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**BC Hydro Generation**  
**Public Safety Management Plan**  
**(PSMP)**

**Hugh Keenleyside**

**July 2015**

**Prepared by:** Project Support and Public Safety

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**Jonathan Knowles**  
**Public Safety Manager**

**Reviewed by:**

**Approval:**

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**Chris Egan**  
**Plant Manager**

# BC Hydro Generation

## Public Safety Management Plan (PSMP)

Hugh Keenleyside

July 2015



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## **PSMP Distribution**

A current version of the PSMP can be found on BC Hydro's Controlled Document Filenet Search:

<http://w3ecm/eargcd/simpleSearch.jsp?docClass=all&documentType=Public+Safety+Management+Plan+%28PSMP%29&documentNo=&facility=all&docContains=&pagesize=100&quickForm=Search>



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## 1.0 Purpose

The Occupier's Liability Act of British Columbia requires that the occupier of any property in the Province provide all reasonable restraining and warning devices necessary to protect the public from dangers and hazards associated with that occupation of property. Restraining and warning devices recognized as necessary and employed by BC Hydro must be maintained to an acceptable standard.

- The *Occupier's Liability Act* defines "Occupier" as "a person who  
(a) is in possession of the premises, or  
(b) has responsibility for, and control over, the condition of the premises, the activities conducted on those premises and the persons allowed to enter those premises;"

In addition to its fee owned property, BC Hydro is also responsible for public safety on Crown land it holds under Crown tenure where the foregoing conditions are met.

The purpose of BC Hydro's Public Safety Management Plans (PSMP) is to document hazards and their associated risks and to outline control measures implemented to eliminate or reduce the risk of public injury or death at, or associated with, BC Hydro's generating facilities during normal operations. Through the development and maintenance of a PSMP for each of its facilities, BC Hydro also seeks to demonstrate due diligence by identifying and mitigating hazards and risks associated with its operations.

This PSMP addresses:

- public activities in the area affected by the facility;
- hazards to the public that may be present;
- safety control measures that are employed to protect the public;
- public safety control measures that are within Public Use Management Area (PUMA) boundaries and are in place primarily to address public safety hazards and risks created by normal Generation Operations;
- procedures for inspection, remediation and modification of safety controls;
- revisions to the PSMP, as required, due to changes in operating procedure, physical plant, legal or management direction and/ or the public interest.

This PSMP applies to areas under the **Generation Plant Manager's** jurisdiction.

Areas NOT included in this PSMP are:

- Distribution facilities;
- Transmission facilities;
- Arrow Lake Power facilities
- BC Hydro properties under the control of a third party (i.e. property leased to a third party) that are unaffected by the facility or its operation; and
- Property owned by the Crown or others including public roads and provincial, municipal and regional district land and facilities that are unaffected by the facility or its operation.

This PSMP is applicable throughout the range of normal operating conditions. Situations outside of the range of normal operations (e.g.; spilling, summer drawdowns) are the subject of separate emergency protocols, such as *System Operating Orders* and *Local Operating Orders*, which supersede this PSMP.



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The term “public” does NOT refer to BC Hydro workers or contractors working for BC Hydro. Safety practices for these workers are managed in accordance with the requirements of applicable WorkSafe BC *Occupational Health and Safety Regulations* and BC Hydro’s *Work Protection Practices and Safety Practice Regulations*.





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## **2.0 Responsibilities**

**BC Hydro** has an obligation to:

- understand public use within areas affected by the operation of its facilities;
- identify the hazards and risks involved with public use of areas affected by BC Hydro's assets and their operations; and
- take all reasonably appropriate steps to remove or, where that is not possible, to reduce the risks.

**Plant Managers** are responsible for ensuring that a PSMP is prepared, implemented, and maintained for each facility under their control. Specifically, the **Plant Manager** is responsible for ensuring that:

- a PSMP is in place and aligns with the requirements of *OSH 701*;
- inspections and remedial measures are performed, as required, under the PSMP;
- records are kept of inspections and remedial measures;
- training is conducted so that staff involved are capable of fulfilling their respective roles and responsibilities;
- safety controls are implemented or modified when changes to the physical plant or operating procedures may create an additional or modified public safety risk; and
- revisions to the PSMP are performed as and when required, and that revised pages are sent to the public safety department for revisions of the digital copy and subsequent updates to the PSMP websites.



### 3.0 Public Uses, Safety Hazards and Safety Control Measures

The Generation Area has been divided into various components in order to address public uses, safety hazards, and safety control measures specific to each.

#### 3.1 Public Uses

Table 1 lists known and potential public activities within the BC Hydro Generation Area

**Table 1: Public Activities**

Swimming	ATV	Biking	Camping
Climbing	Diving	Fishing	Hiking
Horse riding	Jumping	Motorbike riding	Person entering*
Skiing, Skating	Snowmobiling	Water-skiing	Watercraft**
* Person entering	Includes but not limited to entry for work, travel, general interest, or exploring and may include entry using a motor vehicle.		
** Watercraft	Includes but not limited to powered and non-powered boats, canoes, kayaks and personal watercraft.		

#### 3.2 Safety Hazards

A hydroelectric generation facility could pose one or more hazards in areas used by the public, including:

- changes in water level, flow velocity and volume;
- submerged hazards;
- hazards resulting from the design or placement of structures or from their operation, such as intake or discharge areas;
- seasonal hazards such as ice and debris; and
- steep or unstable slopes around the facility or the watercourse.

All components have been examined for public safety hazards and the results summarized for each.

#### 3.3 Safety Control Measures

Safety control measures are initiatives designed to protect the public by the installation of physical restraints and by raising awareness of hazards and risks associated with generation facilities.

Where the risks are high and the consequences severe, a site is designated a **Danger Zone** in which unauthorized access is prohibited and appropriate control measures are implemented.

Where the risks are medium or low and the consequences are minor, a site may be deemed a **Warning Zone** in which the public are alerted to the specific nature of the risk and warned accordingly.



Selection of the appropriate control measure will depend upon the nature and degree of risk each safety hazard represents to the public. The practicality and effectiveness of implementation and the site-specific conditions being addressed will influence the choice of control measure used.

Control measures employed at Hugh Keenleyside include:

- **Warning** – sign
- **Restraint** – fence, gate, boom
- **Education** (internal and external) – media advertising, pamphlets, website, employee awareness

### 3.4 Public Notifications

The public is advised of the hazards associated with the presence and operation of Hugh Keenleyside through a variety of means.

Newspaper notices, such as Safety on Reservoirs and Safety Around BC Hydro Facilities are published annually at the start of the summer high periods.

BC Hydro's Internet site

([https://www.bchydro.com/community/recreation\\_areas/arrow\\_lakes\\_reservoir.html](https://www.bchydro.com/community/recreation_areas/arrow_lakes_reservoir.html)) provides information on Arrow Reservoir, access and directions, boater safety, safe anchorage sites, the navigational lock on Hugh Keenleyside Dam, recreational opportunities and boater services. Links are also provided to daily reservoir levels, the Ministry of Forests recreational sites and the Canadian Hydrographic Navigational Maps.

Details of the Public Notification documents and the schedule for issuing the notifications are included in Appendix 4.



## 4.0 Safety Control Specifications

All guidelines are provided to assist in the placement, inspection, and replacement of safety control devices. Actual placement of the control devices will depend on site conditions, such as terrain and visibility.

### Signs

Existing signs that are in place, in good shape and in compliance with the minimum standards of the BC Hydro Sign Standard will remain. Some existing signs do not conform to the format found in the BC Hydro Sign Order Shop or Replacement Sign Index but were deemed to be adequate at the time of the latest review and meet the signage minimum requirements.

When ordering replacement signage, refer to the “Replacement Sign” section shown in Appendix 2 and the BC Hydro Sign Order Shop. Details concerning sign size, format, color, text, and lettering must be in accordance with the specifications documented in the BC Hydro Signage Standard available on the BC Hydro Sign Order Shop except in situations where multiples of the unique sign are present and in good condition, meeting BC Hydro Sign Standard minimum requirement. In such cases, the replacement should be the same as the existing remaining signs to preserve consistency in overall appearance.

A commonly used sign is the “No Trespassing” sign. Installation guidance for this sign is provided below.

**Table 2: Guidelines for Placement of “No Trespassing” Signs on Fences & Gates**

Fence Type	Length	Sign Placement
<b>Fence only</b>	< 10 meters	<ul style="list-style-type: none"> <li>one sign at mid-point</li> </ul>
	10 to 20 meters	<ul style="list-style-type: none"> <li>sign at each corner post within 1 meter of corner</li> </ul>
	> 20 meters	<ul style="list-style-type: none"> <li>sign at each corner post within 1 meter of corner</li> <li>remainder of signs to be installed at regular spacing along run but no more than 20 meters apart where vegetation and terrain are factors</li> <li>where line-of-sight is adequate, spacing may be up to 50m</li> </ul>
<b>Fence with vehicle gate</b> (can have integrated man-gate)	< 20 meters	<ul style="list-style-type: none"> <li>sign on either side of gate if there is room; if there is no room, sign on each section of gate</li> <li>follow guidelines for <i>Fence only: &gt;20 meters</i></li> </ul>
<b>Fence with man-gate</b>	< 10 meters	<ul style="list-style-type: none"> <li>one sign on gate</li> </ul>
	>10 meters	<ul style="list-style-type: none"> <li>follow guidelines for <i>Fence only: 10 to 20 meters and &gt; 20 meters</i></li> </ul>



**Fences**

Fences around *Danger Zones* shall comply with BC Hydro standards to prevent unauthorized entry.

The purpose of fencing is to reduce hazard exposures. The design and location of such fences will be dependent on site conditions.

**Booms<sup>1</sup>**

To discourage public access to a debris boom, the first section (log) from land may be omitted. On a double boom, a single log section may also be utilized.

**Type 1: Single Debris Boom**, BC Hydro drawing No. 524-C18-03

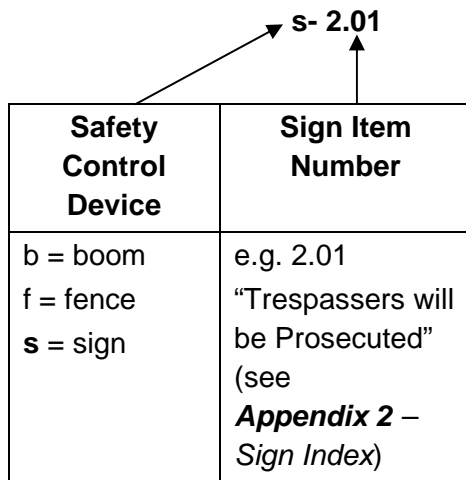
**Type 2: Double Debris Boom**, BC Hydro drawing No. 524-C18-04

**Type 3: Public Safety Boom** – e.g. TUFFBOOM boat buster boom or equivalent

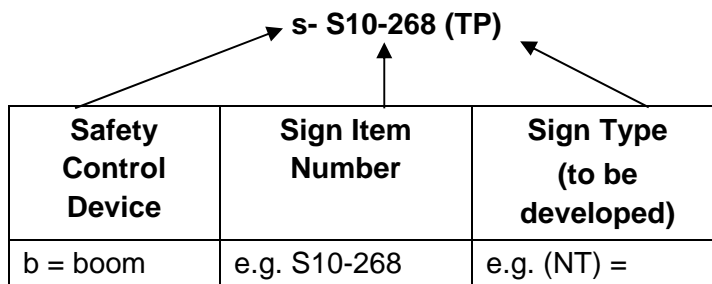
**4.1 Safety Control Identification**

The Public Safety control measures are identified on the maps (Appendix 1). The controls, such as a fence, sign or boom, are only shown on one map even if the control is present on more than one map.

Example of a unique identification (ID) code for a legacy sign:



Example of a unique identification (ID) code for a sign ordered from BC Hydro Sign Order Shop:

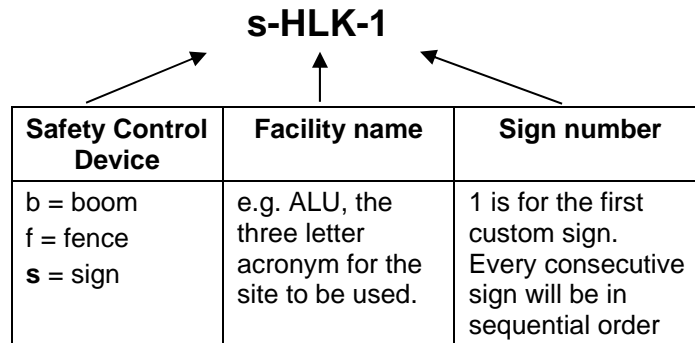


<sup>1</sup> **Note:** Boom drawings are included in **Appendix 3**.



f = fence s = sign	“Trespassers will be Prosecuted” (see <b>Appendix 2 – Sign Index</b> )	Trespassers Will Be Prosecuted (see <b>Appendix 2 – Replacement Sign Index</b> )
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Example of a site specific unique identification (ID) code for a custom sign that is not available on the BC Hydro Sign Order Shop:



**New Signs**

Newly created Public Safety signs will be assigned a unique sign identification code and will be added to the Public Safety Replacement Sign Index in Appendix 2 of this PSMP.



## 5.0 Inspection Program

Although observations by staff or others can provide input at any time during the year, regular inspections of the PSMP safety controls at the respective facility are made and documented on a schedule established by the **Plant Manager** in accordance with the general inspection schedule in Table 3.

PSMP maintenance orders for annual inspections and corrective action work orders, should repairs be required, should both be entered into Passport. This should preferably be completed prior to the May long weekend. If safe access to a particular component or control measure is not possible at the time of the planned inspection, it should be noted, documented and rescheduled in Passport.

**Table 3: Components Inspection Schedule (General)**

Component	Frequency of Inspection	Timing
All	Once per annum	Once in spring prior to May long weekend, subject to safe winter access conditions

Guidelines for inspection of control devices are documented in **Appendix 5** of this PSMP. Staff assigned to conduct the inspections shall complete the *Safety Control Deficiency Report* (see **Appendix 5**) and file the report in the designated retention file.<sup>1</sup>

During inspection, the **Inspector** discovering an unsafe condition or an unreliable control device will, if possible, immediately remedy the deficiency”. If all control devices receive a “pass”, the **Inspector** will complete and file the deficiency report. If the inspector cannot remedy the deficiency at the time of inspection, it is the responsibility of the **Inspector** to:

1. implement interim safety measures and notify the **Plant Manager** so that full repair can be properly undertaken. If interim measures are not possible, the **Inspector** shall immediately notify the **Plant Manager**, who will arrange for the necessary repairs.
2. complete the *Safety Control Deficiency Report* and *Safety Control Remediation Report* (see **Appendix 5**) and forward it to the **Plant Manager** and utilize Passport history files to document all remediation.

<sup>1</sup> **Note:** See page 14 for a schematic of the Inspection workflow.



## **6.0 Remediation Program**

Remediation of a defective or missing safety device can be initiated at any time and for a variety of reasons, including:

- A report that indicates a deficiency; or
- BC Hydro staff or an individual outside of BC Hydro observing or being made aware of breakage, loss, or failure of a safety control due to vandalism, or other causes, including fallen trees, erosion, high water events, motor vehicle accidents, acts of trespass into *Danger Zones*, etc.

Regardless of the initiating factor, the prompt and effective remedy of any deficiency in public safety controls is regarded as a priority. Once remedial actions have been concluded, a *Safety Control Remediation Report (Appendix 5)* must be completed<sup>1</sup>.

Upon receiving the remediation report(s), the **Plant Manager** will:

1. arrange for repair of the safety control device(s);
2. approve the remediation report(s) when repairs are completed; and
3. file the completed report(s) in the designated retention file.

It is important to maintain a record of remedial actions in regard to public safety in order to establish due diligence. Chronic maintenance issues that affect public safety could indicate where more attention to some aspect of the PSMP is required.

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<sup>1</sup> **Note:** See page 14 for a schematic of the Inspection workflow.





## **7.0 Modification, Records Maintenance and Review**

### **7.1 PSMP Modification <sup>1</sup>**

Modification of the PSMP (e.g. addition, deletion, or modification of safety controls) may be required as a result of inspection, legal requirement, management direction, or changes to the physical plant or operation procedures.

The **Plant Manager** is responsible for ensuring that proposed changes to the physical layout or to operational procedures of the facility will not adversely affect public safety. Hazards that may develop as a result of such changes include, but are not limited to:

- new access to *Danger Zones* as outlined on the PSMP maps;
- changes to land and water conditions that may present new risks or hazards to the public;
- the introduction or alteration of structures that might create or pose a risk to public safety.

If a proposed change to the plant or its operation will result in new or increased risk then corrective action must be taken. This action may include:

- adjusting the planned change or condition to eliminate or mitigate the hazard; and/or
- developing and implementing appropriate safety controls.

Safety controls made redundant by physical or operational changes must be removed.

The **Plant Manager** is responsible for approving any changes to the PSMP in consultation with BC Hydro's Public Safety Department Manager. When a modification is indicated, the Public Safety Department will assist the **Plant Manager** with PSMP modification

The Public Safety Department will modify the PSMP to:

- record the location of any new or revised safety control on the appropriate *Map (Appendix 1)*;
- revise *Safety Control Specifications*, as required;
- Revise pages of the PSMP and associated map sheets to update the digital master copy.

The **Plant Manager** will:

- incorporate the change(s) by adding any new safety controls to the appropriate *Safety Control Deficiency Report (Appendix 5)*;
- Complete a *PSMP Modification Report (Appendix 6)* and file it with the record copy of the PSMP

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<sup>1</sup> **Note:** See page 14 for a schematic of the Inspection workflow.



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## **7.2 Records Maintenance**

It is the responsibility of the BC Hydro Public Safety Department to ensure the maintenance of the PSMP records and to update the PSMP on the Controlled Document Filenet Search (CDFS).

