillway capacity is approximately 475 m³/s, which is greater than the 1:1000 year flood. This capacity includes a head loss of approximately one-foot in the approach channel between the main body of the lake and the spillway control structure. In the 2000 Dam Safety Review carried out by AGRA Monenco the maximum daily outflow was calculated at 457 m³/s, 20% larger than estimated by earlier investigators, but is still within the original dam design parameters, as the maximum flood level 222.41 (729.72) is lower than the design core elevation 223.0 (731.66).

3. Dam Breach due to Earthquake

All three Snare hydroelectric dams are gravity dams of moderate head (maximum 21 m). Consequently, they are very resistant to earthquake

damage. If either the Snare Falls or Snare Forks dams were to be breached, very little downstream damage would occur because the small volumes of water that would be released would be dissipated quickly by the first two lakes encountered downstream - Strutt Lake and Slemon Lake. In the extremely unlikely event that the Snare Rapids dam was to be breached by a very strong earthquake, then both downstream dams would be taken out too, either by the flood of water from the upstream breach, or by the earthquake itself.

The force of the earthquake would forewarn NTPC personnel at or in the vicinity of the Snare Rapids staff house. They would have time to move immediately to adjacent high ground while the breach develops and widens, and then to notify the control centre operator by radio. The highest rise in water levels would occur just below each dam. The flood wave would have virtually no major affect upon Russell Lake or Marian Lake because they are essentially part of Great Slave Lake.

4.6 Failure of Spillway Operating Equipment During an Emergency

If a spillway gate at the Falls, or the stop log hoist at the 5B spillway fails to operate, the field crew shall:

1. determine the possible cause of failure and effects on reservoir operations.
2. and, if gate failure could endanger one of the dams, determine what immediate assistance is required to remedy the problem including:
 - a. replacement parts;
 - b. manpower, and
 - c. repair equipment
3. determine temporary replacement or operating procedures.
4. contact the System Control & Hydro Planning Manager report conditions, in the event of conditions not predicted or not covered by operating instructions, request directions on how to proceed.
5. if dam security is threatened, notify the HRD and the System Control & Hydro Planning Manager.

4.7 Response During Periods of Darkness and Adverse Weather

The normal period of high flows and potential high precipitation events occurs in the summer months when the Snare structures are subject to a predominance of daylight. If, however, a response was needed during a period when darkness was a

hindrance, artificial illumination equipment is available at the Emergency Response Facility. This building is located near the Snare Rapids helipad and contains a portable generator, halogen lights, flashlights and propane lanterns.

Also contained in the Emergency Response Facility are torches, heaters, tarps and rope to aid in response during adverse weather.

4.8 Spring, Seepage or Increased Drainage

Periodic measurement of seepage is taken by operating staff at:

1. Left abutment drainage sump at Snare Rapids;
2. 5B Spillway Side Dam; and
3. Downstream of the powerhouse at Snare Forks.

If new springs or seepage are observed or existing ones increase abnormally, the observer shall report the following to the System Control & Hydro Planning Manager:

1. Location of springs or seeps, including identification of structure or embankment and a description of affected area;
2. Size;
3. Estimated discharge or change of discharge;
4. Nature of flow - clear or cloudy;
5. Type of flow - wet spot, slow seepage, boil, or piping; and
6. Reservoir and tailwater elevations.

The HOD shall decide what immediate emergency measures are necessary.

4.9 Droughts

4.9.1 Aquatic Habitat and Downstream Licensed Minimum Water Release Requirements

There are no minimum flow requirements from Big Spruce Reservoir, The Falls Forebay or the Forks Forebay. In 2013 the minimum flow restriction of 5.66 m³/s below the Falls forebay was removed and replaced with a condition that allows zero flow for 24 hours. Also, the minimum flow release requirement from the Forks forebay is a 0.0 m³/s (0.0 cfs).

There are no minimum flow requirements from Big Spruce reservoir because water will always be backed up to the base of the Rapids dam by the Snare Falls dam as long as the Falls forebay is kept within licensed limits. The constriction at the outlet of Strutt Lake backs up water to the Forks dam so that even a complete cessation of flow for extended periods would not eliminate fish habitat between the Forks dam and the outlet of Strutt Lake. Also, outflow from water stored in Strutt Lake would continue for many days

should a complete halt to Forks dam outflows ever occur. At any rate, only a short 1 kilometre section of channel between Strutt and Slemon Lake would be affected. Slemon Lake is so large that it would buffer any downstream effects for a month or more.

4.9.2 Licensed Minimum Water Level Requirements

The level of Big Spruce reservoir must be kept above 217.8 meters (715.0 ft.) according to its water licence unless a written request is filed with the Water Board and a letter of approval received. The Falls forebay must be kept above 201.8 meters (662.0 ft.) according to its water licence unless a written request is filed with the Water Board and a letter of approval received. The Forks forebay must be kept above 173.1 meters (568.0 ft.) according to its water licence unless a written request is filed with the Water Board and a letter of approval received.

4.9.3 Special Water Licence Exemptions for Scheduled Maintenance

For short periods of time each year, it is necessary to apply to the Water Board for special exemptions to draw down the Falls forebay to about 201.2 meters (660.0 ft.) so that the tailrace of Rapids plant can be dewatered for scheduled inspections and repairs.

After periods of high spillage from the Falls dam, rock debris accumulates in the tailrace channel below the spillway. This raises tailrace levels and consequently reduces the output of the Falls generator. It is therefore necessary approximately every five years on average to apply to the Water Board for special exemption to cease Falls dam releases completely for one eight hour period while debris is cleared from the tailrace with heavy equipment.

4.9.4 Operational Strategies for Drought Conditions

a. Maintaining High Generation Efficiencies with Low Average Plant Flows

During the worst historical drought conditions, Big Spruce reservoir net inflows averaged 26.0 m³/s (in 1980/81) and only 24.6 m³/s the following year. If such a drought were to recur, then there would be a very large shortfall in hydroelectric generation. As happened during the last drought, this would be foreseen in the springtime because of snow survey information and satellite information on early Indin River snowmelt runoff. Consequently, heavy base-load diesel generation would start in June. If this action were not taken, it might not be possible to make up the hydro-generation shortfall for the following 12 months with the existing diesel generation capacity.

In conjunction with the lighter summer loads, the heavy base load diesel generation would result in small amounts of summertime hydro generation. To maintain reasonably high generation efficiencies, with such low amounts of water usage (15 to 16 m³/s) in the summer, it would be necessary, as in the early 1980's, to shut individual hydro units off for periods of up to half the day each day. Then, whenever each unit was on, it could be operated much closer to optimal. Such reduced summertime outflows would also raise the average annual elevation of Big Spruce Lake and hence the total amount of generation from the Rapids plants. In addition, it would store more water for wintertime use. This would allow higher generation rates and hence higher generation efficiencies in the wintertime. And secondly, it would provide more water so that the hydro units could be on at all times or at least 22 hours per day. Hence no intakes would freeze.

Because of its unique design, the Falls unit would be kept on 24 hours a day both summer and winter. Its generation efficiency can be maintained even with low plant flows.

The above mode of operation requires one licence exemption. The 5.66 m³/s minimum outflow requirement from the Forks plant would have to be changed to zero for half of each day in the summer, and for about two hours per day in the wintertime. As previously indicated, this will not unduly stress the aquatic environment.

b. Extra Big Spruce Reservoir Drawdown

During the worst historical drought, NTPC asked for special exemption, as provided for in the licence, and received it to draw down Big Spruce reservoir below the licensed minimum level of 217.9 meters (715.0 ft.). As 0.30 meter of stored water saves about 4.3 GWH of diesel generation worth a substantial amount in savings to NTPC customers, NTPC would again request an extended late winter/early spring drawdown at the end of a drought if snow survey data collected at the time indicated that the probability of subsequent full reservoir recharge was high.

4.9.5 Failure of Outflow Components and the Maintenance of Licensed Flows/Elevations

If the Rapids generator were to fail, then about 2.8 m³/s (100 cfs) of Big Spruce reservoir outflow could be released through the station service generator at Snare Rapids. Within 24 hours, the 5B spillway gates would be opened to provide more water downstream. Hence the licensed minimum outflow from the Falls forebay could be sustained. During the few days it would take the 5B spillage to work its way through the several small lakes between the 5B spillway and the Falls forebay, minimum licensed outflows

from the Falls forebay could be sustained by withdrawing water from storage. This would only draw down the Falls forebay about 0.1 meter. As the forebay would initially be the usual 0.5 to 0.6 meter above the licensed minimum level, it would not be drawn down too low

The above procedure would be satisfactory as long as Big Spruce reservoir is above the minimum licensed level of 217.9 m (715.0 ft.).

In the very unlikely event that Big Spruce reservoir was below this level at the time that the Rapids generator failed, then the constriction in the 5B channel would not allow sufficient spillage from Big Spruce reservoir to satisfy downstream licensed minimum flow releases for more than a few weeks. If this were to happen, then NTPC would immediately remove some of the restrictions. A wintertime operation would involve a drag line. A summertime operation would require blasting and some hand labour.

If the Falls plant generator were to fail, licensed minimum forebay flow releases would be maintained by opening the spillway gates.

If one of the Forks generators were to fail, licensed minimum Forks forebay outflows would be sustained by the second generator. If both were to fail simultaneously, the Forks forebay level would rise 0.1 to 0.2 meter above its usual operating level within one half of a day. At that point, there would be sufficient outflow over the uncontrolled Forks spillway to meet the licensed minimum release requirement.

4.10 Severe Storms

Heavy rainfall or snowfall, high winds and/or heavy icing conditions can result in building and equipment damage, major transmission line outages, communications failure and road washouts.

If severe weather conditions are forecast or experienced, local staff shall:

1. Keep abreast of forecasts and storm developments;
2. Maintain close surveillance of all dam facilities; and
Immediately report any storm damage or personal injury to the System Control & Hydro Planning Manager

The System Control & Hydro Planning Manager shall:

1. Notify the HRD and the Operations Director of any damage;
2. Take action to restore services and repair damages; and
3. Ensure safety of any members of the public in area.

Snare Hydro Emergency Preparedness Plan

If the HRD is informed of an accident already reported to the RCMP, he shall report the event to the Operations Director.

5.0 General Responsibilities Under the EPP

5.1 Dam Owner/ Operator Responsibilities

During an emergency condition:

1. Identification of the emergency condition;
2. Notification of the RCMP;

Person responsible for the notification: HRD

3. Implementation and direction of emergency repairs;
4. Update emergency status to the RCMP;

Person responsible for the notification: HRD

5. Provisions for security measures at the dam; and
6. Reporting termination of emergency situation on-site at the dam.

In non-emergency conditions, owner operator must also provide for:

1. Routine maintenance and operations of the dam;
2. Routine surveillance of the dam; and
3. Annual review, updating and distributing of the EPP.

5.2 Operations Superintendent Responsibilities

Responsibility for the day-to-day operation of the Snare Dams rests with the System Control & Hydro Planning Manager whose headquarters are the Yellowknife Area Office and can normally be contacted there. Local staff attends the dams each day. Normal working hours are 0800 to 1700 hours, Monday to Friday at Yellowknife and seven days a week at Snare Hydro.

During an emergency, decisions regarding operations at the Snare Dams shall be made by the HRD. Where advice or special expertise is required, it is the responsibility of the HRD to obtain guidance from NTPC Engineering, and others such as government agencies or outside consultants.

An organization chart showing the relationships between key NTPC personnel identified in the EPP is shown in Section 1-1.

6.0 Preparedness

6.1 Emergency Notification Directory

The Communications Directory contains specific contacts which may be necessary in handling an emergency. Contacts are grouped as follows:

- 6.1.1 NTPC
- 6.1.2 RCMP
- 6.1.3 NWT Emergency Coordinating Committee
- 6.1.4 Local Municipalities

For **order of notification** required in particular emergencies, refer to Section 1.1.

Long Distance Telephone Calls

1. To dial direct from within NWT (area code 867), but not within municipality, to NWT (area code 867); dial 1 + 867 + number.
2. To dial direct from outside NWT (area code 867) to within NWT (area code 867); dial 1 + 867 + number.
3. To dial direct from NWT (area code 867) to outside of NWT (area code 867); dial 1 + area code + number.

Snare Hydro Emergency Preparedness Plan

6.1.1 NTPC

Yellowknife Area Office

Manager, System Control
Ken Dies

867-669-3327(O)
867-873-8034 (H)
867-445-6515 (cell)

Mech. Services Manager
Sergio Catlyn

867-669-6881 (O)

Elec. Services Manager
Robert Burgin

867-669-3308 (O)
867-766-3328 (H)
867-444-8424 (cell)

Director, Hydro Region
Jay Picket

867-669-3301 (O)
867-445-3988 (cell)

Sr. Civil Hydro Eng.
Gamini Hettiarachchige

867-669-3312 (O)

Sr. Mech. Eng.
Lal Jayatilleka

867-669-3313 (O)
867-445-3065 (H)

Yellowknife Control Centre 669-3370

Snare Staff House 669-6896

Snare Rapids Powerhouse 669-6896

Snare Falls Powerhouse 669-6898

Snare Cascades Powerhouse 669-6899

Snare Forks Powerhouse 669-6893

Head Office – Hay River

President & CEO
Emanuel DaRosa

867-874-5276 (O)
867-874-4202 (H)
867-875-7694 (cell)

Director, Safety & Envir.
Edward Smith

867-874-5327 (O)
867-874-2491 (H)
867-875-7737 (cell)

6.1.2 RCMP

Behchoko 867-392-1111

6.1.3 GNWT Emergency Measure Organization

Yellowknife 873-7554 (24 hours)
FAX 873-8193

6.1.4 Local Municipalities

Behchoko

Hamlet Office 392-6500
Garage 392-6111
Medical emergency 392-6075
Fire 392-2222, 371-2222
RCMP 392-1111

Yellowknife

City Hall 920-5600
RCMP 669-1111
Ambulance 873-2222
Fire 873-2222
Stanton Hospital 669-4111

6.1.5 Other Agencies

Aboriginal Affairs and Northern Development Canada (AANDC)

Nahum Lee 669-2757

Fisheries and Oceans Canada (DFO)

24 Hour Emergency Line 1-800-265-0237

6.2 Telecommunication Information

Telephone and Radio

This Section briefly describes the telephone and radio facilities available at Snare.

