Appendix F

Public Safety

Contents

1. Xeneca Power Development Waterway Public Safety Management Guideline – December 2011; *KGS Group*

Xeneca General Public Safety

REV A

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Prepared By

Holly Hampton, P. Eng.
Civil / Structural Department Head

Approved By

Stefan Kohnen, P.Eng.
Regional Manager

KGS Group
Mississauga, Ontario

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GLOSSARY OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
CDA	Canadian Dam Association
OMNR	Ontario Ministry of Natural Resources
NWPA	Navigable Waters Protection Act
PSCP	Public Safety Communication Plan
SSWPSMP	Site Specific Waterway Public Safety Management Plan
WPSMG	Waterway Public Safety Management Guideline
WHMIS	Workplace Hazardous Materials Information Systems

Chapter 1.0
Plan Basis

1.0 CHAPTER 1 - PLAN BASIS

1.1 INTRODUCTION

Dams, control structures, and their appurtenances, by their very nature, may present a number of potential hazards to the public. An important aspect of dam safety management is protecting the public from hazards of dams at every stage of the dam life cycle, from design to decommissioning. Public safety is a most important element of an Owner's due diligence in all stages and most importantly in the operational phase of the project. This Waterway Public Safety Management Guideline (WPSMG) has been created to determine if any potential public safety hazards exist within the area of influence of structures that are owned and operated by Xeneca and to address those issues if they exist.

In developing in developing this WPSMG the most current dam safety management guidance and practice, such as the Canadian Dam Association Dam (CDA) Safety Guidelines (2007), CDA Guidelines for Public Safety around Dams (2011), Ontario Ministry of Natural Resources (OMNR) Dam Safety Technical Bulletins (2011) and OMNR Public Safety Around Dams Best Management Practices (2011). The CDA and OMNR Public Safety Guidelines and Best Mangement Practices go beyond "dam safety" as being primarily concerned with protecting the public from catastrophic failure of the dam brought about by extreme events.

Potential hazards may arise in areas where the dangers posed by structures on the waterway are not well known to the public. This is especially true in the immediate upstream and downstream vicinity of hydroelectric dams and control structures. The risk to the public may increase when rapidly changing flow conditions around dams and hydraulic structures are combined with a general lack of public knowledge about the dangers posed. Even relatively low head structures could possibly create submerged hydraulic eddies where overflow water continuously re-circulates, trapping individuals in what are called "Drowning Machines". It is possible that the drowning fatalities that have occurred in Canada around dams may have been prevented by application of more rigorous public safety measures, public education and physical warnings directed toward the structures and areas of specific hazards.

This Corporate Waterway Public Safety Management Plan (WPSMP) is intended to be a "living document" which can be changed and added to as conditions change and the "state of the art" evolves.

1.2 PURPOSE

The purpose of this WPSMP is to:

- provide effective and consistent guidelines for employees of Xeneca and Contractors working for Xeneca to utilize in addressing public waterway safety around its structures,
- provide guidance in the identification, assessment, mitigation and communication of potential public waterway hazards caused by structures owned and operated by Xeneca, and
- provide a guideline for the development of Site Specific Waterway Public Safety Management Plans (SSWPSMP) for each of Xeneca's dam facilities.

1.3 SCOPE

This WPSMP provides specific guidance to minimize risks posed to the public within the scope of dykes, dams, control structures, and associated appurtenances. This is accomplished through the following methods and procedures:

- identifying potential hazards;
- evaluating risks;
- controlling potential hazards;
- selecting appropriate mitigation strategies (control measures);
- communicating these to the public;
- providing a template for developing Site Specific Waterway Public Safety Management Plans (SSWPSMP);
- providing guidance on responding to and documenting safety incidents; and
- maintaining a managed system.

These methods and procedures are provided in the following Chapters of this WPSMP.

1.4 GOVERNING PRINCIPLES

The number one priority of Xeneca is the safety of its staff and Contractors and the public at Xeneca's facilities. The following governing principles to be applied in Xeneca's business practices are intended to provide overall guidance to achieving this goal:

- Make conservative decisions regarding operations as they relate to the health and safety of the public to ensure safety remains the first priority.
- Integrate public safety considerations into business practices and decisions.
- Engage in partnerships that enhance public safety awareness and address public safety issues in the communities in which we operate.
- Carry out design, construction, and generation activities in a responsible manner to ensure that the safety of personnel and the public is not jeopardized.
- Ensure accountability for safety around Xeneca facilities with timely reporting to the responsible authorities within Xeneca's management system.

This WPSMP is a key component in achieving Xeneca's safety goals and provides a managed system approach to reduce public safety incidents associated with the waterways at Xeneca facilities. By following the system outlined within this document, Xeneca can identify areas of concern for public safety, determine impacts, design structures accordingly, and install control measures and monitor the outcomes.

1.5 ASSIGNMENT OF RESPONSIBILITIES

Responsibility levels are identified to ensure that the WPSMP is carried out effectively. The ???? of Xeneca has taken ownership of this WPSMP and is responsible for establishing for each site, accountabilities and procedures for delegation of responsibility for the following roles:

- Development of the SSWPSMP, including identification of hazards and assessment of risks posed by operations of the dams and hydropower facilities.
- Implementation of the SSWPSMP, including planning and execution of all site-specific maintenance and inspection activities.
- Ensuring that the site and operating personnel are trained in the SSWPSMP and identification of potential hazards.
- Investigating incidents and monitoring compliance with the SSWPSMP.
- Monitoring of the SSWPSMP to ensure that Guidelines and site specific plans are reviewed (and updated as necessary) on a set schedule.
- Developing and following a maintenance program for all physical control structures in place

for public safety around Xeneca facilities.

1.6 ASSUMPTIONS

The following assumptions form the basis in applying this Plan to Xeneca facilities:

1. Physical barriers (e.g. fences, gates, booms, etc.) are intended to act as deterrents and are not designed to prevent access from those seeking to unlawfully gain access to Xeneca property or controlled areas.
2. Physical barriers are not intended to address naturally occurring hazards which would have been present even if the dam were not in place. This might include features such as naturally occurring rapids, land forms and stranding sites.
3. Partially open water and cracked ice are part of normal river/reservoir conditions from late fall through the spring seasons in Ontario and present inherent dangers to any winter recreational use of the waterways. Temporary signage with possible lighting will be used as warning against the dangers posed by these conditions on Xeneca property or controlled areas only. It is not Xeneca's responsibility to determine safe locations for winter activities along the various waterways.
4. Warnings regarding dangerous conditions such as signage, sirens or strobe lights are meant to warn the public regarding potential dangerous conditions of the waterway and are not expected to prevent access from those seeking to unlawfully gain access to Xeneca property or controlled areas. Audible or visual warning systems are meant to warn the public of possible sudden changes in the waterway and that exit from the area should begin immediately.
5. It is recognized that changes will occur over time in the standards for control measures outlined in these Guidelines. These changes do not imply that existing control measures need to be replaced or are not sufficient. If they continue to meet the intent, they shall be considered to be in compliance until such a time as they are scheduled for replacement, following which they will be replaced with control measures meeting the new standards.

1.7 CONTENTS OF WPSMP

This WPSMP is intended to provide the required methods and procedures to implement the public safety goals of Xeneca. A brief description of the contents of this WPSMP follows:

1.7.1 Chapter 2 - Hazard Identification and Risk Assessment

A methodology to be used to assess the potential hazards and risks at each facility is presented. A SSWPSMP will be developed for each facility based on the identification of hazards and subsequent assessment of the possible risks posed at the dam and related facilities. The risk assessment will take into account the identified potential hazards, the degree to which the public is exposed to them, if any, and the consequences if the hazard potential is realized. This allows the appropriate decisions to be made to install control measures to eliminate or reduce the risks.

Potential hazards and the degree of public exposure will be assessed through site inspections, review of construction and/or operating procedures, interviews with staff and other stakeholders, and hydraulic assessments.

The risk assessment process involves a systematic review of each identified potential hazard, its potential impact on the public and the assignment of a risk rating to the potential hazard. This risk rating is a measure that depends on the assessed probability of a hazard occurring and the consequences if it were to occur.

The results of the Hazard Identification and Risk Assessment is to be included in the SSWPSMP.

1.7.2 Chapter 3 - Hazard Mitigation (Control Measures)

This Chapter of the WPSMP identifies control measures to reduce and mitigate the impact from potential hazards identified at each facility. This section describes the various control measures to reduce the risk of exposure and the hierarchy and context in which control measures should be considered. Control measures may take a number of forms including the following in decreasing order of desirability:

- elimination of the potential hazard;
- mitigation of the potential hazard;
- installation of physical barriers and warning systems;
- public education; and

- the provision of emergency response measures.

The SSWPSMP developed for each site will identify the potential hazards, risks and existing control measures as well as consequent control measures to be adopted for each site. Maintenance and inspection requirements for each control measure are also to be identified.

1.7.3 Chapter 4 - Public Education and Communication Plan

This chapter of the WPSMP describes the goals of a public education program and the methodology and procedures to achieve them. Public education and communication plans are necessary to communicate potential hazards to the public and achieve a desired public response. The goals of a public education plan are to raise the general awareness of the potential hazards associated with dams, control structures and hydroelectric facilities and to communicate information about unique hazards associated with specific sites.

The two (2) goals are to be addressed by developing a comprehensive Public Education and Communication Plan. The plan should cover the widest audience possible with the goal of raising general awareness about the dangers posed by dams and the warning signs to look for as well as communicating information regarding potential hazards unique to each site and specifically target the education of the local population.

1.7.4 Chapter 5 - Public Safety Incident Reporting

Public safety incidents must be reported to continually gain knowledge and improve public safety. Such reporting will also assist in the handling of any claims that may arise. Chapter 5 presents the procedures that are to be followed to report the incidents.

The primary purpose of reporting, recording and investigating public safety incidents is to review the effectiveness of installed control measures and identify gaps, changes or improvements necessary to accommodate changes in public usage. This also provides the input necessary to identify corrective actions to mitigate undue risk to the public due to Xeneca operations or facilities.

This section describes a procedure for documenting incidents and a rating system for reporting incidents. Public safety incidents may be rated from "Low" to "Extreme" depending on the severity of the exposure. Both actual and near miss incidents are to be reported. Accountability and requirements for incident investigation and follow-up are to be defined. Incident reporting forms are to be completed to allow reporting to be carried out in a clear and concise manner. These forms are included with this WPSMP.

1.7.5 Chapter 6 - Contents of SSWPSMP

A SSWPSMP is to be developed for each facility according to this plan. This chapter describes the form and the content of the site specific plan. Sections to be included are:

- the responsibilities and accountabilities related to waterways public safety for each facility;
- site descriptions including drawings;
- hazard identification;
- an inventory of control measures;
- public education and communication plan;
- methodology of reporting incidents; and
- inspection, monitoring and maintenance requirements.

The site specific plan shall be set up in such a manner as to allow it to be a living document which can be revised or added to as required.

1.7.6 Chapter 7 - Periodic Review of the WPSMP and SSWPSMP

Periodic reviews of the WPSMP and the SSWPSMP must be conducted to examine all existing and newly identified potential public safety hazards as well as changes in public activities. This chapter provides the rationale for reviews, along with their frequency and scope. The section also describes follow up actions and interim measures when defective control measures are identified.

Chapter 2
Hazard Identification and Risk Assessment

2.0 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard Identification and Risk Assessment is the first step in the process of developing a Site Specific Waterway Public Safety Management Plan (SSWPSMP) for a structure. A hazard exists if there is reasonable potential for anyone to suffer serious injury or death because of the site features and/or conditions. The following sections describe the process for identifying hazards and assessing the risk that the hazards may pose.

This process is to be carried out for existing and proposed new facilities. For proposed new facilities it is understood that the methodologies and procedures discussed below refer to the hazards and risks based upon the proposed facilities being in operation and during the construction phase of the new facilities, even if not explicitly stated. A separate SSWPSMP is required for a particular proposed structure during the construction phase and when in operation.

The hazard identification process provides guidance in developing a list of those locations or features of a dam or control structure and its appurtenances that are potentially hazardous to the public. The risk assessment process then takes into account the identified hazards, the degree to which the public is exposed to them and the consequences if the hazard potential is realized. This process of identifying the hazards and classifying the risk of each provides a systematic means of documenting the rationale for instituting operating procedures, installing physical control measures and carrying out other components identified in the SSWPSMP for the protection of the public.

Hydraulic control structures, hydroelectric generating facilities and their associated ancillary structures can present hazards to the public by virtue of their configuration, operation and the degree of public interaction with them. As illustrated in Figure 2.1, for the purpose of assessing the hazards, a site can be separated into the following components:

Structure: Any part of a dam structure, powerhouse, intake structure, intake canal, overflow spillway, stoplog sluice, spillway/sluice gate or any other appurtenances.

Headpond: The stretch of water or reservoir immediately upstream of the structure and generating facilities. In the case of a run of river structure this could encompass the entire forebay area; or for a structure with significant storage this could just be the immediate forebay area upstream of the structure. It is up to the reviewer to determine the limits of this area.

Upstream area: The reach of river upstream of the headpond where flow and water levels are influenced by the downstream structure. In the case of a run of river structure this could simply be the river reach upstream of the immediate headpond; or for a structure with significant storage, this could be one or more reservoirs upstream of the immediate forebay area. The key requirement is that the water levels and flows are significantly affected by the presence of the downstream structure. It is up to the reviewer to determine the limits of this area.

Spillway channel: The river reach immediately downstream of the spillway. This may be a separate channel that conveys spillway flows into the main river or may be part of the main river channel immediately downstream of the spillway.

Powerhouse tailrace: The river reach immediately downstream of the powerhouse. This may be a separate channel that conveys powerhouse flows into the main river or may be part of the main river channel immediately downstream of the powerhouse.

Downstream area: All reaches of the river downstream of the spillway channel and powerhouse tailrace where the structure still significantly influences flow and water levels, especially where constrictions exist.

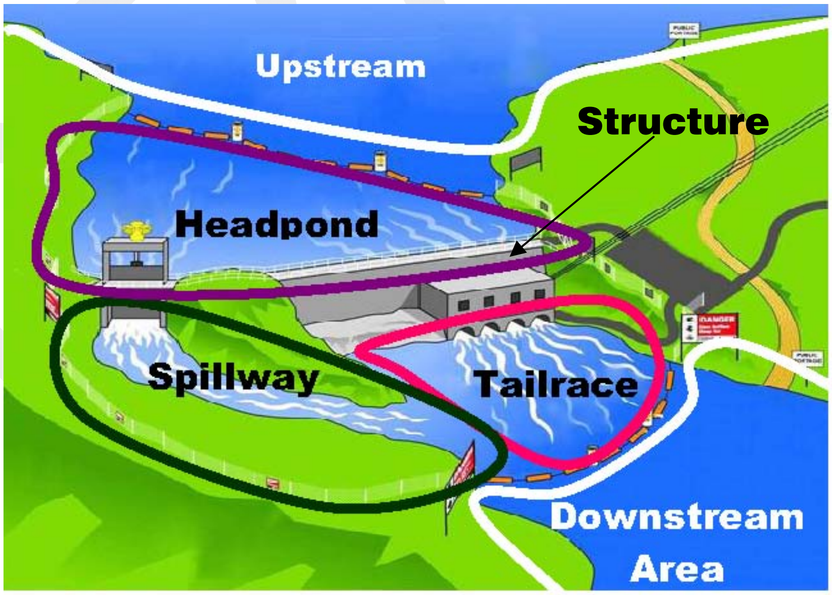

Figure 2.1: Site Components

These areas must be clearly identified and documented in the SSWPSMP preferably in written form describing the boundaries of each and including a drawing or map showing the relative locations of each.

For existing facilities in operation, as a minimum, a hazard identification and risk assessment is to be reviewed for all water conveyance structures every 2 years with particular attention to whether the assumptions made previously remain valid, such as:

- Has the degree of public interaction changed?
- Are there new public interactions occurring at the site (for example, the construction of a new boat launch, the opening of a new campground, the opening of a new trail, etc)?
- Have the potential consequences changed for a specific public interaction (for example, boating hazards created by lowering water levels to accommodate maintenance or rehabilitation work at the dam)?
- Have there been changes to the operating procedures for the structure (for example, sluice gates placed on remote operation or changes made to peaking times)?
- Have any new structures, or modifications to existing structures, taken place since the last assessment that would create a change in public safety at the site (for example, a new overflow spillway constructed)?

It should also be noted that changes and additions to the SSWPSMP should be made within this 2 year interval whenever new operating procedures are put in place, structures are built or repairs are made that significantly change the existing structures.

2.1 HAZARD IDENTIFICATION

The hazard identification process consists of the following activities:

- Site inspection.
- Hydraulic assessment (if required).
- Interview with Plant Staff, Site Supervisory Staff and Maintenance Engineering Staff (for facilities already in operation).
- Public/Stakeholder Meetings and Consultations.

All four activities should be applied in developing the initial SSWPSMP for a site. They should also be repeated, using the initial SSWPSMP as a checklist for each subsequent 2 year review. It should be recognized that these activities may overlap and are not exclusive of each other.

2.1.1 Site Inspection

The first step in preparing a SSWPSMP is to conduct a site inspection. The site inspection can be conducted by Xeneca staff or an outside consultant who is familiar with the requirements of Xeneca's Waterway Public Safety Management Plan. These staff must have the necessary technical experience to identify potential public safety hazards and possible control measures that could be installed to mitigate them.

Prior to the site inspection, information should be gathered and reviewed to familiarize the inspection personnel with the potential public safety issues at the site. This information should include the existing SSWPSMP (if it has been developed), general arrangement drawings (existing or proposed), available aerial photography, historical records of public safety issues or incidents, available road and recreational maps of the area, Emergency Preparedness Plans (existing or proposed when available), Operation and Maintenance Manuals (existing or proposed when available) and other available resources. Once the pertinent information about the site is gathered and reviewed the site inspection can take place.

It is important to spend a significant amount of time at site conducting the actual site inspection. The inspection itself may take as little as 4 hours for a simple site and up to a week for very complex and far ranging locations.

The site inspection is intended to identify potential physical hazards as well as to investigate the degree of public usage and interaction with the facilities (or expected public usage and interaction with the proposed facilities. Signs of public usage to look for include; worn pathways, refuse left from camping, fishing or other activities, graffiti, displaced signs or fencing and other forms of vandalism.

A site description for an existing or proposed specific site should be prepared using the data gathered during the site inspection, and should include the following:

- A detailed location map of the structure (or proposed structure) and its associated components and the surrounding area.
- One or more schematic drawings of the existing or proposed site, including areas upstream and downstream, that show:
    - site property boundaries;
    - the locations of all identified hazards;
    - flood inundation limits;
    - the locations of all safety devices identified during the risk assessment;
    - the locations of all roads, access routes and trails (over land and water) leading to the identified hazards; and
    - the various types of ongoing public activities in the vicinity of the hazardous areas and the level of use.
- Descriptions of each component of the dam discharge facilities and their stage-discharge rating curves.
- A review of past incidents and "near misses".

The site inspection should include, but is not limited to, the areas listed below. A list of associated potential hazards has also been included to aid in the identification process. It should be recognized that these lists are not exhaustive and specific circumstances at each site will dictate what the inspection must address.