## **7.3 PSMP Review**

It is important that PSMP forms and content are consistent and that current conditions and standards are accurately reflected. Therefore, every three years the **Public Safety Department** will complete an on-site hazard risk assessment of the generating facilities utilizing the Canadian Dam Association – Guidelines for Public Safety Around Dams and undertake a review of the PSMP to ensure that:

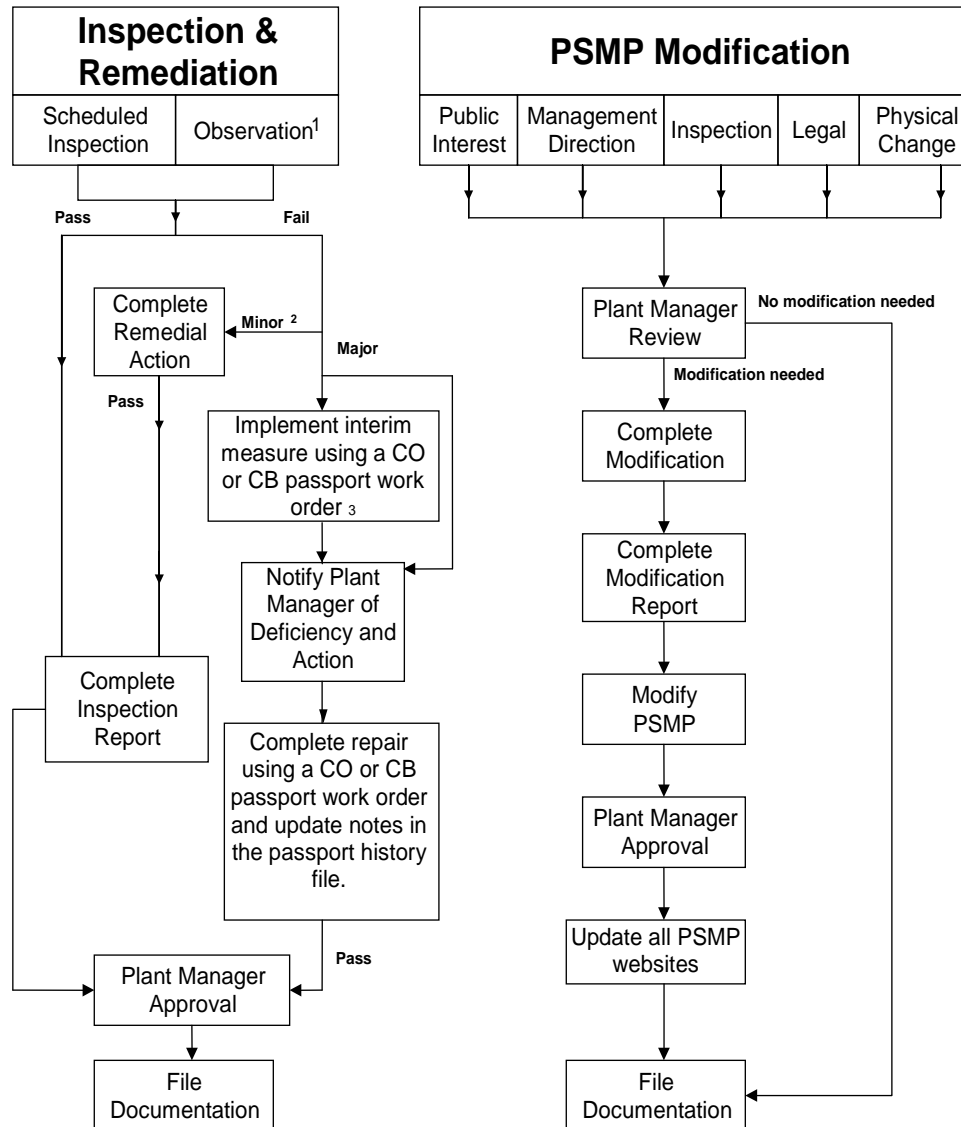
- Controls in place are working as planned to reduce previously reviewed risks and hazards.
- All documented revisions made to the PSMP over the three year period since implementation of the plan have been incorporated; and
- Revisions are consistent and compliant with current BC Hydro and industry standards for public safety.

The Risk Assessments are records and are kept in the PSMP for historical tracking. Each revision to the PSMP; physical controls or operational adjustments or other, shall be noted in subsequent revisions to the PSMP document.

Operational Safety - Public Safety will assist the **Plant Manager** to ensure consistency and compliance with applicable standards.



## PSMP Inspection, Remediation and Modification Workflows



**Notes:**

1. Information received from BC Hydro staff or outside observer regarding a problem with a safety control device.
2. Minor repairs (e.g. removal of vegetation growth at a sign) can be completed by the inspector immediately and do not require follow-up actions.
3. Interim measures may be completed if possible (e.g. placement of danger tape)

**Figure 1: Inspection, Remediation and PSMP Modification Workflows**



## **8.0 Description of Hugh Keenleyside**

This PSMP covers the Arrow Lakes Reservoir and Hugh Keenleyside Dam.

The Arrow (a.k.a. Hugh Keenleyside) Project was one of several developments constructed under the Columbia River Treaty and is operated to maximize mutual benefits with respect to flood control and hydroelectric power generation for Canada and the United States. The original facility was not constructed to have power generation capacity. However, under a joint initiative between the Columbia Power Corporation (CPC) and the Columbia Basin Trust (CBT), the Arrow Lakes Generating Station (ALH) was constructed adjacent to the north end of Hugh Keenleyside Dam in 2002. The Arrow Lakes Power Corporation (ALPC), a joint venture of CPC and CBT, owns ALH. ALPC has overall responsibility for ALH equipment and facilities and for ALH operations.

Hugh Keenleyside Dam is situated on the Columbia River about 8 km upstream of the City of Castlegar. The 853 m long dam was completed in 1968 and consists of an earthfill dam, a concrete dam, four spillways, eight low-level ports and a navigation lock. The public has access to the earthfill dam and the south side of the Navigational Lock. All other areas of the dam are restricted from public access. BC Hydro owns and operates the roadway across the dam that has been temporarily closed for Public use. When Public use of the road was permitted, it was coordinated with ALPC which has jurisdiction over the roadway north of the dam.

The 240 km reservoir formed by the dam inundated the former Upper and Lower Arrow Lakes and is known as Arrow Lakes Reservoir. The reservoir is a significant recreational resource for residents and tourists, supporting numerous beaches, parks, marinas and boat launch ramps. The reservoir can be accessed at a variety of locations between the dam and the City of Revelstoke to the north. BC Hydro operates hydroelectric powerplants fed by tributaries at two locations on Arrow Reservoir – Walter Hardman and Whatshan. Public safety at each of these plants is addressed in its own PSMP.

During the Arrow Project, land was cleared and the resulting wood waste burned to reduce the post flooding problems of floating debris and submerged hazards. Although some debris enters the reservoir today from undercut banks on the reservoir shoreline, the majority of the woody material originates from Interfor's log storage and transport from Arrow Lakes Reservoir to the mill downstream of Hugh Keenleyside Dam. Interfor removes the debris that collects at the debris boom while BC Hydro removes debris in and around the lock. The reservoir is relatively free of floating debris.

ALH has priority on any water discharged from the reservoir; the remaining balance is discharged through the dam. A 1500 m long concrete-lined intake channel diverts water from the reservoir to the ALH powerplant, situated about 400 m downstream from the dam. In the event that ALH suddenly reduces generation, discharge gates at the dam are opened to maintain river flows downstream of the facility and to prevent impacts on fish and fish habitat. During normal working hours an operator opens one or more gates manually. At night, when there are no operators on duty, flow is re-established remoting from FVO, who have the ability to remotely operate one low level outlet port and two spillway gates. Most gate operations are performed locally.

The 55 km section of the Columbia River between the dam and the Canada–USA border supports a significant fishery and recreational boating and shoreline use is popular. Boaters using the Columbia River can access Arrow Lakes Reservoir through the navigation lock in the dam. Although a majority of current lock use is by industrial vessels and log booms, public recreational use has the potential to grow substantially in the future. Navigational charts of the Lower Columbia River and Arrow Lakes Reservoir to Revelstoke, prepared by the Canadian



Hydrographic Service are available to boaters using this waterway. (see [geoportal.gc.ca/eng/Maps/Viewer](http://geoportal.gc.ca/eng/Maps/Viewer))

The Hugh Keenleyside facility is divided into four sub areas in this PSMP, as follows:

1. Arrow Lakes Reservoir (ALR)– from the City of Revelstoke to the HLK headpond (includes the “Party Pit” north of the dam)
2. Headpond (HP) – from the upstream debris boom to the concrete dam
3. Earthfill Dam (ED) – from the south access gate to the gate south of the lock, including the south shore for a distance 850 m upstream and 250 m downstream
4. Lock and Concrete Dam (LCD) – concrete portion of the dam to the north abutment, includes the lock, office, low level outlets and spillway
5. Tailrace (TR) – from the concrete dam to the end of the rockfill groin

*In recognition of the practicalities of geography, access and convenience, the Revelstoke Plant Manager administers the portion of Arrow Lake Reservoir from Revelstoke to the Shelter Bay ferry on behalf of the Hugh Keenleyside Plant Manager.*

**Table 4** lists the code, reference section, and location map for each component.

**Table 4: Hugh Keenleyside Components**

Component	Code	Reference Section	Map # (Appendix 1)
1. Arrow Lakes Reservoir	ALR	9.1	1,2,3 and 4
2. Headpond	HP	9.2	5 and 6
3. Earthfill Dam	ED	9.3	5 and 7
4. Lock and Concrete Dam	LCD	9.4	5 and 8
5. Tailrace	TR	9.5	5 and 9



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## **9.0 Components**

### **9.1 Arrow Lakes Reservoir (ALR)**

This component contains the entire Arrow Lakes Reservoir from the City of Revelstoke to the headpond of Hugh Keenleyside Dam. At full pool the reservoir is approximately 220 long.

#### **9.1.1 The upper reach of the reservoir between Shelter Bay and the City of Revelstoke.**

Within this reach there is the City of Revelstoke, several small boat access sites within the City limits, some other popular sites on the left side (looking downstream) of the reach, and provincial parks at Blanket Creek and at Shelter Bay (Arrow Lakes Provincial Park). Owners of numerous small private holdings on Revelstoke Reach can access the reservoir directly.

When the reservoir is drawn down each spring the flow reverts to the original river channel, exposing numerous shoals on both left and right banks. In addition, many stumps, root wads and other such debris are concealed in the increasingly shallow water as the reservoir level recedes. To further complicate navigation, currents in the river are strong and can vary as reservoir levels change and can fluctuate without warning if discharges from Revelstoke Dam change. Signs at boat access sites in the City of Revelstoke and on all public routes to the reservoir warn of the dangers.

Although this sub area is part of the Arrow Reservoir and, therefore, contained within the Hugh Keenleyside PSMP, it has been delegated to Revelstoke Plant Manager for implementation and administration. Each year the Revelstoke Plant Manager forwards completed Safety Control Deficiency and Remediation Reports for the Revelstoke Reach sub area (**Appendix 5**) to the Hugh Keenleyside Plant Manager for his records.

#### **9.1.2 Upper Arrow Lakes**

This part of the component includes the portion of Arrow Lakes Reservoir from the “Narrows” in the south to Shelter Bay in the north. It includes the communities of Burton and Nakusp, and MacDonald Creek Provincial Park.

Upper Arrow Lakes Reservoir can be accessed directly via public boat ramps at Nakusp, Burton (seasonal), at the provincial park and numerous informal water access sites on the east side of the reservoir.

Within this sub area the reservoir is not subject to strong currents from Revelstoke Dam discharges or from ALH/ HLK intakes. Risks for recreational boaters are confined to floating debris that may be encountered on the reservoir or submerged shoals that can become exposed during seasonal fluctuations in reservoir level.

Boater Advisory signs on all access routes remind boaters that the lake is a storage reservoir and is subject to such hazards. Additional similar signs are posted at provincial park and community boat ramps. Public notifications are also posted on BC Hydro’s website and in local newspapers.

The boat ramps at Nakusp and Edgewood are under redevelopment. Reservoir warning signs must be placed at the entrance to these boat ramps.

#### **9.1.3 Lower Arrow Lakes**

This part of the component includes portion of Arrow Lakes Reservoir from the “Narrows” in the north to the City of Castlegar in the south. It includes the communities of Fauquier and Edgewood, Deer Park, Renata, and Syringa Provincial Park. The HLK dam, lock forebay and tailrace, are covered in Sections 9.4 through 9.7



Lower Arrow Lakes Reservoir can be accessed directly via public boat ramps at Fauquier, Edgewood (seasonal), Syringa Creek, two private marinas and numerous informal water access sites, primarily on the east side of the reservoir. Boats can access the Columbia River just downstream from HLK at Robson where a formal boat launch is situated.

Risks for recreational boaters in most of this sub area are confined to floating debris that may be encountered on the reservoir or submerged shoals that can become exposed during seasonal fluctuations in reservoir level.

Boater Advisory signs on all access routes remind boaters that the lake is a storage reservoir and is subject to such hazards. Similar signs are posted at provincial park, community and private sector boat ramps. Public notifications are also posted on BC Hydro’s website and in local newspapers to remind reservoir users of potential hazards and to take appropriate safety precautions.

BC Hydro’ upper warehouse is situated just off the Broadwater Road to the north of the ALH approach channel. The warehouse is secured by perimeter fencing which is signed to restrict unauthorized entry.

The old borrow area for Hugh Keenleyside Dam has developed over the years into a popular party area, known locally as the “Party Pit”. Activities in the “Party Pit” off Rialto Road are on both BC Hydro and CPC land. Periods of high-use, such as Graduation Week pose a high risk to BC Hydro as likelihood of injury is elevated at that time. BC Hydro decided to reduce the risk and in 2013 restricted access to the “Party Pit” by constructing a 400 m long berm along Rialto Road and installing a steel gate to the only access road into the pit.

**2014: Description, Public Use, Hazards**

**Table 5: Hazards, Activities & Control Measures Implemented – Arrow Lakes Reservoir (ALR)**

Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
<b>Changing water levels</b> [reservoir]	Fishing, Swimming, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – Boater Advisory signs on main access routes to reservoir explain the risks associated with recreating on the reservoir. Signs are visible to all reservoir-bound traffic.</li> <li>• <b>Education</b> – Notices are placed in local newspapers informing the public of the risks associated with Arrow Reservoir. BC Hydro’s Internet website also informs these public of these risk and provides a link to daily reservoir levels and the Navigation charts for the reservoir.</li> </ul>
<b>Submerged shoals and debris</b>	Fishing, Swimming, Watercraft, Water-	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – At all public routes to the reservoir.</li> <li>• <b>Education</b> – As above.</li> </ul>

<sup>1</sup>Note: **Appendix 2** Map 2 shows location of public safety controls in this component.  
**Appendix 3** contains control specifications.  
**Appendix 4** contains public notifications.



Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
[reservoir]	skiing	
<b>Floating debris</b> [reservoir]	Fishing, Swimming, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – At all public routes to the reservoir.</li> <li>• <b>Education</b> – As above.</li> </ul>
<b>Strong currents, turbulence &amp; fluctuating flows</b> [reservoir]	Fishing, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – At all public routes to the reservoir.</li> <li>• <b>Education</b> – As above.</li> </ul>
<b>ATV/person collisions</b>	Youth partying (Party Pit only)	<ul style="list-style-type: none"> <li>• <b>Barriers</b> – a berm and locked gates have been installed to prevent access to the Party Pit.</li> </ul>

2015: Description, Public Use, Hazards

Table 6: Hazards, Activities & Control Measures Implemented – Arrow Lakes Reservoir (ALR)

Hazard	Known & Potential Activities	Control Measures
<b>Changing water levels</b> [reservoir]	Fishing, Swimming, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – Boater Advisory signs at new/modified boat ramps</li> </ul>
<b>Submerged shoals and debris</b> [reservoir]	Fishing, Swimming, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – Boater Advisory signs at new/modified boat ramps</li> </ul>
<b>Floating debris</b> [reservoir]	Fishing, Swimming, Watercraft, Water-skiing	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – Boater Advisory signs at new/modified boat ramps.</li> </ul>





**9.2 Headpond (HP)**

This component deals with public safety issues immediately upstream of Hugh Keenleyside Dam. The Headpond component includes the forebay downstream of the debris boom and the strip of BC Hydro owned land on the south side of ALH canal upstream of Hugh Keenleyside Dam as shown on Map 6.

This component contains several hazards. The forebay in front of the concrete dam section is a *Danger Zone* in which public access is restricted. Within the forebay the spillgates and low level ports at the dam are protected by a debris/ safety boom. Signs on the boom and on the floating guidewall prohibit entry to the forebay and warn of the hazards. Access to the forebay from the left bank is restricted by fencing, signs and a locked gate. (Removed for the Spillway Project and will be replaced following the project completion) The ALH approach channel can be reached by boaters who beach their craft on the left bank immediately upstream of the forebay and walk across the narrow strip of BC Hydro property that separates the approach channel from the reservoir. Signs on the left bank restrict boater access from the reservoir. Access to this narrow strip by land is normally restricted by a fence at the north abutment of the concrete dam. This fence has temporarily been removed for the spillway project but will be re-established at the project’s completion.

The existing debris boom for the forebay is at its end-of-life and a F16 project is underway to replace this boom. The need to make the replacement boom more visible to boaters has been included in the Project’s User Requirements.

**2014: Description, Public Use, Hazards**

**Table 7: Hazards, Activities & Control Measures Implemented – Headpond (HP)**

Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
<p><b>Strong currents, turbulence &amp; fluctuating flows</b> [lock and discharge area]</p>	<p>Fishing, Watercraft, Water-skiing, Person entering</p>	<p><b>Barriers, Boom</b>– The existing debris boom is scheduled to be replaced in F16 with a more high visibility boom.</p> <p><b>Warning, Signs</b> – Signs on the debris boom and along the shoreline on the strip of land south of ALH’s canal are well signed indicating the hazards that are present.</p> <p><b>Audible Signal (siren), Light (beacon)</b> - Beacon and siren at the dam are activated to signal impending discharge from spillway. This will suddenly increase flow velocities in the forebay.</p> <p><b>Education</b> – As above. Public address system enables dam operator to communicate with boaters in tailrace and lock area. Emergency contact signs are displayed at several locations on the dam crest.</p>

<sup>1</sup>Note: **Appendix 2** Maps 5 and 6 show locations of public safety controls in this component. **Appendix 4** contains control specifications. **Appendix 5** contains public notifications.



