

PROJECT NO. 131-13550-00

BALA GENERATING STATION PUBLIC SAFETY MEASURES PLAN

REPORT REVISION 4

CONFIDENTIAL



WSP
600 COCHRANE DRIVE
5TH FLOOR
MARKHAM, ON
L3R 5K3

T: +1 905-475-7270
F: +1 905-475-5774
wsp.com

PROJECT NO. 131-13550-00

BALA GENERATING STATION PUBLIC SAFETY MEASURES PLAN

SWIFT RIVER ENERGY LIMITED
CONFIDENTIAL
PROJECT NO. 131-13550-00
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| Prepared by | Reviewed by | Reviewed by: | Approved by: |
| B. Peter, P.Eng., KGS Group | S. Kohnen, P.Eng., KGS Group | G. Bourgeois, P.Eng., WSP Canada | F. Belerique, SREL |
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| Prepared by | Prepared by | Reviewed by | Approved by: |
| K. Seto, P.Eng., WSP Canada | G. Bourgeois, P.Eng., WSP Canada | H. Walsh, P.Eng., WSP Canada | F. Belerique, SREL |
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| Prepared by | Prepared by | Reviewed by | Approved by: |
| K. Seto, P.Eng., WSP Canada | G. Bourgeois, P.Eng., WSP Canada | H. Walsh, P.Eng., WSP Canada | F. Belerique, SREL |
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| Prepared by | Prepared by | Reviewed by | Approved by: |
| K. Seto, P.Eng., WSP Canada | G. Bourgeois, P.Eng., WSP Canada | H. Walsh, P.Eng., WSP Canada | F. Belerique, SREL |
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| Prepared by | Prepared by | Reviewed by | Approved by: |
| K. Seto, P.Eng., WSP Canada | G. Bourgeois, P.Eng., WSP Canada | H. Walsh, P.Eng., WSP Canada | F. Belerique, SREL |

SIGNATURES

This document has been developed to document the public safety measures at Bala G.S.

PREPARED BY



K. Seto, P.Eng.
WSP Canada Inc.

August 23, 2019



G. Bourgeois, P.Eng.
WSP Canada Inc.

August 23, 2019

REVIEWED BY



H. Walsh, P.Eng.
WSP Canada Inc.

August 23, 2019

APPROVED BY



F. Belerique
Swift River Energy Ltd.

August 23, 2019

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1 ACCOUNTABILITY

1.1 OWNERS

MINISTRY OF NATURAL RESOURCES AND FORESTRY (MNR)

As the **Owner of the North and South Bala Dams**, MNR must ensure that its role and responsibilities, as listed in the Public Safety Measures Plan for the Bala Falls Dam (Appendix C), are maintained:

- The established policy for Public Safety Around Dams (as defined in the Lakes and Rivers Improvement Act guidelines) is implemented with respect to MNR's own infrastructure
- All personnel responsible for the management and operation of the structure are trained in the requirements of the PSMP and are aware of their responsibility, including both the identification of hazards and reporting of incidents (occupational and involving the public), and training records are maintained by MNR
- Any change in site conditions is managed in subsequent version of the PSMP
- Every incident at the site is investigated to minimize the risk of recurrence and records of all incidents and investigations should be kept by MNR and reported to MNR District Manager

SWIFT RIVER ENERGY LIMITED (SREL)

As the **Owner of the Bala G.S.**, SREL must ensure that:

- The established plan for Public Safety Around Dams (as defined in the Lakes and Rivers Improvement Act guidelines) is implemented with respect to SREL's own infrastructure
- All personnel responsible for the management and operation of the structure are trained in the requirements of the PSMP and are aware of their responsibility, including both the identification of hazards and reporting of incidents (occupational and involving the public), and training records are maintained by SREL
- Any change in site conditions is managed in subsequent version of this PSMP
- Every incident at the site is investigated to minimize the risk of recurrence and records of all incidents and investigations should be kept by SREL and reported to MNR District Manager
- Public and Workers safety measures are implemented during construction and operation
- Public education and communication protocols are adhered to and updated as required

BOTH PARTIES

The upstream North Channel area can be considered a **common area** which feeds into both the North Bala Dam (owned by MNR), and the Bala G.S. (owned by SREL). SREL will be installing improved public safety measures for the generating station and will be responsible for the maintenance of these measures.

1.2 DAM OPERATOR

SREL is responsible for the operation of the Bala Falls G.S. As well, under the agreement with MNRF, responsibility of operation of the North and South Bala Dams will be transferred to SREL. As such, SREL must ensure that:

- All personnel responsible for the management and operation of the structure are trained in the requirements of the PSMP and aware of their responsibility, including both the identification of hazards and reporting of incidents (occupational and involving the public)
- Operation, maintenance and surveillance of the dams and G.S. are in accordance with the recommendations and standards of this Public Safety Measures Plan
- Public education and communication protocols are adhered to and updated as required
- Every incident at the site is investigated to minimize the risk of recurrence

2 SITE DESCRIPTION

The Bala Falls site is located in the Township of Muskoka Lake, Village of Bala and district of Muskoka. Muskoka Lake levels and lake outflows are controlled by the North Bala Dam and the South Bala Dam, both owned by the Ministry of Natural Resources and Forestry (MNRF), as well as two hydroelectric generating stations: the Burgess Generating Station (G.S.), operated by KRIS Renewable Energy and the proposed Bala G.S., owned by Swift River Energy Limited (SREL).