Communications to Snare River facilities are via a microwave and radio link. Access can be obtained by calling directly the numbers shown in Section 6.1.1 or by phoning the control centre operator in Yellowknife at 669-3340. Each powerhouse, staff house, and vehicle is equipped with phone access through the microwave system and with repeaters at Snare Rapids Snare Falls and Snare Forks. In addition, the staff house at Snare Rapids and the operator's truck at Snare are equipped with radio telephones to access the Northwest Tel system through their Snare repeater and Rae Edzo repeater. These phones are generally used only if the microwave system is out of service. In addition there is a powerline carrier that can be used as a backup communications system.

6.3 Road Communications

The only year round roads in the Snare Area are gravel roads between Snare Rapids, Snare Falls and Snare Forks. The Snare Rapids to Snare Falls road is 16 km in length. The road from Snare Falls to Snare Forks is 20 km. In the event of a major dam breach at the Snare Rapids, these roads would be flooded at several locations.

During the winter from approximately February 15 to March 15, a winter road is constructed from Rae-Edzo to connect to the local road system at Snare Forks, a distance of 60 km. This section of winter road would not be subject to flooding from a dam breach.

6.4 Air Communications

1. **Fixed Wing Aircraft**

A 3000 ft gravel airstrip, designated C-EV9 “Snare River”, capable of handling DC3 and Twin Otter aircraft is located adjacent to Snare Falls powerhouse at latitude 63° 26' longitude 116° 11'. It is suitable for landing aircraft on wheels all year round, during daylight hours. V.F.R. flight rules apply. Navigational aids were installed in the summer of 2000. Landing of float-equipped planes on all the reservoirs is feasible only during daylight hours and in suitable weather conditions. The airstrip could not be affected by a major dam breach.

Landing of ski-equipped planes on all the reservoirs is normally feasible during winter months and during daylight hours and in suitable weather conditions. During the shortest days of the year, there is sufficient daylight for only a few hours of flying each day. It is impossible to land on the reservoirs for a period of one month in the spring and for a similar period in the early winter because of poor ice conditions.

2. **Helicopters**

There are numerous possible helicopter landing areas at each dam.

6.5 Power Sources

6.5.1 Water Discharge Control Facilities Power Sources

Normal power for all station operations, including all power intake gates and spillway gates, is supplied by station service from the local powerhouse. In the event of a complete station outage, Snare Rapids has an emergency 120 kW hydro generator and Snare Forks has an emergency 150 kW diesel generator to supply station service. The Snare Forks diesel starts out automatically on loss of station service. Each plant can be fed power from the main 115 KV line. At Snare Falls there are emergency gasoline engines to operate the spillway gates. There is also an emergency gasoline engine on the 5B spillway to operate the stop log hoist.

6.5.2 Communication System Power Sources

All communication system power sources are battery operated, charged by station service. Batteries would last for several hours without recharging.

6.5.3 Backup Power Sources

All Snare River hydro facilities are equipped with backup power supplies in the form of batteries and backup diesel engines. There is also a portable gas generator located in the Emergency Response facility located near Snare Rapids helipad.

6.6 Available On-site Equipment and Repair Material

There are various borrow areas with 1/2 km of each dam where materials could be obtained to repair a breach.

The following heavy equipment is located at Snare:

- 2 - Tandem Ford LTS 8000 dump trucks
- 1 - Cat D-6 Bulldozer c/w hydraulic angle blade
- 1 - Cat ITC38 Front end loader c/w bucket, forks, boom, and backhoe
- 1 - John Deer tracked Hi Hoe – back hoe
- 1 - Champion D-760 Grader c/w V-plow, wing-plow
- 1 - Pelomix 1 yd batch cement mixer
- 1 - 16 foot aluminum boats with 40 hp outboard motors
- 2 - 16 foot aluminum boats with 25 hp outboard motors

6.7 Off-site Equipment and List of Contractors

During the period of time when the winter road is available for travel, there is additional construction equipment available in Behchoko and in Yellowknife.

	Office Telephone Numbers
Hamlet of Bohchoko	392-6500
Garage	392-6111
City of Yellowknife	920-5600
Works Garage & City Stores	873-2671
RTL Robinson Trucking Ltd.	873-6271
Two Way Enterprises	873-5322
First Air	669-6600
Air Tindi	669-8200
Great Slave Helicopters	873-2081
Arctic Sunwest	873-4464

7.0 Inundation Maps

In the event of a complete dam breach, the areas of inundation have been determined for each dam site. This area was determined by finding the area covered if all of the water in the reservoir of the dam was immediately displaced into the inundation area. This method neglects the time taken for the water to reach the inundation area and neglects the outflow from the inundation area. Using this method, the inundation areas calculated were slightly larger than the worst case scenario possible. This is considered to be a high factor of safety for this study.

The inundation studies were concentrated in the bodies of water at the outlet of Snare Forks Dam, as this is the only area that would be affected immediately following a dam breach. This area includes Strutt Lake and the section of the Snare River from Snare Forks to Slemon Rapids. Slemon Rapids has been modeled as a constriction point and outflow has been neglected.

1. Snare Rapids

The Snare Rapids dam has the largest reservoir of the dams on the Snare River. A total breach of the Snare Rapids Dam would cause a breach of all the subsequent dams on the Snare River: the Falls, the Cascades, and the Forks. The water in the area shown in Figure 1 would reach an elevation of approximately 176 m (580 ft) within 40 hours after the breach of Snare Rapids dam.

2. Snare Falls

A complete failure of the Snare Falls dam would cause subsequent failure of the Snare Cascades and Snare Forks dam.

3. Snare Cascades

A failure of Snare Cascades would not cause a subsequent failure of the Snare Forks dam. The water from the Snare Cascades reservoir would be contained in the Snare Forks forebay (Judd Lake) and would not cause a significant change in the surface area of the Forks forebay.

4. Snare Forks

A complete failure of Snare Forks would cause an insignificant change to the area of Strutt Lake and the Snare River.

Snare Hydro Emergency Preparedness Plan

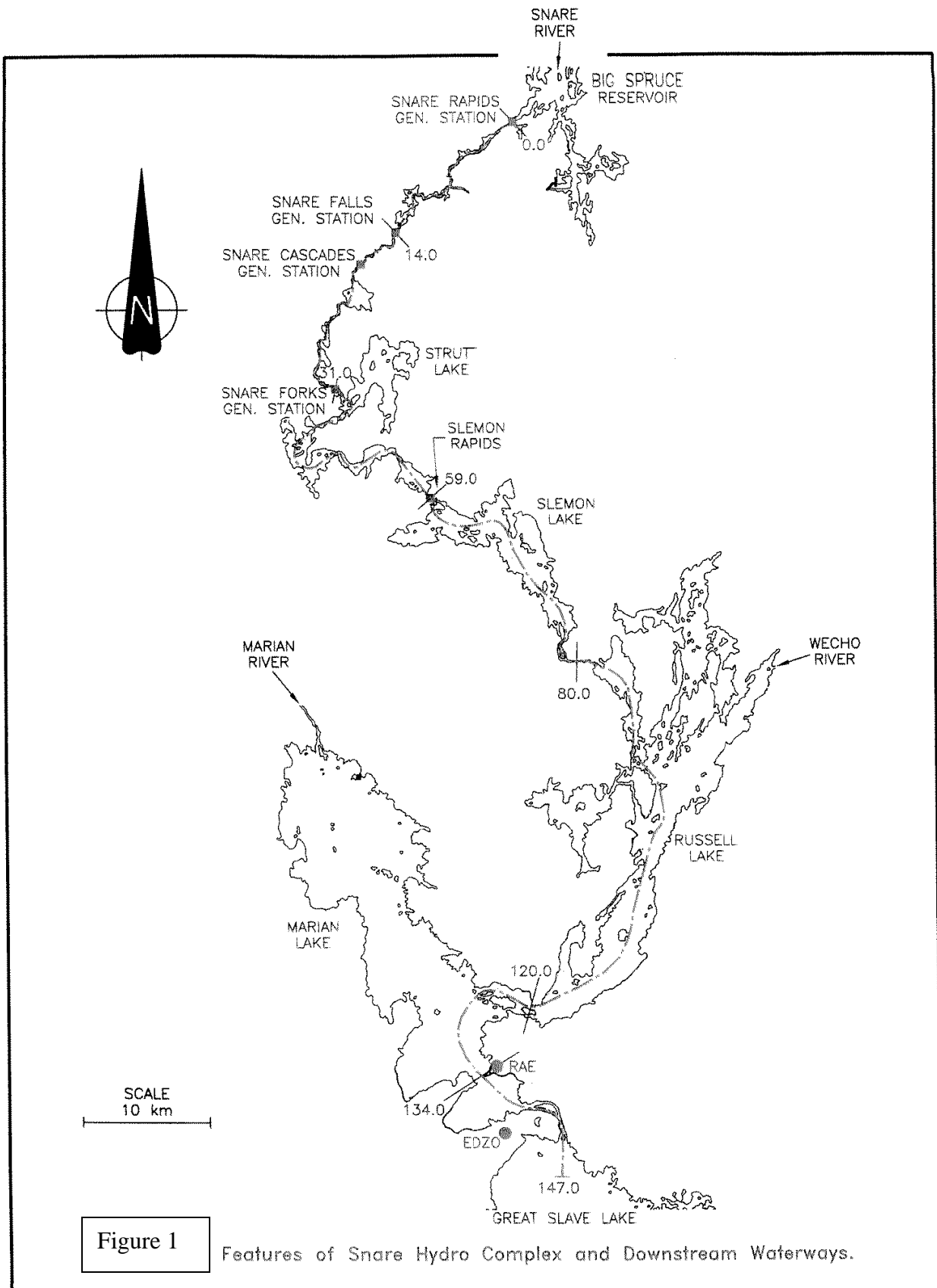
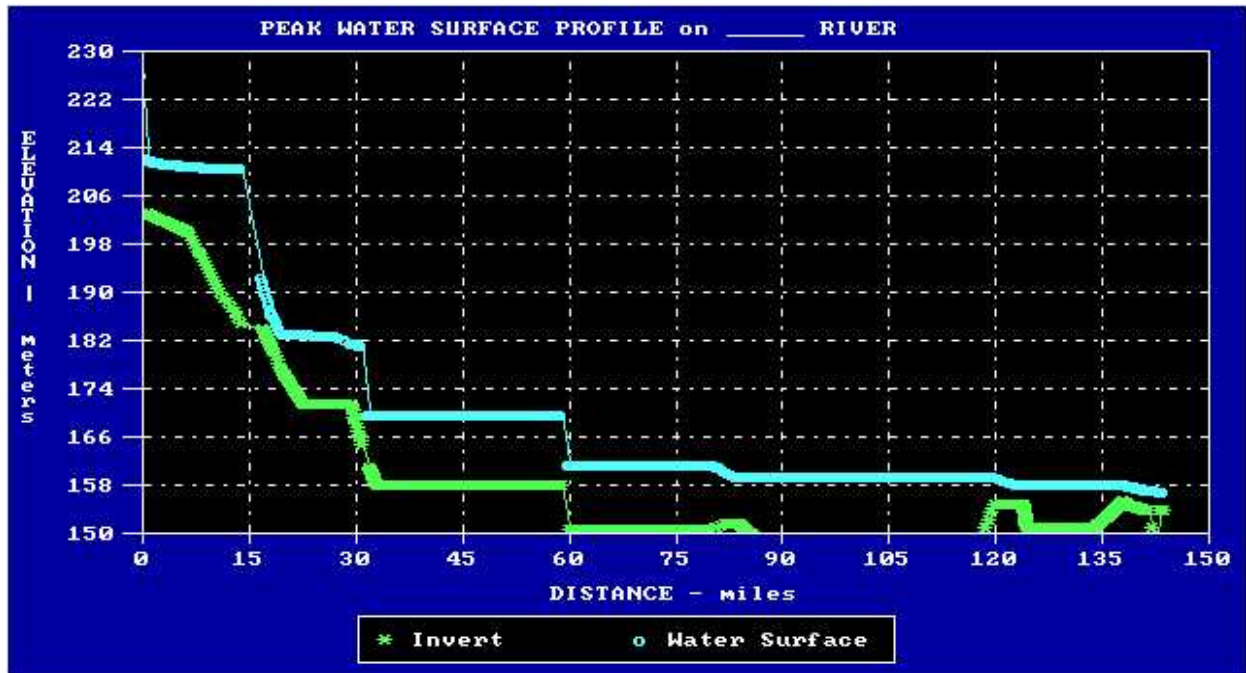


Figure 2

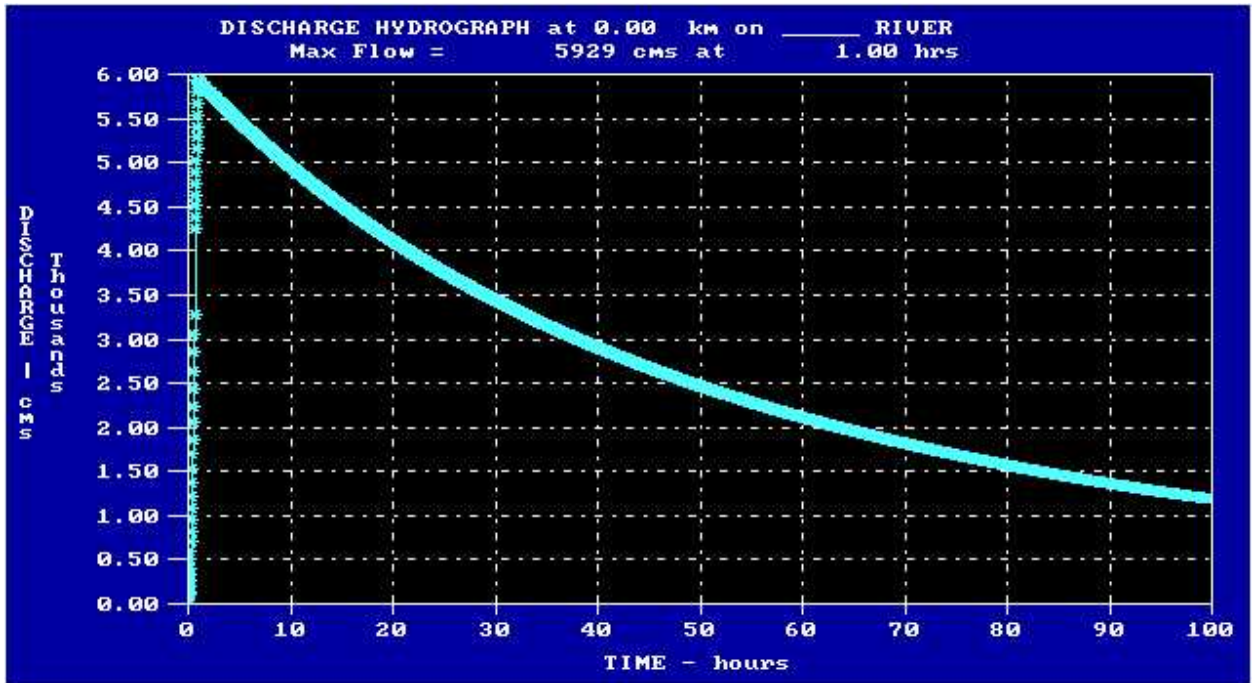


Sunny Day Dam Failure, Peak W.L. Profile – Snare Rapids to Great Slave Lake

Locations:

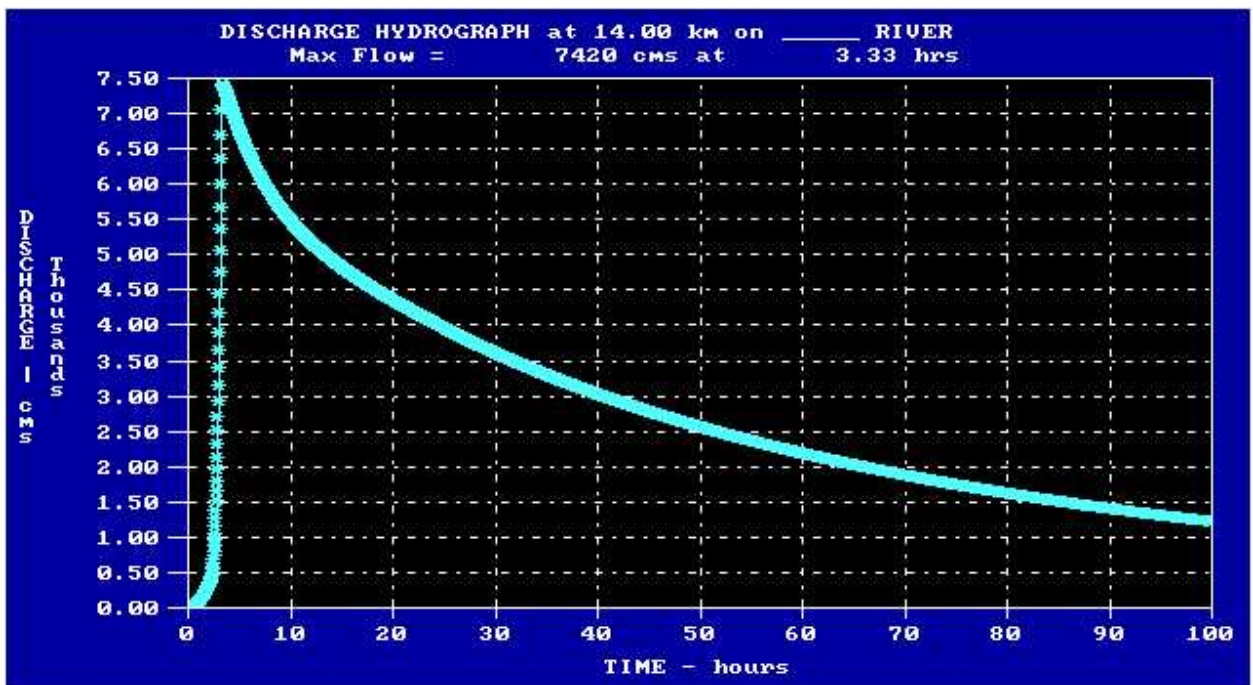
km 0.0	Snare Rapids G.S
km 14.0	Snare Falls G.S.
km 31.0	Snare Forks G.S.
km 59.0	Slemon Rapids (outlet Strutt Lake)
km 80.0	Outlet – Slemon Lake
km 120.0	Outlet – Russell Lake
km 134.0	Rae
km 136.0	Edzo
km 142.5	Highway Bridge
km 144.0	Great Slave Lake

Figure 3



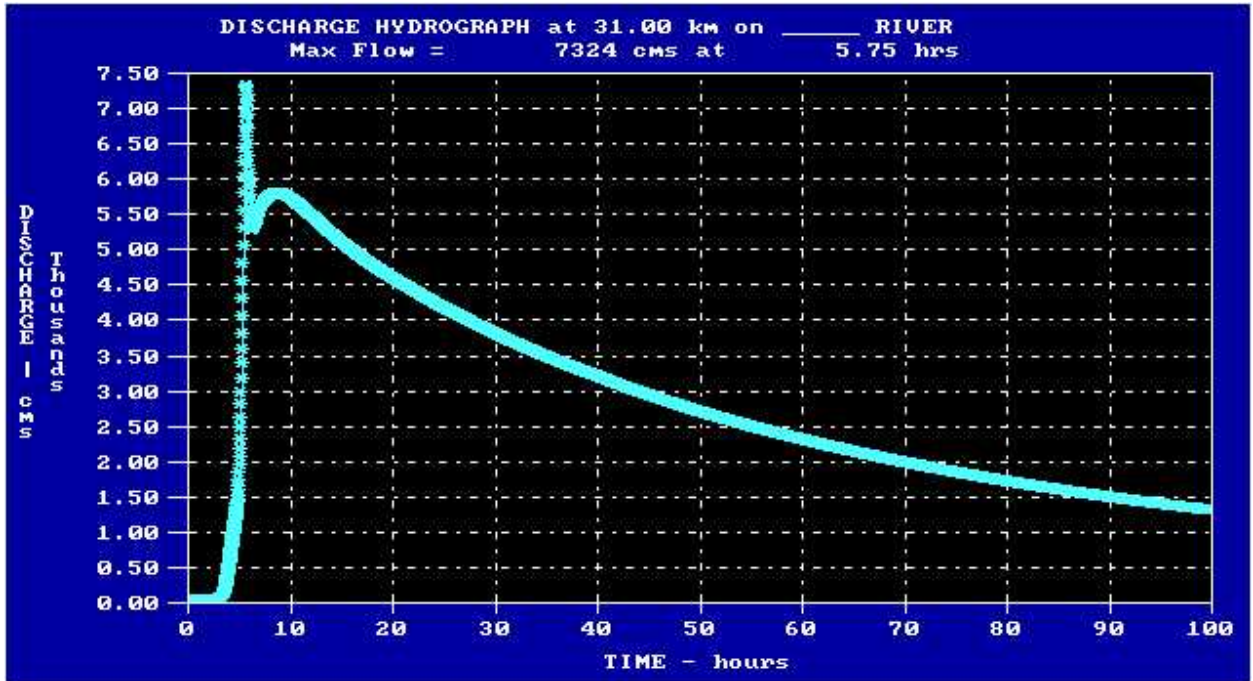
Sunny Day Dam Failure – Outflow Hydrograph, Snare Rapids G.S.

Figure 4



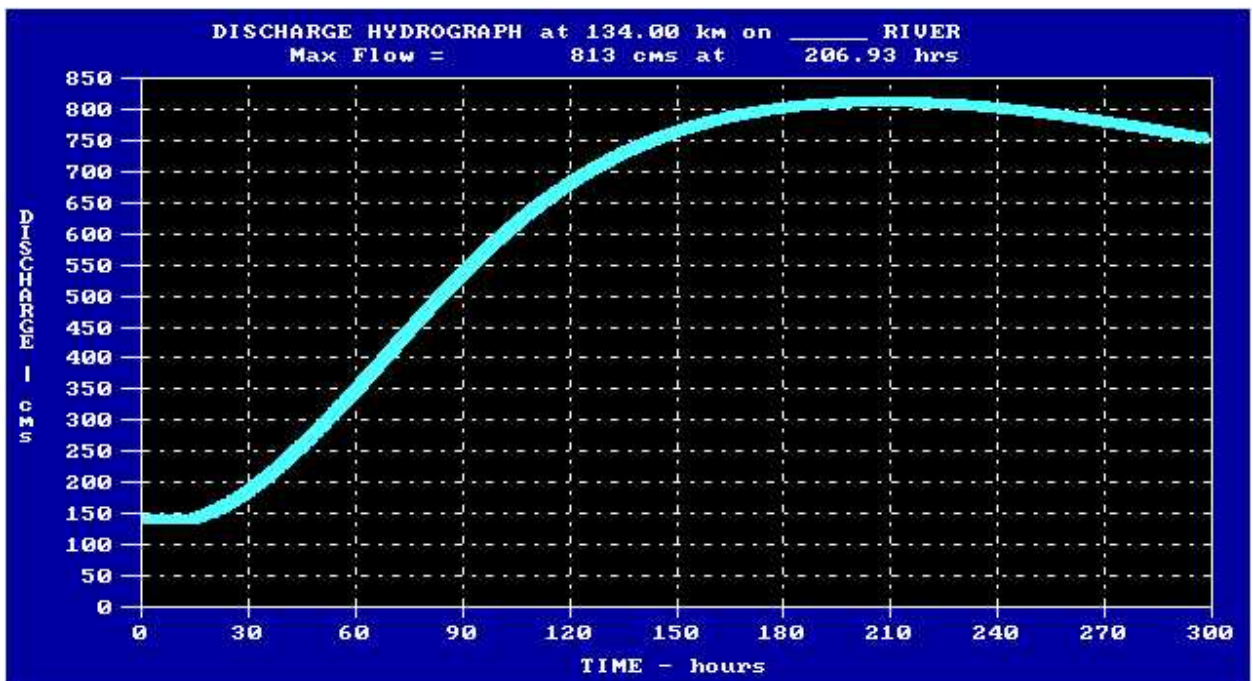
Sunny Day Dam Failure – Outflow Hydrograph Snare Forks G.S.

Figure 5



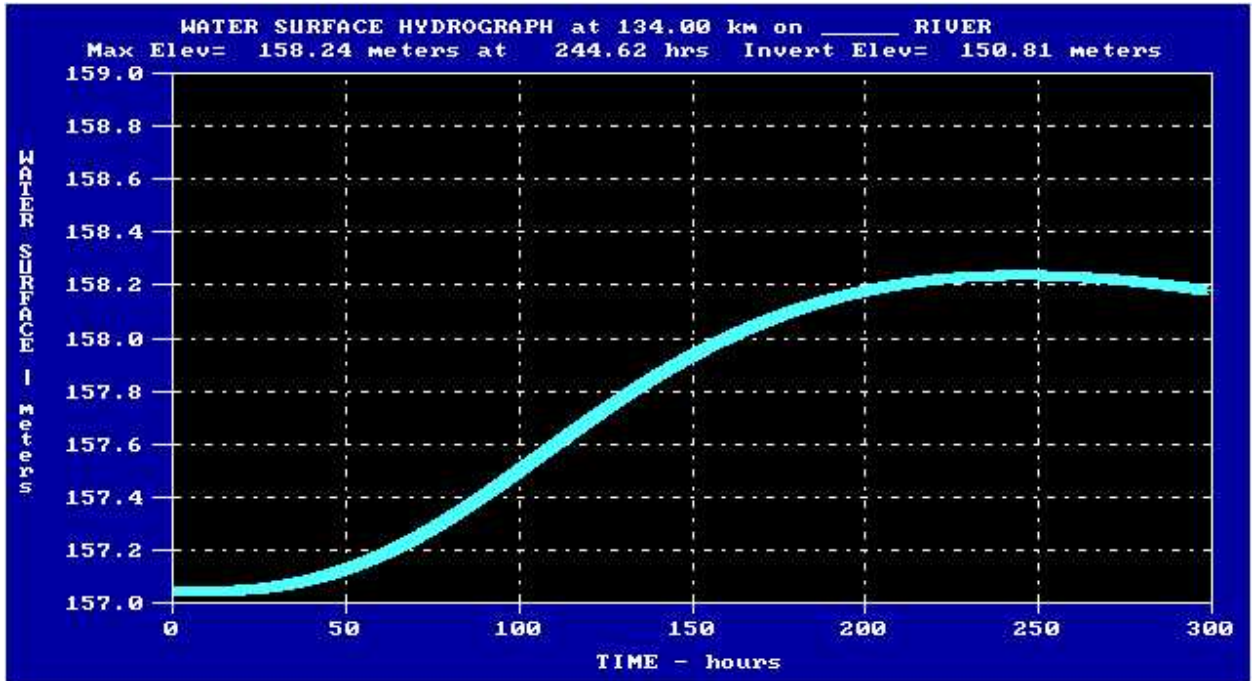
Sunny Day Dam Failure, Outflow Hydrograph, Snare Forks G.S.