2015: Description, Public Use, Hazards

Table 8: Hazards, Activities & Control Measures Implemented – Headpond (HP)

Hazard	Known & Potential Activities	Control Measures
Strong currents, turbulence & fluctuating flows]	Swimming	<b>Access control from land</b> - Following completion of the spillway project the fence that secures the narrow strip of land between the headpond and the canal will be re-established.
Debris boom visibility	Boating	<b>Booms</b> – The existing debris boom is at end-of-life and is proposed to be replaced in Fiscal 2016. Public Safety has met with the project team and have included the need to make the boom more visible in the User Requirements for this Project.

9.4 Earthfill Dam (ED)

This component addresses the public safety issues at and near the earthfill portion of Hugh Keenleyside Dam, including the:

- Upstream and downstream slopes of the earthfill embankment
- The roadway along the crest of the earthfill dam from the south barrier to the ramp leading down to the lock parking lot
- The Arrow Lakes south shoreline for a distance 850 m upstream of the dam
- Downstream south abutment of the dam

These elements are addressed as follows:

- **Upstream and downstream slopes** – The upstream slope of earth fill dam is heavily rip-rapped. The average diameter of this rip-rap in the order of 0.3m which would highly discourage anyone from walking along the upstream slope. Anyone that did walk along the upstream slope would face a serious tripping hazard and would probably require medical treatment. Boats would be discouraged from accessing this slope for the same reason. The surface of the downstream slope of the dam is comprised of much finer material and is grassed throughout. The public could walk along the downstream slope and not face any hazards. Boats could easily beach on the downstream slope, particularly at the toe where the surface is very flat. However during low river levels there are underwater obstacles that pose a hazard to watercraft near the toe of the slope. Buoys mark the location of this hazard.
- **Roadway along the crest of the earthfill dam** – this two lane road is straight throughout its entire length from the south gate to the ramp down to the lock. The posted speed limit is 30 km/h and there are no stopping signs posted along the road. There is a large sign at the south end of the dam indicating that the road across the dam is closed to the public. This discourages the public from entering onto the road. The hazards to the public on this



road are minimal. The most likely outcome would be a vehicle hitting the concrete blocks that support the south gate. However the sign is well marked with warning signs.

- **South shore upstream of the dam** – the public can access the south shore for a distance of about 850 m. At that point there is a small parking lot for the public to access a hiking trail that runs along the old railway bed. The south shore is used extensively for industrial log sorting with heavy machine operating most of the time. It is very unattractive for the public although Plant staff have reported people swimming in the reservoir in this area. Anyone entering the reservoir would be exposed to tripping hazards getting to the reservoir. They would also be a risk from being struck by heavy machinery, which is not a BC Hydro hazard. On the right bank the reservoir can be reached via several industrial road access points. Several danger signs on the right bank alert the public to potential reservoir hazards in this area.
- **South shore downstream of the dam.** The public have been observed downstream of the dam along the south bank. The access road down to the downstream south abutment is gated but people can easily walk down the downstream toe of the dam. The hazards in this area are no greater than accessing the Columbia River at any location downstream of Hugh Keenleyside Dam. Rapid changes in discharge from the dam would have little impact to anyone swimming near the south shore as the spillway discharge is about 450 m from the south shore. There is industrial traffic near the top of the access road to the toe of the dam but this not a hazard associated with BC Hydro's facilities or operation.



2014: Description, Public Use, Hazards

Table 9: Hazards, Activities & Control Measures Implemented – Earthfill Dam (ED)

Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
<b>Changing water levels, floating and submerged hazards</b> [reservoir and earthfill dam]	Fishing, Swimming, Watercraft, Water-skiing, Person entering	<ul style="list-style-type: none"> <li>• <b>Warning, Signs</b> – There are several warning signs posted along the south shore upstream of the dam indicating strong undercurrents</li> <li>• <b>Restrains, Buoys</b> – A series of warning buoys mark shoaling ground immediately downstream of earthfill dam.</li> <li>• <b>Education</b> - Notices are placed in local newspapers informing the public of the risks associated with Arrow Reservoir. BC Hydro’s Internet website also informs these public of these risk and provides a link to daily reservoir levels and the Navigation charts for the reservoir.</li> </ul>
<b>Vehicle traffic</b> [dam crest and south side roadways ]	Person entering	<p><b>Warning, Signs</b>– Advisory sign at entrance to dam crest roadway displays various applicable vehicle restrictions. Regulatory and directional signs control traffic on dam.</p> <p><b>Restrains, Fences, Traffic Lights, Handrails</b> – Gates on both ends of the dam crest road control vehicle access to road across the dam. The north gate is controlled by Columbia Power Corporation who own and operate Arrow Lakes Generation. BC Hydro is responsible for the south gate. This gate is normally left in an open position except when there is work activity on the earthfill dam. Speed humps in roadway have been removed and should be replaced if speeding is observed on the crest of the earthfill dam.</p>
<b>Barriers</b> [locked gates]	ATV, Biking, Motorbike riding, Person entering	<b>Warning, Signs</b> – All gates are visible to oncoming traffic during day or night. Emergency contact sign is displayed on entrance gates.

2015: Description, Public Use, Hazards

Table 10: Hazards, Activities & Control Measures Implemented – Earthfill Dam (ED)

Hazard	Known & Potential Activities	Control Measures
<b>Roadway</b>	<b>Driving</b>	<b>Barriers</b> - It is recommended that the roadway be permanently closed to public vehicle traffic. Currently, the closure is deemed to be temporary.

<sup>1</sup>Note: **Appendix 2** Maps 5 and 6 show locations of public safety controls in this component. **Appendix 4** contains control specifications. **Appendix 5** contains public notifications.



Hazard	Known & Potential Activities	Control Measures
		If the road across the dam is permanently closed the south end of the earthfill dam will be secured and locked except during normal work hours which are from 6:00 a.m. to 4:00 p.m. Monday through Friday and from 8:00 a.m. to 4:00 pm Saturday, Sunday and statutory holidays year round.

**9.6 Lock and Concrete Dam**

This component deals with public safety issues at and near Hugh Keenleyside Dam, including the:

- Concrete Dam which consists of the office, shops, low level ports and spillway (extends from the north abutment of the dam to the ramp leading down to the lock parking lot on the south).
- Navigation lock – including upstream floating guidewall, lock and downstream approach

These elements are addressed as follows:

- **Concrete dam section** – The concrete section of the dam contains the intake and discharge facilities and gate hoist apparatus. Handrails, fences and signs define the limits of the restricted areas. Any upward movement of gates or ports is signaled by a flashing light and a siren on the downstream side of the dam.
- **Dam Access** – BC Hydro owns the dam crest roadway from the south end of the dam to the north abutment of the concrete section. The road use between the north end of the dam and the public road on the left bank is managed by ALGS in cooperation with BC Hydro.

The dam crest roadway is on private land and signage there is not enforceable under the Transportation Act or Motor Vehicle Act and their respective Regulations.

Traffic control signs and lights are positioned along the roadway to restrict vehicle speed, provide direction and regulate vehicle passage both around the Navigational Lock and on the single lane portion of the roadway. A large advisory sign at either end of the Dam Access identifies various restrictions applicable to motor vehicles planning to use the dam crest. Control gates at either end of the concrete dam can control vehicle access across dam.

In 2011, when the Dam Access was open to the public, a vehicle was observed running the red light, speeding, approaching an oncoming vehicle and driving through safety cones before speeding off the dam. Crews were working in the area at time but were on the upstream face of the dam, not the on the roadway. Given the conditions in this area – increased incident likelihood combined with high consequences of exposure, the Dam Access is deemed a Danger Zone and should be restricted from public access.

- **Navigation Lock** – The Lock is primarily used by industry to transport logs and commercial traffic through the dam six days per week. Recreational watercraft also use the Lock to move upstream and downstream, and access is available seven days a week. Signs at both the downstream approach direct boaters to the Lock entrance where instructions on lock passage procedures and contact information are available.



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The lock is a tourist attraction and, as such, the public is permitted to view the lock and its operation from the south side. The public can park vehicles in the Navigational Lock Parking Lot, located on the south side of the Navigational Lock. Pedestrians are instructed to stay within marked walkway areas and are restricted by a fence gate from accessing the downstream and north sides of the lock.



2014: Description, Public Use, Hazards

Table 11: Hazards, Activities & Control Measures Implemented – Lock and Concrete Dam (LCD)

Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
High structures and operating equipment [lock and concrete dam section]	Climbing, Jumping, Person entering, Diving	<b>Warning, Signs</b> – At all <i>Danger Zones</i> . <b>Restraints, Fences, Handrails</b> – At all <i>Danger Zones</i> .
Navigation Lock	Watercraft, Person entering	<b>Warning, Signs</b> – Advisory signs at both upstream and downstream approached provide direction to boaters. Additional signs at the lock inform boaters of safe lock procedure. <b>Restraints, Fences, Traffic Signals, Handrails</b> – Fences and handrails on dam prevent viewers on the dam from accessing the lock. Signal lights indicate when it is safe for vessels to enter/ leave the lock.
Vehicle traffic [dam crest and south side roadways ]	Person entering	<b>Warning, Signs</b> – Advisory sign at entrance to dam crest roadway displays various applicable vehicle restrictions. Regulatory and directional signs control traffic on dam. <b>Restraints, Fences, Traffic Lights, Handrails</b> –. Fences and handrails separate pedestrian areas from traveled portions of the roadway; traffic lights control vehicular traffic on single lane portion of dam crest road. Speed humps in roadway at control gates restrain vehicle speed on dam.

2015: Description, Public Use, Hazards

Table 12: Hazards, Activities & Control Measures Implemented – Lock and Concrete Dam (LCD)

Hazard	Known & Potential Activities	Control Measures
Roadway	Driving	<b>Barriers</b> - It is recommended that the roadway be permanently closed to public vehicle traffic. <b>Currently, the closure is deemed to be temporary.</b>

<sup>1</sup>Note: **Appendix 2** Maps 5 and 6 show locations of public safety controls in this component.  
**Appendix 4** contains control specifications.  
**Appendix 5** contains public notifications.



**9.7 Tailrace and downstream(TR)**

The tailrace area below the dam spillways and discharge ports can be extremely hazardous for small watercraft. This area has been deemed a *Danger Zone*, in which public access is restricted. Water may be released by the dam operator in accordance with agreed protocols during normal working hours (365 days/ year). This provides an opportunity for the operator to observe the tailrace area before commencing a release and to remove any public watercraft from the *Danger Zone*. Large signs on both shores mark the restricted area and advise of the hazards.

Outside of normal working hours discharge gates at HLK can be opened remotely without the benefit of on-site observation. The siren and flashing light (beacon) on the dam are activated to warn boaters of increased discharges when operated remotely from FVO.

Despite the presence of signs, pleasure boats are still entering the Danger Zone at frequency of about two incidents per year. The turbulent water downstream of the discharge facilities has a very low density and boats will sink and become submerged in this water. Life jackets are inadequate to save lives.

The 2014 risk assessment indicates the risk is still HIGH in this area. Since the public is still being observed in this area the existing warning signs and buoys are considered to be inadequate and a public safety boom is proposed to physically restrict access to the Danger Zone along with a larger Danger sign on the downstream end of the rockfill groin on north side of the lock.

**2014: Description, Public Use, Hazards**

**Table 13: Hazards, Activities & Control Measures Implemented Tailrace (TR)**

Hazard	Known & Potential Activities	Control Measures <sup>1</sup>
<p><b>Strong currents, turbulence &amp; fluctuating flows</b> [lock and discharge area]</p>	<p>Fishing, Watercraft, Water-skiing, Person entering</p>	<p><b>Warning, Signs</b> – Signs at <i>Danger Zones</i> effectively define those areas restricted to the public.  <b>Audible Signal (siren), Light (beacon)</b> - Beacon and siren at the dam are activated to signal impending discharge from spillway when opened remotely by FVO.  <b>Warning, Buoys</b> – 5 buoys are in place downstream of the earthfill dam but do not extend across the tailrace.  <b>Education</b> – As above. Public address system enables dam operator to communicate with boaters in tailrace and lock area. Emergency contact signs are displayed at several locations on the dam crest.</p>

<sup>1</sup>Note: **Appendix 2** Maps 5 and 6 show locations of public safety controls in this component.  
**Appendix 4** contains control specifications.  
**Appendix 5** contains public notifications.





2015: Description, Public Use, Hazards

Table 14: Hazards, Activities & Control Measures Implemented - Tailrace (TR)

Hazard	Known & Potential Activities	Control Measures
<p><b>Tailrace – turbulent, low density water</b></p>	<p><b>Fishing from boats, power boats</b></p>	<p><b>Barriers</b> – A Boat Buster boom is being planned for installation around the tailrace. Preliminary estimates, conceptual designs have been initiated and a business case is being prepared to implement this control.</p> <p><b>Warning, Signs</b> – The existing warning signs at the downstream end of the rockfill berm along the north side of the navigational lock are too small to read until you are in the Danger Area. These signs need to be larger such that they can be read at a distance of 400 m (Size of sign would be approximately 4m by 6m)</p>