2.1.1.1 Areas Included in Site Inspection

2.1.1.1.1 Headpond and Upstream Area

Inspection of the headpond and upstream area should focus on items related to the operation of the control structure or hydroelectric facility which may need to be addressed from the perspective of public safety, and should include the following:

- Floating debris, especially collecting near booms or structures or potential for floating debris.
- Inundated structures, which may protrude or be near the surface at low water levels.
- Access to the spillway and observation of flow patterns approaching the spillway.
- Submerged structures, including intakes, dams, etc.
- Dangerous ice conditions due to water flow underneath.

- Access to intakes or other hazardous areas via the waterway.

There can be many naturally occurring hazards in a reservoir beyond the Xeneca's control, such as submerged rocks and trees. These are usually not within the responsibility of Xeneca unless they become hazards through Xeneca operations such as fluctuating reservoir levels (see also 2.1.1.1.13 Natural and Other Hazards).

Inspection of headponds and upstream areas should also focus on areas that might seem appealing for fishing, swimming or other recreational activities, but which are unsafe for such purposes (see also Section 2.1.1.1.15 Recreation Areas).

2.1.1.1.2 Overflow Spillways and Stoplog Sluices

Overflow spillways (fixed weirs) and stoplog sluices tend to produce more gradual changes in water level and flow than underflow sluice gates and powerhouse turbines. They do, however, still present hazards under the following conditions:

- Overflow spillways and water cascading over stoplogs may be difficult to recognize from an upstream location (i.e. waters on approach appear smooth and calm).
- During the winter, areas of thin ice or open water may be difficult to observe.
- The physical drop over spillways may be large and its size can be difficult (if not impossible) to see or to judge from upstream.
- Turbulence at the toe or in the energy dissipater of an overflow spillway, weir or stoplog sluice can create dangerous rolling currents sometimes referred to as "Drowning Machines".
- Access gratings on the decks of the structures may become dislodged if not secured.
- Deck mounted rails associated with gate or stoplog hoisting devices may be exposed creating a hazard for bicycles and other road traffic.
- Water velocities near the spillway may be too great for a boater or swimmer to overcome.

2.1.1.1.3 Underflow Sluice/Spillway Gates

The hazards associated with the operation of underflow sluice/spillway gates depend on a number of factors including the mode of operation, the opening speed and the procedures specified for opening. These include local, remote and automatic operation of the gates with the following definitions:

- Local operation: Staff are dispatched to the site and manually operate the controls to either raise or lower the gate.
- Remote operation: The raising or lowering of gates is performed by staff located either within a control room at the site or at a central off-site facility. The key aspect here is that the staff does not have a direct sightline to where the flow is being directed.
- Automatic operation: Gates are raised or lowered independent of operator intervention, in response to the input of water level gauges or changes in generation.

The following hazards should be considered for Underflow Sluice and Spillway Gates:

- Strong currents upstream of the gates can be hidden below the water surface and difficult to recognize.
- The physical drop over the sluice/spillway may be large and difficult to judge from upstream.
- Turbulence at the toe or in the energy dissipater of a sluice/spillway can create dangerous rolling currents sometimes referred to as “Drowning Machines”.
- Access gratings on the decks of the structures may become dislodged if not secured.
- Deck mounted rails associated with gate hoisting devices may be exposed creating a hazard for bicycles and other road traffic.
- Water velocities near the spillway may be too great for a boater or swimmer to overcome.
- The effect that sluice/spillway flows have on conditions in downstream reaches that are out of sightline of the dam.
- The possible hazard posed by debris that is released upon opening of the sluice/spillway.
- The fact that the public may not be aware that sluice gates can rise and discharge flow at any time, especially when it is done remotely or automatically.

2.1.1.1.4 Spillway Channel

The downstream channel of a spillway often presents an area of significant hazard. The area downstream of a spillway is normally very tranquil when the spillway is not in use but often conceals a stilling basin or other type of energy dissipater with submerged obstacles. When the spillway is in use, the currents can be extremely violent causing adjacent areas to become inundated and extremely slippery. This area poses an extreme hazard to anyone who enters the water in the area due to an accidental slip or fall.

Spillway channels can create the following unique hazardous situations:

- Sudden increases in flows and water levels when gates are opened, which can create high current velocities, turbulence and rapidly changing water levels including inundation of adjacent shore lines.
- Vortices and eddies with strong undercurrents particularly caused by the operation of a few bays.
- Fluctuating water levels and spray, which can produce slippery surfaces on the shoreline.
- Remote operation of gates without a direct sightline to the immediate downstream area.
- Steep, slippery slopes along banks, increasing the likelihood of someone falling into the waterway and making escape from the waterway difficult or impossible.

2.1.1.1.5 Intake Facilities for Hydropower

Intakes and intake canals associated with hydropower facilities can present hazardous situations. This is especially true because intake gates, unlike spillways, are almost always remotely operated. Operators do not, therefore, have the opportunity to view the immediate upstream area. The following hazards should be considered for intake facilities:

- Swift currents in the vicinity of the powerhouse intakes and along canals, especially at constrictions or bends.
- Sudden increases in water levels due to load rejection. May cause access roads to become inundated.
- Steep, slippery slopes along intake canals, increasing the likelihood of someone falling into the waterway and making escape from the waterway difficult or impossible.
- A lack of visible evidence at the surface of dangerous undercurrents at the powerhouse intakes, conduits, tunnels, drop inlet structures and inverted siphons.

- The flow of water under or through gate openings and trash racks at headworks structures near entrances to canals.
- The possibility of a person getting pinned against the trash racks with an improbable chance of escape, due to swimming or boating near intake areas.
- Remote operation of intake gates without a direct sightline to the immediate upstream area.

2.1.1.1.6 Powerhouse Tailraces

Hydropower facility tailraces can create the following unique hazardous situations:

- Sudden increases in tailrace flows and water levels when turbines start up, which can create high current velocities, turbulence and rapidly changing water levels.
- Vortices and eddies with strong undercurrents particularly caused by the operation of a few turbines in a multi-turbine project.
- Fluctuating water levels, which can produce slippery surfaces on the shoreline.
- Remote operation of powerhouse without a direct sightline to the immediate downstream area.
- Steep, slippery slopes along tailrace channels, increasing the likelihood of someone falling into the waterway and making escape from the waterway difficult or impossible.

2.1.1.1.7 Concrete Dam

Hazards associated with concrete dams include the following:

- Slippery surfaces when covered in water, snow or ice.
- Exposure to machinery associated with a powerhouse or spillway that may be stored on the deck.
- Steep slopes on upstream and/or downstream sides, which may increase the likelihood of someone falling into the waterway and making escape from the waterway difficult or impossible.
- Possible fall hazard (into dangerous waters and/or from a dangerous height).
- Swift current velocities along the dam itself.

2.1.1.1.8 Earth Dams and Dykes

Hazards associated with earth dams include the following:

- Steep and continuous slopes to the waterline, which can make the waterway difficult to exit.
- Slippery surfaces when covered in water, snow or ice.
- Possible fall hazard (into dangerous waters and/or from a dangerous height).
- Possible slope movement or slumping without warning during high flow events.
- Large boulders, other rip-rap material and accumulated debris on slopes can pose a tripping and falling hazard.

2.1.1.1.9 Boat Ramps

Boat ramps can present a number of hazardous situations. Accidents at heavily used boat ramps are well-documented. The following conditions must be taken into consideration in order to reduce the occurrence of hazards:

- The proximity of boat access points to project facilities (to be considered in developing the plan for safety devices).
- The proximity of boat ramps to the swift or dangerous water currents that can exist at spillways, powerhouses, intakes or canals.
- The proximate location of boat ramps to areas of high boat traffic where signs and other such methods of boat traffic control may be required to manage the number of boats and the direction and speed of their movement.

2.1.1.1.10 Substations and Power Lines Within Close Proximity to Dams

Substations are located near many project dams and create an electrical shock hazard. Although such facilities are usually well protected with fences, signs and their own set of public safety rules, their associated high voltage power lines may be located in areas where waterway users could accidentally make contact with them. The following factors that affect vertical clearance should be considered when determining the safe height for power lines:

- Fluctuating reservoir levels.
- Hot weather, which causes power lines to sag.
- Ice storms, which cause power lines to sag.

- Accumulation of ice on power lines from turbulent water below, which cause them to sag.

2.1.1.1.11 Bridges

Bridges create unique hazards which need to be addressed in the safety plan such as:

- Bridges may create hazards for boaters attempting to pass under them. Low bridges and bridges with cross members, understructures and cables constructed close to the water surface can be hazardous to boaters.
- Bridges provide a convenient place to fish from and may be construed as being “safe” to the public.
- Bridges are sometimes part of trail network and should have appropriate safety measures provided to avoid accidental or otherwise access to the forebay and downstream area.
- Bridges may become very slippery during freezing weather and may present hazards to both vehicle traffic and pedestrian traffic.

2.1.1.1.12 Associated Project Structures

Project structures such as trash booms, safety booms, ice booms, wingwalls, roadways, trails and other associated works not explicitly described by the previous subsections can present many safety hazards to the public. The following circumstances present some of the possible hazards associated with these structures:

- Falling hazards from dykes, wingwalls or intake structures into reservoirs or tailrace areas.
- Large boulders and other rip-rap material placed on the slopes of abutments can pose a tripping and falling hazard.
- Catwalk structures and slippery spillway surfaces can pose both slipping and falling hazards.
- Control or flow through structures remote from the project site can pose additional hazards which should be evaluated.
- Booms can accumulate visible and submerged debris that can pose a hazard to boaters.
- Booms can become submerged or less visible. This can pose a serious hazard to boaters who drive into them.

- Booms can fail without warning. This can pose a serious hazard to boaters particularly if the currents are strong approaching an overflow structure.
- Booms or cables suspended above the water surface by design or due to rapidly fluctuating water levels can pose a serious threat to boaters in the summer and snowmobilers/ATV riders in the winter if they are at the wrong height.

2.1.1.1.13 Natural and Other Hazards

Natural and other hazards, such as submerged stumps, protruding rock formations and inundated concrete structures, while relatively safe at some reservoir levels, may present serious hazards to boaters and swimmers at other reservoir levels.

2.1.1.1.14 Quarries and Borrow Pits

Many existing dam facilities have associated with their construction, borrow pits and quarries in close proximity to the facilities. Quarries and borrow pits that have not been remediated are often filled with water due to their proximity to the waterway or due to a high water table and can pose hazards to the public. Some of the possible hazards include:

- Falling hazard into the open pit of water, due to varying and loose materials around the site and steep drop-offs.
- Unnoticeably shallow waters or submerged boulders close to the surface causing harm to those diving into the quarry.
- Extremely cold water or temperature fluctuations in the water due to the lack of turbulence to mix warm and cold water within the quarry, causing shock or hypothermia, and potentially drowning.
- Deep snow covering the pit and berms in the winter, creating unnoticeable obstacles for snowmobilers in the winter and possibilities of driving over quarry walls and falling into the quarry.
- Snow covering potential thin ice due to warm spots which can cause recreational users to fall through the ice.

2.1.1.1.15 Recreation Areas

Due to the nature of dams and control structures and the access they provide to the waterway, recreational areas, especially sport fishing areas, often develop in close proximity despite the dangers posed by the structures. Therefore, there are hazardous conditions at many public recreational areas and scenic overlooks in the vicinity of dams and control structures that may require special consideration.

Some hazards posed at these areas can include:

- Slippery and steep slopes.
- Rapidly changing water levels and flows.
- Areas that can be suddenly inundated by spillway or powerhouse operations.
- Dangerous currents that may or may not be apparent from the water's surface.
- Moving machinery associated with the dam's operation.

2.1.1.1.16 Winter Conditions

Thin ice can be extremely hazardous to ice fishermen, snowmobilers and other wintertime recreationists. Of particular concern are thin ice conditions created by project operations. Swift currents, as well as devices to prevent gates from icing up such as heaters and air bubblers, can create thin ice areas. Changing water levels may cause ice to break up and become unstable and in some cases may cause ice to overtop access roads or other access points. Changing water levels in many cases will cause the ice to crack and create a layer of water on top of the ice and under the snow. This is particularly hazardous to snowmobilers who may get trapped in the water. Warm effluent from thermal power plants can also thin the ice cover for a significant distance downstream of the outfall.

Ice and snow accumulation can create terrain visibility problems. This is especially critical upstream of overflow spillways and low profile gravity sections where snowmobilers may have trouble distinguishing the locations of the structures and could potentially drive over them.

2.1.1.1.17 Downstream of Plant (Within Area of Hydraulic Influence)

Water level changes may cause several hazards:

- Sudden increases in flows and water levels can create high current velocities and turbulence.
- Sudden increases in flows may cause debris to dislodge and become a hazard.
- Fluctuating water levels can produce slippery surfaces on the shoreline.
- Fluctuating water levels may create changes in ice conditions.

2.1.1.1.18 Upstream of Plant (Within Area of Hydraulic Influence)

In situations where upstream hydroelectric plants or spill structures are present specific hazards may be present:

- Sudden releases from upstream plants such as from a load rejection may cause rapidly changing water levels at the plant in question.
- Sudden increases in flows may cause debris to dislodge and become a hazard to boaters or other recreational users.
- Sudden releases from an upstream plant may cause unstable ice conditions.

2.1.1.2 Hazard Identification and Control Measures Checklist

A "Hazard Identification and Control Measures Checklist" is provided in Appendix A. As part of the initial site inspection, this checklist should be completed to identify and describe potential hazards and to compile a listing and description of control measures that were in place during the time of the inspection.

2.1.2 Interview with Plant, Site Supervisory and Maintenance Engineering Staff (Applicable for Existing Facilities)

Interviewing the personnel who deal with the structures on an ongoing basis can provide valuable insight to both the nature and extent of public interaction with the site. It can help identify oversights that may have been made during the initial site inspection and provide helpful input to the Hazard Identification.

One key aspect to this interview is the review of operating procedures. Operating procedures, especially those representing changes in flows and levels, should be assessed from the perspective of situations and locations involving public interaction at the facility. Work orders should be reviewed to compare the work order instructions to the procedures actually used. These may be the same in most cases, but if not, reasons for any differences should be solicited from the staff as there are often good reasons for discrepancies.

In any case, the interviewer should encourage the participants to have the freedom to share their knowledge, anecdotes and experiences and express their opinions. It should be made clear that this is an information gathering activity and that all information provided is important, especially from the people with first hand experience of public interaction.

In reviewing operating procedures from a public safety perspective, key items to consider are:

- The basis for spill operations or discharge events (i.e., local operation, remote control or automatic settings).
- Sluice gate opening increments and timing.
- Automatic triggers for sluice gate opening (e.g., high water level settings) and subsequent opening procedures.
- Limit switch settings on sluice gate opening.
- Integration of audible or visual alerts with sluice gate opening or stoplog removal.
- Requirements for pre-spill site inspections.
- Requirements for notifications to both downstream and upstream stakeholders and users.
- Hydroelectric generating unit start up procedures.
- Generating unit load rejection procedures and subsequent initiation of spill events.

The review of operating procedures should consider both time-of-day and seasonal patterns of operations which could affect the frequency, volume and timing of spill or discharge events. It should also take into account the time-of-day and seasonal patterns of public usage of the waterway. The review should be completed primarily for non-emergency events recognizing that under rare severe flood conditions there is likely to be less public interaction and room for event by event management of public interaction with the waterway.

2.1.3 Hydraulic Assessment

While not required in all circumstances, a hydraulic assessment can assist in identifying the extent of the zone of influence of the structure. This includes hazards that are created specifically by Xeneca operations that cause changes in levels and flows, with considerations given to the magnitude and rate of each. Velocity changes due to constrictions and geometry variations must also be examined within the zone of influence. The zone of influence consists of the area around the structure up until the point where the hydraulic conditions stabilize and become essentially unnoticeable to the public.

Hydraulic assessments can be based on the results of actual flow tests or numerical models. They should be considered to understand conditions in instances where:

- Remotely operated or automatic sluice/spillway gate openings are performed creating the opportunity for the release of large amounts of water.
- Downstream or upstream constrictions have been identified in the channel and the effects of water levels and velocities are unknown.
- The spillway channel and/or river bed are normally reduced to no flow or “dry conditions” in order to understand the priming characteristics of the downstream areas.
- Rising water levels present the possibility of stranding the public on “islands” in the river channel.

The hydraulic assessment should include an evaluation of velocity and water level changes created by corresponding changes to sluice gate opening or stop log removal. This can be used to establish increments that either eliminate the hazard posed by spill operations, or provide sufficient time for members of the public to safely vacate the affected area. These results can be used to establish timing for audible alerts or visual warnings.

A hydraulic assessment is often based on a range of flows. In planning a hydraulic assessment, consideration should be given to simulating flows which represent a reasonable worst-case scenario where the public may be reasonably expected to have interaction at the site.

The results of the hydraulic assessments should be documented with the following considerations:

- antecedent conditions;
- discharge rates;

- water levels and velocities;
- visual observations; and
- photographic records.

2.1.4 Public/Stakeholder Meetings and Consultations

Public/Stakeholder meetings and consultations are usually conducted after the initial SSWPSMP has been developed (for existing facilities or proposed new facilities). The purpose of the Public/Stakeholder Meetings and Consultations is primarily to provide information to the Public and Stakeholders about the program that is in place and what measures have been put into place to enhance public safety around a dam or are planned to be put in place for facilities that are proposed to be constructed (both during the construction phase and when in operation). Secondarily, it provides a forum for feedback from the stakeholders which may be useful in future versions of the SSWPSMP.

It is beneficial to conduct a 'Town Hall' or 'Public Consultation' type meeting with key stakeholders present, including Xeneca staff, local municipal staff, downstream land owners, downstream users and other interested parties. Xeneca staff will have knowledge of the historical patterns of public interaction and facility operation and stakeholders can identify areas of use and the level of usage. Discussions should take place on past incidents or “near misses” which may have occurred at the site and the results of the site inspection and operating review. This discussion should be accompanied by a presentation by the primary developers of the SSWPSMP. This may consist of posters showing the hazards identified and existing or proposed mitigation and control measures. This will facilitate the discussion for the further identification and reinforcement of key features of public interaction. This procedure may elicit information about undocumented incidents and undocumented points of interest on the site drawing, as well as catch areas that may be overlooked due to transient or unrecognized conditions. Results can provide direction regarding the need for further assessment and requirements for control measures.

2.2 RISK ASSESSMENT

The risk assessment process involves a systematic review of each identified hazard, its potential impacts on the public and the assignment of a risk rating to the hazard. This risk rating is a measure that depends on the assessed probability of a hazard occurring and the consequences if it were to occur.

A risk assessment can be both qualitative and quantitative in nature. A qualitative risk assessment presents and describes the probability and potential consequences of a hazard in detail without assigning specific numbers to them. Ratings can be adjusted to suit the circumstances with different descriptions used for each risk. This is a particularly beneficial analysis when evaluating risk for something that is not tangible. A quantitative risk assessment assigns numerical values to probability and consequence, whose reliability determines the quality of the risk assessment. The quantification measures can be defined specifically to the project of interest, with the main purpose of developing a method to prioritize risks and mitigation measures.