Figure 6



Sunny Day Dam Failure Flow Hydrograph at Rae

Figure 7



Sunny Day Dam Failure. W.L. Hydrograph at Rae

Figure 8

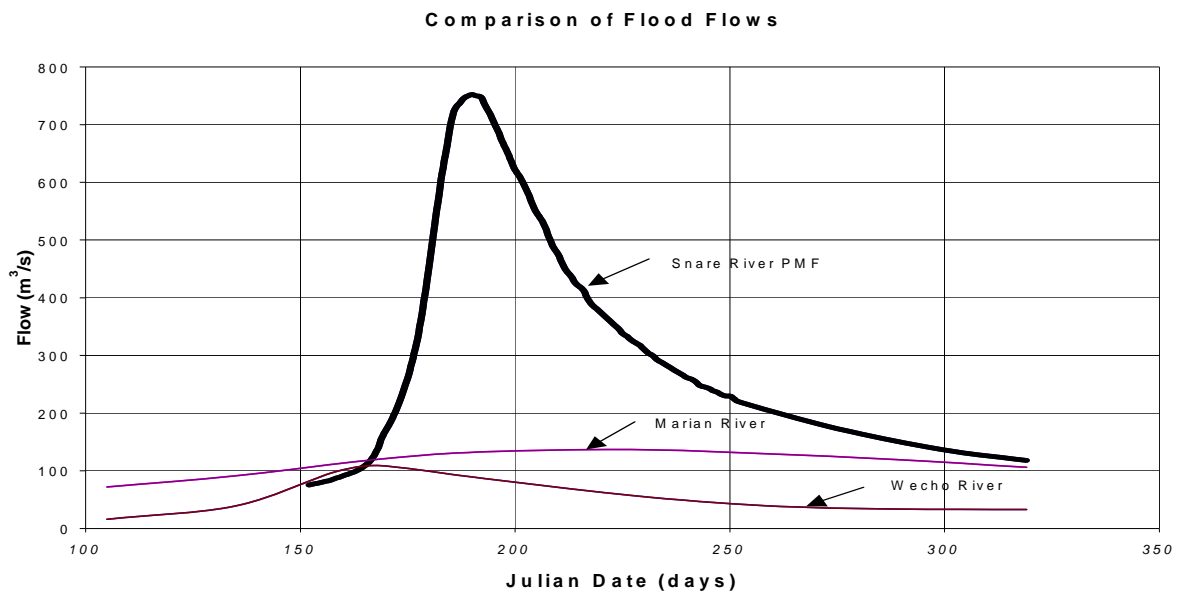
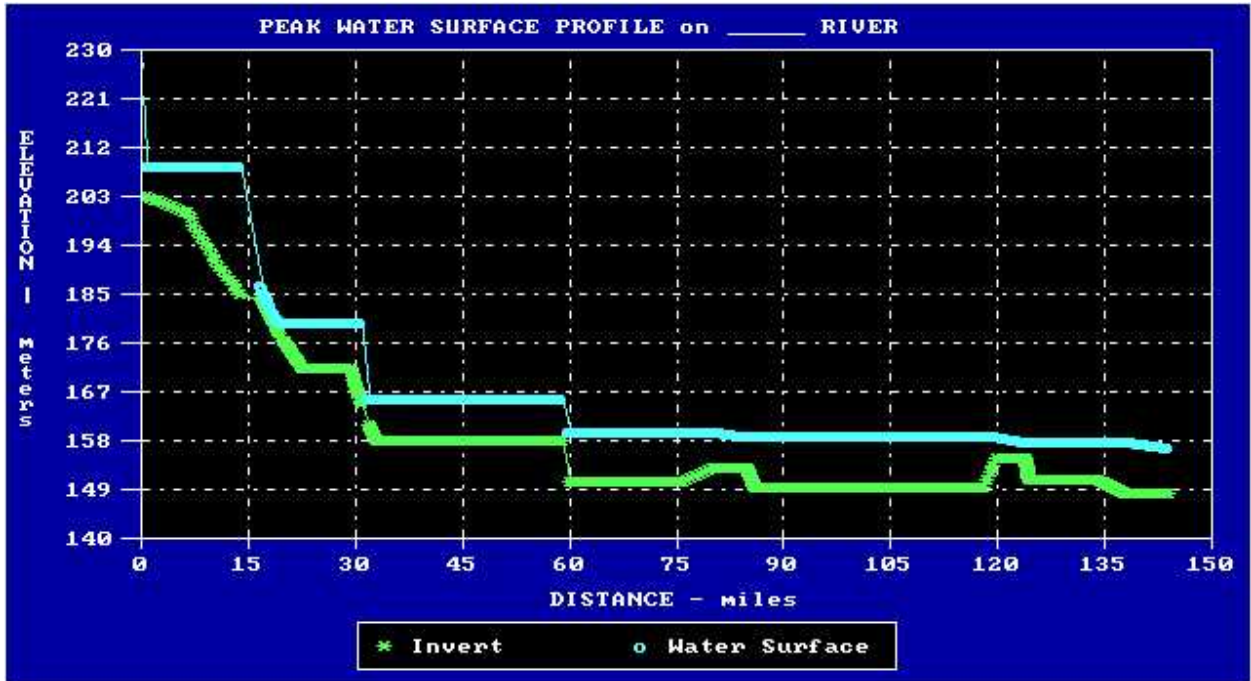


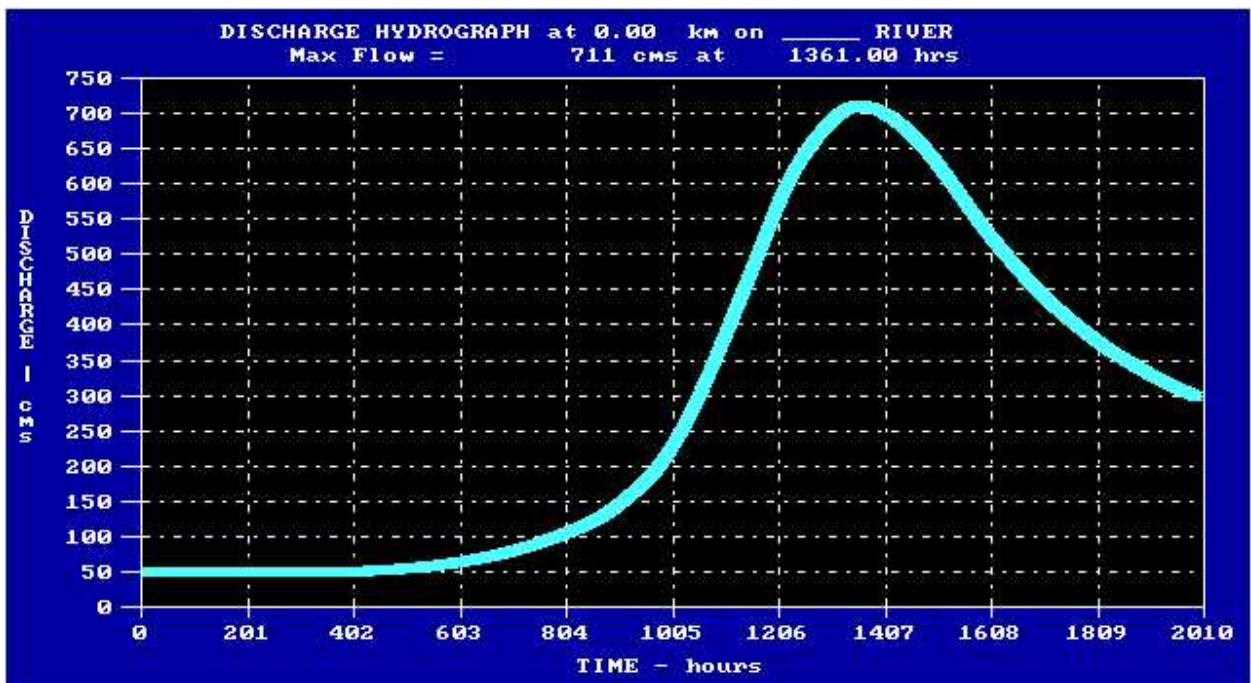
Figure 9



Probable Maximum Flood – Peak W.L. Profile

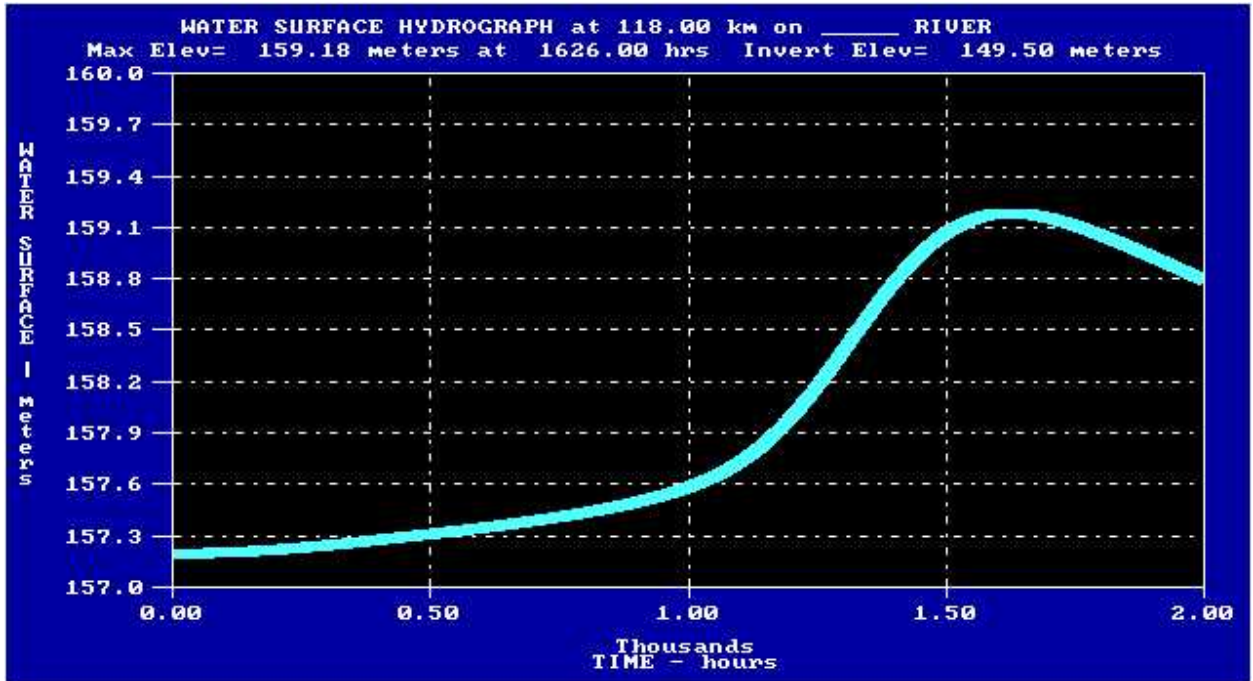
For Locations, see Figure 1

Figure 10



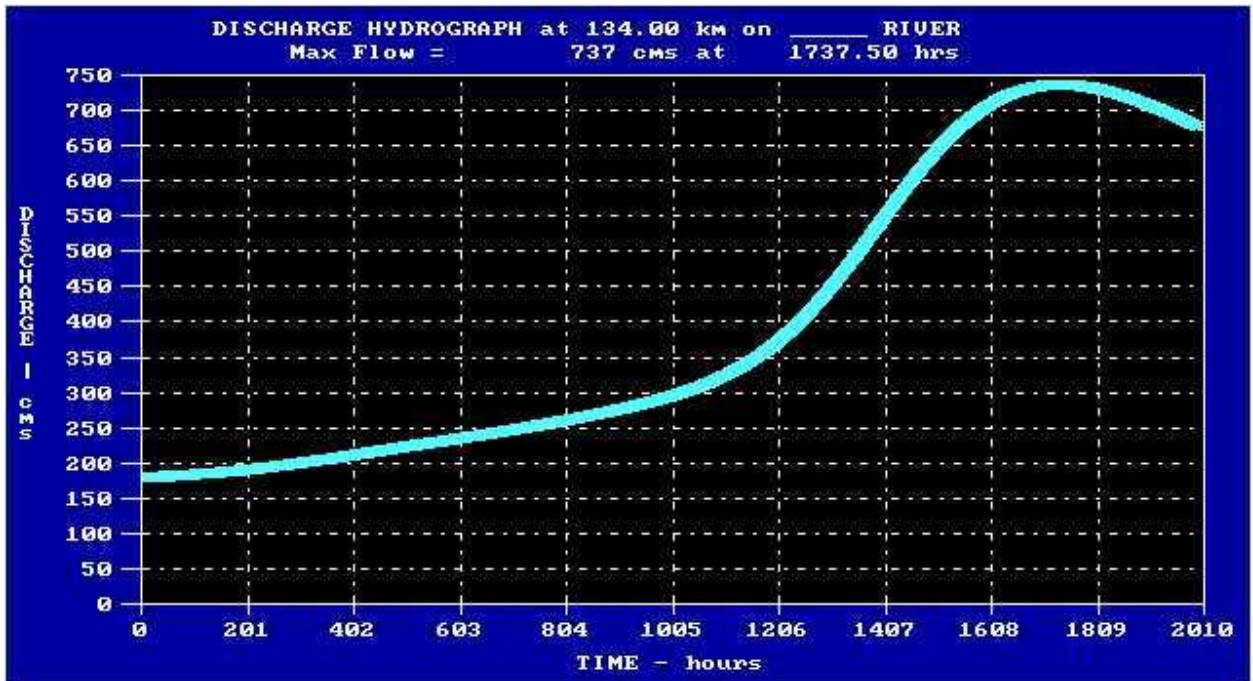
PMF Outflow Hydrograph at Snare Rapids G.S