## **Appendix 1 Maps**

**Map 1: General Arrangement (GA)**

Drawing No. 209-C11-B305

**Map 2: Arrow Lakes Reservoir (ARL) Revelstoke Reach**

Drawing No. 209-C11-B306

**Map 3: Arrow Lakes Reservoir (ARL) Upper Arrows Lake Reach**

Drawing No. 209-C11-B307

**Map 4: Arrow Lakes Reservoir (ARL) Lower Arrows Lake Reach**

Drawing No. 209-C11-B308

**Map 5: Hugh Keenleyside Dam - Components**

Drawing No. 209-C11-B309

**Map 6: Hugh Keenleyside Dam - Headpond (HP)**

Drawing No. 209-C11-00312

**Map 7: Hugh Keenleyside Dam– Earthfill Dam (ED)**

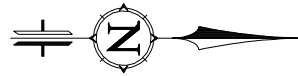
Drawing No. 209-C11-00313

**Map 8: Hugh Keenleyside Dam– Lock and Concrete Dam (LCD)**

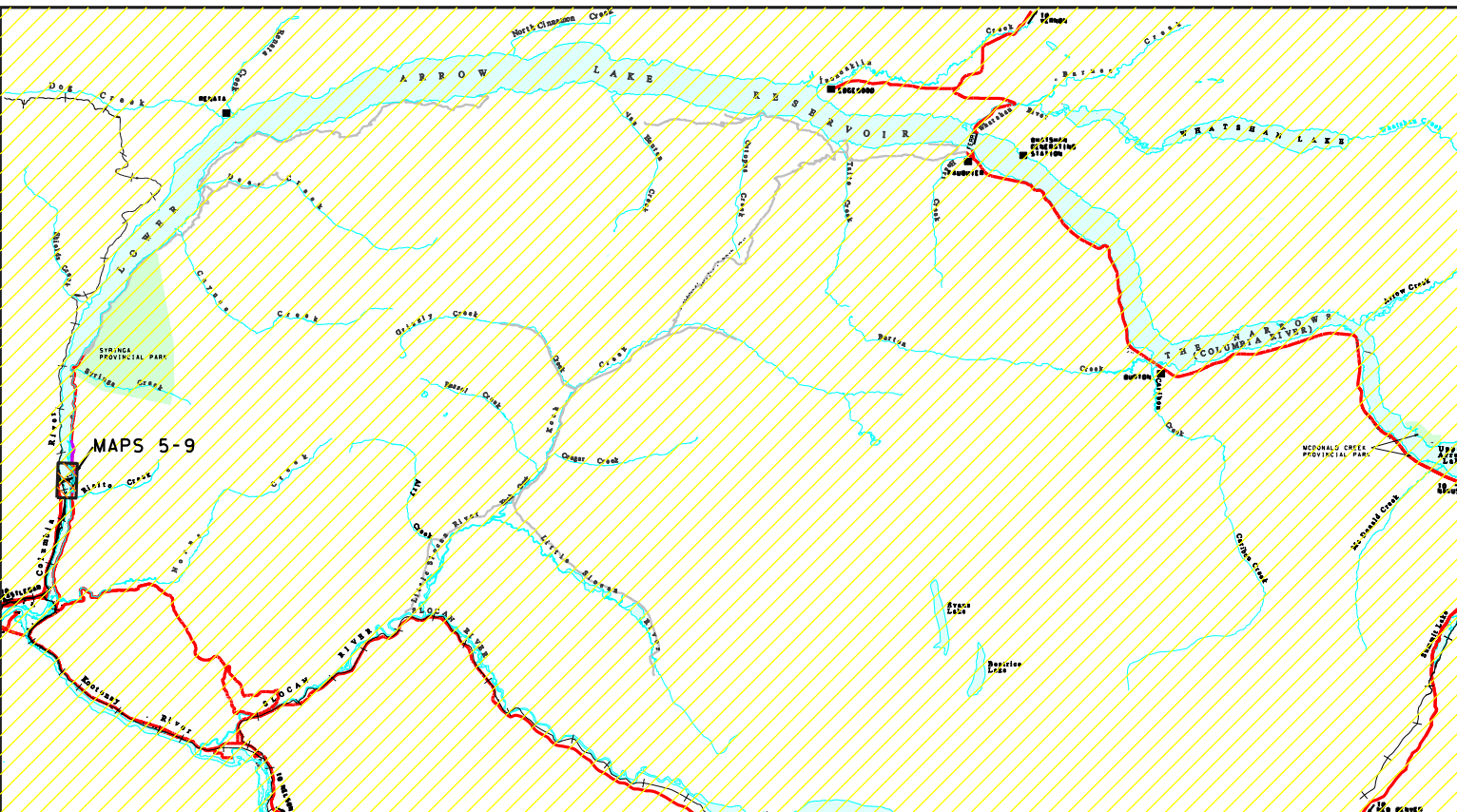
Drawing No. 209-C11-B310

**Map 9: Hugh Keenleyside Dam– Tailrace**

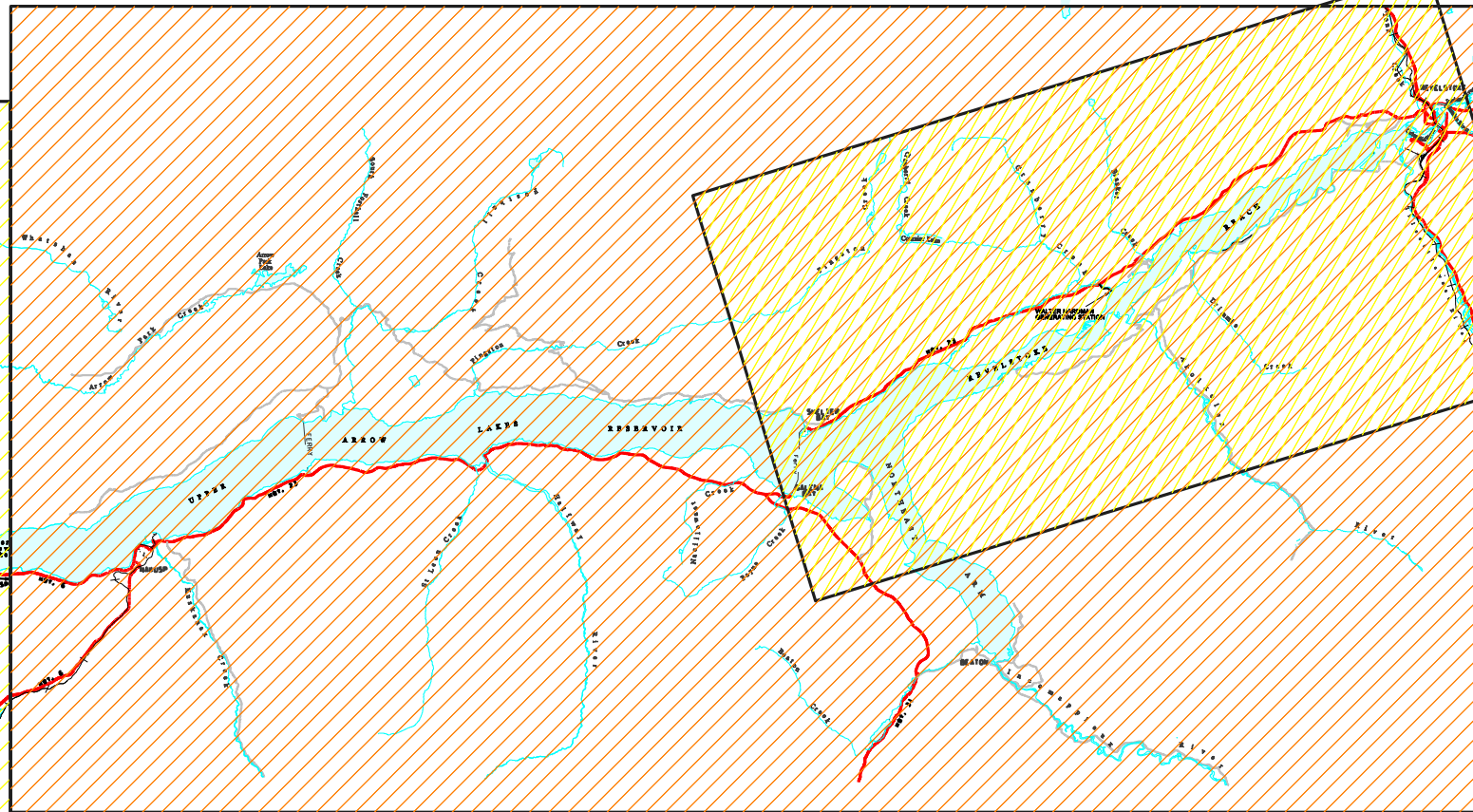
Drawing No. 209-C11-00314



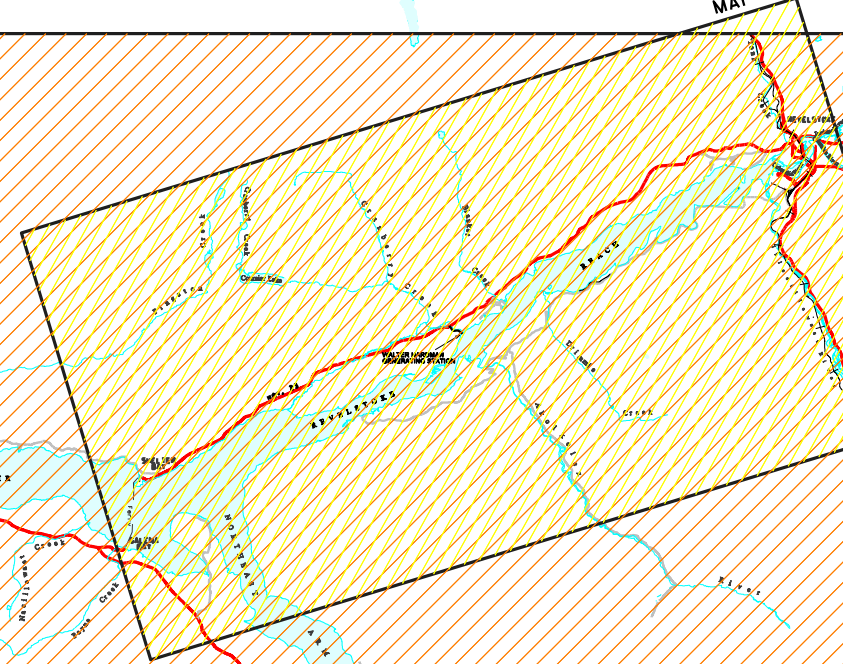
MAP 4



MAP 3



MAP 2

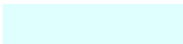





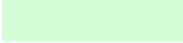



MAPS 5-9

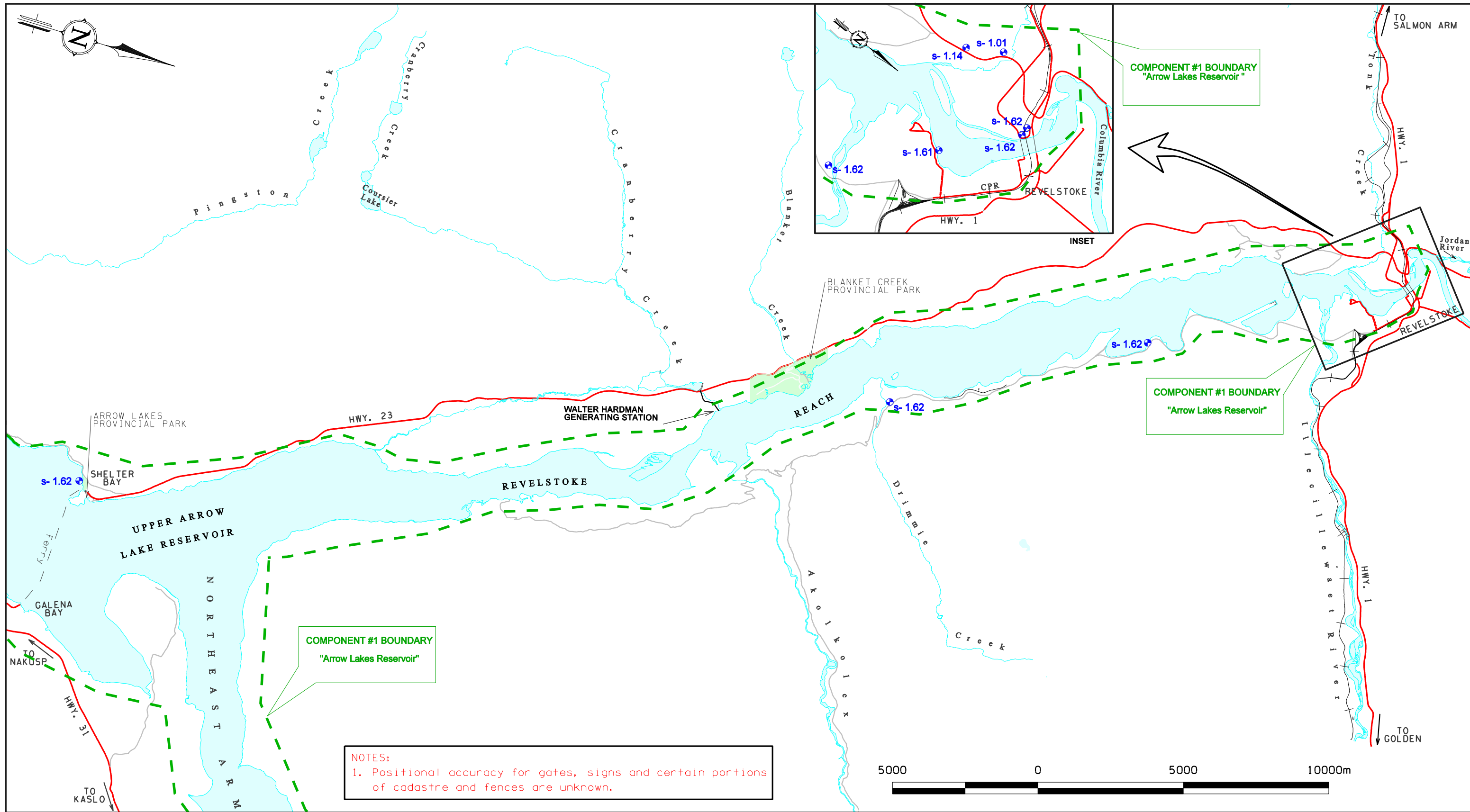
**NOTES:**  
 1. Base map was derived from the BC Ministry of Land Air and Water Protection T.R.I.M mapping, scale 1:20,000  
 2. Positional accuracy for boom, outhouse, gates, signs and certain portions of roads, trails and fences are unknown.












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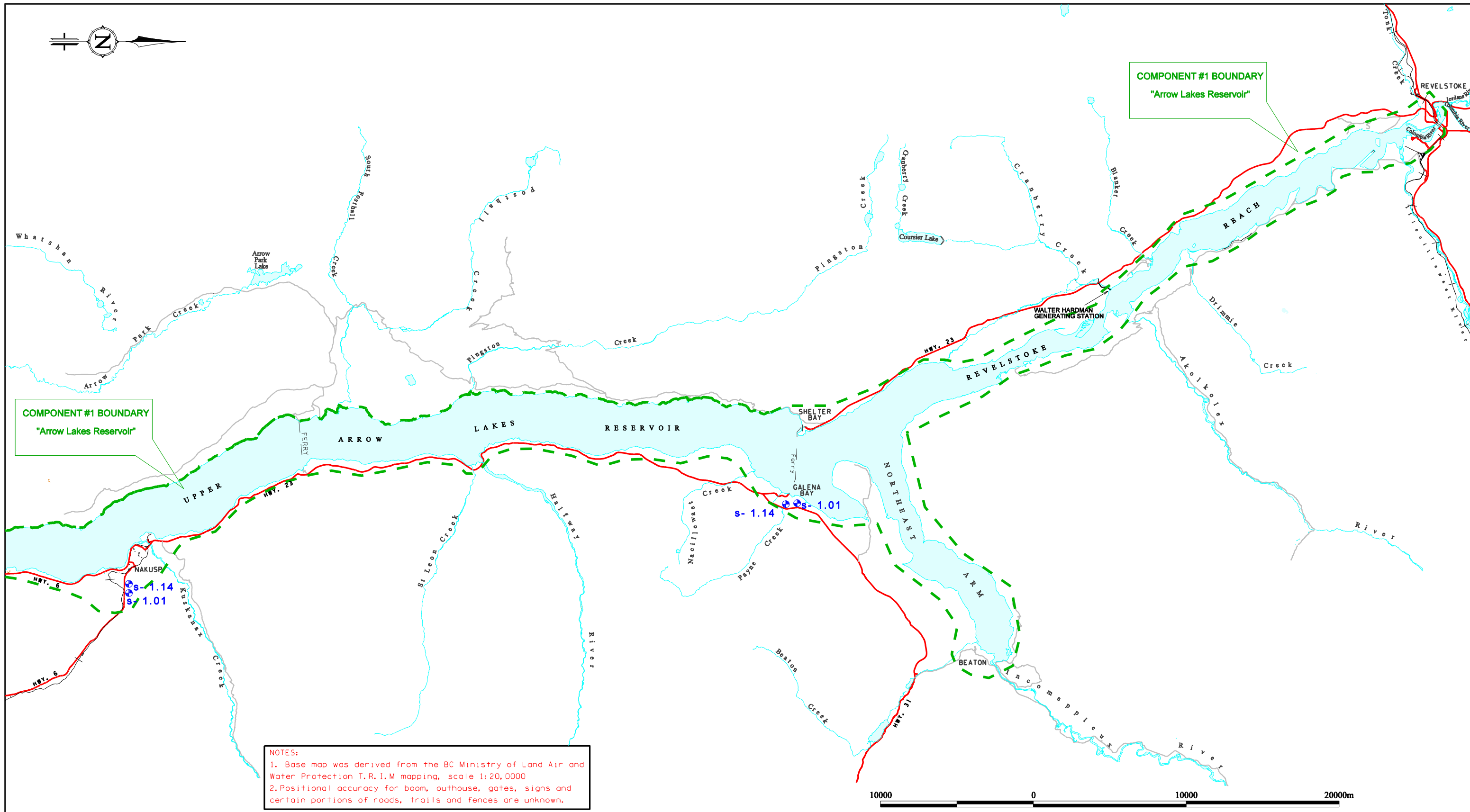
	Normal High Water		Main Roads		Shoreline / River / Creek
	Detail Map Boundaries		Secondary Roads		Railroad
	Provincial Park				

Safety Control Device Prefix	DIGITAL MAP	PROJECT No.	 <b>ENGINEERING</b> SURVEY & PHOTOGRAMMETRY SERVICES DEPARTMENT HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 1 GENERAL ARRANGEMENT	
	PREPARED BY	PHOTO DATE		
	SL/DU	TRIM		
	DATE	PHOTO SCALE		
	Aug. 2015	TRIM		
GRID ORIGIN	DATUM	CONTOUR INT.	DWG. No.	R.
UTM-Z11	NAD83		209 - C11 - B305	1
BCCS	DWG. SCALE			
82E; F; L; K	AS SHOWN			



**NOTES:**  
 1. Positional accuracy for gates, signs and certain portions of cadastre and fences are unknown.

<b>LEGEND</b>	 Normal High Water	 Main Roads	 Shoreline / River / Creek	<b>Safety Control Device Prefix</b>	DIGITAL MAP	PROJECT No.	 <b>ENGINEERING</b> PHOTOGRAMMETRY SERVICES
	 Provincial Park	 Secondary Roads	 Safety Control Device		<b>s = Sign</b>	PREPARED BY	
		 Railroad				SL/DU	
		 Component Boundary			DATE	PHOTO SCALE	
				Aug. 2015	TRIM		HUGH KENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 2 ARROW LAKES RESERVOIR
				GRID ORIGIN	DATUM	CONTOUR INT.	
				UTM-Z11	NAD83	DWG. No.	
					BCGS	DWG. SCALE	209 - C11 - 00306
					82E; F; L; K	AS SHOWN	R. 1

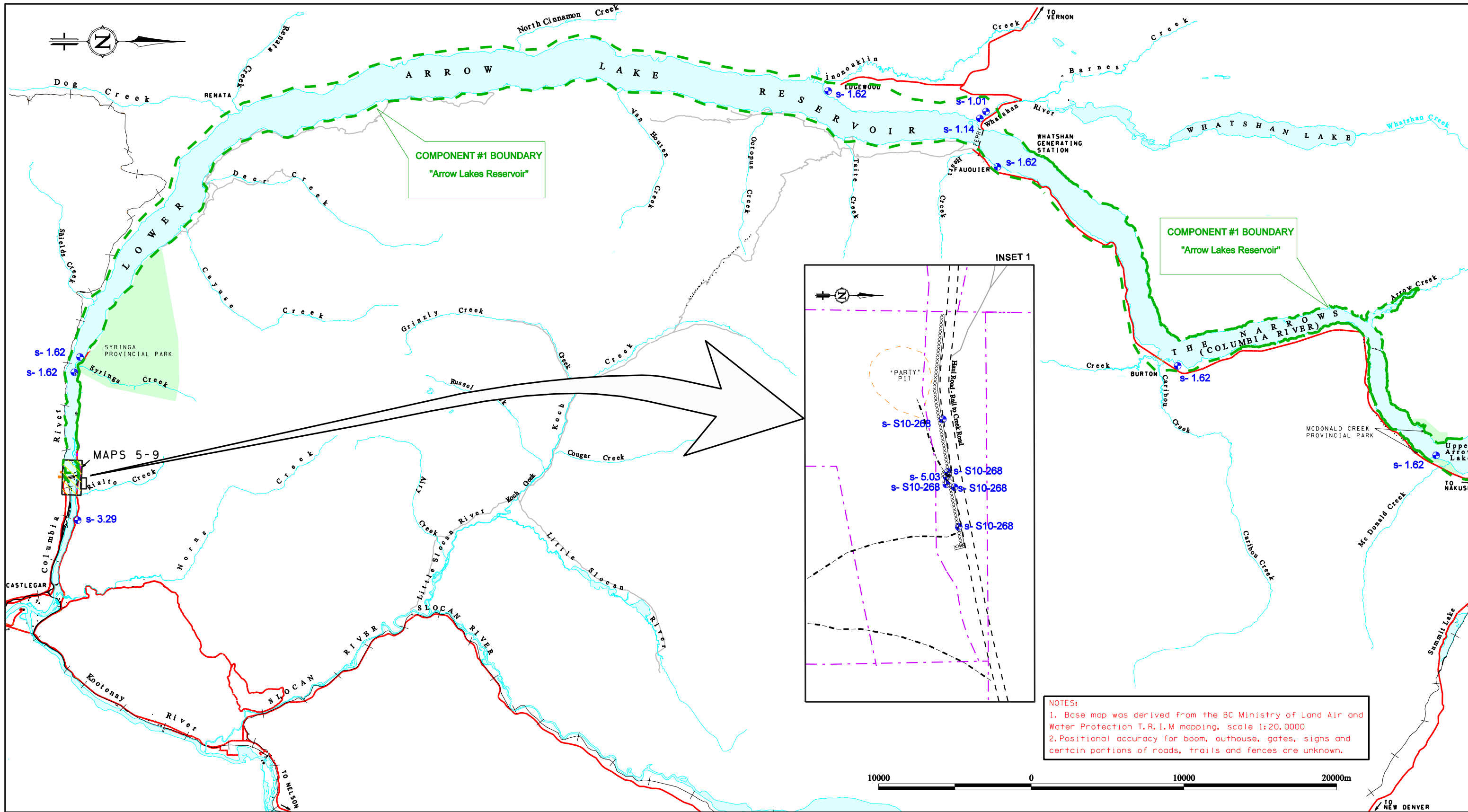


COMPONENT #1 BOUNDARY  
"Arrow Lakes Reservoir"

COMPONENT #1 BOUNDARY  
"Arrow Lakes Reservoir"

NOTES:  
1. Base map was derived from the BC Ministry of Land Air and Water Protection T.R.I.M mapping, scale 1:20,000  
2. Positional accuracy for boom, outhouse, gates, signs and certain portions of roads, trails and fences are unknown.