A semi-quantitative risk assessment should be performed for assessing the risk of waterway public safety hazards. Semi-quantitative risk assessments are used in many industries for various purposes. They allow the assessor to assign values to the scale in which a qualitative assessment is made. This assists in the graphical presentation and understanding of the results. Unlike a purely quantitative risk assessment, the values on the scale are not exact. They rely upon the experience of the assessor drawing upon similar experiences elsewhere. The assigned values for probability, therefore, must be interpreted as order-of-magnitude estimates only and used with the knowledge of their limitations. They will still allow the user to provide prioritization when dealing with hazards. They can be used to guide appropriate measures for mitigation, with the end result leading to a qualitative reduction in their risk level.
An appropriate risk assessment rating for a particular hazard will depend on the nature of the hazard, however it is also very important to consider the following circumstances:

- Nature of public access.
- Identifying the routes by which the public can access hazardous areas will help to determine the best locations and orientation for signage and locations for physical barriers. The popularity of the area and ease of access can also determine the amount of exposure the public has to certain hazards.
- Ability of the public to recognize the hazard.

- The degree to which the public might recognize or choose to ignore a hazard and the possible danger it presents must be considered when managing the risk. For example, the public may associate spill operations with rainfall or snowmelt events, but not with changes in generation or earlier precipitation events in upstream areas of the basin which also result in spill operations. The public may become used to daily or seasonal changes in operation such as a daily peaking operation at a power plant, so a deviation from these changes may require more warning. Another example is when spill operations are only conducted occasionally, recreational users may not immediately recognize the danger that spillway opening sirens represent.
- The nature of public exposure can be determined through the assessment of the frequency and likelihood rating and consequence rating for the hazard. This assessment is described as follows:

2.2.1 Frequency and Likelihood Rating

The frequency and likelihood rating presented here is a qualitative measure of the probability of the public being associated with an incident involving the hazard. Being associated with an incident involving a hazard is defined as either actually suffering an injury due to the hazard itself or encountering a 'near miss' where it appears that good fortune alone prevented interaction with the hazard.

For the purposes of helping the assessor , determine a reasonable frequency and likelihood rating, two scales are presented:

- The number of public visits per year can be estimated based upon the experiences of local staff or for the cases of proposed new facilities in consultation with stakeholders familiar with the public traffic and activities in the vicinity of the proposed new facilities.
- The number of documented exposures to the hazard and an estimate of the number of undocumented exposures to the hazard can be used. For the case of proposed new facilities the number of expected exposures to the hazard over a certain period of time can be used.

Either of these scales may be used along with Table 2.1 to provide a reasonable rating for frequency and likelihood. It is recognized that for the initial development of a SSWPSMP, the estimates will be far from exact but order of magnitude estimates should suffice. Contact with local residents, clubs and parks administration can help to determine the annual number of public visits to an area and the types of activities in which the public might be expected to engage, such as fishing, boating, sightseeing, hiking or vandalism. As the program matures and more documentation is collected, these estimates should be refined.

These two measures should be roughly equivalent but in cases where good information is available for both, the one that provides the highest rating should be adopted.

Table 2.1: Frequency and Likelihood of Incidents Involving the Hazard

Rating	Description	Frequency of Public Presence (Visits/Year)	Frequency of Incidents Involving the Hazard (Including 'Near Misses')	
		Existing Facilities	Existing Facilities	Proposed New Facilities
5	Very Frequent	Very high probability of exposure. More than 1000 visitors in any one of the last 5 years.	More than 10 known incidents involving the hazard in any one of the last 5 years.	Expect more than 10 incidents involving the hazard in any one of the first 5 years in operation
4	Frequent	High probability of exposure. Between 100 and 1000 visitors in any one of the last 5 years.	2-10 known incidents involving the hazard in any one of the last 5 years.	Expect 2-10 incidents involving the hazard in one of the first 5 years in operation.
3	Occasional	Moderate probability of exposure. Between 50 and 100 visitors in any one of the last 5 years.	One known incident involving the hazard in any one of the last 5 years.	Expect one incident involving the hazard in one of the first 5 years in operation.
2	Infrequent	Low probability of exposure. Between 10-50 visitors in any one of the last 5 years.	Any known incident involving the hazard within the lifetime of the project.	Expect an incident involving the hazard within the lifetime of the facility being in operation
1	Remote	Very low probability of exposure, but not impossible. Between 0-10 visitors in the last 5 years.	No known incident involving the hazard.	No incident involving the hazard expected to occur.
0	Impossible	No recorded activity in this area and no access to area.	No possibility of an involvement with the hazard without severe effort.	No possibility of an involvement with the hazard without severe effort.

2.2.2 Consequence Rating

The consequence rating presented in Table 2.2 is a qualitative measure of the expected result if one were to be associated with an incident involving a particular hazard. The consequence rating is based on the **expected maximum** severity of potential injury should the hazard occur. A more negative consequence results in a higher rating on a scale of 1 to 5.

Table 2.2: Consequences of Incidents Involving the Hazard

Rating	Description	Likely Consequences of an Incident Involving the Hazard
5	Catastrophic	Fatality.
4	Major	Injury relating to permanent partial or total disabilities.
3	Significant	Serious injury requiring medical treatment at a hospital or nursing station.
2	Minor	Minor injury requiring first aid or intervention by rescue operations such as in a stranding incident.
1	Negligible	Little or no injury, no medical attention required.

2.2.3 Risk Rating

The frequency/likelihood rating combined with the consequence rating constitute the risk rating, which is qualitatively measured in Table 2.3 as an “Extreme”, “High”, “Moderate” or “Low” risk.

Table 2.3: Risk Rating

Likelihood	Consequences				
	1	2	3	4	5
	Negligible	Minor	Significant	Major	Catastrophic
5 Very Frequent	Moderate 5	High 10	High 15	Extreme 20	Extreme 25
4 Frequent	Low 4	Moderate 8	High 12	High 16	Extreme 20
3 Occasional	Low 3	Moderate 6	Moderate 9	High 12	High 15
2 Possible	Low 2	Low 4	Moderate 6	Moderate 8	High 10
1 Remote	Low 1	Low 2	Low 3	Moderate 4	Moderate 5
0 Impossible	Low 0	Low 0	Low 0	Low 0	Low 0

The risk assessment process must be completed by at least two people in a group setting, to ensure that agreements are made on frequency/likelihood, consequence and the ultimate risk ratings. Any hazards resulting in disagreements shall be discussed further with alternate experts in the field who may have more insight on the nature of the hazard.

2.2.4 Effect of Control Measures on Risk Rating

In Chapter 3, methods of mitigating or eliminating the risk a particular hazard poses to the public are introduced.

Table 2.3 shows the two ways to reduce the risks posed by a hazard:

1. Reduce the consequences of exposure to the hazard (e.g. change the hazard).
2. Reduce the likelihood/frequency of being exposed to the hazard (e.g. restrict access or provide awareness of the hazard).

The consequence of a hazard can be reduced by changing or modifying the hazard itself. This can be a serious challenge to implement on existing systems that are in service. Therefore, when mitigating hazards at an existing site, it is generally simpler to implement control measures to reduce the frequency/likelihood of an incident involving the hazard, thus reducing the risk rating of a hazard.

For facilities that have not yet been constructed, modifications to the proposed design may be warranted to reduce or eliminate the consequence of a hazard.

Determining the effect that each control measure has on the likelihood and frequency rating or consequence rating of a hazard is subjective. It can, however, be determined qualitatively through the use of past experiences with similar control measures. For this reason when determining the effect of a control measure on the risk rating (more likely the likelihood and frequency rating) of a hazard it is recommended that consensus be obtained by a minimum of two people with appropriate experience.

2.2.4.1 Risk Assessment Spreadsheet Tool

A simple Hazard Risk Assessment worksheet is provided in Appendix B and should be used to facilitate the risk assessment process when developing the SSWPSMPs for each structure. This methodology and the associated spreadsheet is based upon the risk management model presented in the internationally recognized risk management standard AS/NZS ISO 31000:2009 – Risk Management. This spreadsheet includes requirements for documenting the location of the hazard, the hazard itself, references to photos of the hazard, the cause, the likely consequence and its associated consequence rating. As examples two lines have been completed in the spreadsheet provided in Appendix B.

The ability of the existing controls and safeguards to meet mitigation requirements are also inputted and assessed for each of the identified potential hazards, in order to obtain a current frequency and likelihood rating. The input of the frequency/likelihood with the existing safeguards in place will produce a current risk rating.

If the current mitigative safety measures are not deemed to provide adequate protection (i.e. bring the hazard to a "Moderate" or "Low" risk rating), additional safety measures needed to bring the area to an appropriate level of safety must be determined. A number of suggested possible mitigative safety measures are presented in Chapter 3. The implementation of safety measures and their corresponding effect on the likelihood of the consequence are also included in the Hazard Risk Assessment worksheet, and are discussed in Chapter 3 "Control Measures".

Once the initial risk rating is established, for existing facilities in operation, the action described in Table 2.4 should be taken in accordance to the risk assigned. For proposed new facilities, the design of the structures and proposed control measures should be such that all risks are rated "Low".

Table 2.4: Risk Response

	Suggested Action	**Suggested Timing**
Extreme Risk	No activity should be allowed in the area until action is taken to mitigate the hazard to a moderate or low risk, or public exposure is prevented on a permanent basis.	Immediate
High Risk	The risk should be reduced to a moderate or low risk as quickly as possible.	Short term (1-3 months)
Moderate Risk	Action plans should be developed and carried out under the regular maintenance schedule.	Medium term (3-6 months)
Low Risk	There is likely no action required.	Normally no action

The risks involved should be ordered and prioritized further as to their relative urgency and importance for mitigation.

Chapter 3
Control Measures

3.0 CONTROL MEASURES

3.1 CONTROL MEASURES

A Control Measure is a means intended to mitigate or eliminate the risk a particular hazard poses to the public.

Prior to determining the appropriate action to be taken for each hazard, a comprehensive list of all safety measures currently in place must be compiled (see Appendix A – Hazard Identification and Control Measures Checklist). These measures should be included in the inventory of Control Measures section of the SSWPSMP and documented in the risk assessment for each site. The inventory in the Control Measures section should include a detailed analysis of the existing Control Measures, including:

- proper location of each device, shown on site plans,
- any additional documentation that is required to accompany a device (i.e. WHMIS, operation and maintenance instructions, etc.), and
- purchasing, repair and replacement records.

The following represents the hierarchy and the context in which Control Measures should be considered:

1. **Eliminate the hazards**: Removing the potential hazard from the area in question is always the best method of dealing with it.
2. **Mitigate the hazards**: Changing the way structures are operated (i.e. altering the speed at which spillways are opened or the order in which spillway gates are opened) or physically altering the locations to reduce the hazard (i.e. flattening steep slopes, providing standardized hand railings) is the next most desirable way of dealing with a hazard. These measures tend to be the most effective and result in the least impact on both the public and Owners.
3. **Physical Barriers** to deter access by the public from hazardous areas (e.g. fences, safety booms, guardrails). These methods are very effective but they negatively impact the public use of the areas posing a hazard. Because of this they tend to be unpopular and are subject to public protests and vandalism. However, for "High" risk hazards that cannot be eliminated or mitigated this may be the only appropriate option.

4. **Public Warnings** of hazards (e.g. through appropriate signs, buoys or audible alerts). Warnings tend to be less effective than the physical Control Measures but are appropriate for “Moderate” risk hazards and some “High” risk hazards where physical control methods are not possible or practical. Some form of public warning should accompany all physical Control Measures.
5. **Public Education** of the hazards associated with the operation of dams and generating stations. This type of response should be part of every hazard mitigation plan. It doesn't represent a control measure per se, but can help in reducing public exposure to hazardous areas over time, as the public becomes more aware of hazardous situations. It should not be relied upon to reduce the likelihood or consequence rating of a hazard but should be used in combination with one of the other mitigation measures that reduces a hazard risk to a “Moderate” or lower level.
6. **Emergency Response Provisions** (e.g. escape measures, such as ladders, ramps or life preservers). This is the least desirable and effective response because it requires the person to be exposed to the hazard before they can be activated. They should only be considered as a fail safe for “Extreme” or “High” risk hazards once they have been reduced to a “Moderate” or “Low” rating using other types of measures.

The selection of an appropriate control measure can be done through utilization of the Hazard Risk Assessment worksheet developed during the risk assessment process (see Appendix B). The implementation of a new control measure or mitigation strategy, when required, will produce a new likelihood or consequence rating for the hazard, and might therefore reduce the overall risk rating. In this manner, it is possible to view the results of implementing particular Control Measures and determine if they are sufficient or worthwhile to implement. If it is found that the new control measure does not reduce the risk to an acceptable level, such as a “Low” or “Moderate”, alternate measures can be tested through the Hazard Risk Assessment worksheet to determine the best choice. Xeneca shall review and confirm the acceptable risk tolerance for each hazard.

3.2 REDUCING RISKS

As noted previously in Chapter 2, there are two ways to reduce the risks posed by a hazard:

1. Reduce the consequences of exposure to the hazard (e.g. change the hazard).

2. Reduce the likelihood/frequency of being exposed to the hazard (e.g. restrict access or provide awareness of the hazard).

The consequence of a hazard can be reduced by changing or modifying the hazard itself. This can be a serious challenge to implement on existing systems that are in service. Therefore, when mitigating hazards at an existing site, it is generally simpler to implement Control Measures to reduce the frequency/likelihood of exposure to a hazard, thus reducing the risk rating of a hazard.

Professionals who practice in the area of risk assessment/risk reduction generally argue that a risk should be reduced to a level where it can be accepted, and have termed this reduction in risk as “ALARP” or “As Low As Reasonably Practicable”. For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. If a risk can not be accepted by Xeneca, then additional Control Measures should be employed until the risk rating can be accepted. This reduction in risk can be based on many different factors, but in the context of this plan, the primary concern is the risk to public safety. To this end the risk rating system has been developed (see Chapter 2) against which each risk can be judged.

This rating system is based on Xeneca’s level of risk acceptance, also known as risk attitude or risk preference. In this case it has been determined that Xeneca and Dam owners in general are relatively risk averse. This is with good reason because the consequences of many of the risks posed by Dam and Hydraulic Structures can be severe. For this reason. it is recognized that it is a priority to try to eliminate as many risks as possible, or reduce existing risks to a “Moderate” or “Low” level.

Other industries may be more risk tolerant and are therefore willing to take on more risk. The middle ground between these two extremes is risk neutral. Each industry and company must judge their own acceptance level and act accordingly.

The risk rating system developed for Xeneca should be used as an overall governing system to form a baseline for risk evaluation. This system provides a framework preventing any one individual's opinion from unduly influencing the risk evaluation process.

3.3 SELECTION OF APPROPRIATE CONTROL MEASURES

In developing a SSWPSMP, each hazardous area identified must be reviewed to see whether it can be better managed. If it has been determined through the risk assessment that Control Measures are required, and as noted previously in Section 3.1, the measures described below should be considered in the following order of preference:

1. Elimination of Hazards.
2. Mitigation of Hazards.
3. Physical Barriers.
4. Public Warnings.
5. Public Education.
6. Emergency Response Provisions.

The following subsections present the types of Control Measures that can be implemented, in order of decreasing effectiveness and desirability. This is not intended to be an exhaustive list, but should provide guidance to the reviewer. Specialized Control Measures may be required for unique situations. As long as it can be demonstrated that they are effective, innovative Control Measures not mentioned below are acceptable.

3.3.1 Elimination of Hazards

In some rare cases it may be feasible to eliminate the hazard altogether. For instance, an underwater obstacle can be removed or a public boat launch can be relocated to a more suitable location. This is the most desirable method of dealing with a hazard from a public safety perspective because it removes the possibility of exposure to and consequences from a hazard. Unfortunately, when dealing with Dams and Control Structures complete elimination of the hazard is often impossible and other options must be considered.

3.3.2 Mitigation of Hazards

When elimination of a hazard is not possible the next set of Control Measures to consider are those that can mitigate the effects of the hazard. These measures involve either changing the hazardous area itself or the practices that pose or exacerbate the hazard. The following subsections describe some of the mitigation options that may be available. For proposed new facilities these mitigation options are to be incorporated into the proposed design and operating practices.

3.3.2.1 Altering Hazardous Areas

Particularly hazardous areas can sometimes be altered to reduce or remove exposure to the hazards. Examples of this are regrading steep slopes, providing safe fishing platforms that are above rocky areas, or raising low lying areas so they will always be above the high water line. As with Elimination of a Hazard, the opportunity and feasibility of using these types of measures is a relative rarity but should be considered wherever possible for both existing facilities and proposed new facilities.

3.3.2.2 Changing Facility Operating Practices

Changing operating practices can be a very effective means to mitigate public safety hazards. Based on a hazard assessment, site-specific operating procedures for dams and hydroelectric facilities need to consider such factors as:

- defining rate of change of sluice gate opening during spill operations to provide warning time to the public;
- providing a recognizable sequence and duration of audible and visual alert signals to warn the public;
- requiring that visual observations (on-site or via surveillance cameras) be made of certain hazards prior to initiating spill or unit generation except in a dam safety emergency (i.e. imminent overtopping); and
- requiring that specific notifications be made to the public and/or key downstream stakeholders of impending spill or dam operations, for certain hazards.

These factors need to be addressed in a hazard assessment and where appropriate, documented in the SSWPSMP and integrated into the site operating procedures. The following describes specific strategies that may be employed for different aspects of facility operation:

Sluice Gates

The area downstream of most underflow type sluice gates will be assigned a hazard rating of “High” or “Extreme”, simply because of the speed with which they can be opened and the force and velocity of the water that can be discharged at small gate openings.

For these reasons, regardless of whether the sluice gate is operated under remote, automatic or local control:

- All sluice gates should be opened in increments so as to provide sufficient warning to persons who may be in the spillway channel, allowing them to safely exit.
- An audible alarm should sound prior to, and during the initial opening of all sluice gates as they are raised from the sill. This must be accompanied by appropriate signage defining what the warnings indicate.
- After the initial opening, an audible and/or visible warning should be used for any additional gate movement that creates a marked increase in water level or flow in the spillway channel. This must be accompanied by appropriate signage defining what the warnings indicate.
- With the exception of an emergency affecting downstream reaches, consideration should be given to operating the sluice gates in conjunction with the presence of observers or video monitoring to oversee the public presence in the affected area.
- The opening increments should be determined based on the site-specific hydraulics of the spillway channel, taking into account the reasonable time for a person to safely exit the area. This can be determined through use of a hydraulic model but it is normally simpler to conduct testing in the field during a period of low public presence.

Guidelines and directives for sluice gate operations and the warning systems should be documented in the SSWPSMP and integrated into site operating procedures.

Stoplog Spillways

Stoplog controlled spillways tend to require more time to operate than sluice gates and initially discharge much less flow at a lower velocity. The reason for this is that stoplogs must be removed one at a time from the top of the gate, therefore less head is acting on the spillway at the beginning of the opening. This results in the downstream area often being classified with a “Moderate” or "Low” rating.

However, for stoplog spillways where the downstream channel has been assessed with a “High” or “Extreme” hazard rating, and the entire Dangerous Waterway Zone is not clearly visible from the structure:

- An audible warning device should be used prior to removing the stoplogs for spill operations. These must be accompanied by appropriate signage defining what the warnings indicate.
- With the exception of an emergency affecting downstream reaches, consideration should be given to removing stoplogs in conjunction with the presence of observers or video monitoring to oversee the public presence in the affected area.