Figure 11



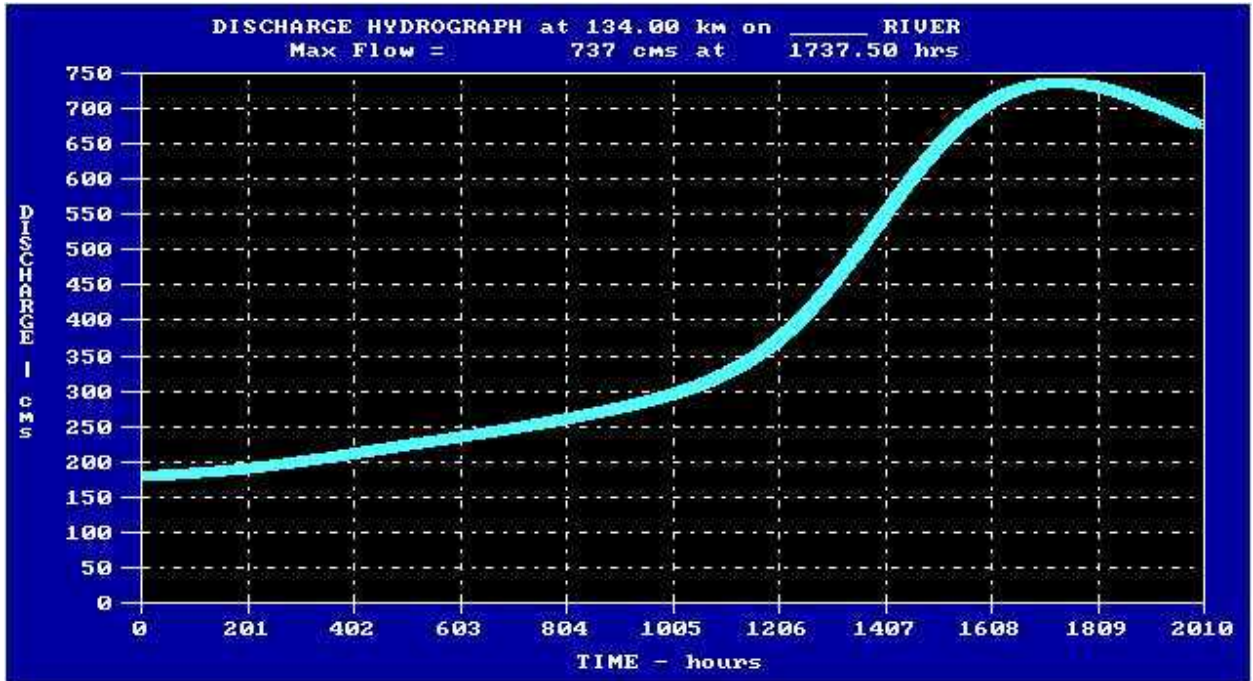
PMF Flood Levels at Russell Lake

Figure 12



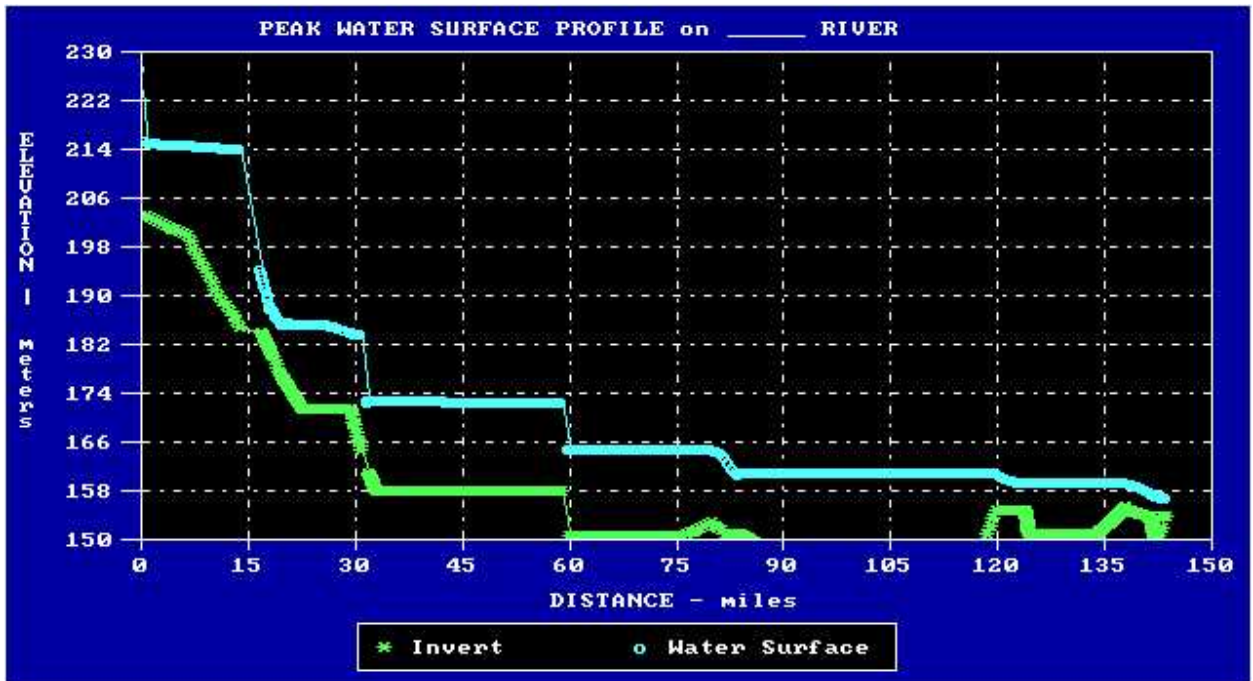
PMF Flood Levels at Rae

Figure 13



PMF Flows at Rae

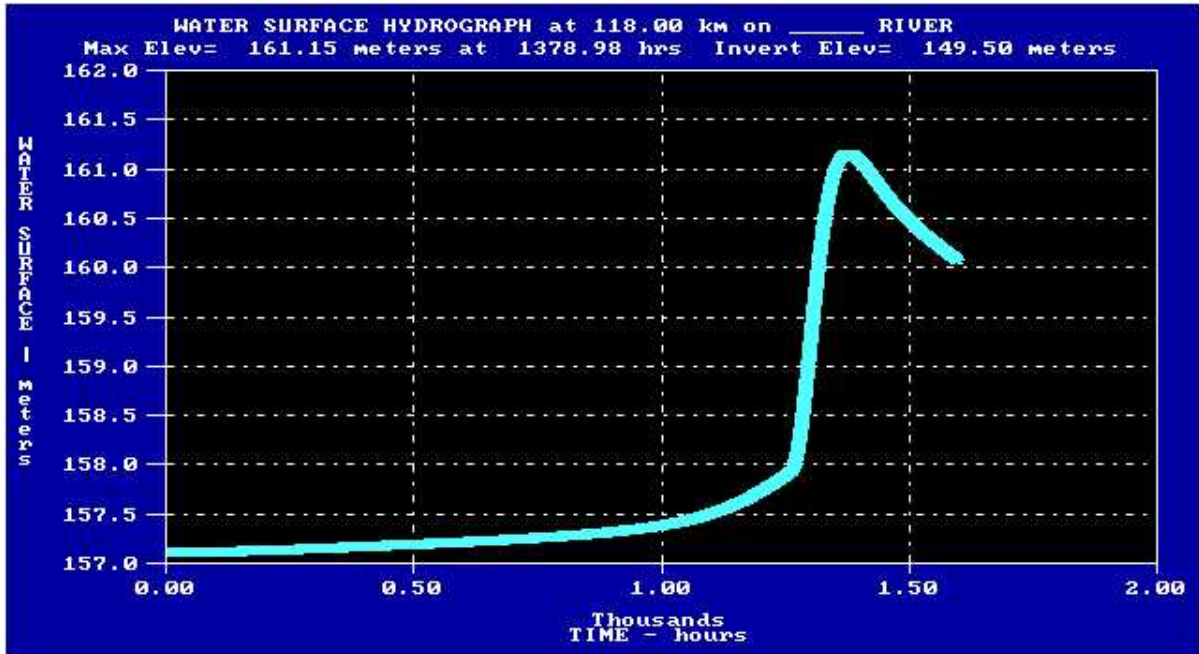
Figure 14



Dam Failure with PMF. Profile of peak W.L.S.

For Locations, see Figure 1

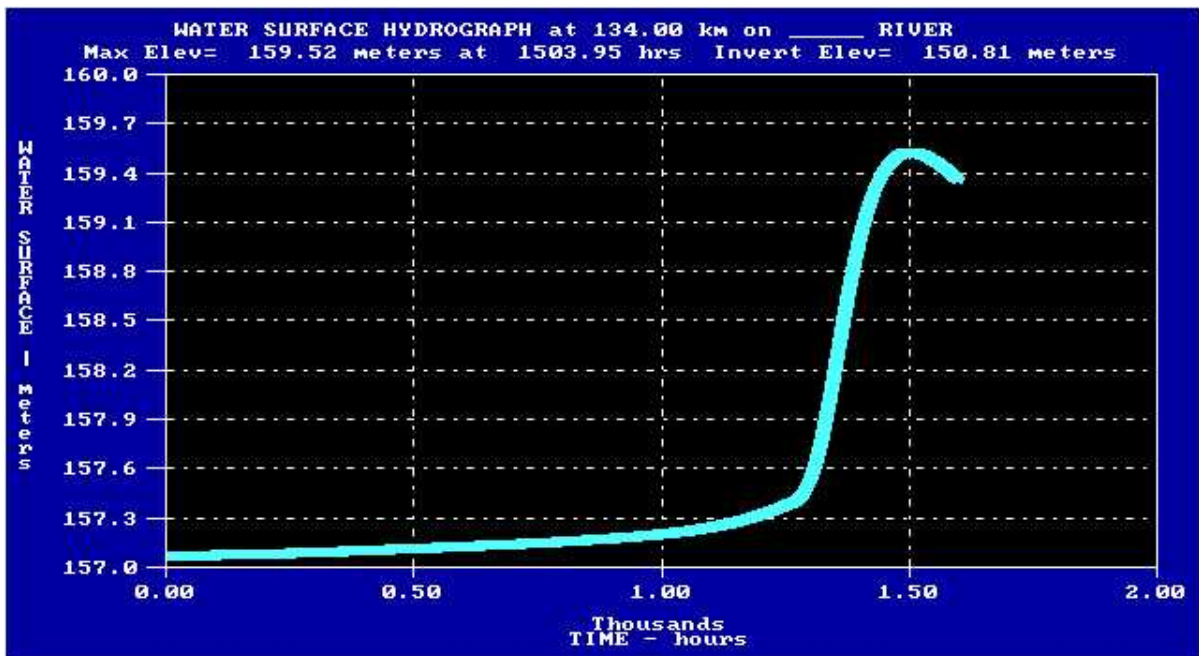
Figure 15



Dam Failures with PMF Water Levels, Russell Lake

Note: Failure of Snare Rapids Main Dam occurred at 1254 hours.

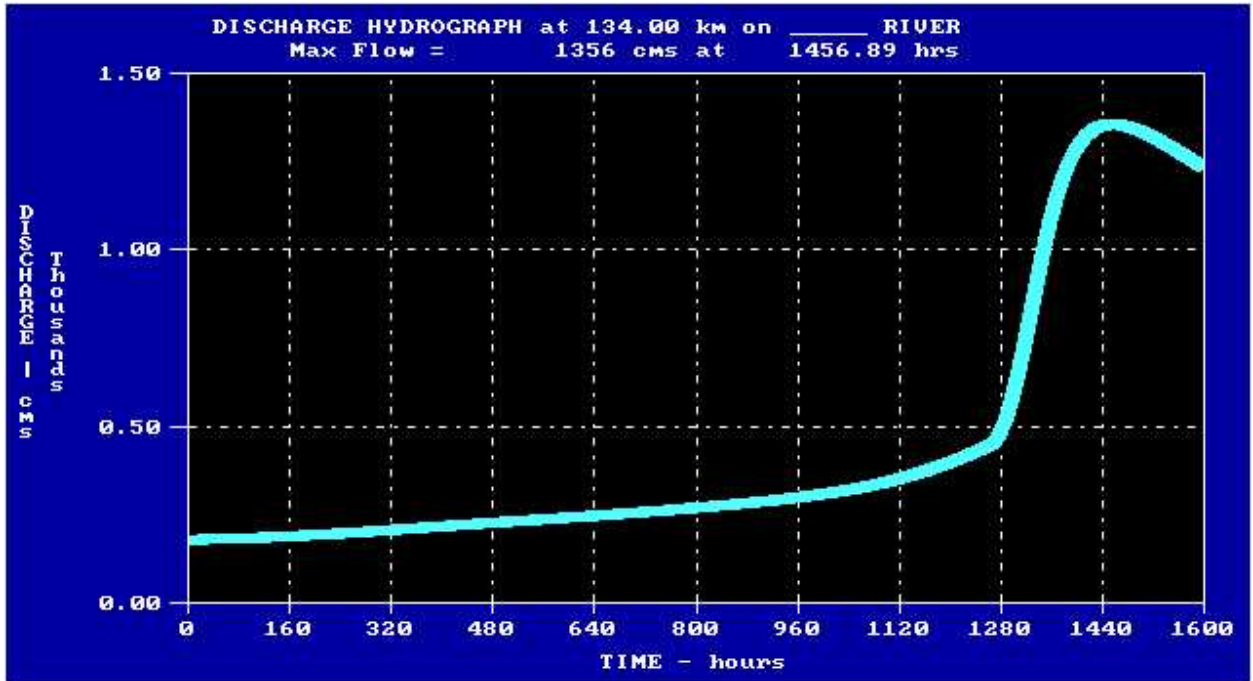
Figure 16



Dam Failure with PMF Water Levels near Rae

Note: Failure of Snare Rapids Main Dam occurred at 1254 hours.

Figure 17



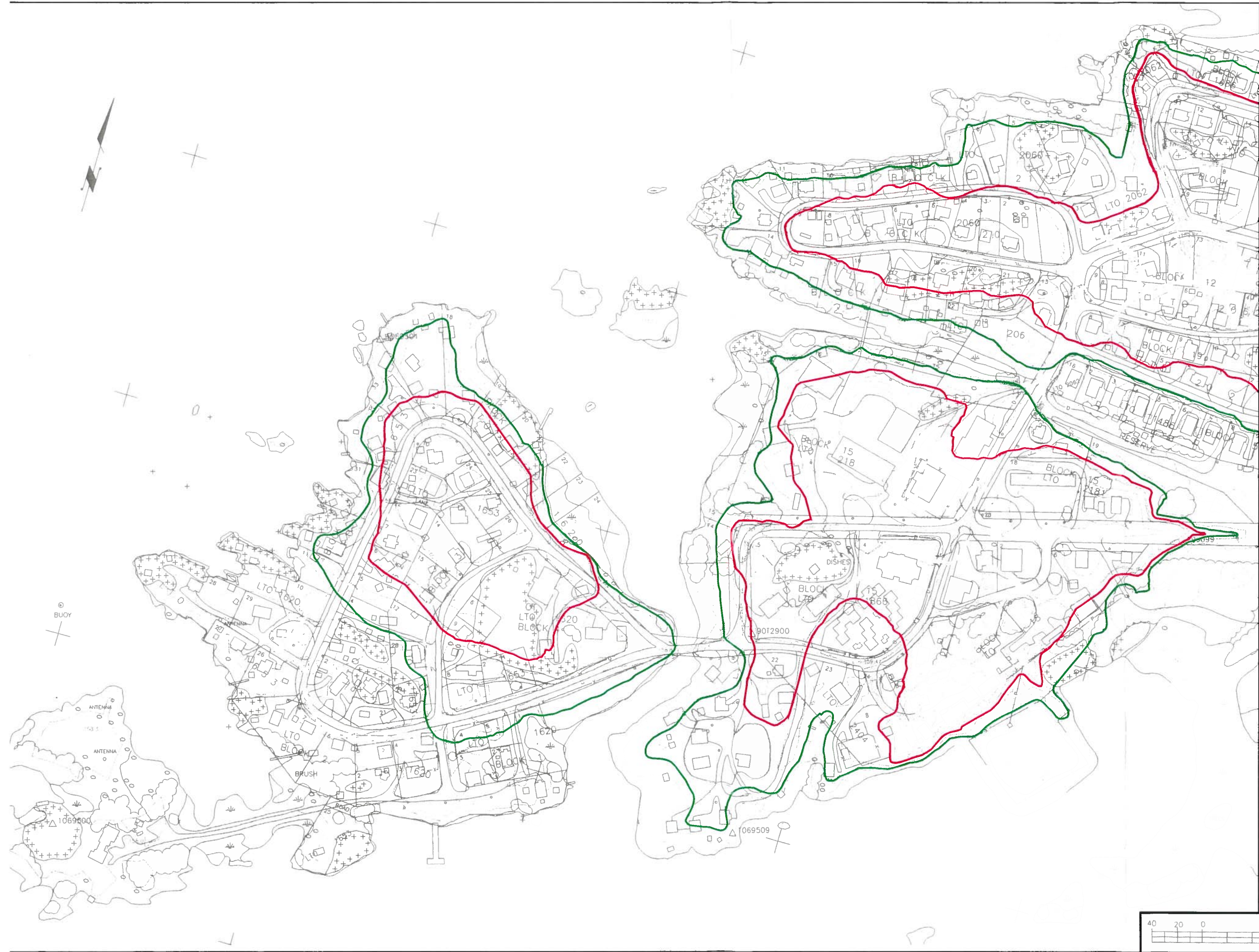
Dam Failure with PMF Flows near Rae

Note: Failure of Snare Rapids Main Dam occurred at 1254 hours.