These structures are located in the same general area on the West side of Muskoka Lake. The North Bala Dam has a normal head of 2.45 m, and consists of 6 sluices, with the following characteristics:

- 1 with seven stoplogs (4.88 m long)
- 2 with seven stoplogs (6.1 m long)
- 3 with eight stoplogs (6.1 m long)

The South Bala Dam has a normal head of 2.44 m, and includes the following components:

- 8 sluices with eight stoplogs (6.1 m long)
- 2 spillwalls with a total length of +/- 24 m

The Bala G.S. is scheduled to go into operation in mid-2019. The powerhouse is located immediately south of the existing North Bala Dam. The hydro-development includes a powerhouse, an intake channel leading to the powerhouse and a tailrace returning water to the Moon River immediately downstream of the powerhouse and existing North Bala Dam. The project is constructed entirely on land owned by the Provincial Crown for which SREL has been awarded Applicant of Record Status by the MNR through its Waterpower Site Release Program.

From a public safety perspective, there are several potentially hazardous zones at the Bala Falls site as shown in Figure 1 including:

- 1 The railway bridge
- 2 The intake area upstream of the powerhouse
- 3 The tailrace area downstream of the powerhouse, and
- 4 The Bala Falls G.S.

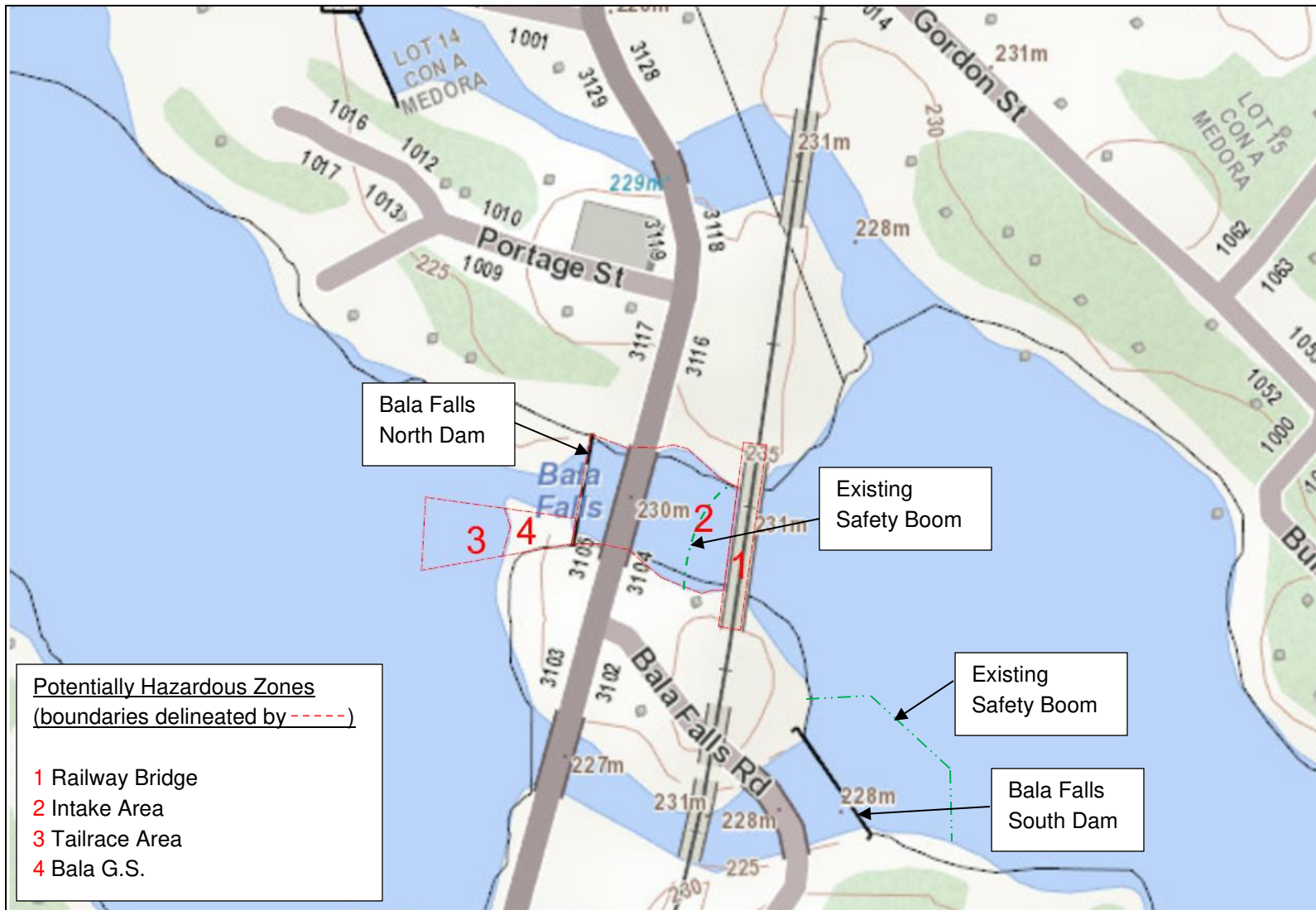


Figure 1 Potential hazards at the Bala Falls site

The Public Safety Measures Plan (PSMP) for the existing North and South Bala Dams was established in 2011 and has been implemented by MNRF at the site since then. The risk assessment was based on the Risk Assessment Tool developed by MNRF in 2010. These documents are attached in Appendix C. The purpose of the PSMP is to identify safety hazards associated with the structures and carry out a comprehensive assessment of public safety at the site through a risk analysis.