Guidelines and directives for stoplog operations should be documented in the SSWPSMP and integrated into the site operating procedures.

Unit Start-up

When the powerhouse units start up and shut down, gate operation can create dangerous flow patterns in both areas downstream and upstream of the units. These flow patterns can be even more hazardous than those created by spill operations. The reason for this is the flow conditions can change extremely rapidly with very little prior indication that this is happening. Depending on the sequence in which the units are operated, complex and powerful eddies can be formed in the downstream channel that are not easily anticipated. In the reservoir upstream of the powerhouse, there may be little or no indication that the currents have changed or increased, and are now posing a particular danger to boaters in the area.

For reservoir and tailrace areas that have been assessed with a “High” or “Extreme” hazard rating and based on a hazard assessment assessing the need for each, the following actions should take place during unit operations:

- An audible and/or visible alarm should sound prior to, and during, the initial unit start up when the gate is opening. These must be accompanied by appropriate signage defining what the warnings indicate.
- After the initial opening, an audible alarm should be sounded for each gate opening for each unit.
- In some cases where the structure is in close proximity to communities/residences, the frequency of audible alarms may create a significant nuisance. In these cases, consideration should be given to using strobe lights and/or directed sound alarms.

- Consideration should be given performing unit start ups with the presence of observers or video monitoring to oversee public presence in the affected areas.
- The rate and sequence of unit operation should consider the upstream and downstream impact on hazardous areas with respect to changing water levels, rates of discharge and dangerous flow patterns. These phenomena should be examined based on the site-specific hydraulics of the tailrace channel, taking into account the reasonable time for a person to safely exit the area. This can be determined through use of a hydraulic model but it is normally simpler to conduct testing in the field during a period of low public presence.

Guidelines and directives for unit operations and warning systems are to be documented in the SSWPSMP and integrated into the site operating procedures.

3.3.3 Physical Barriers

Physical Control Measures are to be considered once it has been determined that the hazards can not be sufficiently mitigated through altering the area or through operational strategies.

Physical Control Measures at a facility should be designed to function as a complete system to clearly delineate the dangerous areas around the facility. The following subsections describe types of physical barriers that can be employed.

3.3.3.1 Waterway Restrictions

The public has a right to access all navigable waters as defined under the Navigable Waters Protection Act (NWPA). As nearly all dams and hydroelectric facilities are located on navigable waterways (with the exception of certain intake canals), public safety Control Measures must be developed to accommodate those navigating the waterway.

The legal limits of this access are discussed in the Transport Canada Safe Boating Guide. In this document, it states "Boat operators should be cautious near canal dams and waste weirs where currents and undertows can be very dangerous. It is illegal to jump, dive, scuba dive, swim or bathe within 40 m (131 ft) of a dam". This means that Xeneca personnel have the right to inform the public of this law and call law enforcement if they find that people are in the water within the 40 m buffer.

If it is impossible to reduce a hazard's risk rating by altering the hazard or changing operating practices, then the next best option is to restrict access to the hazardous area. There are several tools that can be used to provide different layers and levels of protection:

- fencing and barricades,
- buoys defining potentially hazardous areas,
- booms to discourage access to potentially hazardous areas,
- boat barriers to restrict access to potentially hazardous areas,
- suspended safety cables,
- culvert gratings,
- canoe/kayak portages, and
- boat ramps.

Depending on the specifics of the situation, one of the above options or a combination of the options may be selected. In the case of hazardous areas that are not on Xeneca property, the land owner should be contacted for permission to apply these measures in accordance with Section 3.4. Depending on the location it may also be required to apply to Transport Canada to legally designate the waters in an area as restricted from boating or fishing.

The SSWPSMP should include a site plan indicating the location of all booms, buoys and designated areas where the rights to navigation have been restricted. The location of signs is relatively straightforward in terms of the installation, although approvals from land owners may be required to place signs on properties not owned by Xeneca. The location of buoys and booms requires an application to be made under the NWPA, and may potentially be reviewed by Ontario Conservation Authorities if anchoring to the bed of a river or reservoir. In order to have the area designated as restricted from boating, an application needs to be made under the Canada Shipping Act to restrict the rights to navigation. There are several steps involved in this process. Information on the process for making applications under both the NWPA and the Canada Shipping Act is available from Transport Canada.

3.3.3.2 Fencing and Barricades

Fencing and/or barricades can be used to control access to dams and hydroelectric facilities. They should be used to provide a barrier to protect the public from hazardous areas on Xeneca property, or crown land occupied by Xeneca, in the following cases:

- where there is a risk of a vertical fall of over 3.0 m;
- along the steep banks of a power intake canal or tailrace channel;
- at locations of high and/or turbulent water flow caused by water conveyance structures;
- at access points to water conveyance structures; and
- to prevent access to flow control equipment (e.g. those required to operate sluice gates, penstock valves, log lifters, etc.).

The SSWPSMP should include a site plan indicating the location of all fencing and barricades used in the above applications.

A simple barricade (e.g., handrail) may provide adequate restrictions from an obvious hazard (for instance, a vertical fall). One must take into account the reasonable likelihood of someone attempting to climb over or through the barricade and the level of hazard to which they could be exposed. Through the risk assessment process, if a barricade is determined to be inadequate to control access, fencing should be installed that meets the requirements of Xeneca.

When installing fencing and barricades, consideration should be given to integrating the fence and barricade with other physical barriers at the site (e.g. safety booms in place at the entrance to a canal, concrete abutments) to provide a continuous line of protection. In the case of barricades or vehicle gates used to restrict public access to Xeneca property, they should be constructed and installed so as not to create additional hazards. Reflective tape or signs should be installed upon the barricade or vehicle gate to aid in reasonably identifying it. “No Trespassing” signs should be installed at the Xeneca vehicle access points and at intervals along perimeter fencing to ensure that at least one sign is visible at all times. Signs should also be considered for warning the public in advance of them coming upon the barricade or vehicle gate. The Transportation Association of Canada – Geometric Design Guide for Canadian

Roads (1999) suggests that signs used to pre-warn the public of a gate/barricade should be placed where there is less than 65 m clear line of site on access roads with less than 50 km/hr speed limits, and 170 m clear line of site for access roads with a speed limit of 90 km/hr.

Technical Requirements for fencing and barricades are contained in Appendix C.

3.3.3.3 Safety Booms and Buoys

Safety booms and buoys should be designed and installed to meet the requirements of the Canadian Private Buoy Regulations, Navigable Waters Protection Act, and Canadian Coast Guard Regulations. The CDA Technical Bulletin: Booms and Buoys for Public Safety Around Dams (2011) provides guidance on when and where safety booms and buoys should be installed to mark the extent of dangerous water areas around dams.

Safety Booms

Booms are generally made up of the following components:

- horizontal floats;
- connection hardware;
- anchors; and
- buoys.

Booms are meant to serve the following functions:

- provide a visual and physical warning of a designated Dangerous Waterway Zone;
- act as a physical restraint device for stranded boaters or swimmers to prevent them from entering the Dangerous Waterway Zone; and
- promote self-rescue of stranded boaters and swimmers due to its orientation and shape.

Approval by Transport Canada under the Navigable Waters Protection Act must be obtained prior to the installation of any boom, unless it can be shown that such approval is not required.

The ends of booms should be in line with Dangerous Waterways signs installed along the shoreline to create a continuous “barrier” from shore to shore. The intent is that a boom should be located a sufficient distance beyond the Dangerous Waterway Zone to provide protection.

In general design requirements for standalone safety booms (not modified Debris booms) are as follows:

- In accordance with Transport Canada requirements for approval under the Navigable Waters Protection Act, the colour of the booms shall be yellow. The Canadian Coast Guard uses the following colour standard - U.S. Federal Standard for Government Procurement, Colors Vol. 1, FED-STD-595B, Colour Specifications, Yellow #13655).
- They should be UV and abrasion resistant.
- Individual boom floats should have at least 30.5 cm (12 inches) of freeboard in still waterconditions and be at least 60 cm (24 inches) in length.
- Individual boom floats should be foam filled to prevent sinking if punctured.
- For upstream safety booms, the spacing between the individual floats of a safety boom should be a maximum of 3 m (10 feet) to aid in preventing the passage of boats.

Debris Booms

Debris booms are typically not coloured and are designed to float low in the water, which may present visibility problems for boaters. It is therefore recommended that debris booms intended to remain in place during periods of navigation be appropriately delineated in the water by the use of buoys. Buoys can either be installed immediately upstream, or as part of the debris boom, to warn boaters of the location. Similarly, if a debris boom is properly oriented and a sufficiently safe distance upstream of the structure it may be modified for use as a safety boom through the installation of buoys.

Buoys

Buoys are made up of similar components to booms except that they are not connected together.

The general function of a buoy is as a visual warning of a designated Dangerous Waterway Zone. Being individually anchored however they do not serve the same purpose of a boom in being a barrier or restraint. They can be used as a platform for signage, as discussed in Subsection 3.3.4. Site-specific conditions will govern the exact location of the safety buoys.

When used in conjunction with a boom, buoys should be either part of the boom or located immediately in front of the boom on the "public" side. In this case buoys are intended to improve the visibility of the boom and provide a means of communicating the location of the boom.

Upstream Installation

Where the waterway has unrestricted access to boating (i.e., the right to navigation has been established through the Canadian Shipping Act) and a hazard assessment indicates a need, it is recommended that an upstream safety boom be installed to delineate the Dangerous Waterway Zone in the following instances:

- Upstream of overflow spillways.
- Upstream of sluice gates and stoplog spillways.
- Upstream of intakes where there is an adverse risk rating. (Note: an exemption for this item exists if a hydraulic assessment determines that the worst case scenario surface flow rate does not present a hazard to boaters or swimmers, as can occur with submerged intakes. If this is the case it should be documented in the SSWPSMP).

It should also be noted that in reservoir settings where an extremely long continuous span would be required, it may not be feasible to install and maintain a safety boom due to the complications with in water anchors during the winter months. In this case, a series of anchored buoys with appropriate signage (as described in Subsection 3.3.4) may be a more effective option.

Downstream Installation

It is recommended that downstream booms and buoys be installed if a hazard assessment indicates a need and the area meets the following requirements:

- It is a Dangerous Waterway Zone that experiences significant change from relatively calm conditions to turbulence.
- It poses a hazard to navigation.
- Water level is sufficient at all times to provide continuous floatation (i.e., to avoid "grounding" of the boom or buoys).
- It is a tailrace or spillway channel used for navigation that is assessed as a "Moderate" safety risk or above based on changing conditions.

When booms and buoys are required, booms are preferable to buoys (where practical) as they provide a continuous barrier. However, it is recognized that both booms and buoys have performance issues in turbulent flows associated with tailrace and spillway channels. Due to these performance issues, booms and buoys are not recommended for use in highly variable or turbulent flows unless specifically required by Transport Canada.

Seasonal Considerations

Due primarily to ice and flow conditions, safety booms and buoys sometimes it is not practical for them to be left in place year round. In these instances, it is recommended that they be installed at the beginning of the normal boating season and removed prior to ice formation in the waterway. While it is recognized that this can vary depending on the location in the province, the period can generally be defined as being from mid-May to mid-October. The timing for installation and removal should be defined in the SSWPSMP. During installation and/or removal of booms and buoys, reasonable precautions should be taken to ensure that additional hazards are not presented to the public.

Unusual ice conditions or other circumstances may necessitate removal or installation of the booms and buoys outside of the prescribed schedule. Other circumstances could include unusually high temperatures in the spring. Should such conditions occur, the SSWPSMP should be reviewed and appropriate interim measures should be instituted to minimize the hazard to the public, if required.

During winter storage the booms are to be secured and appropriately marked so as not to present a hazard to the public.

3.3.3.4 Boat Barriers

In the case where hazards are particularly extreme, boat barriers should be considered as an alternative to buoys and booms to provide a greater degree of security through the implementation of barriers that can not be bypassed as easily. A boat barrier is generally a security boom made up of much larger boom units or that has a fence mounted on top of it to severely restrict a possibility of a boat from bypassing it. As a caution it should be noted that these types of barriers can cause severe damage to a boat that hits them at speed so they should be used only where absolutely required.

Spilling water creates hazardous areas for boaters and canoeists in the recreational area around dams, and may require the installation of boat barriers. These hazardous areas include:

- free-flow spillways,
- uncontrolled spillways,
- gated structures where the spill is over the gates (bascule or similar gates),
- channels that lead to spillways or other potentially dangerous areas,
- the upstream end of hazardous overflows that are difficult to see, and
- downstream of dams, where boaters may require prevented access to keep them from entering unsafe areas (especially if booms have been ineffective at this task).

However, boat restraining barriers are not required at projects under the following circumstances:

- Bridges or other structures that constitute an adequate physical barrier.
- Hazardous flows and conditions that do not occur at the project site during boating/canoeing season.

It must be verified through historical operating records and recorded information provided by the dam or control structure's owner if boat restraining barriers are to be dismissed as an option due to hazardous flows and conditions. The same procedures apply for safety booms, as described in Subsection 3.3.3.3.

The buoys and floats supporting boat barriers should be marked with signs and symbols that provide a warning to boaters approaching dams. The barriers also serve to mark off and identify hazardous areas. Warning signs should be installed on the dams to identify and warn of the hazards in order to help boaters understand why they are being restricted by the boat barriers. During winter periods, boat barriers may not be visible or may need to be removed to prevent ice damage. Therefore, signs may provide the only means to warn boaters, skiers, or snowmobilers of the hazardous areas and conditions.

The effectiveness of each installation should be evaluated on a case-by-case basis. Where necessary, to avoid excessively long barriers, anchors can be placed in the reservoirs to facilitate installation. It is important to determine the proper location of barriers at each dam. They should be located an adequate distance upstream to be free from the heavy currents upstream of open gates and intake areas. Cables or barriers located on pier noses and over spillway crests are often of little value because the currents are usually too strong in these areas. The placement of boat barriers should be studied and tested to ensure that they will be effective when gates are opened and under high flow conditions. Xeneca should pay particular attention to the effectiveness of barriers if high flows occur during an inspection. The determination of the need for and placement of a boat barrier still varies and requires a case specific assessment at each dam.

The effectiveness of many existing barriers can be improved by making the barriers more visible, spacing the floats closer together, tightening the cables, and/or placing the barriers at the optimum distance from the dam. Specially designed floats can help to minimize debris accumulation. In some cases, dam owners have provided spotlights that illuminate the barriers at night. The colour of the floats on boat barriers is should be yellow as for the safety booms.

3.3.3.5 Suspended Safety Cable

In cases where it is not possible or practical to install floating safety booms, it may be possible to install a cable suspended above the water. The purpose of a Suspended Safety Cable is to:

- warn or prevent boats from entering power intake canals or tailrace discharges from the draft tubes,
- provide a visual warning of a designated Dangerous Waterway Zone by being located a sufficient distance from the hazard,
- act as a physical restraint device for stranded boaters for either upstream or downstream applications and,
- promote self-rescue of stranded boaters due to its orientation.

There are several requirements that must be met by the cable installation:

- The cable is adequately marked with signage affixed to the cable so as to make it clearly visible.

- Suspended cables used for warning (i.e. not intended to act as a restraint) are to be suspended such that they do not impose additional hazards to boaters.

Care must be taken in the design of suspended cables, because a single suspended cable may not be readily visible and could pose a hazard to boaters. Provided the suspended cable barrier is affixed to the structure (e.g. between the tailrace piers), it is not required to be registered under the Navigable Waters Protection Act. However, where it is anchored to shore it needs to be registered in a similar manner as a safety boom to ensure the boating public is aware of the locations.

3.3.3.6 Gratings and Covers

Gratings or covers are required over all exposed stoplog sluices or other openings where there is a risk of the public inadvertently entering. Where gratings are installed, they should be either locked in place or of sufficient weight so as not to permit manual dislodgement. The grating is to be engineered for the loading it may encounter.

Culverts should be assessed to determine if protective gratings are required to prevent public access. Gratings are required where there are submerged openings or discharge points, or where they are required to prevent the public from passing through a fence to gain access to a hazardous area.

3.3.4 Public Warnings

If it is not feasible to reduce a hazard's risk rating by restricting access, then the next best option is to provide public warnings of the hazardous area. Public warning should also be used in conjunction with access restrictions in order to explain the purpose of the restriction and inform of the possible consequences should the public bypass the restriction.

There are several tools that can be used to provide public warnings of a hazard including:

- warning signage,
- audible and visual warning devices, and
- verbal announcements.

Depending on the specifics of the situation, one of the above options or a combination of the options may be selected. In the case of hazardous areas that are not on Xeneca's property or Xeneca's occupied crown land, the land owner should be contacted for permission to install these measures in accordance with Subsection 3.4.

The SSWPSMP should include a site plan indicating the location of all signage and warning devices and the warning conveyed.

3.3.4.1 Signage

Signage is one of the most effective means to notify the public of potential hazards which may be present. The following provides guidance in terms of the minimum requirements for the use of signs:

- All signs used by Xeneca should have a consistent approach to sizing, colour and format. Guidance in determining the wording, size, colour, format and material of these signs is provided in the Canadian Dam Association (CDA) Technical Bulletin: Signage for Public Safety Around Dams (2011).
- The colour red is to be used for "Danger" signs which are meant to indicate where there is a "High" or "Extreme" risk area.
- The colour yellow is to be used for "Warning" signs where there is a "Moderate" risk.
- The colour white is to be used for "Information" signs used for non-hazardous situations such as site or portage identification.
- Signage should be used to identify hazardous locations rated as a "Moderate", "High" or "Extreme" risks on Xeneca's property or Xeneca's occupied crown land and any public use areas.
- All waterway signs should be sized and placed so that they are readable by the public approaching the Dangerous Waterway Zone whether from the shore or from the waterway.
- Plants, grasses and trees that obstruct shoreline warning signs should be removed.
- A sufficient number of waterway signs within hearing distance of any applicable audible warning device and/or within sight of strobe lights should include wording which explains the purpose of the audible alarm and/or strobe lights.

- The SSWPSMP should include the following inventory information in regards to the signage:
  - site plans indicating the location of all signs, and
  - a listing which includes information regarding the overall size of the sign, the language, the pictographs, as well as the specific wording used on the sign.

- When selecting the appropriate sign some of the key considerations are:
  - Viewing distance for determining the size of the lettering and the overall dimensions of the sign itself (this is the primary deciding factor).
  - Pictographs should be included on all signs clearly identifying the hazard and the hazardous activities with a stroke through them. This is particularly important considering non-English speaking and functionally illiterate people that may be present at the site.
  - The degree of warning illustrated by the sign is to be commensurate with the hazard potential (e.g. use of the word “danger” vs. the words “extreme danger”).
  - All signs except those designated as small signs (i.e., less than 1.47 m^2 (16 ft^2) as per the CDA Signage Technical Bulletin should contain the name of the facility, and an emergency contact number or numbers to assist with response and rescue.