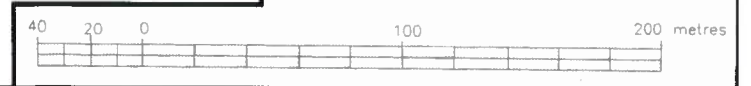
Flood Contours – Rae (see following page)

FIGURE 2.18

- Sunny day dam failure (W.L.=158.3m)
- Dam failure with PMF (W.L.=159.5m)





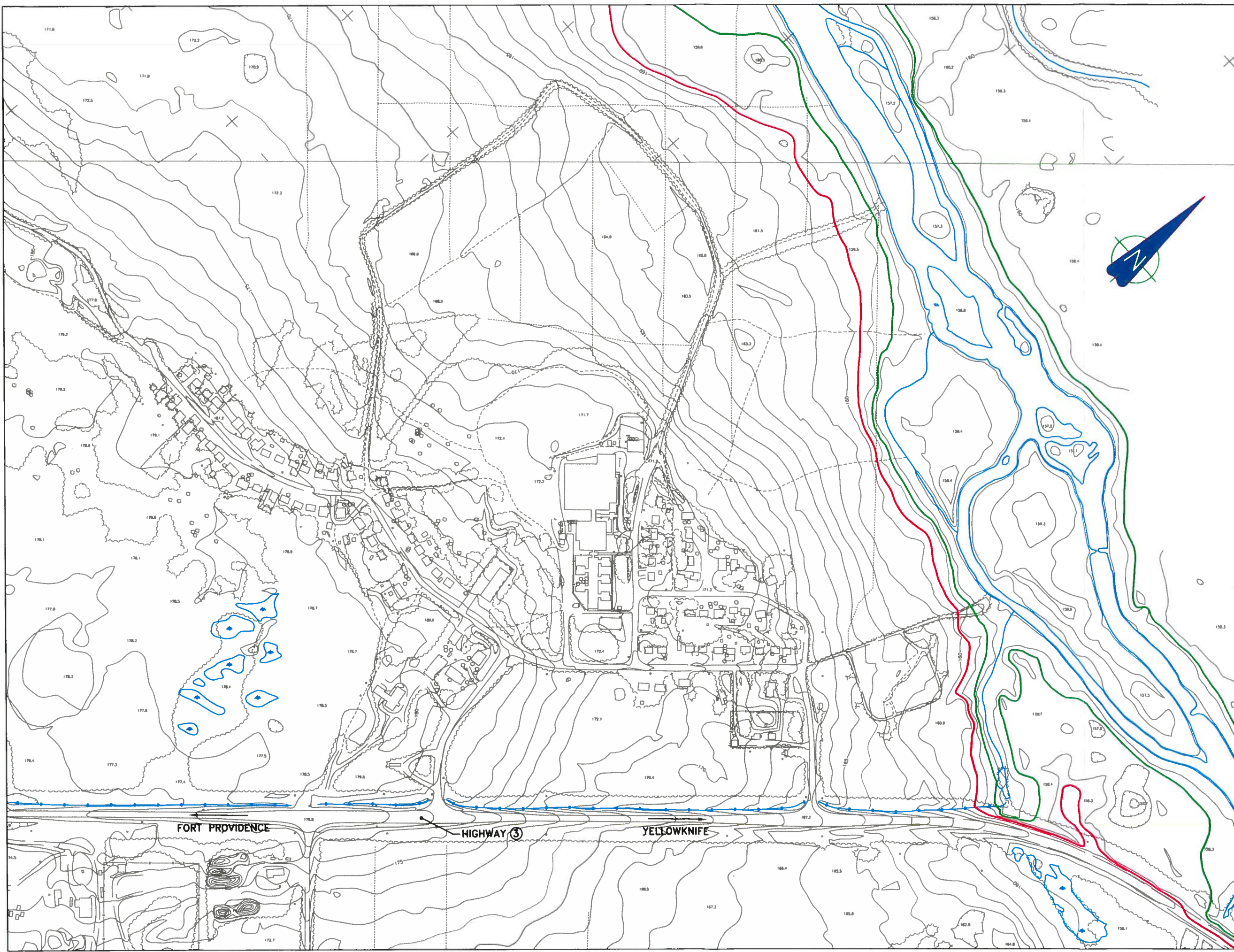
FLOOD CONTOURS:
RAE



Flood Contours – Edzo (see following page)

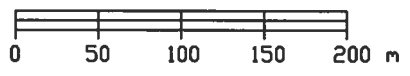
FIGURE 2.19

- LEGEND:**
-  SUNNY DAY DAM FAILURE (W.L. = 158.3m)
 -  DAM FAILURE WITH PMF (W.L. = 159.5m)



FLOOD CONTOURS:
EDZO

SCALE



FORT PROVIDENCE

HIGHWAY 3

YELLOWKNIFE

8.0 Plan Distribution

The plan will be distributed internally as follows:

- Posted on the NTPC Powerbox (manuals section);
- Copies at the Snare Forks, Snare Rapids, and Snare Cascades facility and at the Snare Camp;
- Attach to email and provide notification of updates to Manager, System Control & Hydro Planning; and
- Add to the corporate Emergency Response Procedures Manual.

The Plan will be distributed externally as follows:

- GNWT Emergency Measures Organization;
- Behchoko RCMP;
- Behchoko Fire Department;
- Behchoko Community Government;
- Aboriginal Affairs and Northern Development Canada; and
- Fisheries and Oceans Canada.

9.0 Appendix A – Maintenance and Testing of the EPP

The Safety & Environment Manager shall ensure that local staff maintains familiarity with the continually updated EPP by scheduling period reviews, briefings and operational tests as follows:

1. **Twice Per Year** - Phone numbers and responsible officials' names shall be verified, and the appropriate pages of the EPP updated and distributed. (A complete list of all updates to the plan shall be maintained at the front of the EPP.)
2. **Annually** - All affected personnel shall be given a refresher briefing on the EPP. At the option of the System Control & Hydro Planning Manager this may be done separately or as a part of a regularly scheduled safety meeting. A record of all briefing sessions shall be maintained on file by the System Control & Hydro Planning Manager, showing the dates of the sessions, the location where they were held, and the names of the individuals conducting and attending them.
3. **By-Annually** – All involved personnel should be given a training drill on the EPP. This may consist as a table top exercise or an actual test of timely response to spillway operation.

9.0 Appendix B – List of Third Party Contacts - Suppliers

Generator Rental

Name	Power Plus Rentals
Contact	Dave Lassu
Address	7003 Girard Road Edmonton, AB T6B 2C4
Phone No	780 485 0066
Fax No.	780 485 0041
Cell no	780 721 0971
E-mail Add.	dlassu@telusplanet.net
Max Size Unit	780 KW
Voltage	600

Name	Grizzly Power
Contact	Kevin Nelson
Address	1400-10 Street Nisku, AB T9E 8J4
Phone No	780 955 3305
Fax No.	780 955 2260
Cell no	
E-mail Add.	generators@grizzlypower.com
Max Size Unit	
Voltage	

Name	Wirtenan Electric
Contact	
Address	5635 Gateway Boulevard Edmonton, AB T6H 2H3
Phone No	780 434 8421
Fax No.	780 437 2658
Cell no	
E-mail Add.	wesco@wirtenan.com
Max Size Unit	Transformer, Elect. Equipment
Voltage	Temporary Power Distribution

Name	Finning – Hay River
Contact	Mitch Thompson, Cust. Serv. Mgr
Address	23 Industrial Drive Hay River, NT X0E 0R6
Phone No	867 874 6537
Fax No.	867 874 6570
Cell no	867 874 1104
E-mail Add.	mathompson@finning.ca
Finning 24 Hr	line – 1 888 346 6464

Name	Finning – Yellowknife
Contact	Patrick Kirychuk
Address	327-8 Old Airport Road Yellowknife, NT X1A 3T3
Satellite Ph:	403 982 0933
Phone No	867 766 3578
Fax No.	867 873 6867
Cell no	867 444 3195
E-mail Add.	
General Line,	Parts and Service Sales

Name	Finning – Yellowknife
Contact	Ron Drewry
Address	327-8 Old Airport Road Yellowknife, NT X1A 3T3
Phone No	867 920 7481
Fax No.	
Cell no	867 444 4500
E-mail Add.	
Manager NWT	

Contractors

Name	Nuclear Electric
Contact	Ron Danyluk
Address	Box 57006, 2020 Sherwood Drive Sherwood Park, AB T8A 5L7
Phone No	780 448 1903
Fax No.	780 448 1905
Cell no	
E-mail Add.	
	Electrical Services

Name	Adco Power
Contact	Bill Slater
Address	8750 – 58 Ave Edmonton, AB T6E 6G6
Phone No	780 465 3265
Fax No.	780 466 8086
Cell no	780 910 9410
E-mail Add.	slater@adcopower.com
	Electrical Mechanical Services

Name	Janus Project
Contact	Laurie Denys
Address	#105 8712-48 Ave Edmonton, AB T6E 5L1
Phone No	780 450 1818
Fax No.	780 465 1116
Cell no	
E-mail Add.	ldenys@janusprojects.com
	Electrical Mechanical Services

Name	South Side Porta Weld Ltd
Contact	Danny Kernychny
Address	8110 Davies Road Edmonton, AB T6E 4N2
Phone No	780 465 4861
Fax No.	780 440 6967
Cell no	780 499 8469
E-mail Add.	
	Mechanical Services

Name	Odesco
Contact	Alec
Address	5330 89 Street Edmonton, AB T6E 5G9
Phone No	780 414 1422
Fax No.	780 448 3684
Cell no	
E-mail Add.	
Electrical Services	

Name	Lapka Electric
Contact	Joe Lapka
Address	835 Dusseault Crt Yellowknife, NT
Phone No	867 873 5631
Fax No.	867 873 8446
Cell no	867 444 4013
E-mail Add.	lapkael@ssimicro.com
Electrical Services	

Name	Orbis
Contact	Amin Kassam
Address	311 3624-119 Street Edmonton, AB T6J 2X6
Phone No	780 985 1455
Fax No.	780 988 0191
Cell no	780 913 8585
E-mail Add.	amin@orbisengineering.net
Electrical Services	

Switchgear Parts and Repairs

Name	Laird Electric
Contact	Kevin Pydde
Address	4410 97 Street Edmonton, AB T6E 5R9
	TOLL FREE: 888 450 9636
Phone No	780 450 9636
Fax No.	780 463 3035
Cell no	780 914 7417
E-mail Add.	Kevin.pydde@insulationholdings.com
Electrical Services	

Name	Schneider Electric
Contact	
Address	12825 1144 Street Bonaventure Industrial Park Edmonton, AB T5L 4N7
Phone No	780 453 3561
Fax No.	780 451 5085
Cell no	
E-mail Add.	
Electrical Services	

Governors

Name	Henery & Sons
Contact	
Address	87 Aurora Pointe Claire, PQ
Phone No	514 466 2063
Fax No.	514 466 3275
Cell no	
E-mail Add.	
	Electrical Services

Name	Woodward – Alberta Governor Service
Contact	Jack Hauck
Address	5977 103 A Street Edmonton, AB
Phone No	780 437 4673
Fax No.	780 434 2339
Cell no	
E-mail Add.	after hours: 467 8109 or 922 4504
	Electrical Services

Engine Suppliers

Engine Make	MAN B&W
Rating	Ruston, Paxman, Mirrlees, MAN
RPM	500 to 6,480 kW
	1,200 to 550 RPM
Name	MAN B&W Diesel Canada Ltd.
Contact	John Hawkes
Address	355 Wycroft Road Oakville, ON L6K 2H2
Phone No	905 845 3444
Fax No.	905 842 7892
Cell no	
E-mail Add.	jhawkes@manbw.ca

Engine Make	
Rating	500 to 6,480 kW
RPM	1,200 to 550 RPM
Name	International Energy Systems
Contact	Doug Cullen
Address	570 Ebury Place Delta, BC V3M 6M8
Phone No	604 540 5080
Fax No.	604 540 5090
Cell no	
E-mail Add.	ies@iesl.com

Snare Hydro Emergency Preparedness Plan – Appendix B

Engine Make	Caterpillar
Rating	227 to 4,400 kW
RPM	1,800 to 900 RPM
Name	Finning Power System
Contact	Gary Warneboldt
Address	6735 11 Street NE Calgary, AB T2E 7H9
Phone No	403 295 5740
Fax No.	403 295 5725
Cell no	
E-mail Add.	gwarneboldt@finning.ca

Engine Make	Caterpillar
Rating	227 to 4,400 kW
RPM	1,800 to 900 RPM
Name	Powell Arctic Ltd
Contact	Chris Moskal
Address	1455 Buffalo Place Winnipeg, MB R3T 1L8
Phone No	204 453 4343
Fax No.	204 478 3379
Cell no	
E-mail Add.	moskal@powell.ca

Engine Make	Detroit Diesel MTU
Rating	270 to 4,400 kW
RPM	1,800 to 1,200 RPM
Name	Waterous Detroit Diesel - Allison
Contact	Jerry Neddow, Nick Kwasnycia
Address	10025 51 Ave Edmonton, AB T6E 0A8
Phone No	780 437 8288, 780 437 8274
Fax No.	780 437 5864
Cell no	780 915 5762
E-mail Add.	jneddow@wdda.com

Engine Make	Detroit Diesel, EMD
Rating	780 to 3,600 kW
RPM	1,200 to 900 RPM
Name	Midwest Power Products
Contact	David Jones
Address	1460 Waverley Street Winnipeg, MB R3T 0P6
Phone No	204 452 8244
Fax No.	204 452 2153
Cell no	204 228 9735
E-mail Add.	djones@midwestdda.com

Snare Hydro Emergency Preparedness Plan – Appendix B

Engine Make	Cummins
Rating	36 to 1,860 kW
RPM	1,800 RPM only
Name	Cummins Alberta
Contact	Gary Potter
Address	11731 181 Street Edmonton, AB T5S 2K5
Phone No	780 454 9365 Ext. 233
Fax No.	780 452 9887
Cell no	780 940 1768
E-mail Add.	gary.a.potter@cummins.com

Engine Make	Wartsila
Rating	690 to 11,850 kW
RPM	1,800 to 720 RPM
Name	Wartsila NSD Canada Inc.
Contact	Gordon Murrin
Address	164 Akerley Blvd. Dartmouth, NS B3B 1Z5
Phone No	902 468 1264, 800 468 1264
Fax No.	902 468 1265
Cell no	
E-mail Add.	