SREL retained WSP Canada Inc. (WSP) as the Designer of Record for the Project, and KGS Group (KGS) as the Owner's Engineer to assist with technical review and management of the work. In 2017 WSP and KGS jointly developed an initial public safety plan for the SREL project (i.e. Revision 0 of this document), which was requested by MNRF and the Ministry of Environment, Conservation and Parks (MECP) during the Environmental Screening Review of the project. This 2017 Bala Falls GS public safety plan was based on the existing 2011 WESA/MNRF PSMP and supplemented by conceptual or preliminary design work completed to date for the Project, but which had yet to be finalized for construction.

WSP has now updated the project PSMP based on the final design of the Bala G.S. This document presents a review of the accountability of the owners, operators and contractors in Section 1.0. The risk assessment completed for the Bala G.S. as part of this update to the PSMP is detailed in Section 3.3 and proposed public safety measures for the Bala G.S. are summarized in Section 4.0.

3 SUMMARY OF THE PUBLIC SAFETY ASSESSMENT

3.1 MNRF RISK ASSESSMENT TOOL, MARCH 2010

The risk analysis included in the 2011 PSMP and in the current document was completed according to the MNR Risk Assessment Tool, March 2010 (Appendix D of the 2011 PSMP (WESA, 2011)). The risk assessment evaluation and scoring criteria as determined by MNRF are presented in Tables 1, 2 and 3.

There are two key criteria that must be assessed which are defined as follows:

- Incident Likelihood (Probability): expected level of public interaction for the activity and associated hazards present (either known or estimated)
- Incident Severity (Consequence): most likely outcome of the potential interaction that could reasonably be experienced as a result of dam operations or interaction with MNRF facilities by a member of the public engaging in that activity

TABLE 1 INCIDENT LIKELIHOOD (PROBABILITY) (APPENDIX D OF (WESA, 2011))

Expected level of public interaction for the activity and associated hazards present (either known or estimated)




| Level | Descriptor | Example Description |
|-------|-------------------------|---|
| 5 | Almost Certain to Occur | is expected to occur in most circumstances |
| 4 | Likely | will probably occur in most circumstances |
| 3 | Possible | will occur at some time |
| 2 | Unlikely | might occur at some time |
| 1 | Rare | may occur only in exceptional circumstances |

TABLE 2 INCIDENT SEVERITY (CONSEQUENCE) (APPENDIX D OF (WESA, 2011))

| Level | Descriptor | Example Description |
|-------|---------------|--|
| 1 | Insignificant | no 1st aid required |
| 2 | Minor | 1st aid may be required (by non-EMS personnel) |
| 3 | Moderate | could result in medical treatment or rescue |
| 4 | Major | critical injury is possible (EMS services are required) |
| 5 | Catastrophic | fatality or permanent total disability is likely to result (drowning, severe trauma) |

TABLE 3 PUBLIC SAFETY RATING (APPENDIX D OF (WESA, 2011))

Classify the risk rating for the particular activity, according to Low, Medium or High Risk:

-  **LOW Risk** - A LOW RISK would not require further reduction but reasonable and obvious measures should be implemented as appropriate.
-  **MEDIUM Risk** - A MEDIUM RISK determination means that the Ministry should evaluate all reasonable means to reduce risks as a 2nd priority.
-  **HIGH Risk** - A HIGH RISK determination requires the Ministry to take all reasonable measures to mitigate this risk as a 1st priority.

| RISK RATING | | | Incident Consequences | | | | |
|---------------------|----------------|---|-----------------------|-------|----------|-------|--------------|
| | | | Insignificant | Minor | Moderate | Major | Catastrophic |
| | | | 1 | 2 | 3 | 4 | 5 |
| Incident Likelihood | Almost Certain | 5 | M | M | H | H | H |
| | Likely | 4 | L | M | H | H | H |
| | Possible | 3 | L | M | M | H | H |
| | Unlikely | 2 | L | L | M | M | H |
| | Rare | 1 | L | L | L | L | M |

3.2 2011 MNRF PUBLIC SAFETY MEASURES PLAN FOR THE NORTH AND SOUTH BALA DAMS

The hazards and public safety measures identified in the Public Safety Measures Plan for the existing North and South Bala Dams remain applicable since the construction of the new Bala G.S. will not significantly alter the existing dams, and therefore does not directly affect the functionality and public safety aspects of these dams or their operation.

Tables 4 and 5 present the existing hazards at the North and South Bala Dams respectively, prior to the Bala G.S. being in operation and as determined in the 2011 PSMP (attached in Appendix C).