Location of Waterway Danger Signs

As a minimum, red waterway danger signs are to be installed:

- at the upstream and downstream end of the extent of the Dangerous Waterway Zone;
- at the land access point(s) to the water conveyance structure;
- at all other locations identified as having a “High” or “Extreme” risk rating on Xeneca property or Xeneca occupied crown land;
- in conjunction with safety booms and/or buoys to aid in clearly identifying the Dangerous Waterway Zone around a structure; and
- so they can be read when approaching the dam from land and the waterway.

Where hazards that could create “High” or “Extreme” risks to the public are identified as a direct result of Xeneca’s operations but are not on Xeneca property or Xeneca occupied crown land, procedures found in Subsection 3.4 should be followed.

Location of Waterway Warning Signs

As a minimum, yellow waterway warning signs are to be installed under the following conditions:

- at all locations on Xeneca property or Xeneca occupied crown land identified as having a “Moderate” risk rating;
- with consideration given to access points used by the public (e.g. portages, boat launches, swimming areas, hiking and snowmobile trails);
- with consideration given to public use areas that are within Xeneca property boundaries;
- so that they are clearly visible at all normal access points; and
- so that their number is in proportion to the amount of public interaction through the seasons that the site will experience.

Where hazards that could create “Moderate” risks to the public are identified as a direct result of Xeneca’s operations but are not on Xeneca property, procedures found in Subsection 3.4 should be followed.

Portage Signs

Portage signs are to be used to identify areas where people that are navigating waters must detour the water body on land by means of a provided portage trail. Signs should show where you are and where to go. These signs and accompanying trails should be located in an area satisfying the following conditions:

- Outside of the Dangerous Waterway Zone.
- End points are located upstream of booms and/or buoys on the upstream side, and downstream of booms and/or buoys on the downstream side.
- In the optimum location that encompasses the safety of the navigator and the convenience of as little overland travel as possible.
- Wherever a dam or obstruction (e.g. a bridge) that prevents passage by navigable means is encountered.

No Trespassing Signs

“No Trespassing” signs are to be used to identify no-trespass areas on Xeneca property.

Public Use Area Signs

Public use areas on Xeneca property are to be clearly identified by signage indicating the approved use (e.g. portage trails, hiking trails, boat launches, fishing areas, etc).

Information Signs

Signs explaining the meaning of any audible or visual alert with instructions for the action to be taken following the alert must be present in order for those Control Measures to be effective. These should be placed within sight of the Dangerous Waterway Zone in which these alerts are intended as well as public use areas within range of the signals and at the entrance to the structures themselves.

Lighting

It may be desirable that at least some of the warning signs around dams be illuminated at night or in foul weather conditions for visibility. Illumination is also a requirement for signs in the waterway as part of the Navigable Waters Protection Act. Lighting should be considered for night illumination and visibility at:

- dams,
- tailrace areas,
- substations,
- booms and boat barriers, particularly if boating at night is a regular activity, and
- danger signs.

Specially designed safety measures involving lighting may be necessary so that they are effective under adverse weather conditions. Some areas may not have a convenient power source, therefore, lighting may have to be powered by solar recharged batteries. A regular lighting inspection program should be developed to ensure that lights are functional and effective.

3.3.4.2 Audible and Visual Warning Devices and Strobe Lights

Audible and Visual Warning devices should be used in areas of rapidly changing conditions (e.g. tailrace channels, downstream of spillways), in conjunction with physical barriers and proper signage. They can also be considered in conjunction with proper signage in areas where it is not reasonable to install physical barriers.

The CDA Technical Bulletin: Audible and Visual Signals for Public Safety Around Dams (2011) provides recommendations for the use of audible and visual signaling devices for spillways. The requirements for the use of audible alerts and strobe lights include:

- Audible warning devices are to be used to warn the public in the Dangerous Waterway Zone downstream of all remotely and automatically controlled sluice gates and should be considered for sluice gates with manual control.
- The sequence of sounding an audible alarm is to be designed into the control logic for the sluice gate opening. The timing and duration of the audible alert should be sufficient to provide the public adequate time to safely exit the hazard area.
- After the initial opening, the audible alarm is to be sounded for any change in gate movement that creates a hazardous increase in water level or flow in the spillway channel.

In all applications, an audible warning device should be effective in alerting the public to changing conditions for the full length of the Dangerous Waterway Zone, as established in the SSWPSMP (this may require multiple warning devices connected in series). The system, as designed, requires a level of redundancy or testing verification consistent with the hazard. The operating procedures of the system should include contingency plans, in the event that the audible warning device is out of service. In some instances flashing strobe lights may be used to augment or replace audible alerts, given unique site-specific conditions.

Wherever audible or visual warning devices are used, appropriate signage should accompany them to inform the public of the meaning of the alerts and give direction on how to respond.

3.3.4.3 Verbal Announcements

At sites which are manned, verbal warnings (e.g. walking to the Dangerous Waterway Zone and talking with the public) can be used effectively to warn those fishing and boating in dangerous areas that gates are going to be opened. In order to do this effectively it is important that personnel working on or near dams are adequately trained to advise visitors of a hazard being created. In the event that a verbal warning is not heeded and the public is in imminent danger, then local authorities (i.e. RCMP) should be notified to deal with the problem prior to further action being taken.

3.3.5 Public Education

Used in conjunction with other Control Measures, education is an effective way to further reduce the risk of public interaction with the hazards caused by the nature of dams and hydroelectric facilities. Although it doesn't necessarily reduce the risk rating of a particular hazard, by keeping the public informed and aware of safety concerns generated around these structures, the amount of public interaction with hazardous areas and the number of safety incidents can be reduced significantly. A public education plan is a mandatory part of a SSWPSMP and must include a viable means to convey safety concerns and information to the public who may be unaware of the risks that are found at dams and hydraulic structures. The development of a site specific Public Education and Communication Plan is dealt with in Chapter 4.

3.3.6 Emergency Response Provisions

Emergency response provisions, although an important component of ensuring public safety, are generally not effective as Control Measures. This is because they require that the public be directly exposed to the hazard in order to be activated. There is a high probability that the hazard will cause the person(s) involved to be hurt before the measures can be activated. They should only be considered as a last resort for "High" or "Extreme" risk hazards once they have been reduced to a "Moderate" or "Low" rating using other types of Control Measures.
There are several tools that can be used to provide emergency response to a hazard including:

- life preservers,
- rescue poles,
- escape routes,
- rescue ladders, and
- safety nets.

Depending on the specifics of the situation, one of the above options or a combination of the options may be selected. In the case of hazardous areas that are not on Xeneca property, the land owner should be contacted for permission to install these measures, as outlined in Subsection 3.4.

The SSWPSMP should include a site plan indicating the location of all emergency response provisions.

3.3.6.1 Life Preservers and Rescue Poles

Life rings with attached safety ropes and/or rescue poles should be considered near dams, powerhouses, canals, etc., where it is likely that someone would be available to use them to aid a drowning victim. These devices should be in readily accessible locations and well identified. If the project is unmanned, then the desirability or need must be assessed on a case-by-case basis.

3.3.6.2 Escape/Rescue Ladders

Escape/rescue ladders should be considered for installation under the following conditions:

- Where project waters flow through open but confined channels, such as intake and tailrace channels.
- Where the location or use of the device is considered safe. If these devices would create a more unsafe condition (such as providing and/or encouraging access to an unsafe area), then they should not be employed.

3.3.6.3 Safety Nets

Safety nets should be considered for installation under the following conditions:

- Where channels terminate at hazardous structures such as powerhouse and penstock inlets, or spillways. Alternative measures such as safety cables or booms, which also provide a victim with something to grab when caught in a heavy current, should be considered before the use of safety net.
- With escape ladders located on each side of the safety booms or safety nets (if safe to install and use).
- Where they are feasible to install given variations in water level and the width of the waterway.
- Provided they do not create a hazard in and of themselves.

3.3.7 Other Control Measures

The following details other measures that are not necessarily Control Measures, but should be considered for specific situations to reduce hazards.

3.3.7.1 Portages

Portages require the following at all projects that have even occasional boating, canoeing or kayaking:

- Landing and portage areas around dams or other structures (where necessary).
- Portage signs large enough to direct boaters to safe take-out sites.
- A location that does not create unsafe conditions.
- Warnings, barriers, and at the request of Xeneca, enforcement by local agencies discouraging boaters, canoeists or kayakers of going over lower dams.

3.3.7.2 Boat Ramps

Where boat ramps are considered necessary for recreation facilities found at many projects, they should be located subject to the following conditions:

- If any existing boat ramp is located close to hazardous areas or areas with high water velocities during flood conditions, procedures and facilities should be provided to close the ramps until the flood subsides to safe levels.
- If their location does not create unsafe conditions.
- Information on dangerous areas, restrictions on speed or access, alcohol use restrictions, enforcement and penalties, sailboat clearance for power lines and bridges, and other information relevant to safe boating practices should be provided at boat ramps or through other means, such as pamphlets, brochures, maps, etc.

3.3.7.3 Emergency Preparedness and Response Plan

The site-specific Emergency Preparedness and Response Plan may address waterway public safety scenarios where there is a benefit to doing so. This may include initiatives to work with local first responders to improve rescue operations associated with specific site hazards.

3.3.7.4 Power and Communication Line Clearance Requirements

Vertical clearance height for power and communication lines over reservoirs must be taken into consideration for the following reasons and circumstances:

- High voltage power lines near powerhouses and substations may be located where fishermen or boaters could accidentally make contact with them.
- They require special signage and, in some cases, high-visibility line markers.

Mitigation strategies include:

- restricting access, and
- posting proper signage.

3.4 HAZARD AREAS NOT ON XENECA PROPERTY

- There will likely be situations where specific hazards caused as a direct result of Xeneca's operations are located away from Xeneca property. In these cases it is normally preferable for Xeneca to show due diligence and implement specific Control Measures as required in accordance with the WPSMG. Xeneca must work with and obtain permission from the land owner/stakeholder before installing Control Measures on their property.
- If permission cannot be obtained through a simple dialogue and negotiation, Xeneca's obligation is to provide advice to the landowner in a formal letter, describing the nature of the hazard posed and the correct course of action for the landowner to take. This advice would be offered both from a due diligence perspective, and to solicit the assistance of others in advising members of the public of site specific hazards. The purpose of the formal notification would be to accurately describe the potential hazard and recommend risk mitigating strategies which are beyond Xeneca's direct accountability or control. In all cases, where formal correspondence is required to communicate issues of public waterway safety, Legal Council should be consulted to ensure the content is consistent with Xeneca's position.

3.5 CHANGES TO CONTROL MEASURE STANDARDS

- When changes occur in the standards for Control Measures, it is not always necessary to replace the existing Control Measures. Instead, an assessment should be made on the effectiveness of the current Control Measures relative to the new standards. If they meet the objective, they shall be considered to be in compliance until such a time as they are scheduled for replacement, following which they will be replaced with Control Measures meeting the standards.

Chapter 4.0
Public Education and Communication Plan

4.0 PUBLIC EDUCATION AND COMMUNICATION PLAN

Public education is an effective way to reduce the possibility of public exposure to hazards inherent to dams, control structures and hydroelectric facilities. By keeping the public informed and raising awareness of safety concerns generated around these structures, the amount of public interaction with hazardous areas and the number of safety incidents can be reduced significantly. A public education and communication plan is a structured means to convey safety concerns and information to the public who may be unaware of the risks that are found at dams and hydraulic structures.

This goal is addressed through the following activities:

- choosing the proper message to send to the public,
- determining target groups to be educated,
- selecting tactics to enhance communication of the message to specific target groups,
- selecting a media mix which will convey the message to the appropriate audience.

4.1 GOALS OF THE PUBLIC EDUCATION AND COMMUNICATION PLAN

The Public Safety Communication Plan (PSCP) is an integral part of the Hazard Mitigation Plan for all sites in order to further reduce public exposure to hazardous areas. The PSCP must be defined in terms of general hazards present at most or all of Xeneca's structures. It should also educate the public of expected responses to specific control measures, i.e. that the spillway area should be evacuated when a spillway siren is heard and that red danger signs should be followed as they are indications of severe hazards.

It should be noted that a PSCP alone cannot be relied upon to effectively reduce the likelihood or consequence rating of a hazard. It is intended to be used as reinforcement of safe practices and physical control measures that reduce a hazard's risk rating and improve public compliance with control measures.

4.2 TARGET AUDIENCE

The target audience of the PSCP should be as large as possible, including anyone who might be, at any time, in the vicinity of a dam or hydroelectric facility.

The targeted audience for the PSCP includes visitors to the waterways within the zone of influence of all Xeneca dams and generating stations in the entire province of Ontario or specific regions with more than one structure in them. The target audience will typically include:

- general public,
- children,
- anglers and other outdoor enthusiasts,
- tourists,
- hunters, trappers/commercial fishermen, and
- immigrants and new residents.

The PSCP should present the general details of safety around dams such as descriptions of warning signs and audible and visible control measures and caution to stay away from dams. Province wide television and radio advertisements, as well as provincial publications can be used to reach the widest audience range possible. Nearby towns, schools, sporting facilities and tourist accommodations (campgrounds, bed and breakfasts, hotels, etc.) should be identified to receive educational information and materials.

4.3 EDUCATIONAL MESSAGES

Educational messages for the PSCP should provide a description of hazardous areas and/or control measures that can be found in the vicinity of the structures, and appropriate action to take to avoid exposure to these hazards.

In general, educational messages should be kept simple and easy to understand, thus minimizing confusion and inappropriate responses due to misunderstanding. The core messages should include:

- making aware of dangers and hazards,
- obeying posted signs and barriers that are in place,
- staying safe, staying away from dams, and

- that seasonal dangers may exist in the vicinity.

4.4 ADVERTISING TACTICS

Multimedia advertising in the form of radio, newspaper, television and billboard promotions will be used to ensure the messages reach the target audiences. Campaigns will be directed through existing channels of communication and others methods will be employed where it is deemed appropriate.

4.5 COMMUNICATION DELIVERY METHODS

Existing public safety programming in schools will include a message with regards to safety in the vicinity of dams, control structures and hydro electric facilities.

Posters and pamphlets can be made available at festivals or events within the communities and schools in close proximity to the dam.

The Xeneca website contain seasonal tips on safety in the vicinity of dams.

Collaborative campaigns with partners such as water safety organizations, injury prevention groups, government and industry will be undertaken..

4.6 TIME FRAMES AND FREQUENCY

The advertising will take seasonal activity into consideration in identifying the time frames where specific advertisements will be required, i3ncluding:

1. prior to and during hunting and fishing seasons,
2. summer activity season: camping, fishing, boating, hiking, swimming,
3. winter activity season: ice fishing, snowmobiling, cross-country skiing, and
4. school year: educational programs that correspond with the curriculum.

4.7 BUDGET

An annual budget for the distribution and production of the public education and communication methods should be established. Some of the budget items for the communications strategy may include the following costs associated with the development of the campaign:

1. pamphlet printing,
2. poster creation and printing,
3. advertising costs, and
4. distribution costs.

The budgets should include details of the types and quantities of advertisements to be made and distributed and their unit and total costs.

4.8 REVIEW AND UPDATE PROCEDURES

The public safety education message should be periodically updated/changed to ensure that attention is captured and renewed in the public.

Statistics on public safety incidents across the company should be kept and monitored in order to help determine the effectiveness of the public safety plan. The number of incidents should be reduced with effective public education and communications plans in place. An inventory of the types of education and communication materials should be maintained in order to compare with the types of incidents that occur during the same distribution period. This may direct the review in determining if the current strategies are effective and in determining if different messages need to be conveyed to different target audiences. The review can also determine if proper quantities of material are distributed, by following up with distributors on quantities left available. Surveys can be completed both when incidents occur and by sampling the population of their exposure to the education and communication materials.

4.9 PUBLIC FEEDBACK

The public should have a means to indicate how to improve public safety at each site. This may include comments on Xeneca's webpage, a drop box, or comments provided to Xeneca employees. The means to submit feedback should be made simple, easy to use, and readily available to the public. Site staff should determine how to deal with the feedback and implement recommendations where possible.

This feedback should be documented and become incorporated into the changes involved with the periodic review of the PSCP.

4.10 ACTION PLAN

The following steps will be taken to implement an effective Public Education and Communication Plan:

1. Write a “draft public education and communication plan”.
2. Plan the content of the campaign – main message, action plan, etc.
3. Make use of language and slogans consistent with Xeneca’s main public safety communications.
4. Produce and distribute materials.
5. Contact governmental and nongovernmental organizations, public interest groups, the media, schools, sporting goods stores, etc, to bring attention to the campaign or to partner with them to get safety messages out.
6. Create a section on the Xeneca website to provide information about the hazards associated with dams and how to stay safe, as part of the PSCP.

Chapter 5
Public Safety Incident Reporting

5.0 PUBLIC SAFETY INCIDENT REPORTING

Hazardous or potentially hazardous interactions between the public and Xeneca generating facilities, dams and flow control structures must be documented for continuing public safety. All public safety incidents are to be reported to the Plant Manager or his delegate if they:

- occur on Xeneca property,
- occur within the “Dangerous Waterways Zone” established by Xeneca , or
- occur as a direct result of Xeneca’s operations on the waterway.

In cases where it is unclear as to whether an incident is reportable as a “public safety incident/injury”, the incident is to be treated as one and recorded appropriately.

5.1 INCIDENT/INJURY REPORTING

The purpose of reporting, recording and investigating public safety incidents is to review the effectiveness of installed control measures, identify gaps, changes or improvements necessary, to accommodate changes in public usage and corrective actions to mitigate undue risk to the public due to Xeneca operations or facilities.

During the initial development of the Site Specific Waterways Public Safety Management Plan (SSWPSMP), past incident reports at other sites provide a tool to evaluate the effectiveness of any existing physical control measures at these sites and act as an important input to the risk assessment process to understand public interaction.

It is important to document and follow up on any incident involving public safety, whether it actually resulted in injury or fatality or if it was a “near-miss” but had the potential for injury or fatality.
As a guide, incidents can be categorized into the following groups:

“Low” Category Incidents: Incidents that do not result in or are unlikely to have resulted in injury but indicate a deficiency in control measures, signage, public education and communication or even security. No medical attention is required. Examples of these are:

- public breach of restraining barriers such as fencing, booms, touchpad doors, etc.,
- public disregard for posted regulations such as fishing inside a marked "Warning Zone", or,

- not using proper portage routes, etc.

“Medium” Category Incidents: Incidents that result in minor injuries or could have potentially resulted in minor injuries either requiring simple first aid (no hospital/doctor visit required) or low risk/low priority rescue (self rescue from non-life threatening conditions). Examples of these types of incidents include:

- a slip on rocks causing abrasion, or
- stranding due to rising water in a low current zone that can be waded or swum across.

"High” Category Incidents: Incidents that result in or could have potentially resulted in serious injury, likely requiring a hospital evaluation and visit or high risk/high priority rescue. Examples of these types of incidents include:

- near drowning, slips and falls on the shore or in the waterway resulting in a broken bone, concussion or cuts requiring stitches,
- stranding in a high current zone that requires special expertise, e.g. lifeguard training,
- equipment for rescue, or
- boat rescue.

“Extreme” Category Incidents: Incidents that result in or could have potentially resulted in permanent partial or total disabilities or potentially resulted in death (not due to suicide or homicide). Examples of these types of incidents include:

- falls into a high current zone resulting in multiple injuries,
- falls from a height resulting in long-term injury,
- drowning due to being trapped in current, or
- a combination of falling from a slippery surface and getting caught in a “drowning machine”.