LEGEND	Normal High Water	Main Roads	Shoreline / River / Creek	Safety Control Device Prefix	DIGITAL MAP	PROJECT No.	<b>ENGINEERING</b> SURVEY & PHOTOGRAMMETRY SERVICES DEPARTMENT  HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 3 ARROW LAKES RESERVOIR	DWG. No. 209 - C11 - B307	R. 1
	Secondary Roads	Railroad	Safety Control Device		PREPARED BY DU	PHOTO DATE TRIM			
	Component Boundary			DATE Aug, 2015	PHOTO SCALE TRIM				
				GRID ORIGIN UTM-Z11	DATUM NAD83				
				<b>s = Sign</b>	BCCS 82 E; F; L; K	DWG. SCALE AS SHOWN	CONTOUR INT.		



**NOTES:**  
 1. Base map was derived from the BC Ministry of Land Air and Water Protection T.R.I.M mapping, scale 1:20,000  
 2. Positional accuracy for boom, outhouse, gates, signs and certain portions of roads, trails and fences are unknown.

LEGEND		Normal High Water
		Detail Map Boundaries
		Provincial Park

	Main Roads
	Secondary Roads
	Railroad
	Shoreline / River / Creek
	Component Boundary

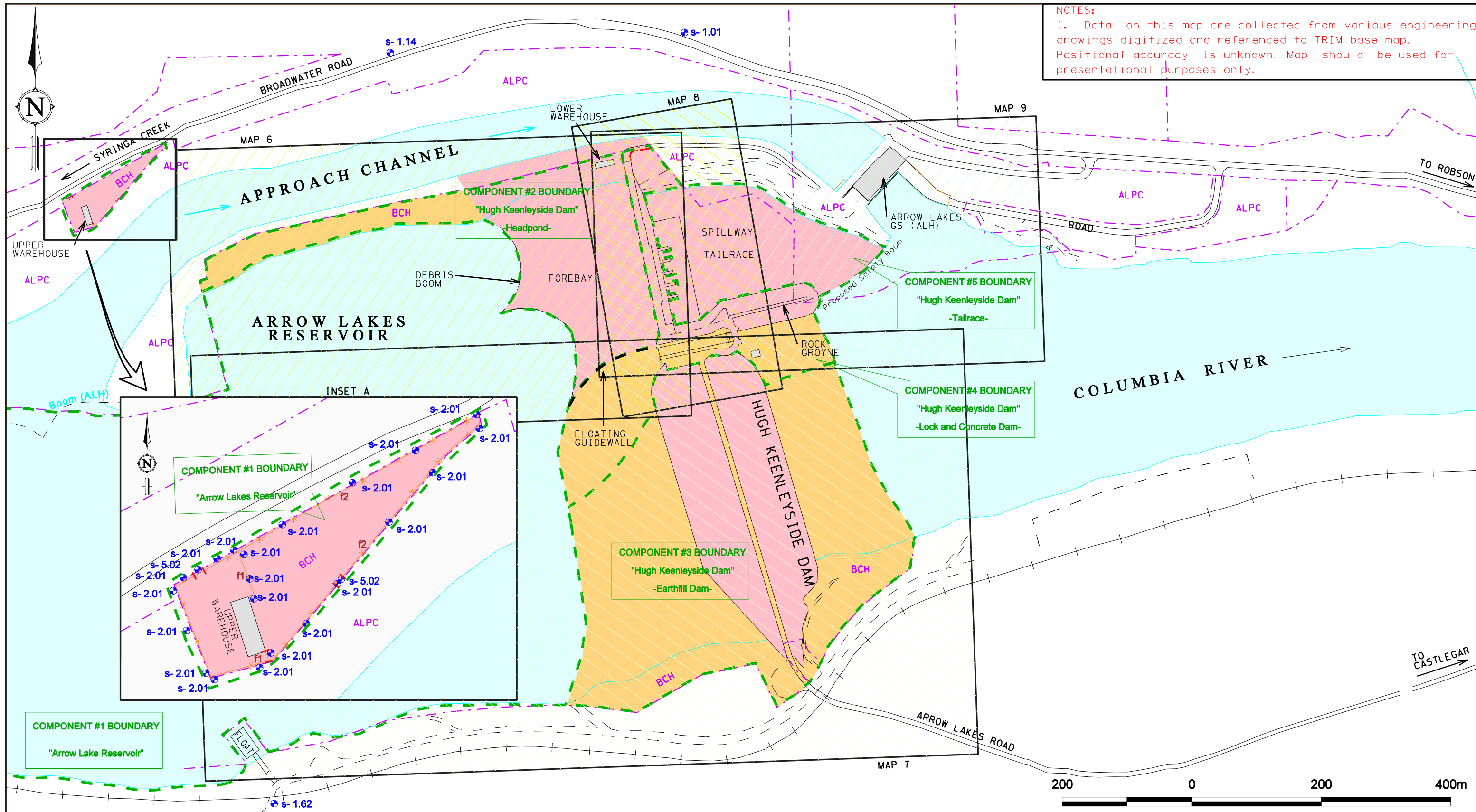
	Forestry Road (Inset)
	Trail (Inset)
	Property Boundary (Inset)
	Berm (Inset)
	Safety Control Device
	Vehicle Gate

<b>Safety Control Device Prefix</b>
<b>s = Sign</b>

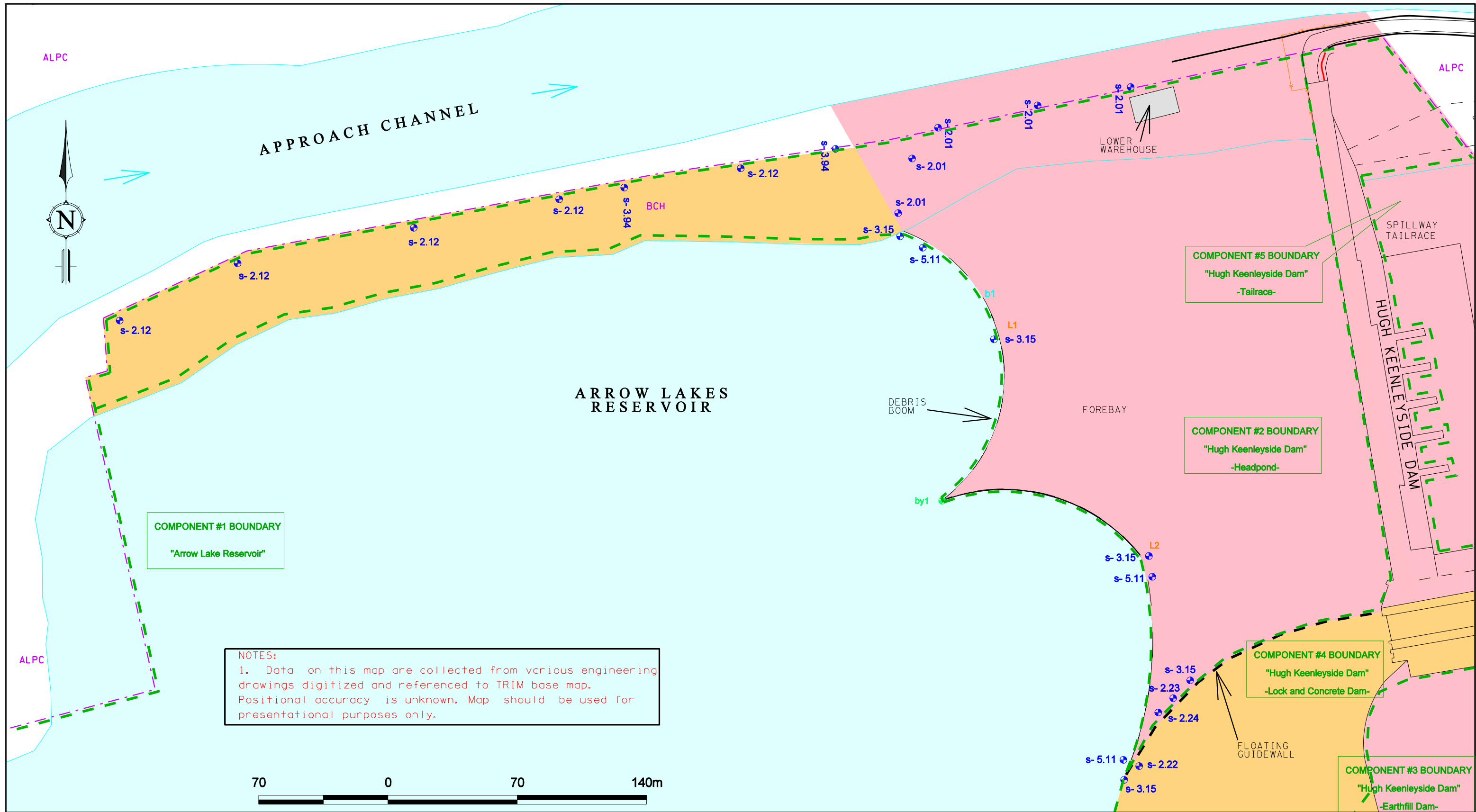
DIGITAL MAP	PROJECT No.
PREPARED BY DU	PHOTO DATE TRIM
DATE Aug, 2015	PHOTO SCALE TRIM
GRID ORIGIN UTM-Z11	DATUM NAD83
BCCS 82 E; F; L; K	DWG. SCALE AS SHOWN

<b>BChydro</b> ENGINEERING SURVEY & PHOTOGRAMMETRY SERVICES DEPARTMENT	
HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 4 ARROW LAKES RESERVOIR	
CONTOUR INT.	DWG. No. 209 - C11 - B308
	R. 1

NOTES:  
 1. Data on this map are collected from various engineering drawings digitized and referenced to TRIM base map. Positional accuracy is unknown. Map should be used for presentational purposes only.



<b>L E G E N D</b>	Normal High Water	Hard Surface & Loose Surface Road	Shoreline	<b>Safety Control Device Prefix</b>	DIGITAL MAP	PROJECT No.	<b>BChydro</b> <b>ENGINEERING</b> PHOTOGRAMMETRY SERVICES	
	Detail Map Boundary	Trail	River / Creek		PREPARED BY	PHOTO DATE		HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN
	DANGER ZONE	Building / Structure	Boom		SL/DU	N/A		
	Restricted Area	Parking Area	Safety Control Device		Entrance Gate	DATE		PHOTO SCALE
No Public Admittance	Fence Line	Vehicle Gate	Railroad	Aug, 2015	N/A			
WARNING ZONE	Property Boundary	Electrical Lines		GRID ORIGIN	DATUM			
Observe Danger Signs	Component Boundary			UTM-Z11	NAD83			
				BCGS	DWG. SCALE	CONTOUR INT.	DWG. No.	
				82 E	AS SHOWN		209 - C11 - B309	
							R. 1	

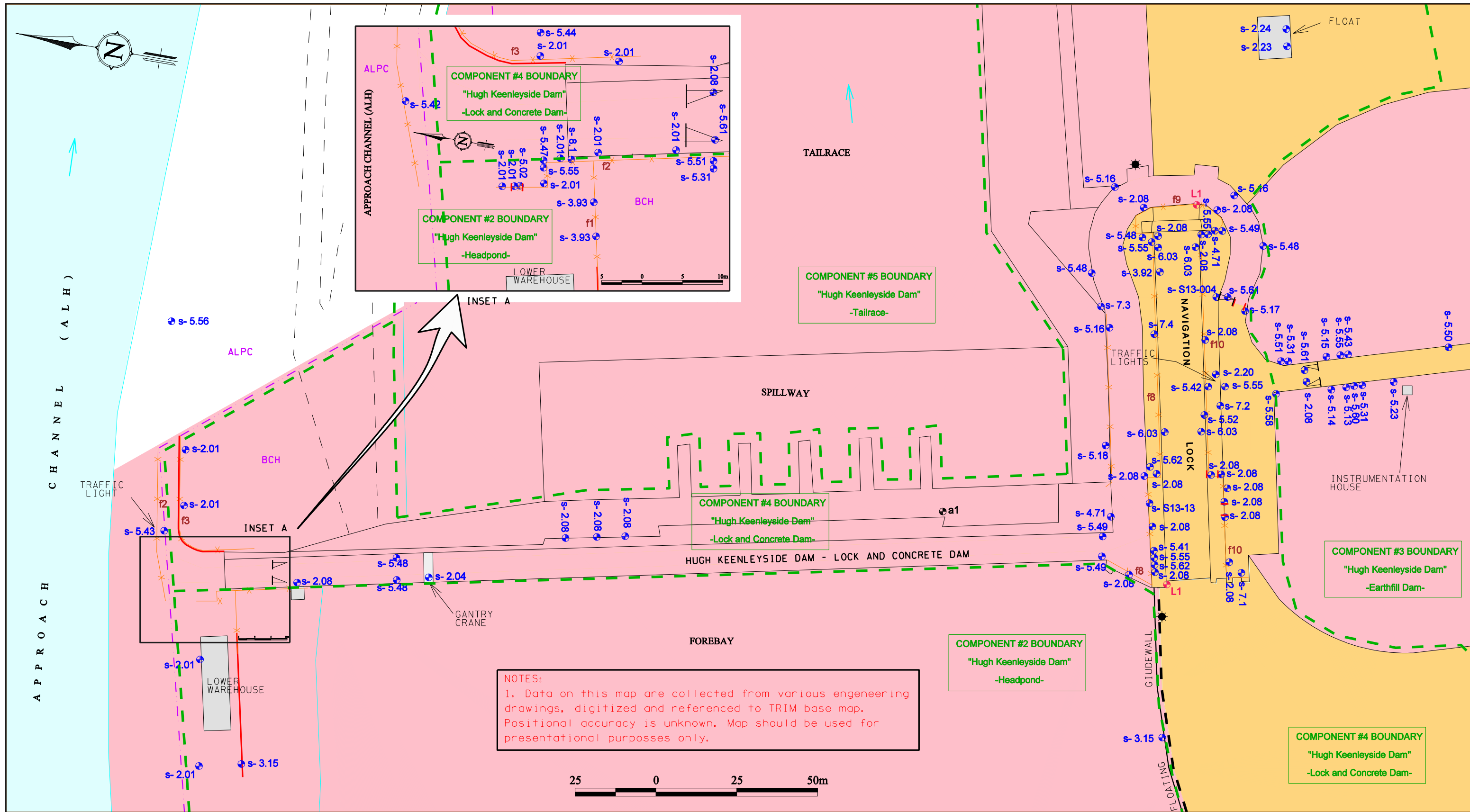


**NOTES:**  
 1. Data on this map are collected from various engineering drawings digitized and referenced to TRIM base map. Positional accuracy is unknown. Map should be used for presentational purposes only.