Voltage Regs	
Rating	
RPM	
Name	Innovelec
Contact	W. M.. (Bill Cackett)
Address	3 Rhatigan Road East Edmonton, AB T6R 1M9
Phone No	780 430 6155
Fax No.	780 430 6155
Cell no	780 905 8748
E-mail Add.	bcackett@shaw.ca

Outside Agencies

A copy of the EPP will be sent to all agencies involved in the emergency procedures as listed in Section 6.1.

NTPC will revise and update the EPP as necessary and arrange for distribution of the revisions to all outside agencies. A record of review by outside agencies shall be maintained on file by the OS.

Surveillance

Routine inspections shall be made once per year by NTPC personnel, usually in the fall. A Water Resource Officer from INAC generally accompanies NTPC personnel on the inspection each year. A formal geotechnical inspection of the structures is performed at 5 year intervals.

Public Facilities

There are no public facilities at the sites.

10.0 Appendix C – NTPC Report: Dyke 1 Breach, July 15, 2006



**Snare Forks
Freeboard Dyke 1 Breach
June 15, 2006**

EXECUTIVE SUMMARY

On June 15, 2006 a section of Snare Forks Dyke 1 was washed away by waters from the Snare Forks forebay. The Northwest Territories Power Corporation (NTPC) assembled an Emergency Response Team immediately upon discovery of the breach and hastened to mobilize personnel and equipment for the emergency.

Crews already onsite for scheduled maintenance of the dyke began placing rock in the breach to form a closure groyne. All appropriate regulatory bodies and surrounding community governments were notified of the event and kept apprised of the situation as progress was made.

Work on the groyne proceeded from June 16 to June 28 when closure of the breach was achieved. Crews then focussed on reducing the flow through the dyke by placing granular material and riprap on the upstream face of the dyke. Work on the dyke is ongoing and is expected to be complete in September, 2006.

During the repair period NTPC kept in regular communication with the Community of Behchoko to ensure they were aware of the breach and the efforts made to close it and that the breach did not negatively impact the community.

NTPC has worked closely with both Indian and Northern Affairs Canada and the Department of Fisheries and Oceans to ensure environmental obligations and responsibilities are met. Mitigation measures of the downstream effects of the breach are currently underway and include sedimentation reduction and periodic water quality monitoring which includes Behchoko drinking water.

INTRODUCTION

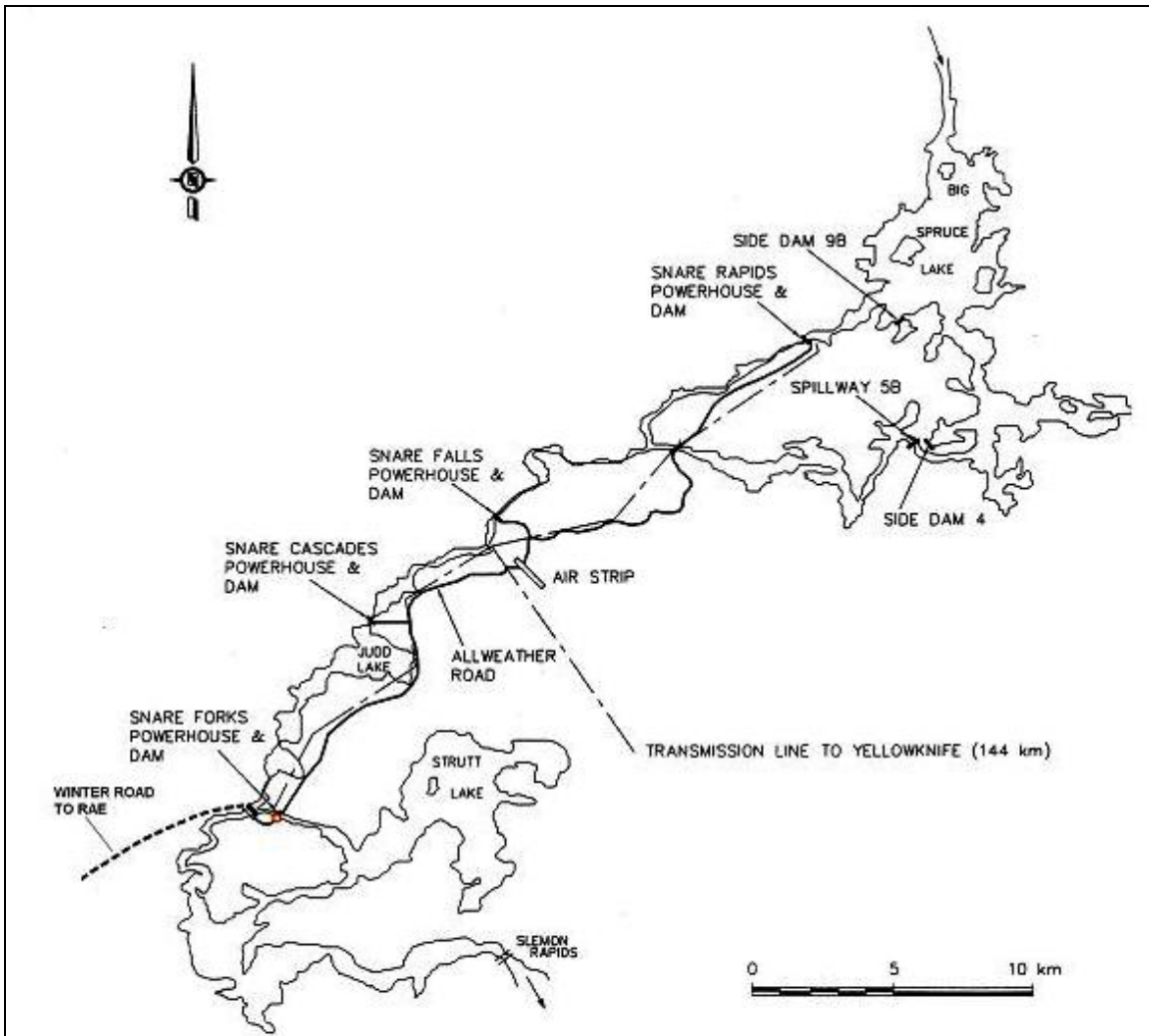
This report is to comply with Water Licence NIL4-0150 which states the following:

Part E, Item 6: The Licensee shall implement the Emergency Preparedness Plan and notify an Inspector immediately should a failure of any of the structures associated with the Power Generation Facility occur, or seem likely to occur, which would result in an uncontrolled release of water.

Part E, Item 7: The Licensee shall provide the Board with detailed written reports of each event referred to in Part E, Item 6. These reports shall be submitted to the Board not later than thirty (30) days after the event has terminated.

Dyke 1 breached on June 15, 2006 and was closed on June 28. Further repair of the dyke continued until July 30. Although some additional work is required, for the purposes of this report the breach event is considered terminated as of July 31, 2006.

Figure 1: Snare Hydro System



GEOGRAPHIC SETTING

The Snare Hydro system is located approximately 144 km north-northwest of Yellowknife, NT on the Lower Snare River. The system is a cascade type development comprised of four hydro plants: Snare Rapids, Snare Falls, Snare Cascades, and Snare Forks. The 63.3 m difference in elevation between the Big Spruce Reservoir (located above Snare Rapids Generating Station (GS)) and Strutt Lake (located below Snare Forks GS) is used for electric power production. The drainage area supplying the Snare Rapids GS/Big Spruce Reservoir is 15,200 km² producing a mean annual flow of 48.3 m³/s. The incremental drainage areas intercepted by each of the three downstream plants are minimal and produce negligible increases to the flow as measured at Snare Rapids.

The Big Spruce Reservoir is a medium sized reservoir with a maximum surface area of 130 km². When full, the Big Spruce Reservoir has a live storage volume of 546 million m³ between the full supply level (elevation) of 222.3 m and the low supply level of 217.9 m. This volume is sufficient to provide flow regulation on an annual cycle, but too small to support multi-year regulation. Storage volumes in the forebay reservoir of the downstream plants are relatively limited; sufficient for daily regulation at Snare Falls and Snare Forks but too small for any practical regulation at Snare Cascades. Rated plant capacities in Megawatts (MW) are as follows:

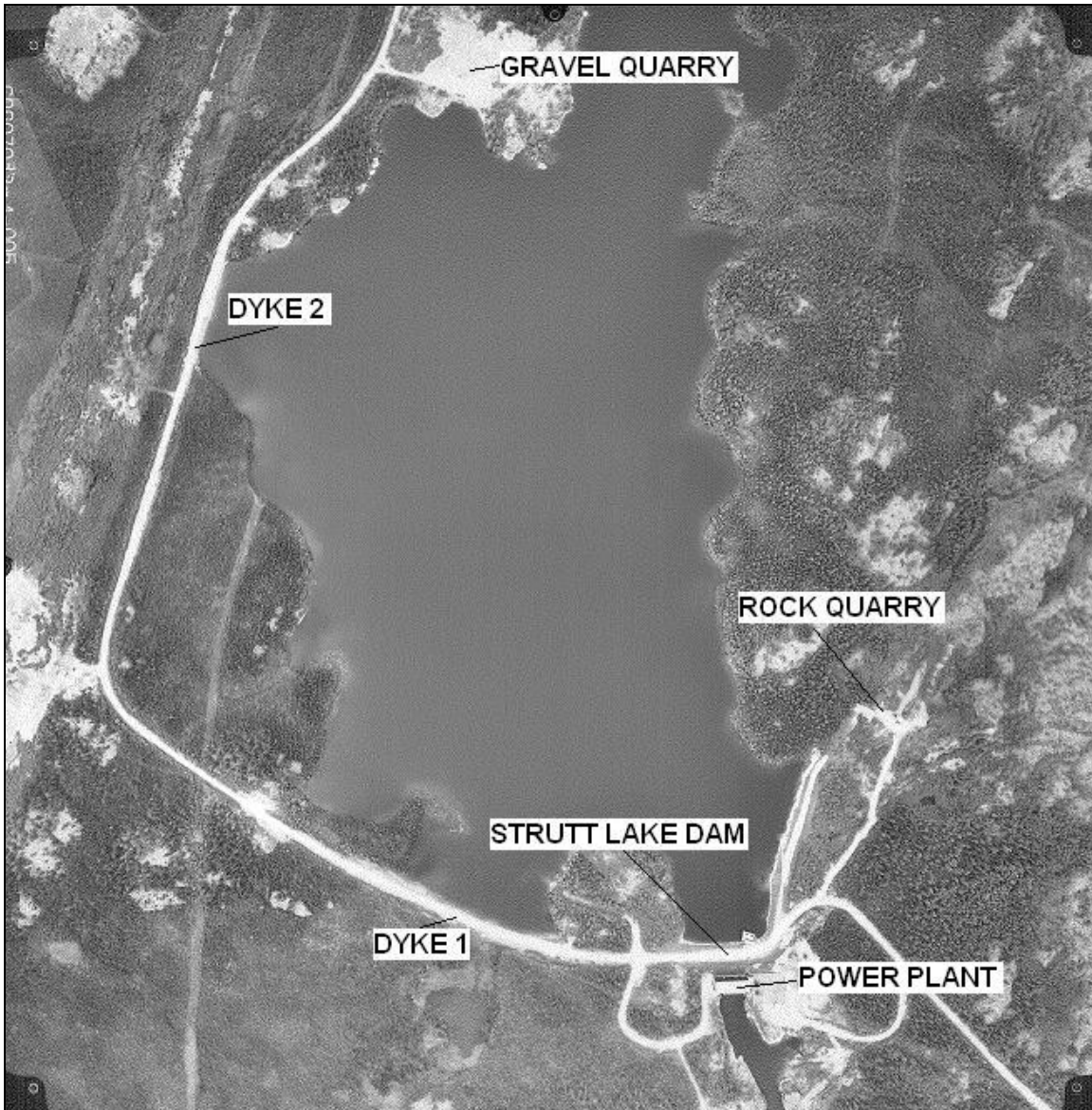
Snare Rapids:	8.5 MW
Snare Falls:	7.4 MW
Snare Cascades:	4.3 MW
Snare Forks:	9.2 MW

The Snare Hydro System is connected to Yellowknife by a 144 km long transmission line operating at a voltage of 115 kV. Other communities served by the system include Ft. Rae and Edzo from a 115 kV, 39 km long tie line and Dettah via a 6.9 kV, 11 km long feeder off the Bluefish transmission tie line, which connects the Bluefish GS to the Snare Yellowknife system. Currently the Snare Hydro system supplies 60% of the capacity and 80% of the energy requirements of the Yellowknife market.