TABLE 4 RISK ANALYSIS OF EXISTING HAZARDS AT THE NORTH BALA DAM, PRIOR TO THE BALA G.S. BEING IN OPERATION (WESA, 2011)

For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

| HAZARD NUMBER | Step 1 IDENTIFY | | | Step 2 L LEVEL (1,2,3,4,5) | Step 3 C LEVEL (1,2,3,4,5) | Step 4 RISK RATING (High/Medium/Low) | Step 5 RECOMMENDED CONTROLS |
|---------------|------------------------------|-------------------|--|-------------------------------|-------------------------------|---|---|
| | ACTIVITY | HAZARD | EXISTING CONTROLS | | | | |
| 1 | Trespass on dam | Falls | "No Trespass" Signage, locked gate and mesh | 1 | 4 | Low | Maintain at each end of the dam: Gate and Guardrail mesh infill panels, and; "No Trespass" signs. Maintain on each face of the dam: Guardrails with part mesh infill at each end, and; Danger signs. Install at each end of dam: Signage with name of dam owner and contact information. |
| 2 | Swimming upstream | Drowning | "Danger" Signage at dam; safety boom; "No Swimming" sign installed by third party on left bank between dam and Road 169 bridge | 3 | 5 | High | Redesign, install and maintain: Safety Boom and components (requires Qualified Engineer); Install: New "Danger" sign on upstream side of Road 169 bridge; Physical barrier on accessible banks along upstream dangerous water area. |
| 3 | Wading / swimming downstream | Drowning | "Danger" Signage at dam | 2 | 5 | High | Install: Warning signage downstream of the dam to warn of potential changes in flows; Document practice of conducting visual inspections of downstream dangerous water area prior to removing stoplogs to ensure communication to all MNR personnel (revise MRDOM). Consider increasing amount of normal discharge. |
| 4 | Paddling through dam | Capsize, Drowning | "Danger" Signage at dam; safety boom | 1 | 5 | Medium | Install: New "Danger" sign on upstream side of Road 169 bridge. Maintain: Safety Boom. Consider vessel operation restriction. |
| 5 | Swimming / Wading upstream | Drowning | "Danger" Signage at dam; Safety Boom | 2 | 5 | High | As Hazard 2 above and; Ensure physical barriers deter access to the water between the dam and the safety boom. |

TABLE 5 RISK ANALYSIS OF EXISTING HAZARDS AT THE SOUTH DAM, PRIOR TO THE BALA G.S. BEING IN OPERATION (WESA, 2011)

For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

| HAZARD NUMBER | Step 1 IDENTIFY | | | Step 2 L LEVEL (1,2,3,4,5) | Step 3 C LEVEL (1,2,3,4,5) | Step 4 RISK RATING (High/Medium/Low) | Step 5 RECOMMENDED CONTROLS |
|---------------|--|-------------------|---|----------------------------|----------------------------|--------------------------------------|---|
| | ACTIVITY | HAZARD | EXISTING CONTROLS | | | | |
| 1 | Trespass on dam | Trips / Falls | "No Trespass" Signage; locked gate | 2 | 4 | Medium | Install at each end of the dam: Gate and Guardrail mesh infill panels; "No Trespass" signs; Signage with name of dam owner and contact information. Secure stoplog gain covers. Maintain on each face of the dam: Guardrails. |
| 2 | Swimming upstream | Drowning | "Danger" Signage at dam; safety boom | 3 | 5 | High | Redesign, Install and maintain: Safety Boom and components (requires Qualified Engineer) |
| 3 | Swimming / Wading upstream | Drowning | "Danger" Signage at dam; Safety Boom | 2 | 5 | High | As Hazard 2 above and; Install physical barrier and "Danger" signage on left bank between dam and new left bank boom anchor. |
| 4 | Swimming / wading / fishing downstream | Drowning | "Danger" signage at dam; Uninviting flows | 2 | 5 | High | Install: "Danger" signage on downstream road bridges; Physical barriers at fall hazards on accessible banks along downstream dangerous water area. Liaise with landowners on downstream banks as necessary. |
| 5 | Paddling through dam | Capsize, Drowning | Signage at dam, Safety Boom | 1 | 5 | Medium | Redesign, install and maintain: Safety Boom and components (requires Qualified Engineer). Consider vessel operation restriction. |

3.3 PUBLIC SAFETY RISK ASSESSMENT FOR BALA G.S.

3.3.1 PUBLIC INTERACTION AROUND THE BALA G.S.

The proposed development area is heavily used by the public for both aquatic and terrestrial recreational activities. The area immediately around the Bala Falls G.S. development is a known recreational area, where the public participates in activities including:

- Swimming upstream and downstream of the dams
- Boating/paddling upstream of the dams
- Boating/paddling downstream of the dams including white water kayaking in the downstream channel during high flow conditions
- Portaging around the dams (north of the North Bala Dam, and south of the proposed G.S. site)
- Climbing up onto the CP rail bridge and jumping off into the area upstream of the dam (this is a prohibited activity but has been noted to occur (WESA, 2011))
- Picnicking, sightseeing and general recreation:
 - On the rocks immediately downstream of the existing MNR North Bala Dam when not in use,
 - At Diver's Point,
 - At Margaret Burgess Park on the north side of the downstream channel, and,
 - On the future park on the lands immediately south of the planned Bala Falls G.S.