<b>LEGEND</b>		Normal High Water		Hard Surface & Loose Surface Road		Shoreline	<b>Safety Control Device Prefix</b>	DIGITAL MAP	PROJECT No.	<b>BChydro</b> <b>ENGINEERING</b> PHOTOGRAMMETRY SERVICES				
		<b>DANGER ZONE</b> Restricted Area No Public Admittance		Trail		River / Creek		<b>by = Buoy</b>	PREPARED BY		PHOTO DATE	HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 6 HUGH KEENLEYSIDE DAM HEADPOND		
		<b>WARNING ZONE</b> Observe Danger Signs		Building / Structure		Boom		<b>f = Fence</b>	DATE		PHOTO SCALE			
				Parking Area		Safety Control Device		<b>s = Sign</b>	Aug, 2015		N/A			
			Fence Line		Property Boundary		GRID ORIGIN	DATUM	UTM-Z11	NAD83				
					Electrical Lines		Vehicle Gate	BCGS	DWG. SCALE	AS SHOWN	CONTOUR INT.	DWG. No.	209 - C11 - 00312	R. 0
					Component Boundary		Railroad							
							Entrance Gate							

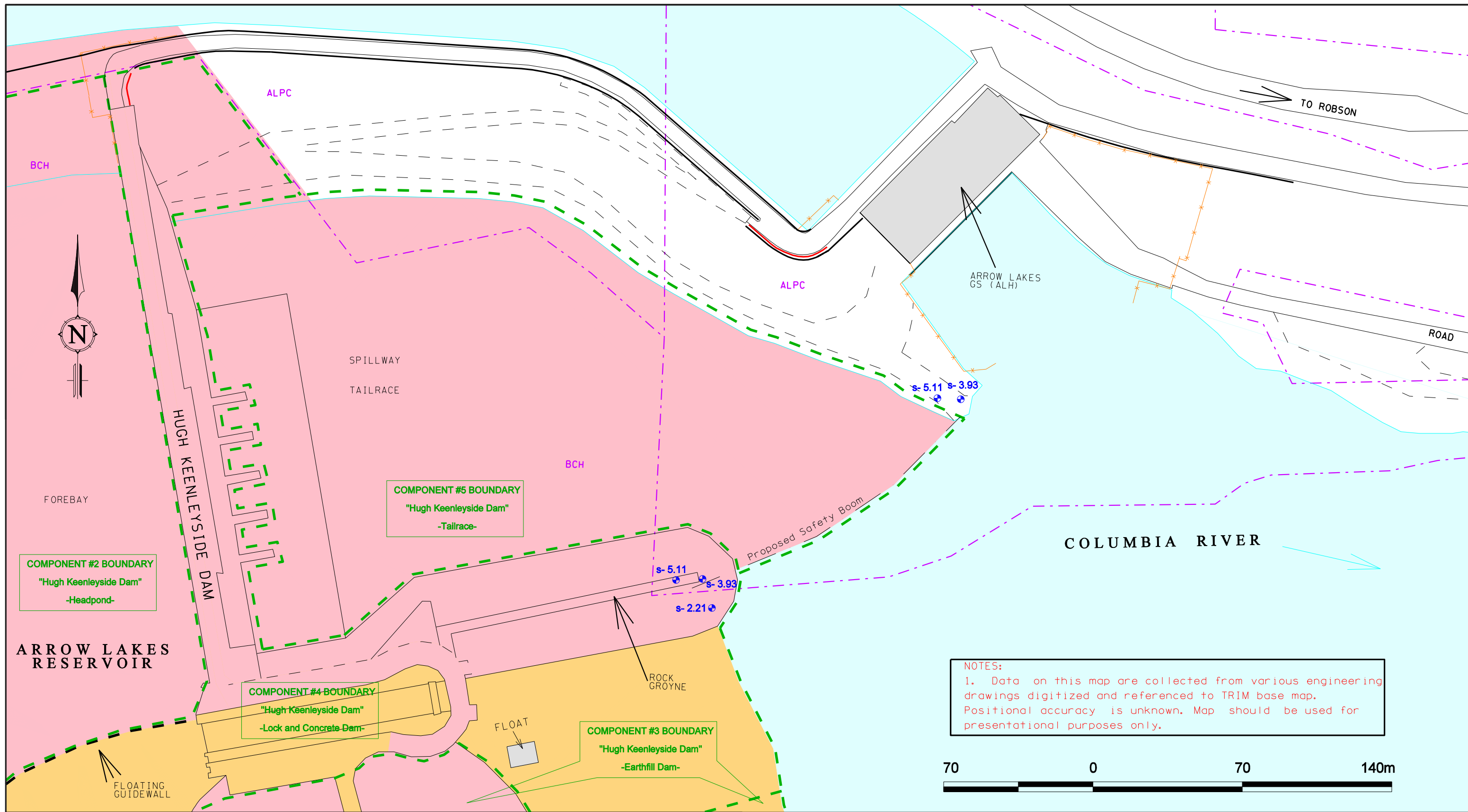






**NOTES:**  
 1. Data on this map are collected from various engineering drawings, digitized and referenced to TRIM base map. Positional accuracy is unknown. Map should be used for presentational purposes only.

<b>LEGEND</b>		Normal High Water		Trail		Shoreline	<b>Safety Control Device Prefix</b> <b>a = Audible Signal</b> <b>by = Buoy</b> <b>f = Fence</b> <b>s = Sign</b> <b>L = Light</b>	DIGITAL MAP	PROJECT No.	<b>ENGINEERING</b> PHOTOGRAMMETRY SERVICES HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 8 HUGH KEENLEYSIDE DAM LOCK AND CONCRETE DAM	DWG. No. 209 - C11 - B310	R. 1	
		<b>DANGER ZONE</b> Restricted Area No Public Admittance		Hard Surface & Loose Surface Road		River / Creek		PREPARED BY DU	PHOTO DATE N/A				
		<b>WARNING ZONE</b> Observe Danger Signs		Building / Structure		Boom		DATE Aug, 2015	PHOTO SCALE N/A				
		Component Boundary		Parking Area		Vessel Control Light		GRID ORIGIN UTM-Z11	DATUM NAD83				
			Fence Line		Guard Rail		Vehicle Gate		Hydro Pole		Entrance Gate	CONTOUR INT.	DWG. SCALE AS SHOWN



**NOTES:**  
 1. Data on this map are collected from various engineering drawings digitized and referenced to TRIM base map. Positional accuracy is unknown. Map should be used for presentational purposes only.

<b>LEGEND</b>		Normal High Water		Hard Surface & Loose Surface Road		Shoreline	<b>Safety Control Device Prefix</b>  by = Buoy f = Fence s = Sign b = Boom L = Light	DIGITAL MAP	PROJECT No.	<b>ENGINEERING</b> PHOTOGRAMMETRY SERVICES  HUGH KEENLEYSIDE DAM PUBLIC SAFETY MANAGEMENT PLAN MAP 9 HUGH KEENLEYSIDE DAM TAILRACE	R.	
		<b>DANGER ZONE</b> Restricted Area No Public Admittance		Trail		River / Creek		PREPARED BY	PHOTO DATE		DWG. No. 209 - C11 - 00314	0
		<b>WARNING ZONE</b> Observe Danger Signs		Building / Structure				Boom	DATE			
				Fence Line		Safety Control Device			Aug, 2015		N/A	
			Property Boundary		Parking Area		Entrance Gate	GRID ORIGIN	DATUM			
			Electrical Lines		Vehicle Gate		Railroad	UTM-Z11	NAD83			
			Component Boundary					BCGS	DWG. SCALE	CONTOUR INT.		
								82 E	AS SHOWN			



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## **Appendix 2 Sign Index**

**Section A** Existing Sign Index

**Section B** Replacement Sign Index



Section A Existing Sign Index



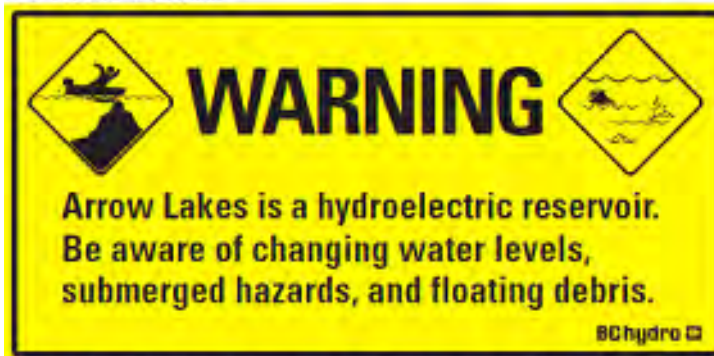
Type 1.01: Boater Advisory - Advance  
Size: 600mm x 1200mm



Type 1.14: Boater Advisory - Arrow Lakes  
Size: 1800mm x 1800mm



Type 1.61: Reservoir and River Warning - Arrow Lakes\*  
Size: 1200mm x 1200mm



Type 1.62: Reservoir Warning - Arrow Lakes Reservoir  
Size: 1200mm x 600mm



Type 2.01: Trespass  
Size: 400mm x 870mm



Type 2.04: Authorized Personnel Only  
Size: 600mm x 300mm



Type 2.07: Private Property - Keep Out



Type 2.08: Authorized Personnel Only  
Size: a – 600mm x 300mm



Type 2.12: Restricted Area  
Size: 400mm x 870mm



Type 2.20: Public Parking  
Size: 900mm x 600mm



Type 2.21: Boat Direction - Left  
Size: 2400mm x 1200mm



Type 2.22: Boat Direction - Right  
Size: 2400mm x 1200mm





## NOTICE TO BOATERS REQUESTING LOCK PASSAGE

**Hours of Operation:**  
Weekdays 6:30 a.m. to 3:30 p.m.  
Weekends and Holidays  
8:30 a.m. to 3:30 p.m.

**FOR YOUR OWN SAFETY AND THE SAFETY OF OTHERS:  
PLEASE OBEY ALL INSTRUCTIONS FROM THE LOCK KEEPER**

### INSTRUCTIONS

- Secure boat to float
- Contact Lock Keeper at 250 365-3115 or use telephone located in box
- Await Lock Keeper's instructions
- Do not leave your boat

**AFTER RECEIVING INSTRUCTIONS FROM THE LOCK KEEPER**

- Secure life jackets on all persons
- Await green light
- Proceed into lock and hold onto or loop rope around bollard for quick release. **DO NOT TIE TO BOLLARD.**
- Await Lock Keeper's instructions over the PA system before leaving lock on your journey

**BChydro**

**Type 2.23: Notice to Boaters Requesting Lock Passage**  
Size: 2400mm x 1200mm

**LOCK  
KEEPER'S  
CONTACT  
TELEPHONE**

BC Hydro

**Type 2.24: Lock Keeper's  
Contact Telephone**  
Size: 600mm x 600mm

## DANGER

**Strong surface and  
underwater currents**

## KEEP OUT

**BChydro**

**Type 3.15: Danger - Strong Surface and Underwater Currents  
- Keep Out (Horizontal)**  
Size: a – 900mm x 450mm  
b – 1200mm x 600mm  
c – 1800mm x 900mm  
d – 2400mm x 1200mm



Type 3.29: River User Advisory  
Size: a – 1200mm x 1200mm



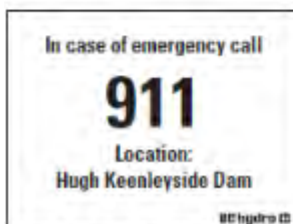
Type 3.92: Escape Ladder.  
Size: 900mm x 600mm



Type 3.93: Danger - Strong surface and underwater currents - Keep Out (generic)  
Size: 3000mm x 1500mm



Type 3.94 Danger – Strong Currents



Type 4.71: Emergency Contacts – Hugh Keenleyside Dam  
Size: 600mm x 450mm





**Type 5.02: No Parking in Front of Gate**  
Size: 450mm x 600mm



**Type 5.03: Checkerboard**  
Size: 750mm x 750mm



**Type 5.05: Sharp Curve Left Ahead**  
Size: 600mm x 600mm



**Type 5.11: Boating Restriction (NWPA)**  
Size: a – 600mm x 770mm  
b – 900mm x 1150mm



**Type 5.13: 50 km/h**  
Size: 600mm x 750mm



**Type 5.14: Left marker**  
Size: 300mm x 900mm



**Type 5.15: Right Marker**  
Size: 300mm x 900mm



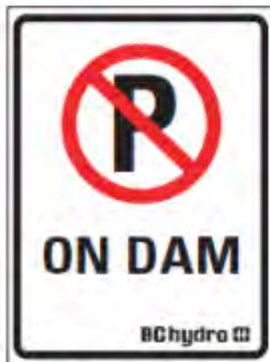
**Type 5.16: No Parking Anytime**  
Size: 450mm x 450mm



**Type 5.17: No Parking Left**  
Size: 450mm x 450mm



**Type 5.18: No Parking Right!**  
Size: 450mm x 450mm



**Type 5.23: No Parking on Dam**  
Size: 450mm x 600mm



**Type 5.31: Slippery Road**  
Size: 750mm x 750mm



**Type 5.41: Checkerboard with Left Arrow and Light.**  
Size: 1200mm x 1200mm



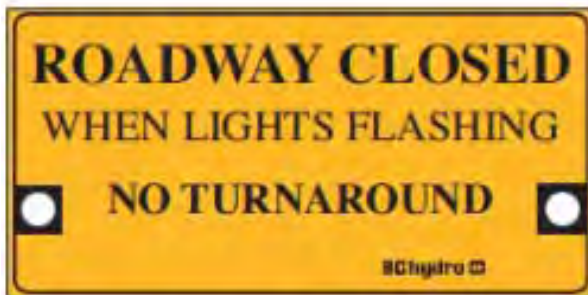
**Type 5.42: Checkerboard with Right Arrow and Light.**  
Size: 1200mm x 1200mm



Type 5.43: Signal Stop  
Size: 430mm x 430mm



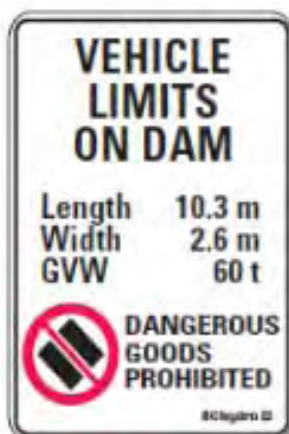
Type 5.44: Roadway Closed.  
Size: 2400mm x 1200mm



Type 5.45: Roadway Closed - No Turnaround.  
Size: 2400mm x 1200mm



Type 5.46: Logging Truck.  
Size: 750mm x 750mm



Type 5.47: Vehicle Restriction Across Dam.  
Size: 1200mm x 1500mm



Type 5.48: Pedestrians Use Sidewalk - Left Arrow.  
Size: 450mm x 450mm



Type 5.49: Pedestrians Use Sidewalk - Right Arrow.  
Size: 450mm x 450mm



Type 5.50: 20 km/h Ahead  
Size: 600mm x 750mm



Type 5.51: When Wet  
Size: 600mm x 300mm



Type 5.52: Pedestrian.  
Size: 750mm x 750mm



Type 5.53: 50 km/h Ahead  
Size: 600mm x 750mm



Type 5.55: Maximum 20 km/h  
Size: 600mm x 750mm



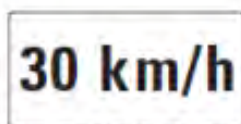
Type 5.56: Traffic Light.  
Size: 750mm x 750mm



Type 5.58: Speed Bump.  
Size: 750mm x 750mm



Type 5.59: Curve Left Ahead..  
Size: 600mm x 600mm



Type 5.60: 30 km/h.  
Size: 600mm x 300mm



Type 5.61: Road Closed.\*  
Size: 120mm x 400mm



Type 6.03: Trip Hazard Warning  
Size: 600mm x 600mm



Type 6.18: Danger - Locked Gate Ahead - No Turnaround  
Size: 450mm x 900mm



Type 6.20 Dam Access



## Public Information Signs at Navigational Lock



### Type s-HLK-1 Arrow Lakes Reservoir



### Type s-HLK-2 – How the Navigation Lock Operates



Type s-HLK-3 - Controlling the Flow of Water



Type 3-HLK-4 Welcome to Hugh Keenleyside Dam



s13-004 Notice to BC Hydro Employees and Contractors



Type 5.62 - Your Speed Radar Indicator





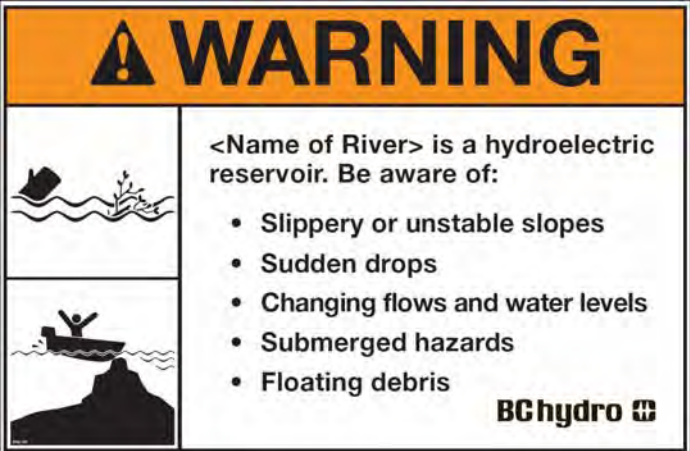
## Section B Replacement Sign Index

The following sampling of “Generation Public Safety Signs”, that all meet ANSI standards and BC Hydro’s Sign Store Approval, can be found in BC Hydro’s Sign Order Store Catalogue located on the BC Hydro Web Site. (search using the words “sign store”).





Other applicable signs are also available within the following categories:

- Electrical Safety
- General Safety
- Dam and Water Hazards
- Boat and Water Safety signage
- Restricted access and parking signs
- Traffic Signs




For ease in marking up maps, a two letter identification code is used for the more common type of signs that are shown in the “Generation Public Safety Signs” section. The following is a sampling of 9 out of 38 signs in this section of the Sign Store Catalogue that can be ordered when replacing old or worn out signs. The intent is to find a replacement sign that matches as closely as possible the message of the old vintage sign.