The geographic locations of the Snare Hydro plants are as follows:

Snare Rapids GS	Latitude	63 ⁰ 31' N
	Longitude	116 ⁰ 00' W
Snare Falls GS	Latitude	63 ⁰ 26' N
	Longitude	116 ⁰ 11' W
Snare Cascades GS	Latitude	63 ⁰ 25' N
	Longitude	116 ⁰ 13' W
Snare Forks GS	Latitude	63 ⁰ 20' N
	Longitude	116 ⁰ 20' W

Figure 2: Aerial View of Snare Forks Hydro Development



DESCRIPTION OF SNARE FORKS GENERATING STATION

The Snare Forks GS is located 10 km downstream of Snare Cascades. It is the plant furthest downstream in the cascade and discharges into Strutt Lake. The Plant has been in service since 1976.

The design of this plant takes advantage of the natural topographic features of the site, namely the fork in the Snare River where the river splits around an island. The powerhouse is located in the south channel at the toe of the Strutt Lake Dam while the spillway is adjacent to the west channel of the Snare River into which it discharges. The Snare Forks Forebay Reservoir is contained by the Strutt Lake Dam, the Snare Forks

Dam, three freeboard dykes (Dykes 1, 2, and 3) and the spillway weir, and floods back to the tailrace of the Snare Cascades GS. Both the Snare Forks Dam and the Strutt Lake Dam are conventional rock fill dams with sloping impervious cores of glacial till. Under normal operating conditions there is no water against the face of the freeboard dykes except for occasional small, wind-driven waves.

Snare Forks powerhouse contains two generating units each rated at 4.6 MW. These units were originally located at Ontario Hydro's Notch GS on the Montreal River, Ontario. They were purchased and rebuilt to suit the head and flow conditions at Snare Forks. The main parameters of the Snare Forks GS are below:

Forebay Reservoir	
Full Supply Level (FSL):	173.7 m
Low Supply Level (LSL):	173.1 m
Surface Area:	6.7 km ²
Live Storage:	4.0 million m ³
Overflow Spillway	
Length:	100.0 m
Sill Elevation:	173.7 m
Strutt Lake Dam	
Length:	160.0 m
Max. Height:	18.0 m
Snare Forks Dam	
Length:	105.0 m
Max. Height:	10.0 m
Forebay Containment Dykes 1, 2, 3	
Low Earth Fill Structures:	2 to 3 m in height
Powerhouse	
Rated Gross Head:	14.3 m
Rated Plant Output:	9.2 MW (2 x 4.6 MW units)
Flow at FSL (units at full load):	82.0 m ³ /s
Average Annual Energy Output:	41.2 GWh

EVENTS LEADING TO BREACH

On June 13, 2006 the elevation of the Snare Rapids reservoir was 222.27 m. NTPC was spilling 161 m³/s from the 5B spillway and logs were pulled to increase the spill flow to 269 m³/s. That afternoon the Snare operator reported that Dyke 1 at Snare Forks had eight to ten inches of freeboard. The forebay level at Snare Forks was 174.5 m and the spillway was passing 198 m³/s. It was decided to send in personnel to top up the dyke. On June 14 three contract heavy equipment operators were contacted and notified of the dyke topping to be done at Snare Forks. On June 15 a charter plane was arranged for 09:00 to transport the equipment operators to Snare. The flight was delayed and did not arrive until 12:00. Upon arrival the equipment operators received a site orientation and readied their equipment.

Figure 3: Dyke 1 Breach Discharge Route



BREACH EVENT

On June 15, 2006 at 15:20 the Snare operator reported that Dyke 1 at Snare Forks had been breached by water and a section of the dyke approximately 12.0 m wide by 4.5 m deep had washed away. The water travelled through the breach and passed through a forested area, re-entering the Snare River system in Strutt Lake and forming a channel approximately 500 m long.

The Snare Forks reservoir level at the time of the June 15 breach was 174.0 m. By June 23 the reservoir had stabilized at 174.3 m. On June 23 the flows passing the Forks development consisted of 90 m³/sec at the overflow spillway, 82 m³/sec through the powerhouse units and 97 m³/sec through the breach. When the breach was closed off on June 28 the reservoir climbed back to 174.7 m with 187 m³/sec at the overflow spillway and 82 m³/sec through the powerhouse units.

ONSITE EQUIPMENT AND MATERIALS

Onsite heavy equipment, which includes two dump trucks, one dozer, one loader, one excavator and one grader, is maintained year round for use in maintenance and emergencies.

Fill material available at Snare Hydro includes sand, crushed gravel, and blast rock. At the time of the breach 800 m³ of blasted rock was available in the Snare Forks rock quarry.

RESPONSE

June 15

Upon notification at 15:20 of the Snare Forks Dyke 1 breach NTPC assembles an Emergency Response Team (ERT) which meets at 15:45. The ERT meets at least once daily until after breach closure and then continues to meet regularly regarding further dyke work and mitigation measures of downstream effects. The ERT consists of the following individuals:

Leon Courneya	President & CEO
Judith Goucher	Director, Finance & CFO
Al Dube	Director, Engineering & CE
John Locke	Director, IT & CIO
Randy Patrick	Director, North Slave
Brian Willows	Director, Corporate Operations
Paul Campbell	Assistant Director, Hydro Division
Robert Schmidt	Corporate Safety & Environment Manager
Norm McBride	Plant Operations Manager
Greg Haist	Projects Manager
Ken Dies	System Control & Hydro Planning Manager
Rod Gray	Logistics Manager
Cory Strang	Treasurer
Chris Zorica	Marketing & Communications Officer
Colin Stang	Civil Engineer
Lloyd Courage	Consulting Engineer
Edward Smith	Environmental Analyst
Stuart Robinson	Hydro Maintenance Planner
Ginger Lester	Administrative Assistant to CFO

At 16:30 Colin Stang, Norm McBride and Stuart Robinson travel to Snare by helicopter. They arrive at 17:45 and conduct an aerial inspection, then land and complete a more extensive inspection. The breach has now grown to approximately 30 m.

A crew starts placing large boulders in the breach using a dump truck, loader and excavator, and makes 1.7 m to 3.4 m of progress by the time Colin, Norm and Stuart arrive.

Dykes 2 and 3 are inspected and no concerns are noted.

Colin Stang, P.Eng, NTPC is designated Project Monitor and Site Commander.

The ERT reconvenes at 19:00, receives reports from onsite personnel. It is determined that two more equipment operators, a mechanic and a geo-technical specialist will be sent to Snare.

A mechanic travels to Snare that evening to ensure the heavy equipment, although regularly maintained, will be capable of transporting large volumes of rock for an undetermined amount of time.

The following organizations are contacted:

GNWT Emergency Measures Organization (EMO)
Wek'eezhii Land and Water Board (WLWB)
Indian and Northern Affairs Canada (INAC) (contacted by WLWB as per communication protocol)
Department of Fisheries and Oceans (DFO) (contacted by EMO as per communication protocol)
Rae/Edzo Senior Administrative Officer (SAO)

June 16

Breach is estimated at 40 m wide.

Equipment operators from Camco Construction Ltd. arrive at Snare. They begin dumping rock into the breach to form a closure groyne.

Geo-technical specialist Dave Matheson arrives from Calgary to inspect Dyke 1. He believes that the breach can be closed but is concerned that as progress is made on the east bank the west bank will erode. Plans are made to armour the west bank with sand bags to prevent this erosion.

NTPC Environmental Analyst Eddie Smith contacts INAC, DFO and Environment Canada directly to discuss the breach and arrange a site visit. At 11:00 Water Resource Officer Scott Stewart of INAC and Fisheries Biologist Ernie Watson of DFO accompany Smith to site by helicopter. Photographs of the breach and channel are taken and water is sampled above the breach and in Strutt Lake by INAC. Matheson discusses the dyke with the regulators providing background on the site and the incident, as well as on plans to close the breach.

Regulators request that NTPC close the breach as quickly as possible rather than allowing water levels in the forebay to recede before beginning the project.

NWT Rock Services travels to site to assess the quarry in preparation to blast for larger rock.

Crews have reduced the width of the breach to approximately 26 m.

June 17

Equipment operators continue to place rock fill with an average diameter of 0.6 m or greater into the breach and continue to make progress with the closure groyne.

Forty 2000 lb. sand bags are placed by helicopter on the west bank of the breach to prevent erosion. With the west bank armoured the equipment operators are averaging 5 loads per hour and have made 3.1 m of progress.

June 18

Crews continue to dump rock into breach. The width of breach sits at approximately 20 m and as progress is made the west bank continues to erode.

June 19

Water erodes underneath and around the sand bags placed on the west bank and they are swept downstream by the current.

NWT Rock Services discover an existing drill pattern in the quarry from the original 1976 construction eliminating the need to drill. They will instead clean out existing drill holes and blast saving three days of work.

Although the west bank does erode as the east bank is filled in, it is felt that with a second equipment crew and twenty-four hour filling the breach can be closed.

June 20

INAC forwards authorization to drill and blast to obtain material to repair the breach under the Mackenzie Valley Landuse Regulations Section 17.

Keystone Environmental is requested to visit the site and provide professional environmental expertise and advice.

Work continues on filling the breach and work begins to raise the crest elevation of the dyke using gravel fill.

At 18:00 the closure groyne is measured at 25 m and the breach at 31 m.

June 21

Keystone Environmental sends Steve Clark to Yellowknife to travel to site with Eddie Smith.

DFO personnel - Enforcement Officers Paul Donnelly (lead) and Gerald Fillatre and Fisheries Biologist Ernie Watson visit the site collecting water samples and photographs.

NTPC, DFO, and Keystone meet on Dyke 1 to discuss the breach, channel, and downstream effects. DFO reiterates the urgency to close the breach as soon as possible.

June 22

Work continues on hauling, placing, and compacting fill on Dyke 1.

NWT Rock Services finishes cleaning out the existing drill holes and prepares the quarry for blasting.

Ongoing repairs to heavy equipment are necessary as the gravel trucks are not made for hauling rock in large volumes on a continual basis.

June 23

Lloyd Courage arrives at Snare to take over site command duties from Colin Stang.

NWT Rock Services blast a supply of larger rock from the quarry.

Round the clock shifts are implemented from June 23 to July 1 to fill the breach and stabilize the dyke.

June 24

Filling of the breach continues. Rapid erosion of the west bank of the breach is observed overnight.

June 25

It is decided to change the alignment of the rock fill dyke to the upstream direction to direct the main flow away from the eroding dyke face, as the west bank is eroding too quickly to allow closure.

As a contingency plan a large helicopter is located that is capable of slinging large rocks to armour the west bank of the breach against erosion.

A smaller grade of rock fill is used to bring the crest of the dyke to grade.

June 26

The breach is now approximately 20 m wide and the closure groyne is 41 m long.

It is decided that the large helicopter will not be needed as clear progress is now being made in closing the breach.

Work continues to fill the breach.

June 27

The breach is now approximately 10 m wide.

Flow is reduced through the Snare Falls spillway to reduce flow through the breach and allow for a final push to close it.

Figure 3 - Snare Forks Breach June 27, 2006



June 28

The breach is officially closed at 11:00.

The flow through the dyke is estimated to be 10 m³/s.

Equipment operators begin placing finer material on the upstream edge of the dyke to reduce the flow of water through the larger rocks of the dyke.

The low section on the east side of Dyke 2 is topped up.

June 30 to July 14

Finer materials are placed on the upstream face of the Dyke 1 and the flow through the dyke is reduced to less than 1 m³/s.

July 15 to July 30

Transition rock/gravel, impervious gravely till and rock riprap wave erosion protection materials are placed on the upstream face of the rock fill section of the dyke to reduce leakage, secure the breach and stop wave action from eroding the finer material used to seal the dyke.

The road across the crest of Dyke 1 is topped up.

July 31

All crews working on the dyke depart from Snare.

Total leakage through Dyke 1 is estimated at 0.03 m³/s (1 cubic foot/second) as observed at the bedrock exposure 250 m downstream of the dyke.

WORK TO BE DONE

When the reservoir level at the Snare Forks facility normalizes (reaches full supply level (FSL) with no spilling through the 5B spillway) the riprap placed on the upstream face of the dyke will have to be reworked and added to, as when the riprap was originally placed water levels were approximately 1 m above normal forebay FSL. The crest of Dyke 1 will be graded 175.78 m and maintained at not less than 175.70 m. Dykes 2 and 3 will be rehabilitated and raised to the same elevation.

ENVIRONMENTAL MONITORING

The NTPC Environmental Department is conducting an ongoing water monitoring program of the Snare system. Sampling locations include the four Snare Hydro forebays (Snare Rapids, Snare Falls, Snare Cascades and Snare Forks), each lake downstream of the dyke breach (Strutt Lake, Slemmon Lake, Russell Lake, Marian Lake and Great Slave Lake), and the Fort Rae and Edzo water intakes. Samples were taken June 16, June 24, and July 24 to date and a monthly sampling regimen is currently being followed. Water samples are analyzed for pH, electrical conductivity, solids, turbidity, and metals.

NTPC has also commenced measures to mitigate the movement of further sediment from the new channel into Strutt Lake.

POINTS OF NOTE

- At its largest the breach was approximately 40 m wide.
- It took 14 days to close the breach.
- It took 33 days (June 29 to July 31) to complete the rock placement and construct the upstream blanket consisting of rock spalls, sand & gravel, impervious glacial till and rock riprap wave erosion protection sealing the dyke to approximately 0.03 m³/sec of leakage flow.
- The approximate quantities of materials used were as follows:
 - Quarry Rock: 7863 m³ (from quarry east of Strutt Lake Dam)
 - Sand & Gravel: 3870 m³ (from borrow pit west of Dyke 2)
 - Glacial Till: 6690 m³ (from borrow pit west of Dyke 2)
- At no point was the Snare Forks reservoir level above the maximum high flow level of 175.26 m.
- At no point was the spill through the Snare Forks spillway beyond the designed capacity of 378 m³/s.

QUARRY ROCK USAGE

Raise & widen dyke section east of the breach:	186 m ³
Rock fill closure section of breach, 88 m wide:	3675 m ³
Downstream rock toe:	720 m ³
Riprap wave erosion protection (full length of Dyke 1 is 260m):	2607 m ³
<u>Outwash fan (rock washed downstream by the breach flow):</u>	<u>675 m³</u>
Total quarry rock used:	7863 m ³