3.3.2 RISK ANALYSIS OF HAZARDS AROUND THE BALA G.S.

The general arrangement and local conditions associated with the presence and the operation of the new Bala G.S. were reviewed with respect to public safety. A risk analysis of hazards at the Bala G.S. was completed according to the MNR Risk Assessment Tool. This review resulted in the identification of the following activities which could expose the public to a range of potential hazards from trip/fall to drowning. The activities identified through this process are as follows, in no particular order of severity, likelihood or risk:

- 1 Trespass on G.S. (and related structures)
- 2 Swimming upstream
- 3 Wading/swimming downstream
- 4 Paddling upstream
- 5 Paddling downstream
- 6 Jumping off CP bridge (illegal trespassing)

The hazards corresponding to each activity at risk are also listed in Step 1 of Table 6. The anticipated likelihood and severity of each potential hazard identified through this process were determined from the incident likelihood and severity ratings shown in Tables 1 and 2. Steps 2 and 3 of the Risk Assessment Matrix shown in Table 6 indicate the corresponding likelihood and severity of each hazard. The combination of likelihood and severity attributed to each activity determines the risk of that activity. For the Bala G.S., it was determined through this assessment that the risk to public safety could range from low (trespass on G.S.) to high (swimming and paddling upstream).

Since the new Bala G.S. is located immediately adjacent to the existing North Bala Dam, and shares a common approach channel, it is apparent that most of the risks for the G.S. are similar to those for the existing North Bala Dam. The seasonal timing of discharge, however, will be changed. Under existing conditions prior to development of the Bala Falls GS, the South Bala Dam has been used preferentially year-round to control outflows from the lake, and the North Bala dam has been primarily used during the fall and spring freshet to control flood flows in excess of the South Bala dam's capacity. The result is that during the summer and early fall recreation period, under existing conditions, the north channel has minimal flow with almost no surface velocity. Under future conditions, when the Bala Falls GS goes into operation, flow will be drawn through the north channel year-round, creating higher velocities within that channel during the summer and early fall recreation period, which increases risk towards public safety in the upstream area. A modified safety boom configuration and other measures are recommended across the North Channel to mitigate potential risks (see Section 4.2). As most flow will be through the Bala Falls GS, there will be reduced flow through the North Bala Dam and along Margaret Burgess Park. Downstream of the powerplant, velocities will be reduced under the new operating conditions as flow passage through the plant removes energy from the water (at normal and full plant flow) compared to the existing conditions where most flow is passed through the South Bala Dam and enters the Moon River under high velocities. The future velocities in the downstream area are also directed towards mid-river and away from the hazards.

In order to assess the potential effect of the proposed modifications to the facility, including the change in intake location and the change in low flow operational regime (cycling), the velocity in the north channel (both upstream and downstream of the North Bala Dam) under varying flows was modelled, and the modelling was revised in 2018 based on the final project design configuration. The results of the updated analysis were used to recommend the location and configuration of safety features (booms, buoys, signage, and fencing as discussed in Section 4) and show that flow velocities will increase in the North Channel within the boomed areas, and upstream of the upstream boom where safety buoys will be placed to guide the public to lower velocity areas. Velocities are not expected to increase significantly at the Bala town docks. The residual effect of the project on public access to the Bala Falls area will be a restriction from waters within the safety booms and buoys at the intake and tailrace as seen in Drawing 131-13550-00-C-401. This is discussed in more detail in the following Section, which describes risk analysis, mitigation measures, and residual risk.

4 PUBLIC SAFETY MEASURES FOR THE BALA GENERATING STATION

The objective of implementing public safety measures is to ensure hazards are controlled to minimize risks to public safety around the Bala G.S. site. These measures are recommended in accordance with the following hierarchy adapted from the Canadian Dam Association (CDA) guidelines (CDA, 2011):

- Eliminate the hazard wherever possible
- Mitigate the hazards where practical

- Control the exposure to the hazards by installing physical control measures to warn or deter access by the public to hazardous areas, such as:
 - Safeguard devices to restrict access by the public to hazardous areas
 - Warning devices
 - Illumination and surveillance devices
- Develop and deliver information, education and training programs to the public
- Install protective devices to allow for response to incidences and emergencies

Most of the risks at the site are generally addressed by the same mitigation control measure strategies applied in 2010/2011 by MNRF to the existing North Bala Dam, with some modifications or enhancements being required as described in the next sections.

The assessed hazards, ratings, proposed control measures, and residual risk after the implementation of these mitigating measures for the Bala G.S. site are summarized in Table 6, and discussed further in the following sections.

4.1 SUMMARY OF OPERATING PRACTICES AND CONTROL MEASURES

With respect to the operation of the North Bala Dam it is recommended that SREL's local dam operators continue the practice documented in the WESA PSMP, as follows:

"Operators report that they routinely drive over the road bridges on both Bala Falls Road and District Road 169 on the approach to the Bala Dams to view the entire channels that will be affected by dam operations. If individuals are in the water or on rocks in the areas to be affected, the operator warns them of the impending hazard and waits until they are clear before proceeding to operate the dam." (WESA, 2011)

If the Bala GS is to be started from a stopped condition, SREL's operator will use remote cameras with infrared capability, which will be installed at the intake and tailrace, to verify whether there is anyone in the hazardous area prior to start-up. If SREL's operators are on site, they will do the same review by walking the site and visually observing the upstream and downstream areas. When individuals are observed as being in these areas, the operators will delay start up until the individual has left the area. If the individual does not appear to be leaving the area, and the operator is not on site to speak with the individual, the operator will manually trigger a horn to alert that the plant is about to start up. This horn will be triggered remotely if the operator is not on site. To further mitigate this potential hazard, when starting the station a gradual ramping rate (i.e. start up over approximately 30 minutes, in keeping with industry practice) will be used. This practice will be documented in the Operation, Maintenance and Surveillance Plan for the site.