	<p><b>S13-121 - (WN) Warning - Hydroelectric Reservoir - 48"x32"</b></p> <p><b>WN</b></p>
---	---



<div> <p style="text-align: center;"><b>NOTICE</b></p> <p>&lt;Name of River&gt; is a hydroelectric reservoir. Be aware of:</p> <ul style="list-style-type: none"> <li>• Slippery or unstable slopes</li> <li>• Sudden drops</li> <li>• Changing flows and water levels</li> <li>• Submerged hazards</li> <li>• Floating debris</li> </ul> <p style="text-align: right;"><b>BChydro</b> </p> </div>	<p>S13-122 - (NV) Notice - Hydroelectric Reservoir - 48"x32"</p> <p style="text-align: center; font-size: 2em;"><b>NV</b></p>
<div> <p style="text-align: center;"><b>! DANGER</b></p> <div style="display: flex;"> <div style="flex: 1;">   </div> <div style="flex: 2; padding-left: 10px;"> <p style="font-size: 2em;"><b>Dam Outflow Keep Out</b></p> <p>Access beyond this point may result in drowning</p> <p style="font-size: 0.8em;">&lt;Name of Dam&gt; 1-877-311-8611 In an emergency call 911</p> <p style="text-align: right;"><b>BChydro</b> </p> </div> </div> </div>	<p>S13-116 - (OT) Danger - Dam Outflow - Keep Out - Access beyond this point may result in drowning - 36"x24"</p> <p style="text-align: center; font-size: 2em;"><b>OT</b></p>
<div> <p style="text-align: center;"><b>! DANGER</b></p> <div style="display: flex;"> <div style="flex: 1;">   </div> <div style="flex: 2; padding-left: 10px;"> <p style="font-size: 2em;"><b>KEEP OUT</b></p> <p><b>Underwater Intake – Swift Currents and Undertow</b></p> <p style="font-size: 0.8em;">[Generating Station] Dam 1 877 311 8611 In an emergency call 911</p> <p style="text-align: right;"><b>BChydro</b> </p> </div> </div> </div>	<p>S13-114 - (UI) Danger - Keep Out - Underwater Intake - Swift Currents and Undertow - 36"x24"</p> <p style="text-align: center; font-size: 2em;"><b>UI</b></p>



 <p><b>NO TRESPASSING</b> Trespassers will be prosecuted</p> <p>BChydro</p>	<p>S10-268 - (NT) No Trespassing Sign 18"x24"</p>
<p><b>! DANGER</b></p>  <p><b>KEEP OUT</b> Dam Ahead</p> <p>Swift currents and undertow Access beyond this point may result in drowning</p> <p>&lt;Name of Dam&gt; 1 877 311 8611 In an emergency call 911</p> <p>BChydro</p>	<p>S11-078c - (DA) Danger - Keep Out - Dam Ahead - Swift currents and undertow - Access beyond ... - 72"x36"</p>
<p><b>! DANGER</b></p>  <p><b>KEEP OUT</b> Powerhouse Outflow Swift Currents and Undertow</p> <p>&lt;Name of Dam&gt; 1 877 311 8611 In An Emergency Call 911</p> <p>BChydro</p>	<p>S14-003 - (PHO) Danger - Powerhouse Outflow - Swift Currents and Undertow - 108"x60"</p>



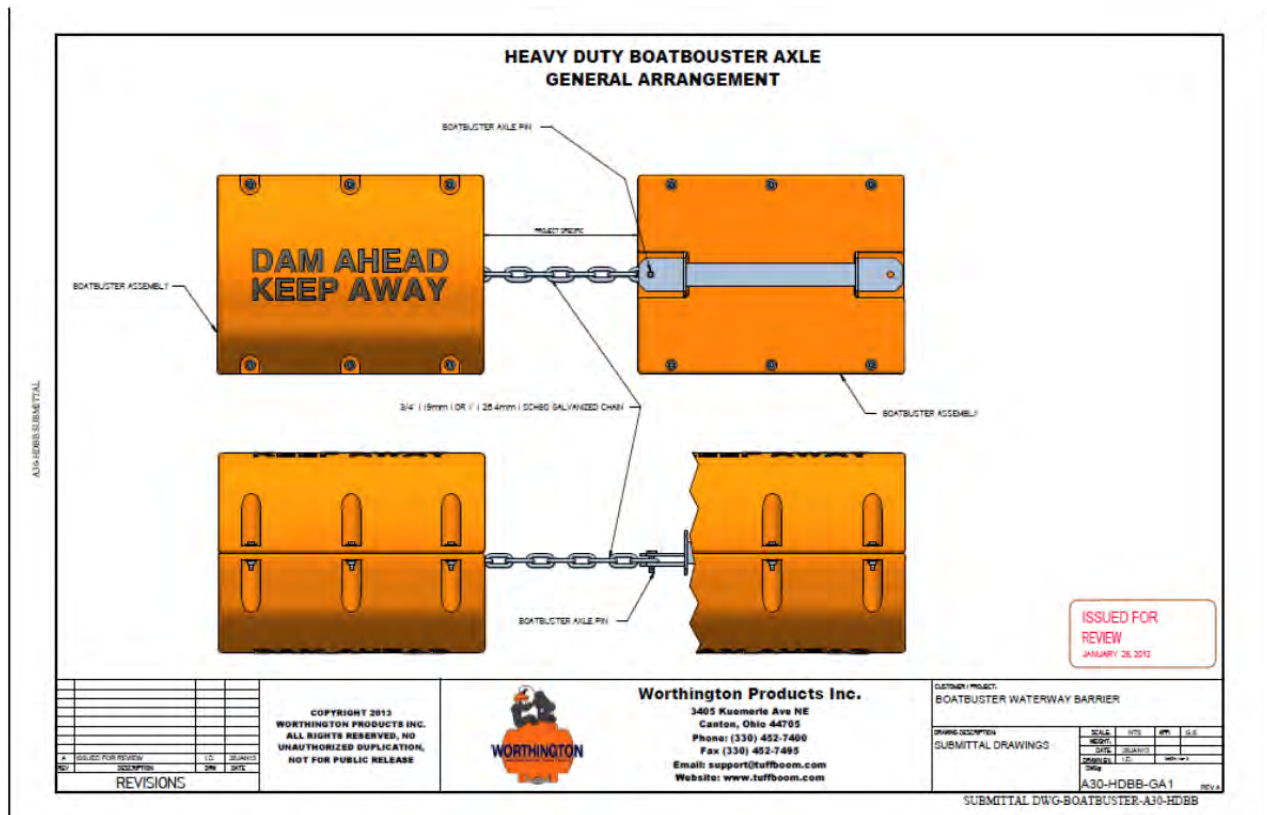
	<p>S10-065 - (EH) Electrical Hazard Sign 24"x36"</p> <p style="text-align: center;"><b>EH</b></p>
	<p>S11-126 - (DS) Blank Dam Safety Sign (24"x36")</p> <p style="text-align: center;"><b>DS</b></p>



## Appendix 3 Safety and Debris Booms

A Worthington Boat Buster boom is to be installed across the tailrace and is in the planning stages. The following is a generic drawing depicting the Boat Buster Public Safety boom general arrangement.

The headpond debris boom, installed between the end of the floating guidewall to the left bank, is a special design and not the typical two logs bolted together. Refer to Engineering’s Design drawings of this boom for details.





## Appendix 4 Public Notifications

### Newspaper Notices:

- *Safety on Reservoirs*
- *Safety Around BC Hydro Facilities*

### BC Hydro Website:

[https://www.bchydro.com/community/recreation\\_areas/arrow\\_lakes\\_reservoir.html](https://www.bchydro.com/community/recreation_areas/arrow_lakes_reservoir.html)

### Public Notifications:

Public notifications will be issued according to the following schedule:

**Table 15: Public Notification Schedule**

Component	Notification Title <sup>1</sup>	Frequency
All	<i>Safety Around BC Hydro Facilities</i>	late spring
All	<i>Safety on Reservoirs</i>	early summer

<sup>1</sup>Note: See **Appendix 5** for public notifications.



## Safety on Reservoirs

Arrow Lakes Reservoir

### Warning

Play it safe when boating or swimming this summer.

Arrow Lakes Reservoir can be an enjoyable recreation destination, provided certain common sense safety precautions are observed.

Because water from Arrow Lakes Reservoir is utilized for flood control and the production of electricity, reservoir water levels can rise or fall daily. Reservoir users should be aware that changing water levels can conceal submerged hazards, particularly in shallow water near the shoreline. It is important that visitors be aware of these potential dangers and take precautions to stay safe. Canadian Hydrographic Charts covering the Lower Columbia River and Arrow Lakes Reservoir are an excellent reference for boaters.

Boating, fishing and swimming above or below a dam or generating station can be very dangerous. For your own safety and the safety of those with you, obey all warning signs and stay out of restricted areas.

Boaters must comply with all Canadian Coast Guard regulations and practice safe boating at all times.

**Have fun – but be careful!**

**BC Hydro**



## Safety Around BC Hydro Facilities

### Hugh Keenleyside Dam

#### An important message for visitors

BC Hydro's generation and storage facilities can be interesting places to visit provided certain safety precautions are observed.

Hydroelectric facilities and the areas nearby can be dangerous to the unwary or the adventurous. Some hazards are readily apparent and some are not. Hazards such as water flows may change quickly and without warning.

Visitors should stay well clear of generating facilities including water intake areas, discharge channels and all electrical and operating equipment. Areas immediately upstream and downstream of generating facilities are particularly dangerous for boaters and swimmers.

Please respect fenced and gated areas and observe all posted signs. Stay within designated and marked observation areas and be sure to supervise children closely.

For further information about our operations, please visit our website at [www.bchydro.com](http://www.bchydro.com).

Have a safe and informative visit!

**BC Hydro**





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## **Appendix 5 Safety Control Deficiency and Remediation Reports**

### **Guidelines for Inspections and Documentation of the following components:**

- **Revelstoke Reach (RR)**
- **Upper Arrow Lakes Reservoir (UAL)**
- **Lower Arrow Lakes Reservoir (LAL)**
- **Hugh Keenleyside Dam (HLK)**
- **Tailrace (TR)**



---

### Guidelines for Safety Control Inspections

Guidelines are provided to assist in the inspection of safety controls. A PM work order is required to direct the plant staff to conduct the annual inspections of all public safety control measures in time to allow remediation to be completed prior to the May long weekend.

If a safety control fails inspection it must be marked up on the enclosed site map to show the specific location of the item to be addressed, described in the comment section of the Safety Control Deficiency Report and a Condition Based (CB) or Corrective Order (CO) must be entered into Passport (Section 7.0 – *PSMP Inspection, Remediation and Modification Workflows*).

Report any deficiencies to public safety controls, incidents of vandalism or public trespass and any public endangerment issues into the Passport history files.

#### Booms

- ✓ Cables and anchors secure
- ✓ Boom forms a continuous restraint

#### Fences and Gates

- ✓ Upright and secure
- ✓ No holes or missing sections
- ✓ No holes under fence
- ✓ No paths established around fence
- ✓ No vegetation overgrowing fence

#### Signs

- ✓ Securely mounted
- ✓ Clear and understandable
- ✓ Visible (limiting factors could include vegetation, size of lettering, snow cover, etc.)
- ✓ Condition (defaced, damaged, etc.)



---

## **Safety Control Remediation Report**

Utilize passport history files to document all remediation and record the passport work order number within the PSMP deficiency report item. When a deficiency in the PSMP is noted, the following activities are required:

- CO work order raised to conduct corrective work that must be done immediately.
- CB work order raised to do remediation in a timely and well planned manner including entering data into the passport history file for future reference.



## Safety Control Deficiency Report

**Location:** Hugh Keenleyside

**Inspector:** \_\_\_\_\_  
(print name)

**Inspection Date:** \_\_\_\_\_  
(yyyy/mm/dd)

**Components**

1. Revelstoke Reach (RR)
2. Upper Arrow Lakes Reservoir (UAL)
3. Lower Arrow Lakes Reservoir (LAL)
4. Hugh Keenleyside Dam (HLK)
5. Tailrace (TR)

ID Code	Component/Location/Comment
<b>Signs</b>	
<b>Fences/Gates</b>	

**Hugh Keenleyside – Public Safety Management Plan**



ID Code	Component/Location/Comment
<b>Booms</b>	



---

**Appendix 6  
PSMP Modification Report**



# PSMP Modification Report

File # \_\_\_\_\_

Safety Issue: \_\_\_\_\_

<b>Location:</b>	<input type="checkbox"/> Revelstoke Reach (RR) (map 2)	<input type="checkbox"/> Upper Arrow Lakes Reservoir (UAL) (map 3)
	<input type="checkbox"/> Lower Arrow Lakes Reservoir (LAL) (map 4)	<input type="checkbox"/> Hugh Keenleyside Dam (HLK) (maps 5 and 6)
	<input type="checkbox"/> Tailrace (TR) (map )	

**Location Description:** \_\_\_\_\_

## Modification Required:

Boom (b)     Fence (f)     Sign (s)     Other: (specify) \_\_\_\_\_

**Modification Description:**<sup>11</sup> \_\_\_\_\_

**Safety Control ID Assigned:**<sup>12</sup> \_\_\_\_\_

**Modification Completed:**                     

**Notes:** \_\_\_\_\_

## PSMP Report Revisions Completed:

- N/A     Applicable Authority/ Regulation Revised (**Appendix 1**)
- N/A     Map(s) Revised (**Appendix 1**)
- N/A     Sign Index Revised (**Appendix2**)
- N/A     Safety Control Specification(s) Revised (**Section 4**)
- N/A     Public Notifications Revised (**Appendix 4**)
- N/A     Deficiency Report(s) Revised (**Appendix 5**)
- N/A     Other: \_\_\_\_\_
- N/A     Revised Page(s) Distributed to Copyholders

**PSMP Report Revisions Distributed:**                     

\_\_\_\_\_  
Completed (Person Responsible for Modification)

\_\_\_\_\_  
Date (yyyy/mm/dd)

\_\_\_\_\_  
Approved (Plant Manager)

\_\_\_\_\_  
Date (yyyy/mm/dd)

<sup>11</sup> **Appendix 2** contains sign descriptions  
See **Section 4** for safety control specifications.

<sup>12</sup> **Section 4** contains the format of safety control ID codes.



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**Appendix 7  
Risk Assessment Forms  
and Associated memos**





ARROW LAKES RESERVOIR (ALR)

Anticipated (Current or Expected) Risk Level

As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future

Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization				Comments (Includes assumptions, conclusions or observations)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RR	RL	







**Earthfill Dam**

**Anticipated (Current or Expected) Risk Level**

As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future

Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization				Comments (Includes assumptions, conclusions or observations)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RR	RL	







**Public Safety Around Dams Risk Assessment Tool**

Date	Name	Signature
27 May 2015	Dave Cattanach	

**TAILRACE**

<b>Dam Name</b>	<b>HUGH KEENLEYSIDE DAM</b>
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This component includes the area discharge area for the dam (low level outlets and spillway) and extends downstream to where the flow pattern (turbulence and velocities) match those of the natural flow in the Columbia River.

Activity Location within the Hazardous Area	Activity Description	Potential Hazard																										Risk Reduction Measures Present at the Time of Assessment														Risk Assessment				Comments								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RR	RL									
		Rapidly increasing water levels	Rapidly increasing water flows	Strong currents or undertows	Frequently dry riverbed	Presence of spillway with spillway gate	Automatic Emergency Operated Spillway Gate	Presence of spillway with stop-logs	Presence of overflow spillway or dam	Presence of discharge valve/pipe	Submerged hydraulic jump	Submerged underwater structures	Remote control flow equipment	Automatic control flow equipment	Steep or slippery banks	Falling from height >3 metres	Pinching or crushing	Thin ice	Changing flow/depth may result in Stranding	Floating debris	Flow or level changes as a result of maintenance	Unsecured mechanical/electrical equipment	Unsecured or exposed live electrical conductors	Inadequate guardrails/handrails for public	Open holes or tripping	Other (define)	Other (define)	Signage	Public Education (Local Initiatives)	Safety Buoys	Safety Booms	Audible Danger Signalling Devices	Visual Danger Signalling Devices	Fencing	Barricades (Vehicle or People)	Security Patrols	24/7 Video Surveillance	Operational Controls (Procedures)	Write a letter to the Adjacent Property Owner	Other (define)	Other (define)	Incident Likelihood Rating (ILR)	Incident Consequences Rating (ICR)	Risk Rating	Risk Level									
From Water/Ice	Fishing from Boat	X	X	X		X	X		X				X														X	X	X													4	5	20	HIGH									
	Boating (under power)	X	X	X		X	X		X				X														X	X	X													4	5	20	HIGH									
	Sailing																																																					
	Windsurfing																																																					
	Canoeing/Kayaking/Rowing																																																					
	Waterskiing																																																					
	Swimming																																																					
	Jet Ski																																																					
	Scuba Diving																																																					
	Swimming/Diving																																																					
From Shore/Structure	Skating																																																					
	Ice fishing																																																					
	Snowmobiling																																																					
	Fishing from Shore																																																					
	Walking																																																					
	Climbing																																																					
	Camping																																																					
	Picnicking																																																					
	ATV / Dirt Biking																																																					
	Hiking																																																					
	Skiing																																																					
	Snowshoeing																																																					
	Driving																																																					
	Biking																																																					
Scuba Diving																																																						
Swimming / Diving																																																						
Accessing electrical equipment																																																						
Accessing mechanical equipment																																																						

**TAILRACE**

**Anticipated (Current or Expected) Risk Level**

As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future

Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization			Comments (Includes assumptions, conclusions or observations)	
Signage	Public Education (Local Initiatives)	Safety Buoys	Safety Booms	Audible Danger Signalling Devices	Visual Danger Signalling Devices	Fencing	Barricades (Vehicle or People)	Security Patrols	24/7 Video Surveillance	Operational Controls (Procedures)	Write a letter to the Adjacent Property Owner	Other (define)	Other (define)	Incident Likelihood Rating (ILR)	Incident Consequences Rating (ICR)	Current or Expected Risk Level		Current or Expected Risk Rating
1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RL		
			X											1	5	5	MEDIUM	Installation of a public safety boom is planned for F17
			X											1	5	5	MEDIUM	









Date	Name	Signature
18 Dec 2013	Dave Cattarach	

**TAILRACE**

Dam Name	HUGH KEENLEYSIDE DAM
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Describe the boundary of the Component:

Activity Location within the Hazardous Area	Activity Description	Potential Hazard																										Risk Reduction Measures Present at the Time of Assessment														Risk Assessment				Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RR	RL	
From Water/Ice	Fishing from Boat	X	X	X	X	X	X	X																					X	X	X						4	5	20	HIGH						
	Boating (under power)	X	X	X	X	X	X	X																					X	X	X						4	5	20	HIGH						
	Sailing																																													
	Windsurfing																																													
	Canoeing/Kayaking/Rowing																																													
	Waterskiing																																													
	Swimming																																													
	Jet Ski																																													
	Scuba Diving																																													
	Swimming/Diving																																													
	Skating																																													
From Shore/Structure	Fishing from Shore	X	X	X	X	X	X	X																				X	X							4	3	12	HIGH							
	Walking																																													
	Climbing																																													
	Camping																																													
	Picnicking																																													
	ATV / Dirt Biking																																													
	Hiking																																													
	Biking																																													
	Snowshoeing																																													
	Driving																																													
	Biking																																													

TAILRACE																				
Anticipated (Current or Expected) Risk Level																				
As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future																				
Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	ILR	ICR	RR	RL	Current or Expected Risk Level		Current or Expected Risk Rating
X	X	X	X	X										1	5		5	MEDIUM		
X	X	X	X											1	5		5	MEDIUM		
X	X	X	X											2	4		8	MEDIUM		Presence of a boom will further deter people from fishing from the shore

Date	Name	Signature

**SPILLWAY**

Describe the boundary of the Component.