5.2 DOCUMENTATION

Waterways public safety incidents which fall under the above listed categories are to be formally documented and reported, using the “Waterway Public Safety Incident Report” form attached and shown in Appendix D and in accordance with the chain of responsibility identified in Subsection 1.5, Assignment of Responsibilities.

Chapter 6

Required Content for a Site Specific Waterway Public Safety Management Plan (SSWPSMP)

6.0 REQUIRED CONTENT FOR A SITE SPECIFIC WATERWAY PUBLIC SAFETY MANAGEMENT PLAN (SSWPSMP)

The following sections provide the required content for producing a SSWPSMP. These content guidelines apply to all SSWPSMPs. For those SSWPSMPs in development, the following sections provide a thorough description of the site requirements for proper safety management. These sections must be re-examined during the periodic reassessment and review of SSWPSMPs to ensure that they conform to current standards.

6.1 CONTENT OF SSWPSMP

The following sections as a minimum should be included in the SSWPSMG. Additional sections can be added if needed for clarification or the order of the sections can be changed from the list shown.

6.1.1 Assignment of Responsibilities

A listing of the responsibilities assigned to the different working levels of Xeneca should be included in this section. It is sufficient to generically list positions such as Plant Operators and Maintenance Personnel at the facility level. For Plant Managers and individuals with higher levels of responsibility, specific individuals should be listed including contact information. Additionally, stakeholders and resources within the community should also be listed in this section. This section should include emergency numbers for the local hospital, fire hall, search and rescue, coast guard, and emergency measures organizations. All of this information should be kept up to date and reviewed on a minimum 6 month basis.

6.1.2 Site Description and Inspection

The site description and inspection section is valuable for helping the reader understand the relationship between the public and the dam, control structure, and its appurtenances. This section should also follow the guidelines provided in Subsection 2.1.1: *"Site Inspection".* This section should present the following:

- A detailed location map of the dam, its associated components and the surrounding areas.
- Schematic drawings of the dam-site, including areas upstream and downstream, that show:

  - site property boundaries,
  - the locations of all identified hazards,
  - flood inundation limits,
  - the locations of all safety devices identified during the risk assessment,
  - the locations of all roads, access routes and trails (over land and water) leading to the identified hazards, and
  - the various types of ongoing public activities in the vicinity of the dam.

- Hazardous areas and the level of use.
- Descriptions of each component of the dam discharge facilities and their stage-discharge rating curves.

6.1.3 Historic Public Safety Issues

This section will not be applicable to the creation of the initial SSWPSMP for new facilities. However, this section of the SSWPSMP is to be continuously updated with any newly identified public safety issues or incidents (including near misses) as they develop. This section should provide a description of public safety issues and incidents with a discussion on the details of the incidents as well as actions resulting from an assessment of the incidents.

6.1.4 Hazard Identification

All hazards within each site's structure, headpond, upstream area, spillway channel, powerhouse tailrace, and downstream area must be identified and documented. The potential hazards listed in Section 2.1 should aid in the identification process, and should be updated with any additional hazards found during the site inspection.

6.1.5 Risk Assessment

A complete risk assessment must be carried out involving all hazards identified during the site inspection. This procedure is detailed in Section 2.2.

6.1.6 Inventory of Control Measures

A comprehensive list of all existing control measures in place at a site must be compiled, including:

- proper location of each device, shown on site plans,
- drawings and photos (as required) showing physical description of control measure,
- any additional documentation that is required to accompany a device (i.e. WHMIS, operation and maintenance instructions, etc), and
- purchasing, repair and replacement records.

6.1.7 Interim Measures for Missing or Defective Control Measures

The SSWPSMPs should address the process to be followed in the event that an unmitigated hazardous condition or a defective (damaged, poorly located, etc.) control measure is reported. The process to be followed is included in Subsection 7.5.5 *"Interim Measures When Defective Control Measures are Identified"*.

6.1.8 Implementation of Control Measures to Reduce Risk

This section should be referenced to the risk assessment table completed for each site and the resulting suggestions for implementation of control measures.

6.1.9 Public Education and Communication Plan

Public education and communication plans must be formulated according to Chapter 4.

6.1.10 Methodology for Public Safety Incident Reporting

Public safety and security incidents must be recorded as outlined in Chapter 5, using the form provided in Appendix D.

6.1.11 Inspection, Operation and Maintenance Schedule Requirements

An effective inspection, operation and maintenance schedule must be incorporated in each SSWPSMP to ensure that all safety measures remain operative and efficient. A systematic evaluation procedure is also required to ensure that all safety devices are working properly. Section 7.5.3 provides a time frame for the inspection of Control Measures.

7.0 REASSESSMENT AND REVIEW PROCEDURE

7.1 PURPOSE

The "Reassessment and Review Procedure" ensures that the WPSMG is periodically updated to include any new information about best management practices, processes or control measures. In addition, it ensures that all Site Specific Waterway Public Safety Management Plans (SSWPSMPs) continue to meet current requirements. Through periodic reviews of incident reports, public safety controls can be modified to address specific concerns at each site. However, incidents that arise at one facility might also be concerns at other facilities, so all updates should be considered across all facilities.

7.2 SCOPE

This procedure applies to the WPSMG and to all previously implemented SSWPSMPs.

7.3 FREQUENCY OF REVIEW

The WPSMG should be reviewed and updated a minimum of once every 2 years or when a significant modification to the operations or an incident occurs that warrants modification to the WPSMG. The WPSMG should be updated before updating the SSWPSMPs to ensure that all the individual Plans meet the current standards. SSWPSMPs should be reviewed and updated at least once every 2 years. However, as described in Section 6.2, assignment of responsibilities and key contact information should be updated on an on-going basis as changes occur. Similar to the WPSMG, the SSWPSMP should be revised / updated as soon as a significant modification to the operations or an incident occurs that warrants revisions/updates to the SSWPSMP to be made.

7.4 WPSMG

Sources of valuable information regarding many aspects of public safety management should be referenced so they can be easily checked for revisions when updating the WPSMG. Sources that should be checked include, but are not limited to, the following:

- Dam safety journals and articles, e.g. Canadian Dam Association (CDA) Bulletin for changes in local, provincial and federal regulations.

- Organization websites such as:
  - Federal Energy Regulatory Commission
    http://www.ferc.gov/industries/hydropower.asp
  - Canadian Dam Association
    http://www.cda.ca
- Ontario Ministry of Natural Resources
  http://www.mnr.gov.on.ca/,mr/water
- American Association of State Dam Safety Officials
  http://www.damsafety.org/
- Ontario Power Generation
  http://www.opg.com/safety/water/
- Standard control measures specifications
- Local, provincial and federal regulations, e.g., the necessary actions for installation of safety booms and buoys.
  http://www.dfo-mpo.gc.ca/index-eng.htm
- It should be noted that the web sites are only examples of information available and should not be relied upon as providing the only information and requirements with respect to regulations on specific safety measures.

7.5 SSWPSMP

The purpose of the periodic review is to update the site-specific plans based on new information coming from the updated WPSMG, as well as from incident reports at all sites. Feedback from site staff and the local population should also be taken into consideration. In light of all the information received and/or reviewed, public safety controls can be modified to address local concerns, if necessary.

7.5.1 Site Description

Changes to the physical characteristics of a dam or its appurtenances need to be documented in the relevant SSWPSMP. These changes should be made no later than the next regularly scheduled review of the plan. Alternatively, the changes may be documented at the time they are made. The latter option should be seriously considered if the changes are extensive and/or if the next regularly scheduled review is not due for some time, e.g., more than a year.

The following items merit consideration when updating SSWPSMPs:

- Addition or removal of physical components to or from a dam or its appurtenances.
- Changes in population or activities around the dam.
- Addition, removal or relocation of public safety control measures.
- Any new site description information required by the updated WPSMG "Site Description" section.

7.5.2 Hazard Identification and Risk Assessment

The "Hazard Identification" and "Risk Assessment" sections need to be updated at each review. Any previously hazards not addressed or hazards needing more detailed assessments should be considered in the revisions. Risks associated with each hazard will also need to be revised to reflect reductions achieved by implementing controls, or identified as new hazards or new issues arise. The goal of the risk assessment is to reduce the risk for each hazard to an acceptable level.

As structures age, new hazards might be identified that should be added to the SSWPSMP. Sources of information should include:

- Public safety incident reports.
- Concerns raised by employees or the public.
- Concerns arising from the Public Education and Communications Plan.
- Upcoming proposed or planned projects.
- Any new information required by the updated WPSMG risk assessment procedure.

In some cases, the considerations described above might require the implementation of new control measures, or relocation or removal of current control measures. Such changes will require that the control measure inventory be updated in the risk assessment documentation and that locations of current control measures be changed on site plans.

7.5.3 Inspection, Operation and Maintenance

Newly implemented procedures and regulations affecting the inspection, operation, or maintenance of control measures shall be updated for the site being reviewed. Considerations for changing these procedures and regulations should be based on the following:

- A review of each previously identified hazard to determine if the implemented control measure(s) have reduced public safety incidents.
- A review of Public Safety Incident reports to determine whether control measures are working.
- A review of inspection and maintenance records for current control measures.
- Any newly acquired information as specified in the updated WPSMG, "Inspection, Operation and Maintenance" section.

The review process should result in a reduction in Public Safety concerns. Keeping detailed records of public safety issues and mitigation methods will provide a written record of the controls implemented. Operation and maintenance records will provide a sound basis for determining if there is a control method that can be implemented to reduce the risk to the public. A comparison of records across the Corporation will help to identify the primary hazards that should be addressed, and will help to focus the public safety hazard control program.

In addition to the periodic review of the SSWPSMP, all physical control measures – e.g. signs, booms, buoys, audible alarms, strobes, fencing and access gates – are to be inspected annually as a minimum. In the case of emergency response provisions such as life preservers, safety nets, etc. located in public areas, these should be checked much more frequently to ensure they are in place and in good condition. Records should be kept of the completed inspection and maintenance activities and the results of all tests done on the control measure equipment. Results of the annual inspections and tests should be included in the periodic review of the SSWPSMP.

7.5.4 Public Education and Communications Plan

The plans need to be reviewed and updated based on any incidents that might have occurred at each site. The public needs to be continuously educated as some hazards arise on a recurring basis, such as those associated with seasonal weather (e.g., thin ice) or activities. Any new strategies for conveying information to employees and the public shall be added during the periodic review of the Public Education and Communications Plan. Sources can include, but are not limited to, the following:

- Measures being used by other corporations, e.g. Ontario Power Generation.
- New strategies developed from suggestions or brainstorming coming out of meetings with employees or the public.
- Changes in current strategies due to the effectiveness (or lack of effectiveness) of the current measures.
- Any new information as specified in the updated WPSMG “Public Education and Communications Plan” section.

Employees directly involved with public safety management or site maintenance shall be made aware of any newly implemented safety control measures and be given appropriate training. The training should be documented and refresher training shall be given at a specified frequency.

7.5.5 Interim Measures for Missing or Defective Control Measures

The SSWPSMPs should include the procedure(s) to be followed in the event that an unmitigated hazardous condition or a defective control measure is reported that is associated with the Xeneca’s operations, or occurs on Xeneca property. As part of such procedures:

- Immediate steps should be taken to minimize the risk to the public.
- The appropriate Xeneca person responsible for the facility should be notified.

7.5.6 Methodology for Public Safety Incident Reporting

The methodology and forms required for public safety incident reporting should be reviewed at a minimum every 2 years to ensure they meet the needs for the program.

8.0 REFERENCES

1. 1. Guidelines for Public Safety and Security Around Dams, (2011), Canadian Dam Association.

2. Technical Bulletin: Signage for Public Safety Around Dams, (2011), Canadian Dam Association.

3. Technical Bulletin: Booms and Buoys for Public Safety Around Dams, (2011), Canadian Dam Association.

4. Technical Bulletin: Audible and Visual Signals for Public Safety Around Dams, (2011), Canadian Dam Association.

5. Best Management Practices: Public Safety Around Dams, (2011), Ontario Ministry of Natural Resources

6. Guidelines for Waterways Public Safety, Document No. DS-LP-GUI-001 Rev 5, (2010), Ontario Power Generation.

7. Exterior Danger and Warning Signs, Document No. DS-LP-STD-002 Rev 1, (2008), Ontario Power Generation.

8. Fences and Barricades, Document No. DS-LP-STD-004 Rev 1, (2008), Ontario Power Generation.

9. Waterway Booms and Buoys, Document No. DS-LP-STD-005 Rev 1, (2008), Ontario Power Generation.

10. Audible and Visual Danger Signals for Water Conveyance Structures, Document No. DS-LP-STD-006 Rev 1, (2008), Ontario Power Generation.

11. Risk Assessment for Waterways Public Safety, Document No. DS-LP-PRO-007 Version 1.0, (2009), Ontario Power Generation.

APPENDIX A

Hazard Identification and Control Measures Checklist

Public Water Safety Around Dams Management Guidelines Hazard Identification and Control Measure Checklist - Revision Record				
Section	**Description of Revision**	**Rev**	**Effective Date**	**App. By**
Entire		0		

Owners Review	**Date Reviewed**	**Comments**
Facility Manager		

DRAFT

General

This checklist shall form part of every Site Specific Waterways Public Safety Management Plan. It shall be used in the initial site visit to identify and describe potential hazards and to compile a listing and description of control measures in place at the time of the inspection. Where a particular hazard or control measure is not existent, the form shall still be filled out to indicate that this is the case and why. As much information as possible shall be recorded associated with each hazard or control measure.

Section 1 is a description of the potential hazards and the existing control measures in place to mitigate or eliminate the risk posed to the public by the hazard. Section 2 describes the individual control measures including the location, suitability and adequacy to mitigate or eliminate the risks of the hazard.

1. Site Visit Information

Facility Owner	Xeneca
Facility	
Names of Field Observers	
Observation Dates	
Weather Conditions	
General Site Conditions at Time of Observation	
General Comments	
Public Activities	

2. Hazard Identification Checklist

HAZARD AREA
Headpond
POTENTIAL HAZARDS
☐ Difficulty in recognizing water cascading over spillway or sluice stoplogs from upstream (i.e. waters on approach appear smooth and calm). ☐ The physical drop over spillways may be large and its size can be difficult (if not impossible) to see or to judge from upstream. ☐ High flow velocities and/or dangerous undercurrents near spillway, powerhouse intakes, along canals (especially at constrictions or bends), conduits, tunnels, drop inlet structures and inverted siphons can be hidden below the water surface and difficult to recognize, and can be difficult for boater/swimmer to overcome. ☐ Floating debris collecting near booms/structures. ☐ Access to the spillway and observation of flow patterns approaching the spillway. ☐ Submerged structures or natural features, including intakes, dams, stumps etc., which could protrude or be near the surface at low water levels. ☐ Dangerous ice conditions due to water flow underneath. ☐ Access to intakes or other hazardous areas via the waterway. ☐ Sudden increases in water levels due to load rejection at the powerhouse, which could cause access roads to become inundated. ☐ Steep, slippery slopes along canals. ☐ Flow of water under/through gate openings and trash racks at headworks structures near entrances to canals. ☐ Pinning against trash racks due to swimming/boating near intake areas. ☐ Remote operation; no direct sightline to upstream area. ☐ Proximity of boat access points to facilities (safety device plan considerations). ☐ Proximity of boat ramps to swift/dangerous currents at spillways, powerhouses, intakes, canals. ☐ Proximity of location of boat ramps to areas of high boat traffic where boat traffic control might be required. ☐ Rock formations. ☐ Moving machinery associated with dam operation. ☐ Thin ice due to swift currents or heaters and air bubblers. ☐ Changing water levels causing ice breakup or road/access point overtopping. ☐ Visibility problems causing snowmobilers to drive over structures.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES
HAZARD AREA
Spillway Channel
POTENTIAL HAZARDS

- ☐ Turbulence at the toe or in the energy dissipater of an overflow spillway, weir or stoplog sluice can create dangerous rolling currents sometimes referred to as "Drowning Machines".
- ☐ Access gratings on decks can become dislodged if not secured.
- ☐ Exposure of hoisting device rails (traffic/cyclist hazard).
- ☐ Deck mounted rails associated with gate or stoplog hoisting devices might be exposed creating a hazard for bicycles and other road traffic.
- ☐ The effect that sluice/spillway flows have on conditions in downstream reaches that are out of sightline of the dam.
- ☐ The possible hazard posed by debris that is released upon opening of the sluice/spillway.
- ☐ The public might not be aware that sluice gates can rise and discharge flow at any time, especially when it is done remotely or automatically.
- ☐ Sudden increases in flows and water levels when gates are opened, which can create high current velocities, turbulence and rapidly changing water levels including inundation of adjacent shore lines.
- ☐ Vortices and eddies with strong undercurrents particularly caused by the operation of a few bays.
- ☐ Fluctuating water levels and spray, which can produce slippery surfaces on the shoreline.
- ☐ Operation of gates without a direct sightline to the immediate downstream area.
- ☐ Steep, slippery slopes along banks, increasing the likelihood of someone falling into the waterway and making escape from the waterway difficult or impossible.
- ☐ Local operation: Staff are dispatched to the site and manually operate the controls to either raise or lower the gate.
- ☐ Remote operation: The raising or lowering of gates is performed by staff located either within a control room at the site or at a central off-site facility (i.e. staff does not have a direct sightline to where the flow is being directed).
- ☐ Automatic operation: Gates are raised or lowered independent of operator intervention, in response to the input of water level gauges or changes in generation.
- ☐ Thin ice due to swift currents or heaters and air bubblers, which may be difficult to observe.
- ☐ Changing water levels causing ice breakup or road/access point overtopping.
- ☐ Visibility problems causing snowmobilers to drive over structures.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

HAZARD AREA
Powerhouse Tailrace
POTENTIAL HAZARDS
☐ Sudden increase in tailrace flows and water levels when turbines start up (high current velocities, turbulence, rapidly changing water levels). ☐ Strong undercurrents of velocities and eddies from a few turbines in a multi-turbine project. ☐ Fluctuating water levels (slippery shoreline surfaces). ☐ Remote operation of powerhouse with no direct sightline to immediate downstream area. ☐ Steep, slippery slopes along tailrace channels (increase chance of falling into waterway with a difficult/impossible chance of escape). ☐ Access to draft tubes. ☐ Proximity of boat access points to facilities (safety device plan considerations). ☐ Proximity of boat ramps to swift/dangerous currents at powerhouse and canals. ☐ Proximity of location of boat ramps to areas of high boat traffic where boat traffic control might be required. ☐ Moving machinery associated with dam operation. ☐ Thin ice due to swift currents or heaters and air bubblers. ☐ Changing water levels causing ice breakup or road/access point overtopping. ☐ Visibility problems causing snowmobilers to drive over structures.
DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

HAZARD AREA
Structures (Concrete Dams/Wingwalls, Earth Dams and Dykes, Trash Booms, Safety Booms, Ice Booms, Catwalks, etc.)
POTENTIAL HAZARDS
☐ Slippery when covered in water, snow, ice. ☐ Exposure of powerhouse/spillway machinery stored on deck. ☐ Steep upstream/downstream slopes (waterway difficult to exit). ☐ Fall hazard (into water or from a dangerous height). ☐ Swift current velocities along dam. ☐ Control or flow through structures remote from the site. ☐ Slope movement or slumping of earth dams or dykes without warning during high flow events. ☐ Large boulders/rip-rap and accumulated debris on slopes of earth dams and dykes (tripping/falling). ☐ Catwalk structures (slipping/falling). ☐ Submerged booms (boaters could drive into them). ☐ Accumulation of debris on booms (visible and submerged debris). ☐ Failure of booms without warning. ☐ Suspended booms at the wrong height. ☐ Moving machinery associated with dam operation.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

HAZARD AREA
Downstream Areas (Within Area of Hydraulic Influence)
POTENTIAL HAZARDS
☐ Sudden increase in flows and water levels (high current velocities, turbulence, inundation of areas). ☐ Sudden increase in flows which can cause debris to dislodge (hazard to boaters). ☐ Fluctuating water levels (slippery shoreline surfaces). ☐ Fluctuating water levels (changes in ice conditions or road/access point overtopping). ☐ Floating debris collecting near booms. ☐ Submerged structures or natural features, including intakes, dams, stumps etc. that could protrude or be near the surface at low water levels. ☐ Remote operation; no direct sightline to downstream area. ☐ Proximity of boat access points to facilities (safety device plan considerations). ☐ Proximity of boat ramps to swift/dangerous currents at spillways, powerhouses, canals.