During an emergency closure of the unit, there is a small surge wave that could briefly overtop the stoplogs on the North Bala Dam. WSP proposes that an additional log is installed in each sluice such that there is sufficient freeboard over the stoplogs in all sluices to prevent water from a surge wave spilling over the logs. This would mitigate overflow in the Bala north falls should there be members of the public using the rock area below the North Bala Dam.

4.2 SUMMARY OF PHYSICAL CONTROL MEASURES

Upon review of the potential risks identified for the site, physical control measures, which restrict public access to hazardous areas, were included in the final design of the G.S. project.

Proposed physical control measures are shown in Appendix A on Drawings 131-13550-00-C-401, 131-13550-00-C-402, and 131-13550-00-C-403, and include:

- Modified safety boom across the North Channel, upstream of the approach channel on the upstream side of Highway 169 Bridge
- Warning buoys in the approach channel, upstream of the CP bridge
- Warning buoys in the tailrace channel
- Safety boom in the tailrace channel
- Warning signs on the water-adjacent faces of the powerhouse (North, West)
- Safety barrier with fence on each side of powerhouse
- A throw ring on the North West side of the powerhouse deck facing downstream
- Fencing and signage along the upstream shore between the Bala G.S. and the upstream safety boom
- Cameras with infrared capability at the intake (2) and tailrace (1) which can be used to view these areas remotely
- Horn which can be manually triggered by operators (on site or remotely) to warn people if individuals are observed as being in the warning or hazardous zones prior to plant start up.

SREL is responsible for the installation and maintenance of the above proposed physical control measures.

SREL has also taken some specific actions with CP Rail to enhance public safety and mitigate risks associated with illegal trespass on CP Rail property, upstream of the dam. These actions include:

- CP Engineering Services has ordered new No Trespassing signs, to increase public awareness of the dangers and penalties relating to trespassing on CP property. CP will place the new signage strategically in the area of the bridge and closest public crossings
- Development of an enforcement campaign
- Granting OPP authorization for their officers to enforce the Trespass to Property Act on CP property
- Sharing communication / community outreach materials and getting public safety messages to the community

TABLE 6 RISK ANALYSIS OF HAZARDS AT BALA GENERATING STATION

| Hazard Number | Step 1 Identify | | Step 2 L Level | Step 3 C Level | Step 4 Risk Rating | Step 5 Proposed Controls/Mitigation | Step 6 Revised L Level | Step 7 Revised C Level | Step 8 Revised Risk Rating |
|---------------|----------------------------|------------------|----------------|----------------|--------------------|--|------------------------|------------------------|----------------------------|
| | Activity | Hazard | | | | | | | |
| 1 | Trespass on G.S. | Trips/Falls | 1 | 4 | Low | Safety barrier with fence | 1 | 4 | Low |
| 2 | Swimming upstream | Drowning | 3 | 5 | High | Danger signage Modified safety boom placed in V formation further upstream than current boom Safety buoys Fencing added between existing fencing and safety booms | 2 | 4 | Medium |
| 3 | Wading/swimming downstream | Drowning | 3 | 5 | High | Danger signage Safety boom Warning buoy | 1 | 4 | Low |
| 4 | Paddling upstream | Capsize/Drowning | 5 | 5 | High | Danger signage Modified safety boom placed in V formation further upstream than current boom | 2 | 4 | Medium |

| | | | | | | | | | |
|---|---|------------------|---|---|------|--|---|---|--------|
| | | | | | | Safety buoys directing paddlers to lower velocity areas | | | |
| 5 | Paddling downstream | Capsize/Drowning | 4 | 5 | High | Danger signage Safety boom Warning buoy | 1 | 4 | Low |
| 6 | Jumping off CP bridge (illegal trespassing) | Drowning | 2 | 5 | High | Modified safety boom placed 2m downstream of bridge pier to reduce possibility of someone jumping over the boom. Safety buoys warning of hazard | 1 | 5 | Medium |

5 INSPECTION AND MAINTENANCE REQUIREMENTS

The effectiveness of the public safety measures should be reviewed periodically to ensure that they continue to provide the protection intended.