Dam Name	
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Activity Location within the Hazardous Area	Activity Description	Potential Hazard	Risk Reduction Measures Present at the Time of Assessment	Risk Level at the Time of Assessment			
				IL	ICR	RR	RL
		1 Rapidly increasing water levels 2 Rapidly increasing water flows 3 Strong currents or undertows 4 Frequently dry / inverted 5 Presence of spillway with suboptimal Automatic Emergency Operation of Spillway Gate 6 Presence of spillway with stop-logs 7 Presence of overflow spillway or dam 8 Presence of discharge valve/gate 9 Submerged hydraulic jump 10 Stomaged under water structures 11 Remote control flow equipment 12 Automatic control flow equipment 13 Sheep or slippery banks 14 Falling from height >2 metres 15 Prying or crushing 16 Thin ice 17 Changing flowdepth may result in stranding 18 Floating debris 19 Flow or level change as a result of maintenance 20 Unsecured mechanical/electrical equipment 21 Unsecured or exposed live electrical conductors 22 Inadequate guardrails/handrails for public 23 Open holes or tripping 24 Other (define) 25					
		1 Signage 2 Public Education (Local Initiatives) 3 Safety Buoys 4 Safety Booms 5 Audible Danger Signalling Devices 6 Visual Danger Signalling Devices 7 Fencing 8 Barricades (Vehicles or People) 9 Security Patrols 10 24/7 Video Surveillance 11 Operational Controls (Procedures) 12 Write a letter to the Adjacent Property Owner 13 Other (define) 14					
				IL	ICR	RR	RL

<b>SPILLWAY</b>																			
<b>Anticipated (Current or Expected) Risk Level</b>																			
As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future																			
Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future												Risk Characterization		Comments (Includes assumptions, conclusions or observations)					
1	2	3	4	5	6	7	8	9	10	11	12	13	14		IL	ICR	RR	RL	



Date	Name	Signature

**DOWNSTREAM LOCATION (Define)**

Describe the boundary of the Component.

Location Name

Activity Location within the Hazardous Area	Activity Description	Potential Hazard														Risk Reduction Measures Present at the Time of Assessment														Risk Assessment			Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	IR	ICR	RR	RL		
From Water/ice	Fishing from Boat																																
	Boating (under power)																																
	Sailing																																
	Windsurfing																																
	Canoeing/Kayaking/Rowing																																
	Waterskiing																																
	Swimming																																
	Jet Ski																																
	Scuba Diving																																
	Swimming/Diving																																
	Skating																																
	Ice fishing																																
Snowmobiling																																	
From Shore/Structure	Fishing from Shore																																
	Walking																																
	Climbing																																
	Camping																																
	Picnicking																																
	ATV / Dirt Biking																																
	Hiking																																
	Skating																																
	Snowshoeing																																
	Driving																																
	Biking																																
	Scuba Diving																																
Swimming / Diving																																	
Accessing electrical equipment																																	
Accessing mechanical equipment																																	

DOWNSTREAM LOCATION (Define)																			
Anticipated (Current or Expected) Risk Level																			
As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future																			
Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization	Comments (Includes assumptions, conclusions or observations)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	IR		ICR	RR	RL	

Date	Name	Signature

**RISK ASSESSMENT SUMMARY**

Location Name	Perlite Generating Station (Case Study B)
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Activity Description	Potential Hazard	Risk Reduction Measures Present at the Time of Assessment		Risk Assessment			Risk Level at the Time of Assessment	Comments		
		1-34	35	ILR	ICR	RR			RL	
<b>HEADPOND</b>										
Boating (under power)	Rapidly increasing water levels		X				2	5	10	
Canoeing/Kayaking/Rowing	Strong currents or undertows	X	X				4	5	20	
<b>SPILLWAY</b>										
Walking	Presence of spillway with stoplogs						4	3	12	
Climbing	Presence of spillway with stoplogs						4	5	20	
<b>DOWNSTREAM LOCATION A</b>										
Fishing from Boat	Submerged hydraulic jump						5	5	25	
Fishing from Shore	Submerged hydraulic jump	X	X				5	5	25	
<b>SPILLWAY</b>										
Fishing from Boat	Submerged hydraulic jump	X	X	X	X		4	2	8	
Canoeing/Kayaking/Rowing	Submerged hydraulic jump	X	X	X	X		4	2	8	
Fishing from Shore	Submerged hydraulic jump	X	X	X	X		5	3	15	
<b>DOWNSTREAM LOCATION A</b>										
Canoeing/Kayaking/Rowing	Thin ice						5	3	15	
Hiking/ATV	Thin ice						5	3	15	

RISK ASSESSMENT SUMMARY																	
Anticipated (Current or Expected) Risk Level																	
As a result of recent risk reduction measures implemented or additional risk reduction measures to be implemented in the immediate future																	
Activity Description	Additional Risk Reduction Measures have recently been implemented or will be implemented in the immediate future														Risk Characterization		Comments (Includes assumptions, conclusions or observations)
	1-14	15-18	19-22	23-26	27-30	31-34	35	Other (define)	ILR	ICR	RR	RL	ILR	ICR	RR	RL	
<b>HEADPOND</b>																	
Boating (under power)	X	X	X										1	5	5		Large danger signs at safety boom anchor
Canoeing/Kayaking/Rowing	X	X	X										1	5	5		Large sign at safety boom anchor with large signs at ends of approved portage trail to communicate its existence. Signs along the headpond shore on the side the approved portage trail is on to communicate the boundary of the dangerous area to be visible by land
<b>SPILLWAY</b>																	
Walking	X												1	3	3		Fence and gate the end of the dam without such with 2 metre cantilever fencing section on each side and install "No Trespassing" signage on gates onto dam
Climbing	X												1	5	5		Fence and gate the end of the dam without such with 2 metre cantilever fencing section on each side and install "No Trespassing" signage on gates onto dam
<b>DOWNSTREAM LOCATION A</b>																	
Fishing from Boat	X	X	X										1	5	5		Install large sign, safety boom and buoys downstream at the extent of the spillway area.
Fishing from Shore	X	X	X										1	5	5		Install fencing with small danger signs on the shore. Gate the access road to the station
<b>DOWNSTREAM LOCATION B</b>																	
Fishing from Boat	X	X	X										2	2	4		Stepped spillway gate opening plus Large signs at boom ends to indicate Dam Outflow
Canoeing/Kayaking/Rowing	X	X	X										2	2	4		Stepped spillway gate opening plus Large signs at boom ends to indicate Dam Outflow. Add large sign to mark beginning of approved portage trail.
Fishing from Shore	X	X	X										2	2	4		Stepped spillway gate opening plus small signs along the shore that indicate Danger No Trespassing
<b>DOWNSTREAM LOCATION C</b>																	
Canoeing/Kayaking/Rowing	X	X											4	3	12		Need to complete a Hydraulic Assessment to better estimate consequence for summer flows
Hiking/ATV	X	X											4	3	12		Need to complete a Hydraulic Assessment to better estimate consequence for summer flows

## **HUGH KEENLEYSIDE DAM 2015 PUBLIC SAFETY REVIEW**

### **UPSTREAM**

The boat ramps at Nakusp and McDonald Creek were inspected and no public safety concerns were noted. BC Hydro signs were in good condition, although of the older style at McDonald Creek.

The Boater Advisory sign on Broadwater Road just north of Arrow Lakes Power is in good condition and provides general warning to anyone entering the east shore of the reservoir from Castlegar.



There was no public observed using the reservoir at the time of this inspection. As an outcome of the Water Use Planning process, new and expanded boat ramps are being installed on Arrow Lakes Reservoir which will result in increased public use of the reservoir.

### **PARTY PIT**

The public use of the Party Pit, located above Broadwater Road, appears to have been eliminated with the recent installation of the berm and gate. There has been no vandalism of the new works and there was no evidence of recent public use of the site.

The only concern was that one of the culverts is being undermined from runoff from the road. The base of this culvert needs to be backfilled to ensure all runoff passes through the culvert. One or two sandbags wedged under the culvert and some additional hand-placed fill should be suitable.



**Action: - PLANT to repair the culvert**

### **HEADPOND**

The debris boom prevents public access to the danger zone upstream of the spillway section of the dam. However, as the debris boom is constructed of logs, the visibility, particularly during winds or poor lighting, is poor. The boom is scheduled to be replaced in F16 and the issue of visibility will be included in the User Requirements for the project. Plant staff have observed fast moving power boats coming close to this upstream boom.

**Action: - PROJECT DELIVERY - An existing project to replace the debris boom requires Public Safety involvement in order to address the visibility issue.**

### **RIGHT (SOUTH) BANK**

The south bank, particularly upstream of the dam is used by both industry and the public. Log sorting and storage is very active along the shore upstream of the dam and this discourages public use of the shoreline. However, there is a trail head 750 m upstream of the dam which attracts the public to this area. There were no hazards created by BC Hydro's Hugh Keenleyside Dam or the reservoir operation in this area.

### **EARTHFILL DAM**

There was no public activity on the earthfill dam at the time of the inspection. One vehicle approached the dam from the south bank and turned around and left the area after seeing the Dam Closed sign.

However the public frequently drive across the earthfill dam and park on the south side of the lock. The lock is very large and unique and, as such, is a tourist attraction.

The risks associated with the public driving and walking on the earthfill dam are well managed. The road is straight with a 30 km/h speed limit. The public won't normally walk on the earthfill dam as they would drive to and from the lock. There is no parking allowed on the dam crest and parking is limited to the south side of the lock.

The Incident Likelihood Rating is 5 (Very Frequent) but the Incident Consequence Rating is 2 (Minor) as the most likely outcome of incident would be first-aid. This would be associated with a vehicle collision in the parking lot at very low speed.



### **CONCRETE DAM**

This component includes the lock, office building, low level outlet and spillway sections of the dam. In the previous Public Safety Management Plan road surface was identified as a “WARNING ZONE” and the remainder of the structure was identified as a “DANGER ZONE”. However given hazards, such as rails, hatch covers, and overhead works, the entire structure is now identified as a “DANGER ZONE”

The dam was opened to the public for 2 weeks in December 2013. During this period of time more than 10 vehicles would have crossed the dam, resulting in an Incident Likelihood Rating of 5 or Very Frequent. Given the limited sight lines, 90 degree corners, and presence of pedestrians, the Incident Consequence Rating was assigned a rating of 4 or Critical. This rating is associated with permanent partial or total disability and would be the likely outcome of a pedestrian being struck by a car or truck. With these ratings, the Risk Rating associated with the public using the roadway is HIGH (Risk Rating of 20).

If the dam had not been opened to the public in December 2013 the Incident Likelihood Rating would now be 3 and the Risk Rating would have dropped to 12. If the road remains closed the Risk Rating will drop to 4 or LOW by 2020 and no further control measures would be needed.

**Action:** It is recommended that BC Hydro close the road to public access.

## **DOWNSTREAM**

This component includes the area downstream of the low level outlets and spillway. It is bounded by the rockfill groin on the south and the embankment for Arrow Lakes Generating Station canal on the north. The downstream limit is a point approximately 600 m downstream of the dam where the flow becomes uniform and matches the normal flow conditions in the Columbia River

According to plant staff there are about 4 boats per year that ignore the warning signs and enter this Danger Zone. This yields an Incident Likelihood Rating of 4 or Frequent. The most likely outcome of a boat being in close proximity to the dam at the start of a spill could be a fatality (Incident Consequence Rating of 5). The turbulent white water in this area has a low density and boats will sink. Even a person in a life jacket would not be able to remain afloat.

There are control measures in place to reduce this risk, such signage and making a visual observation prior to manually opening the gates or sounding a siren in advance of remote gate operation. However these procedures could fail, resulting in a public incident.

The Risk Rating is High (Rating of 20).

The most effective control measure is the placement of a public safety boom.

**Action: Public Safety plan for the design and construction of a downstream public safety boom.**



## Inter-office memo

To: Richard Brittin  
Cc: Chris Egan, Jonny Knowles  
From: Lori Sandeen  
Subject: Public Safety at the Hugh Keenleyside Dam Crossing -  
Recommendation

DATE: 20 May 2015  
FILE: CSO-PSM-HLK

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During the period between 2006 and 2011 when the Dam Crossing over Hugh Keenleyside Dam was open for Public driving, approximately twelve Public Safety Near-Misses have occurred over the Hugh Keenleyside Dam involving Public traffic. An incident that occurred on 15 August 2011 caused considerable alarm as the Public and workers on the roadway were exposed to a potentially fatal hazard of a speeding vehicle breaching traffic control devices and work-zone delineators. The recommendation from the Public Safety Program is to continue a complete closure of the Dam Crossing for the protection of the Public and workers.

### **Summary of Public Safety at Hugh Keenleyside Dam Crossing**

Given the features of the Hugh Keenleyside Dam Crossing; blind corners, narrow laneways, minimal areas for egress and escape and the continued occurrence of Public Safety Near-Misses when the Dam Access was open to the Public, it is recommended that an indefinite Public closure occur at the Hugh Keenleyside Dam Road Crossing. A Public Safety Risk Assessment completed in 2013 also determined that the risk of serious injury over the Hugh Keenleyside Dam Access was high and that Dam Access closure was the only safe option to that potential Public interaction.

Alternate access crossing the lake is available to the surrounding community with a minimal increase in travel time i.e. <a few minute increase in total travel time when abiding by posted speed limits. The Dam Access is not used as an emergency access route for First Responders.

If the Dam Access Crossing is planned to be re-opened to the Public, an assessment by a Traffic Specialist, Engineer or Technician is recommended in advance given the high rate of Public Safety Near-Misses. During the August 2011 Public Safety Near-Miss, the member of the Public breached a permanent traffic control device before nearly colliding with another member of the Public and then entered the construction work zone.

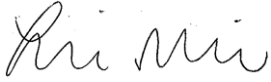
Public use of the roadway from Castlegar to the Navlock, parking lot and turnaround provides access to viewing of the feature and it is not expected that the general recommendation of this memo would impact the Public access to this attraction.

### **Summary**

As Public Safety Incident is very likely to occur at the Hugh Keenleyside Dam Crossing if it is re-opened to the Public despite the presence of the existing traffic

control devices, the Public Safety Program recommends that Public Use is not permitted over the Dam Crossing in the current state.

Thank you,

A handwritten signature in black ink, appearing to read "Lori Sandeen". The signature is written in a cursive, flowing style.

**Lori Sandeen**  
**Public Safety Specialist**



## Inter-office memo

To: James Stark  
Cc: Mary Anne Coules, Al Geissler  
From: Lori Maric  
Subject: Public Safety at the Hugh Keenleyside Dam Road Crossing - Recommendation

DATE: 9 Dec 2011  
FILE: STT-AD-PSM-HLK

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Over the last five years, approximately twelve Public Safety Near-Misses have occurred over the Hugh Keenleyside Dam involving Public traffic. An incident that occurred on 15 August 2011 caused considerable alarm as the Public and workers on the roadway were exposed to a potentially fatal hazard of a speeding vehicle breaching traffic control devices and work-zone delineators. The recommendation from the Public Safety Program is to continue a complete closure of the Dam Road crossing for the protection of the Public and workers.

### **Summary of Public Safety at Hugh Keenleyside Dam Road Crossing**

Given the features of the Road Crossing; blind corners, narrow laneways, minimal areas for egress and escape, the current schedule of capital works being undertaken there over the next three years, and the continued occurrence of Public Safety Near-Misses, it is recommended that an indefinite Public closure occur at the Hugh Keenleyside Dam Road Crossing. As well, alternate access is available to the surrounding community with a minimal increase in travel time i.e. <a few minute increase in total travel time when abiding by posted speed limits. The Road Crossing is not used as an emergency access route.

The following recommendations provide future opportunities for BCH to assess Public Safety at the Dam Road Crossing and are suggested should the Road be re-opened to the Public:

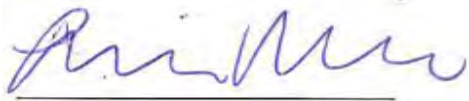
1. Anecdotal evidence of Public Safety Incidences and Near-Misses are acceptable forms of information for the assessment of a Public Safety issue, however, if Public use is permitted over the Road Crossing, formal reporting of future incidences in the IMS is recommended to create a record of the events, help understand the reasons that the behavior is occurring and to contribute to any future assessments for Public Safety control measures.
2. If the Dam Road Crossing is planned to be re-opened to the Public, an assessment by a Traffic Specialist, Engineer or Technician is recommended in advance given the high rate of Public Safety Near-Misses. This recommendation is made irrespective of whether BCH employees or contractors are present on the road crossing. During the August 2011 Public Safety Near-Miss, the member of the Public breached a permanent traffic control device before nearly colliding with another member of the Public and then entered the construction work zone.

Public use of the roadway from Castlegar to the Navlock, parking lot and turnaround provides access to viewing of the feature and it is not expected that the general recommendation of this memo would impact the Public access to this attraction.

**Summary**

As Public Safety Incidents continue to occur at Hugh Keenleyside Dam Road Crossing despite the presence of traffic control devices, the Public Safety Program recommends that Public use is not permitted over the Road Crossing in the current state.

Thank you,



Lori Maric  
Public Safety Program Coordinator