- ☐ Proximity of location of boat ramps to areas of high boat traffic where boat traffic control might be required.
- ☐ Rock formations.
- ☐ Dangerous currents not visible from water surface.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

HAZARD AREA

Other Structures Within Close Proximity to Dams

POTENTIAL HAZARDS

Substations and Powerlines Within Close Proximity to Dams:
- ☐ Fluctuating reservoir levels affecting vertical clearance (electrical shock).
- ☐ Hot weather, causing powerlines to sag (electrical shock).
- ☐ Ice storms, causing powerlines to sag (electrical shock).
- ☐ Accumulation of ice on powerlines from turbulent water, causing them to sag (electric shock).
- ☐ Visibility of powerlines during fog or rainstorms.

Bridges:
- ☐ Low clearance height for those navigating the waterway.
- ☐ Cross-members, understructures, cables close to water surface.

- ☐ Possible high velocities due to channel constrictions.
- ☐ Piers in the waterway which are not identified.

Quarries and Borrow Pits:

- ☐ Falling hazard into the open pit of water (varying and loose materials around the site and steep drop-offs).
- ☐ Unnoticeably shallow waters or submerged boulders close to the surface causing harm to those diving into the quarry.
- ☐ Extremely cold water or temperature fluctuations in the water due to the lack of turbulence to mix warm and cold water within the quarry, causing shock or hypothermia, and potentially drowning.
- ☐ Deep snow covering the pit and berm in the winter, creating unnoticeable obstacles for snowmobilers in the winter and possibilities of driving over quarry walls and falling into the quarry.
- ☐ Snow covering potential thin ice due to warm spots which can cause recreational users to fall through the ice.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

HAZARD AREA

Upstream of Plant (Within Area of Hydraulic Influence)

POTENTIAL HAZARDS

- ☐ Sudden release from upstream plants (e.g. load rejection), causing rapidly changing water levels.
- ☐ Sudden increases in flows may cause debris to dislodge (hazard to boaters).
- ☐ Sudden release from upstream plants, causing unsteady ice conditions.
- ☐ Submerged structures or natural features, including intakes, dams, stumps etc., which could protrude or be near the surface at low water levels.
- ☐ Steep, slippery slopes along canals.

- ☐ Remote operation; no direct sightline to upstream area.
- ☐ Proximity of boat access points to facilities (safety device plan considerations).
- ☐ Proximity of location of boat ramps to areas of high boat traffic where boat traffic control might be required.
- ☐ Rock formations.

DESCRIBE HAZARDS IDENTIFIED AT SITE AND EXISTING CONTROL MEASURES

3. Control Measures Checklist

CONTROL MEASURES AND THEIR REQUIREMENTS INFORMATION TO VERIFY AT SITE MEETINGS
Lighting: ☐ Placed for warning devices with visibility requirements during darkness. ☐ Consideration around dams, tailrace areas, substations, boat barriers, danger/warning signs. ☐ Located where adverse weather conditions may require illumination of warning measures. **Audible and Visual Warning Devices:** ☐ Warn public of remote and automatically controlled sluice gates. ☐ Sufficient time and duration to allow adequate escape time. ☐ Alerts for every step in gate movement that creates hazardous increases in water levels or flow. ☐ Accommodates everyone within the dangerous waterway zone. ☐ Have signs to explain their meaning. **Verbal Announcements:** ☐ Recorded or direct verbal warnings. ☐ Warn public of change in gate operation. **Video Surveillance:** ☐ Areas with high traffic or high concern for public access. ☐ Existing public safety measures are not working. **Boat Ramps:** ☐ Have procedures to close the ramps when high water velocities due to flood conditions occur.
CONTROL MEASURES AND THEIR REQUIREMENTS TO OBSERVE ON SITE
Safety Boom: ☐ Designates dangerous waterway zone. ☐ Physical restraining device. ☐ Promotes self-rescue of those who are stranded. ☐ Has approval under NWPA. ☐ Located upstream of overflow spillways. ☐ Located upstream of sluice gates and stoplog spillways with a risk rating of "moderate" or higher. ☐ Enough water to provide floatation. ☐ Located downstream of spillways or powerhouses where access is a high concern and where flow and velocities would allow placement of a safety boom.

Safety Buoy:

- ☐ Located where safety booms are in place.
- ☐ Located on "public" side of boom or in-line with the boom.
- ☐ Communicates location of boom.
- ☐ Communicates location of debris booms intended to remain in place during navigation periods.
- ☐ Enough water to provide floatation.

Suspended Safety Cable Restraint:

- ☐ Used at locations with minimal water level fluctuations.
- ☐ Delineate Dangerous Waterway zone across narrow channels.
- ☐ Canadian Shipping Act Boating Requirement Regulations when anchored to shore.
- ☐ Promotes self-rescue.
- ☐ Prevents access.
- ☐ Marked with signage to make it visible.
- ☐ Taught cable.
- ☐ Does not impose additional hazards.

CONTROL MEASURES AND THEIR REQUIREMENTS

TO OBSERVE ON SITE

Fencing/Barricades:

- ☐ Used for risk of vertical fall.
- ☐ Used along steep banks of power intake canal.
- ☐ Used at access points to water conveyance structures.
- ☐ Prevents access to flow control equipment.
- ☐ Used in areas where risk of access would put the public in danger.
- ☐ Installed continuous with other control measures.

Barricades:

- ☐ Used depending on likelihood of someone attempting to climb over or through it and level of hazard.
- ☐ Installed continuous with other control measures.
- ☐ Warning signs on approach.

Life Rings:

- ☐ When it is likely someone would be available to use them for a victim.
- ☐ Located in readily accessible location.
- ☐ Well-identified.
- ☐ Located where vandalism is not prevalent.

Escape/Rescue Ladders:

- ☐ Waters flow through opened but confined channels.
- ☐ Installed on both sides of channel (if safe).
- ☐ Located so as to avoid unsafe use.

Safety Nets:

- ☐ Located where channels terminate at hazardous structures.
- ☐ Located with escape ladders on each side of the safety booms or nets.
- ☐ Used if they can increase public safety.
- ☐ Used when the woven rope/ wire is of height to reach the normal water surface when suspended from a cable across the canal.

CONTROL MEASURES AND THEIR REQUIREMENTS

TO OBSERVE ON SITE

Gratings and Gratings on Culverts:

- ☐ Placed over all exposed stoplog sluice openings.
- ☐ Placed over openings that the public may inadvertently enter.
- ☐ Must not be able to be manually dislodged.
- ☐ Prevent public access to culverts.
- ☐ Located on submerged openings or discharge points.

Portages:

- ☐ Includes landing and portage areas around dams and structures.
- ☐ Includes signage to direct boaters.
- ☐ Does not create an unsafe situation.

CONTROL MEASURE
Public Safety General Signage: Includes All Sign Types
REQUIREMENTS
• Consistent sizing, colour, format. • Red signs indicate danger. • Yellow signs indicate warning. • White signs indicate information. • Readable to public approaching from shore and waterway. • Removal of obstructing plants, grasses, and trees. • Located within hearing distance of audible warning devices and visible distance from strobe lights. • Accompanying pictographs.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Waterway Danger Signage
REQUIREMENTS
• Red danger signs located at upstream and downstream extents of Dangerous Waterway Zone. • Located at land access points to water conveyance structure. • Located at "high" or "extreme" risk rating areas. • Located in harmony with other control measures. • Positioned on dam crest for viewing from land. • Formal correspondence with property owners whose land might be affected.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Waterway Warning Signage
REQUIREMENTS
• Located at "moderate" risk rating locations. • Located with access point considerations. • Located with public usage considerations. • Located to be clearly visible at all normal access points. • In proportion to all seasonal public interaction.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Portage Signage
REQUIREMENTS
• Located outside of dangerous waterway zone. • Located outside of the boom and buoy contained areas for upstream and downstream sides. • Balance of safety and convenience of little overland travel. • Located where water navigation is prevented. • Easily visible and provides proper guidance along prescribed trail.

DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
No Trespassing Signage
REQUIREMENTS
• Located at the entrance onto Xeneca property access points. • Located along perimeter fencing.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Public Use of Area Signage
REQUIREMENTS
• Identify approved public use of area.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Information Signage
REQUIREMENTS
• Identify the meaning of audible or visual alerts. • Identify the actions to be taken following the alert.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

CONTROL MEASURE
Power and Communication Line Signage
REQUIREMENTS
☐ Signage indicating vertical clearance over reservoirs. ☐ Visible indicators on powerlines to clearly show the powerline.
DESCRIBE EXISTING CONTROL MEASURES AND LOCATION

APPENDIX B

Hazard Risk Assessment Worksheet

Public Water Safety around Dams Management Plan Risk Assessment

							Proposed Control Measure "A"					Proposed Control Measure "B"			
Hazard No.	**Location or Type of Hazard**	**Description**	**Photo References**	**Implications**	**Consequence Rating (1-5)**	**Existing Control Measures as of December 2011**	**Likelihood Rating (0-5)**	**Risk Rating**	**Proposed Control Measure**	**Revised Likelihood Rating With Control Measure in Place**	**Residual Risk Rating after Implementation**	**Proposed Control Measure**	**Revised Likelihood Rating With Control Measure in Place**	**Residual Risk Rating after Implementation**	**Notes**
1	**Hazard Area 1**	***Identify Location - Example: Headpond***													
1.1	*Example: Inner Forebay Shoreline Access*	*Example: If someone were to fall in the inner forebay channel, they would have little chance of escape.*	*Take photos of hazard area to illustrate the potential danger and reference the photos here.*	*Example: Injury from going over the spillway bays or drowning.*	*Example: 4*	*Example: Only life rings on the spillway deck. No self-rescue tools.*	*Example: 2*	Moderate	*Example: Add one sign on powerhouse and one on footbridge: "Extreme Danger, Water Intake - Keep Away" with warning symbols, add an additional sign on front of footbridge: "Extreme Danger Access Beyond This Point May Result in Drowning" with warning symbols. Install ladders or rescue chain.*	1	Moderate	*Example: Restrict access to this area with fencing and signage.*	0	Low	*Example: Only install these items if they are not going to be more of a hindrance than they are helpful.*
1.2															
1.3															
1.4															
1.5															
1.6															
2	**Hazard Area 2**	***Example: Spillway***													
2.1	*Example: Downstream of the Flat Rocks in the Spillway Channel.*	*Example: This area is a popular area for fishing boats. Turbulent water exists during spillway operation. Due to the existing manually operated spillways, flow changes are gradual. With new automated spillways, there is potential for more rapid flow changes.*	*Photos #s*	*Example: Capsize of boat if boaters/fishermen get too close to the turbulent waters, especially if unaware of rapid flow changes.*	*Example: 4*	*Example: Current Xeneca practice is to perform visual check prior to initiating spill, but not for changes in spill flows where one or more bay are already in operation.*	*Example: 3*	High	*Example: Add signage: "Extreme Danger, Dam Outflow - Keep Away, Access Beyond This Point May Result in Drowning" with warning symbols. One sign should be placed on each shore with an additional sign on the on downstream face of the structure (i.e., 3 signs total). Strobes or sirens utilized to indicate significant flow changes.*	1	Moderate	*Example: In addition to signage and warning systems, Install downstream boom that restricts boater access to this area.*	0	Low	*Example: Downstream booms are technically challenging and difficult to install and maintain. Significant flow changes would be rare (ie: only during a unit / plant outage. Further, historically, there have been no known incidents involving boaters in this area.*

Risk Matrix

Likelihood		Consequences				
		1	2	3	4	5
		Negligible	Minor	Significant	Major	Catastrophic
0	Remote**	Low	Low	Low	Low	Low
1	Remote*	Low	Low	Low	Moderate	Moderate
2	Infrequent	Low	Low	Moderate	Moderate	High
3	Occasional	Low	Moderate	Moderate	High	High
4	Frequent	Low	Moderate	High	High	Extreme
5	Very Frequent	Moderate	High	High	Extreme	Extreme

** with adequate signage and access restricting control measures

* without adequate signage and access restricting control measures

Risk Rating	Suggested Timing	Suggested Action
Extreme Risk	Immediate	No activity should be allowed in the area until action is taken to mitigate the hazard to a moderate or low risk, or public exposure is prevented on a permanent basis.
High Risk	Short term (1-3 Months)	The risk should be reduced to a moderate or low risk as quickly as possible.
Moderate Risk	Medium term (3-6 months)	Action plans should be developed and carried out under the regular maintenance schedule.
Low Risk	Normally no action	There is likely no action required.

Public Water Safety - Risk Matrix
Table 3

KGS GROUP CONSULTING ENGINEERS

APPENDIX C
Fences and Barricades Guidelines

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1.0 SCOPE

This document provides the necessary information for a consistent approach for erecting fencing and barricades on Xeneca property.

2.0 OBJECTIVES

Fencing and Barricades are control measures that may be used in combination with signage to more clearly delineate dangerous areas around Xeneca's facilities. The use of fencing and or barricades within Xeneca is to be consistent with recognized industry standards.

While barricades are to be installed consistent with OHSA or other Regulations/ Bylaws in instances where fencing is specifically required to protect the public from entering a site fencing must be eight feet high (2.44 m) with an additional three strands of barbed wire on top. Where special situations dictate deviation from this standard, the written rationale describing the mitigation strategy applicable for that site is to be provided under the signature of the Plant Manager and submitted to ????? for approval.

Grounding and bonding for fencing is to be provided whenever there is reasonable evidence of a potentially hazardous situation

3.0 ACCOUNTABILITIES

The Plant Manager is responsible for the implementation of these fencing and barricades guidelines.

4.0 BARRICADES

4.1 BARRICADES

Barricades are generally not as restrictive as chain link fencing but may be an effective control measure. Barricades can come in many forms such as:

- concrete Barriers , e.g. a Jersey Barrier;
- a ditch;
- a strategically placed mound of soil or rockfill;
- a gate;
- guardrails or guiderails; or
- handrails.

When utilizing barricades to prevent vehicular traffic, signage should be considered to adequately identify the existence of the barrier.

4.2 VEHICLE ACCESS GATES

Locked Vehicle Access Gates should be installed at locations to prevent unauthorized vehicular traffic, e.g., Xeneca's property boundary.
Vehicle Access Gates are not meant to prevent pedestrian traffic, otherwise fencing should be considered.

Vehicle gates may utilize a standard chain link gate or be constructed of a much simpler frame as shown below in the photo. In this particular example concrete barriers were used in conjunction with the gate to limit vehicular access around the gate.

Photo from OPG Fences and Barricades Standard, DS-LP-STD-004

A good practice is to install signs immediately next to the gate as well as directly on the gate. In doing so when the gate is open the signs will still be visible. Consideration should also be given to install "Road Gated Ahead" signs prior to the gate to give the public advance warning of an impending stop.

Consideration should be given in the design of a vehicle gate to allow for future adjustment of the locking mechanism if misalignment is encountered over time. The example in the previous photo utilizes guy wires with turn buckles to allow for minor adjustment.

All bolted fittings should be well peened or tack welded to prevent unwanted removal by vandals.

Consideration should also be given for providing a vehicle turnaround just prior to the gate.

4.3 GUARDRAILS

A Guardrail is a vehicle traffic barrier that is installed along a structure such as a bridge or across a dam. These are intended to be restraining devices and as such where required guardrails are to be designed by a Professional Engineer to meet the requirements of Section 12 of the Canadian Highway Bridge Design Code – CAN/CSA-S6.

4.4 GUIDERAILS

A Guiderail is a vehicle traffic barrier that is installed along the shoulder of a road. Requirements for the design and installation of Guiderails are found in the Ontario Roadside Safety Manual and the Ontario Provincial Standards, Volume 3, Section 900.

4.5 HANDRAILS

A Handrail is a worker and or pedestrian traffic barrier. Under the Ontario Occupational Health & Safety Act (OHSA), Regulation for Industrial Establishments - R.R.O. 1990, Reg. 851, it is referred to as a “guardrail”. Handrails must meet the requirements of Section 13 and 14 of the above Industrial Regulations.

5.0 FENCING MATERIALS

Chain link fencing within Xeneca is to meet the following standards specified by the Canadian General Standards Board and any additional Xeneca installation requirements specified under Section 6.2 of this standard.

- Fabric for Chain Link fence CAN/CGSB-138.1
- Steel Framework for Chain Link Fence CAN/CGSB-138.2
- Gates for Chain Link Fence CAN/CGSB-138.4

Each of the above standards has optional requirements which are specified below.

5.1 FABRIC FOR CHAIN LINK FENCE CAN/CGSB- 138.1

The above standard has optional requirements under section 9.1, which must be specified in the application of the standard. For Xeneca fencing they are as specified in the table below.

Options to Be Specified Under CAN/CGSB-138.1, Sec. 9.1	Section	Specified
a. Type, class, style and grade of fabric	4.1	• Type: No. 1 (Steel) • Class: Zinc coated galvanized before weaving • Style: 2 (Medium)* • Grade: 2
b. Mass per unit area of core wire coating	6.2.2	As per standard
c. Size of mesh and height of fabric	6.4.1	Size of mesh: Standard* Height of fabric: 2.4 meters
d. Standard length of roll if other than 15 m	6.4.4	As per standard
e. Marking details, if other than as specified	7.2	As per standard
f. Sampling, if other than as specified	8.1	As per standard

*Increasing zinc coating, mesh size, or using cables through fencing can improve durability or performance.

5.2 STEEL FRAMEWORK FOR CHAIN LINK FENCE CAN/CGSB- 138.2

The above standard has optional requirements under section 9.1, which must be specified in the application of the standard. For Xeneca fencing they are as specified in the table below.