SREL operators should informally visually inspect public safety measures on an at least monthly basis or whenever they are on site, and should record the elements which they have reviewed in a work log or similar, whether or not a deficiency or damage is observed. This visual review should include:

- Inspect fences on both sides of the north channel and upstream and downstream of the Bala G.S. to ensure fences are not damaged and to look for signs of unauthorized entry to the water in dangerous locations
- Inspect signage to ensure that all signs are present, in good condition, and free of graffiti
- Inspect safety booms (upstream and downstream) visually to check for signs of damage or trespass
- Inspect safety buoys (upstream) visually to check for signs of damage or trespass and to ensure that the anchors are functioning to keep the signage facing the correct way as shown on drawing 131-13550-00-C-402
- Inspect throw ring and rope to ensure they are present, in good condition, and without signs of damage, vandalism, or wear

SREL should conduct a more formal inspection of all control measures on at least an annual basis, in keeping with the CDA guidelines (CDA, 2011). The inspection requirements for maintaining public safety measures at the Bala G.S. site include, but will not be limited to:

- Inspect fences on both sides of the north channel and upstream and downstream of the Bala G.S. to ensure fences are not damaged and to look for signs of unauthorized entry to the water in dangerous locations
- Inspect signage to ensure that all signs are present, in good condition, and free of graffiti
- Inspect safety booms (upstream and downstream) visually to check for signs of damage or trespass
- Inspect safety buoys (upstream) visually to check for signs of damage or trespass and to ensure that the anchors are functioning to keep the signage facing the correct way as shown on drawing 131-13550-00-C-402
- Inspect throw ring and rope to ensure they are present, in good condition, and without signs of damage, vandalism, or wear
- Inspect guardrail to check structural integrity, signs of rust, loose bolts, or damage
- Inspect and test video surveillance cameras, as required

If any damage is observed during an inspection, the inspector should assess whether it can be temporarily repaired. Otherwise, the hazard should be highlighted with tape. All damage and/or deterioration must be reported to SREL so that SREL can initiate permanent work to remedy any damage as soon as reasonably possible, dependent on the level of risk to the public. If damage appears to be due to an unauthorized entry/intrusion or vandalism, then SREL must be notified immediately.

For each hazard/control measure inspected, inspection and maintenance records should identify:

- Date of inspection

- Name of person performing inspection
- Control measures/devices inspected and their condition
- Corrective actions necessary
- Confirmation of any corrective actions completed

6 PUBLIC EDUCATION PLAN

SREL should implement initiatives that promote public safety and awareness at the site. The initiatives should:

- Inform the public about the risks and hazards related to the Bala G.S.
- Communicate roles and responsibilities of the public with respect to following signage and respecting the limits placed by physical control measures
- Either notify the public or raise their awareness in regard to hazards identified at the site, for example:
 - Safety focused newsletters
 - Targeted social media advertising
 - Information made available on SREL's website and social media channel
 - Coordination and communication with local regulators, MNR, OPP, CP Rail, local media, other stakeholders as appropriate
- How the public can report any concerns about public safety

7 RECORD MANAGEMENT

This document, the Bala G.S. Public Safety Measures Plan, will be a living document that is subject to change and should be updated with consideration of developments which may occur during the life of the Bala G.S. such as:

- Changes in degree of public interaction
- Changes in the potential consequences for a specific public interaction
- New construction at the site which creates a change in operation
- Identification of new public interactions
- Changes in operating procedures

SREL should have the following documentation, maintained up-to-date, as a minimum standard for the Bala G.S.:

- Site-specific Public Safety Measures Plan (this document)
- Site-specific risk assessments
- Site-specific hydraulic assessments
- Public safety incident reports
- Maintenance and inspection reports
- Submissions to regulators

It is recommended that SREL review the effectiveness of the PSMP on a minimum annual basis or whenever an issue is observed or a development (as described above) occurs. SREL should have the

PSMP independently reviewed every five years. SREL should retain all records and documents for a minimum of two PSMP review cycles.

8 INCIDENT REPORTING

SREL must document any safety incidents involving members of the public, including “near misses” This documentation should be used to inform the review and update of the PSMP. Each incident report should contain, at a minimum, the following information:

- Date and approximate time of incident
- Location of incident
- Type of incident
- Activities and sequence of events that led to the incident
- Description of any response actions taken
- Description of any resulting injury

SREL should develop a public safety incident report template which includes the above information, similar to the sample document produced by CDA and attached as Appendix B. All incidents should be reported to the MNRF District Manager. Serious incidents should be reported within 48 hours. Other incidents should be reported on a monthly basis.

9 REFERENCES

- CDA. (2011). *Guidelines for Public Safety Around Dams*. CDA.
- MNRF. (2011). *Best Management Practices for Public Safety Around Dams*. MNRF.
- WESA. (2011). *Bala Falls Dams - Public Safety Measures Plan - Final Report*. MNRF.

APPENDIX

A

PUBLIC
SAFETY
MEASURES
DRAWINGS



| LEGEND | |
|--------|---|
| | BOREHOLE : HATCH, MAY 2008, REF: Swift River Energy Limited - North Bala Dam Hydroelectric Project Feasibility Report |
| | BOREHOLE : GENVAR, SEPT. 2013 |
| | EXISTING POLE |
| | EXISTING LAMP STAND |
| | EXISTING OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND UTILITIES |
| | EXISTING SAFETY BOOM |
| | EXISTING GUARD RAIL |
| | EXISTING CANADIAN PACIFIC RAILWAY |
| | EXISTING TOPOGRAPHIC OR BATHYMETRIC CONTOUR |
| | PROPERTY LIMIT LINE |
| | EXISTING PORTAGE TRAIL |
| | EXISTING FENCE |
| | PROPOSED FENCE |
| | CAMERA |
| | INFORMATION SIGN |