Options to Be Specified Under CAN/CGSB-138.2, Sec. 9.1	Section	Specified
a. Type and style of fence posts & rails	4.1	Type: No. 1, Hot rolled, butt or electrical resistance welded Style: A (Heavy)
b. Material & dimensional requirements of fence posts, rails and truss rods	6.1, 6.2 & 6.3	As per standard
c. Material for fittings	6.4	Malleable or ductile cast iron, or steel and hot dipped galvanized after fabrication
d. Barbed wire material & construction	6.5	Zinc coated steel, 2 strand
e. Requirement for solid aluminum barb	6.5	N/A
f. Requirement for barbed tape or ribbon	6.6	N/A
g. Wind strength characteristics	6.8.1.1	As per standard
h. Spacing of line posts	6.8.1.2	Distance shall be as per standard and uniform in spacing
i. Requirement for rails or tension wires	6.8.1.3	Top rail, bottom tension wire
j. Requirement for brace rail and truss rod	6.8.1.4	As per standard
k. Strength of brace rails	6.8.3	Not specified
l. Design wind load requirements	6.8.4.5	As per standard
m. Strength of truss rods	6.8.6	Not specified
n. Preparation for delivery	7.1	As per standard
o. Sampling requirements	8.1	Not specified

5.3 GATES FOR CHAIN LINK FENCE CAN/CGSB- 138.4

The above standard has optional requirements under section 9.1, which must be specified in the application of the standard. For Xeneca fencing they are as specified in the table below.

Options to Be Specified Under CAN/CGSB-138.4, Sec. 9.1	Section	Specified
a. Type of framework manufacture	4.1.1	Type 1, hot rolled, butt or electrical resistance welded
b. Style of gate	4.1.2	As specified on site plan by Xeneca
c. Size of gate frame members, if other than specified in Table 1	6.1.1	As per standard
d. Size of gate frame members for styles 3 and 4	6.1.1	N/A
e. Requirement for installation of chain link fabric on inside of gate	6.2	Outside as per standard
f. Requirement for barb wire top	6.3	Three strands of barbed wire
g. Material used for fittings	6.4	Malleable or ductile cast iron, or steel and hot dipped galvanized after fabrication

h. Packaging, labeling, packing and marking details, if other than normal practice.	7.1	As per standard
i. Sampling requirements	8.1	N/A
j. Gate hinges	6.4.6	Only two hinges for each section of gate.

6.0 INSTALLATION OF CHAIN LINK FENCE

Chain link fencing within Xeneca is to meet the following standard specified by the Canadian General Standards Board and any additional Xeneca installation requirements specified under section 6.2 of this standard.

6.1 INSTALLATION OF CHAIN LINK FENCE CAN/CGSB-138.3

The above standard has optional requirements, under section 7.1, which must be specified in the application of the standard. For Xeneca fencing they are as specified in the table below.

Options to Be Specified Under CAN/CGSB-138.3, Sec. 7.1	Section	Specified
a. Requirement for disposal of earth removed from post holes	4.5	Unless otherwise stipulated by the Xeneca site representative, earth removed from post holes shall be used for filling and compaction with hand tools where required to maintain proper bottom closure and smooth fence contour.
b. Line and level requirements for fence installation	5.1	The fence fabric shall follow the fence lines both as shown on site plan provided by Xeneca and further clarified at site by the Xeneca site representative.
c. Location of terminal posts	5.2.1	The locations of terminal posts are fixed by the site plan and further clarified at site by the Xeneca site representative.
d. Grade specifications	5.3	The bottom of the fence fabric, after the installation is complete, shall be touching the ground to not more than 25 mm in the ground of the finished grade elevation.
e. Depth of footing	5.4	As per standard
f. Grouting materials	5.4.2	As per standard
g. Requirement for installation of chain link fabric on inside of fence	5.6.	Outside

6.2 XENECA ADDITIONAL INSTALLATION REQUIREMENTS

This section stipulates additional Xeneca requirements in addition to Canadian General Standards already provided for in this standard.

6.2.1 Height of Security Fencing

Where required, new security fencing, for the outer most perimeter of fencing that a member of the public first comes into contact with, is to be a minimum of eight feet high (2.44 m) with an additional three strands of barbed wire on top.

6.2.2 Installation of Chain Link Fabric

- Fence fabric shall be installed knuckled edge at the top, barbed edge at the bottom.
- Offset bands are to be evenly spaced at not more than 400 mm apart.
- After stretching, the top of fabric shall contact the top rail at mid-level of the top diamond.
- The tension of the fabric should be just enough to prevent a person from creating slack in the weave using one hand, to the satisfaction of the Xeneca contract administrator.
- Wire ties shall be 3.5 mm nominal diameter, non-ferrous wire.

6.2.3 Barbed Wire Installation

- Three strands of barbed wire shall be tightly strung above the fence. The supporting brackets shall slope outward, supporting the barbed wire outside the fence line unless the fence is on the property boundary. In the case of fencing installed along the property boundary, barb arms are to slope inward and must not extend beyond the property line.
- Each strand shall be continuous around corners and shall be fastened to each end post and gatepost with a centre band.
- The strand shall be inserted in the slots of the barb arms on line and corner posts, and fastened with wire ties on each barb arm to prevent removal from the slots.
- Wire ties shall be 3.5 mm nominal diameter, non-ferrous wire.
- Barbed wire is to be fastened using “Gripples”. Turnbuckles are not to be used for barbed wire installation on security fencing.

6.2.4 Installation of Bottom Tension Wire

- The tension wire shall be strung tight, on the outside of the line posts, inside the fabric, at the mid-levelof the bottom diamond.

- It shall be terminated by wrapping and then fastening with a "Gripples" to the satisfaction of the Xeneca site representative.
- Turnbuckles are not to be used for bottom tension wire installation on security fencing. "Gripples" are to be used for fastening.
- The bottom tension wire shall be fastened to the fabric by a steel closed wire ring, clip, twisted wire tie, or weaved at minimum 1 meter spacing.
- Bottom wire rings or clips shall be non-ferrous or zinc coated and placed at minimum 1 meter spacing.

6.2.5 Installation of Gates

- Gates shall be hung to swing "out" unless otherwise specified on the site plan. This is to facilitate opening with significant snow accumulation. The location of the gate holdbacks can be determined on the site.
- The top of both gateposts shall be set at same elevation regardless of ground contour.
- The clearance between the gate and the crown of roadway or top of siding track rails shall not exceed 50 mm.
- All gates are to have only 2-hinges to minimize the creation of a "ladder" for unauthorized access.
- The fabric is to be installed on the public side of the gate with the barbed edge at the top and with the fabric flush with the bottom edge.
- All gates should be capable of opening approximately 180 degrees.
- All sizes of gates shall have a diagonal brace member, horizontal braces should not be used. In addition, the diagonal brace shall run from the toe to upper hinge corner.
- The bottom hinge bolt shall be turned up and the top one turned down.
- Hinges shall be installed with hinge bolts parallel to the fence line and so adjusted that the clearance between gatepost and frame does not exceed 50 mm.
- The dimensions of hinges and latches shall be such that gates can be installed with no more than 50 mm of space between gate sections or between gate and post.
- A 600 mm length of 1¼ NPS pipe shall be driven into the roadway surface to form a socket for the cane bolt(s) when the gate(s) is in the closed position.
- All bolts/nut assemblies are to have the threads tack welded on the end of the bolt protruding from the nut to stop unwanted removal. This will still facilitate future adjustment.

- One leaf of all double gates and all single 3.6 m gates shall contain a man-gate.
- Man-gates shall be fitted in a 0.61 m by 2 m opening at the upper corner on the latch side of the gate. The space between man-gate and frame shall not exceed 50 mm.

6.2.6 Cantilever Sections

Cantilever sections are to be used wherever fencing terminates at a location where the public can easily access around the end, e.g. at a shoreline or on a cliff or drop off. The section should extend out at least 1.5 metres and be welded solidly in place. In tailraces and spillways the cantilever should be installed at an elevation that allows for typical low water periods. In these instances it is advisable to make the portion of the fencing, and associated cantilever section that may be potential under water during high flows, as a sacrificial section. This will prevent extensive damage to a much larger portion of fencing.

6.2.7 Floating Fence

There may be occasion where due to the lack of soil or solid rock a floating fence, i.e., posts not set in soil, may be utilized, e.g., along a shoreline of rip rap as shown below. The fence posts are welded to 1½ inch (38 mm) x 4 inch (102 mm) rectangular galvanized tubing. The tubing is run both horizontally in line with the fence and at each fence post a perpendicular horizontal piece is welded as an out rigger approximately 3 feet (914 mm) on either side, see photo below.

Photo from OPG Fences and Barricades Standard, DS-LP-STD-004

6.2.8 Wooden/Plastic Fence

Wooden/Plastic fencing is typically used when it is desirable to have an electrically insulated section of fence between two sections of metal fencing. Wooden fencing can also be used in place of metal fencing when there is a real concern of touch potential for a member of the public that can not be eliminated by typical grounding and bonding requirements. See Section 7 regarding grounding requirements for metal fencing.

Wooden/plastic fencing should be constructed from standard 38 mm thick x 140 mm wide cedar lumber. The face of the fence is to be vertical boards that face outward. The horizontal boards should be on 24 inch (610 mm) centers that are bolted to vertical metal fence pots. The spaces between the vertical boards should be no more than 0.25 inches (6 mm) to prevent finger access. Wood screws are to be used that are epoxy coated (for wood) or stainless (for plastic). All screws should be installed on the inside of the fence so as to prevent a member of the public from removing fence boards with a screwdriver.

Consideration should be given for the use of recycled plastic lumber instead of wood for insulated fence. It is ultraviolet light resistant, environmentally friendly low maintenance and lasts much longer than wood.

6.2.9 Miscellaneous

- All bolted fittings are to be well peened or tack welded to prevent unwanted removal by vandals.
- If an endpost or gatepost adjoins a building or rock wall face, the end post shall be set as close as possible. If a small gap of 100 mm or more is left it should be filled with vertical galvanized pipe (e.g., top rail) with maximum 4 inches (102 mm) clearance between vertical sections.

Photo from OPG Fences and Barricades Standard, DS-LP-STD-004

- Footing excavations shall be dewatered before concrete or grout is placed. Where concrete is placed on rock, the rock face shall be cleaned before concrete is applied.
- In freezing weather, the temperature of the concrete at time of placing shall be 10-27ºC. If the concrete is air entrained, its temperature shall be maintained above 10ºC for not less than 3 days after placing. Concrete shall not be placed in contact with frozen soil or rock without specific approval from the Xeneca contract administrator.

7.0 FENCE GROUNDING AND BONDING

Note:

• Grounded as used in this document means connected to the station ground grid, connected to ground rods driven along its length, or a single continuous conductor below the fence.

• ***In cases of doubt, unusual situations or difficulty in meeting the requirements for grounding or bonding, a professional Electrical Engineer is to be consulted.***

For security purposes, wire station-fences are normally installed on the periphery of switchyards, transformer, generation and distribution stations. They are also used within the station to enclose electrical equipment such as capacitor banks and pipe gaps. In general, boundary (property) fences remote from the station area need not be grounded. In special cases such as proximity (less than 2 m) to a station fence, a special study is required. Overhead line crossings are not considered a significant factor in the decision to ground the boundary fence.

Station fence grounding is of major importance because:
(i) The outside of the fence is usually accessible to the general public.
(ii) The voltage involved is the more dangerous touch voltage.
(iii) The fence may occupy a position on the periphery of the ground-grid area where surface potential gradients are the highest.

Two different situations may be found in the existing practice for fence grounding:
(i) Inclusion of the fence within the main ground grid area. This situation is found only when:
(a) the station fence is located within 2 m of grounded station equipment or
(b) when a railway siding is inside the fenced area.

(ii) For all cases other than (a) and (b) mentioned above, the fence grounding system is separated from the main grid and connected to its own ground electrodes.

7.1 FENCE GROUNDING SYSTEM

7.1.1 Station Fence is connected to the main grid and also to its own ground electrodes:

Inclusion of the fence within the ground grid area increases the size of the area and thereby reduces, often substantially, the ground grid resistance, and hence the maximum ground grid potential rise (E=IR) as well. In order to make the grounding installation as effective as possible, particularly during winter months, ground rods equally spaced, not more than 12 m apart, should be installed along the fence and connected to the fence ground electrode. By connecting the fence and its grounding system to the main station ground grid, the maximum touch voltage within the station will be reduced.

7.1.2 Station Fence is not connected to the station ground grid but has its own grounding system:

Isolating the station fence from the main grid (aside from sacrificing improvement of station grid resistance) introduces the possibility of inadvertent electric connection between the grid and the fence areas. Gate mounted telephones, telephone signal lines, distribution circuits from the station to a gate house, water pipes, rails, etc. could transfer main grid potentials and introduce dangerous local potential differences during faults; remedial protection measures should be considered. If the fence itself is not tightly coupled to the nearby ground by its own adequate ground system any such inadvertent connections to the main grid could create a hazard along the entire length of the fence under fault conditions. Hence, the station fence should have its own grounding system whether it is connected to the station ground grid or not.

If the station fence grounding is isolated from the main grounding grid the magnitude of touch voltage to the public will be much reduced. This factor is rather important especially for stations where the outside of the station fence is accessible to the public and may more than compensate for the benefits lost by not connecting the fence grounding to the main grounding grid.

7.2 STATION FENCE GROUNDING DETAILS

All wire station fences should be grounded by means of a copper cable buried 150 to 200 mm deep, approximately one metre (touch distance) outside the fence line and connected to the fence at approximately 12 m intervals by means of copper taps. The taps should be interwoven through the fence fabric, making electrical contact with strand wires, and connected to the top rail and to all strands of the barbed wire. The top rail should be bonded at all joints by means of copper cable-jumpers. Hinged gates should be bonded with a flexible copper conductor.

The size of the copper cable for the ground bus, taps, and jumpers should be 67 mm^2 2/0 AWG.

If installation of the station fence ground bus outside the fence is not feasible, the bus should be installed along the fence line.

To minimize the touch potential at station gates, a buried grid mat of one metre squares should be installed encompassing the gate-swing area and connected to the fence grounding system.

7.3 PRIVATELY OWNED FENCES

Metallic Station Fences should not approach closer than 2 m to any metallic component of a privately owned fence.

8.0 REFERENCES

• Ontario Power Generation *'Fences and Barricades'* Standard	DS-LP-STD-004
• Canadian Highway Bridge Design Code	CAN/CSA-S6
• Ontario Roadside Safety Manual	
• Fabric for Chain Link fence	CAN/CGSB-138.1
• Steel Framework for Chain Link Fence	CAN/CGSB-138.2
• Gates for Chain Link Fence	CAN/CGSB-138.4
• Installation of Chain Link Fence	CAN/CGSB-138.3

APPENDIX D

Waterway Public Safety Incident Report

Waterway Public Safety Incident Report

- **1.0 BASIC DETAILS**
- Note: Completion of this section is the minimum requirement for Xeneca incident notification.

Site: Pine Falls G..S.	**Incident Date (d/m/y):**	**Time:** ☐ am ☐ pm
Submitted By:	**Submission Date (d/m/y):**	**Supervisor at Time of Incident:**
Victim Name (if available):	**Victim Contact Info (if available):**	

Location of Incident:			
☐ Upstream Reach	☐ Spillway/Sluiceway Gate Crest	☐ Powerhouse	☐ Recreational Area
☐ Reservoir	☐ Spillway/Sluiceway Outlet Channel	☐ Powerhouse Tailrace Deck	☐ Downstream Reach
☐ Headpond	☐ Powerhouse Intake	☐ Powerhouse Tailrace	☐ Other
☐ Spillway Sluiceway	☐ Powerhouse	☐ Designated Fishing	______________________

- **Detailed Location:**

Incident Classification:		
☐ Actual Incident	☐ Near Miss	☐ Control Measure Failure

Incident Category:			
"Low"	☐ Trespassing in hazardous area	☐ Stranding not requiring rescue	Other:
"Medium"	☐ Injury not requiring First Aid	☐ Stranding requiring rescue	Other:
"High"	☐ Injury requiring First Aid	☐ Injury requiring medical attention	Other:
"Extreme"	☐ Injury requiring extended hospital stay	☐ Fatality due to hazard (not suicide or homicide)	Other:

- **Incident Description including sequence of events and how injury occurred** (include any observations/discussion by staff or public, use other side of page if necessary)**:**

- **This incident is under investigation external to Xeneca?** ☐ Yes ☐ No
- **2.0 DESCRIPTION OF INJURY**
- **Describe which body parts were injured** - only required for "Medium" or higher category incidents:
-
-
- **Source of Injury -** only required for "Medium" or higher category incidents

☐ Impact with structure	☐ Went over spillway/sluiceway	☐ Caught in, under or between	☐ Fall from height less than 3 m
☐ Slip into waterway	☐ Caught in swift current	☐ Electrical Energy	☐ Fall on same level
☐ Impact with in-stream Hazard	☐ Drowning	☐ Fall from height greater than 3 m	☐ Rubbed, scraped or abraded
☐ Other			

- **3.0 ACTIVITIES – Describe what the person was doing at the time of the injury/incident (e.g. fishing from boat, swimming, etc.):**
-
-
-
-
- **4.0 CONTROL MEASURES - Select physical control measures in place at the time of the incident (if any). Attach site drawings, photos and operating procedures.**

☐ fencing	☐ signs	☐ safe fishing area	☐ buoys
☐ boom	☐ local media incl.	☐ local postings	☐ unknown
☐ barricades	☐ internet	☐ walkways	
☐ advance release notification/ schedule	☐ audible warning devices	☐ roadway gates	☐ Other:

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- **5.0 EQUIPMENT – Select the Equipment/Hardware factors relevant to the incident (if any)**

- ☐ control measure failure
- ☐ condition of vehicle or vessel
- ☐ control measure unavailable
- ☐ Other:

- **6.0 ENVIRONMENTAL – Select the environmental factors relevant to the incident (if any)**

- ☐ low visibility
- ☐ slippery surface
- ☐ steep slopes
- ☐ snow/ice
- ☐ dark, night
- ☐ protruding
- ☐ slope instability
- ☐ structural failure
- ☐ low lighting
- ☐ rainy conditions
- ☐ uneven surfaces
- ☐ energized
- ☐ rough water
- ☐ hot environment
- ☐ calm water
- ☐ sharp objects
- ☐ windy conditions
- ☐ floating debris
- ☐ rapid water rise
- ☐ failure of ice cover
- ☐ cold water
- ☐ cold environment
- ☐ remote release of
- ☐ failure of vehicle or vessel
- ☐ sudden release of water
- ☐ exposed mech/electrical equipment
- ☐ Other:
- ☐ ramped release of water
- ☐ strong currents/undertow
- ☐ inaccessible or awkward location

- **7.0 ROOT CAUSE – Select at least one root cause.**

- ☐ communication
- ☐ floating debris
- ☐ insufficient warning
- ☐ supervision
- ☐ maintenance
- ☐ Under review
- ☐ workplace layout
- ☐ No Accountability
- ☐ deviant behaviour (disregard for warnings)
- ☐ insufficient control measure
- ☐ policies and procedures
- ☐ Other:

- **8.0 Corrective Action – describe corrective actions taken, warnings issued, charges laid and control measure repaired or upgraded:**

Note: This form is intended to be an internal incident report for Xeneca use only, it is not intended to be a substitute for or replace a first responder or investigative report.