Swift River Energy Limited

CLIENT REF: -

- NOTES:
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
 - ELEVATION VALUES ARE IN METERS.
 - HORIZONTAL DATUM: SPECIFIED CONTROL POINTS (SCP) AND OBSERVED REFERENCE POINTS (ORP) UTM ZONE 17, 81° WEST LONGITUDE NAD83 (CSRS) (1997) COORDINATES TO UTM ACCURACY PER SEC. 14 (3) OF O. REG. 216(10).
 - SCP: 0081950326, NORTHING: 4984515.039, EASTING: 609461.713
 - VERTICAL DATUM: CANADIAN GEODETIC VERTICAL DATUM (CGVD2011)
 - POSITION OF PROPERTY LIMIT IS FROM TULLOCH ENGINEERING DRAWING (14-3534 Mod 2016 02 10.dwg).
 - SURVEY BATHYMETRY IS FROM GLOBAL SURVEYING SERVICES (G.S.S.) 2008 (OFFSET OF 1.02 m NORTHING AND 1.46 m EASTING TO MATCH THE HORIZONTAL DATUM OF TULLOCH SURVEY).
 - LOCATIONS OF EXISTING UTILITIES SHOWN ON THIS DRAWING ARE FOR INFORMATION ONLY. CONTRACTOR IS RESPONSIBLE TO VALIDATE THESE ITEMS ON SITE PRIOR TO CONSTRUCTION WORKS.
 - EXISTING PORTAGE TRAIL IS SHOWN BASED ON BELIEVED HISTORICAL USE. THESE ARE NOT NORMAL PORTAGE TRAILS AND LOCATIONS ARE APPROXIMATED.
 - CONTRACTOR MUST CONFIRM WITH OWNER THAT APPROVAL FROM LANDOWNERS HAS BEEN RECEIVED PRIOR TO INSTALLING FENCE AND ANCHORS.
 - LOCATIONS OF EXISTING SIGNAGE ARE SHOWN FOR REFERENCE AND MAY VARY FROM WHAT IS SHOWN.

DISCLAIMER: THIS DRAWING AND DESIGN IS COPYRIGHT PROTECTED WHICH SHALL NOT BE USED, REPRODUCED OR REVISED WITHOUT WRITTEN PERMISSION BY GENVAR. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND UTILITY LOCATIONS AND REPORT ALL ERRORS AND OMISSIONS PRIOR TO COMMENCING WORK. THIS DRAWING IS NOT TO BE SEALED.

IF THIS BAR IS NOT 25 mm LONG, ADJUST YOUR PLOTTING SCALE.

25 mm

| ISS. NO. | DATE | DESCRIPTION |
|----------|------------|-----------------------------|
| M 0 | 2019-08-21 | PUBLIC SAFETY MEASURES PLAN |
| L 0 | 2019-08-13 | PUBLIC SAFETY MEASURES PLAN |
| K 0 | 2019-06-25 | PUBLIC SAFETY MEASURES PLAN |
| J 0 | 2019-04-18 | PUBLIC SAFETY MEASURES PLAN |
| I 0 | 2019-04-08 | NAVIGATION PROTECTION ACT |
| H 0 | 2019-03-22 | PUBLIC SAFETY MEASURES PLAN |
| G 0 | 2019-03-08 | PUBLIC SAFETY MEASURES PLAN |
| F 0 | 2019-02-20 | FOR REVIEW |
| E 0 | 2019-01-18 | FOR REVIEW |
| D 0 | 2016-11-11 | FOR LRIA |
| C 0 | 2016-10-14 | ADDENDUM 1 |
| B 0 | 2016-09-30 | FOR TENDER |
| A 0 | 2016-09-09 | FOR COORDINATION |

PROJECT: **NORTH BALA SMALL HYDRO PROJECT**

WSP

DISCIPLINE: **CIVIL**

DESIGNED BY: KARINA SETO, P. ENG.

DRAWN BY: ADAM UNGAR

CHECKED BY: HARVEY WALSH, P. ENG.

TITLE: **PERMANENT PROPOSED CONDITIONS - PUBLIC SAFETY MEASURES - PLAN VIEW**

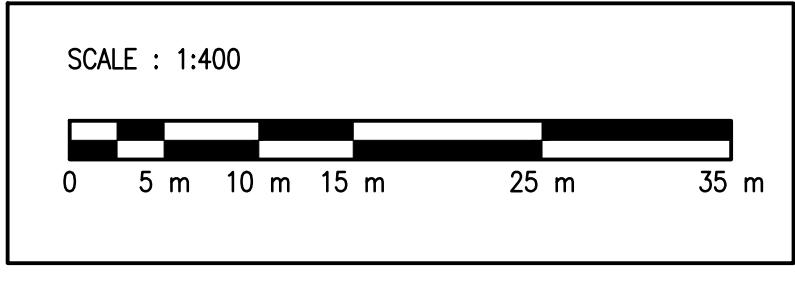
SCALE: 1:400

SHEET: 131-13550-00-C-401

ISSUE: PUBLIC SAFETY MEASURES PLAN

DATE: 2019-08-21

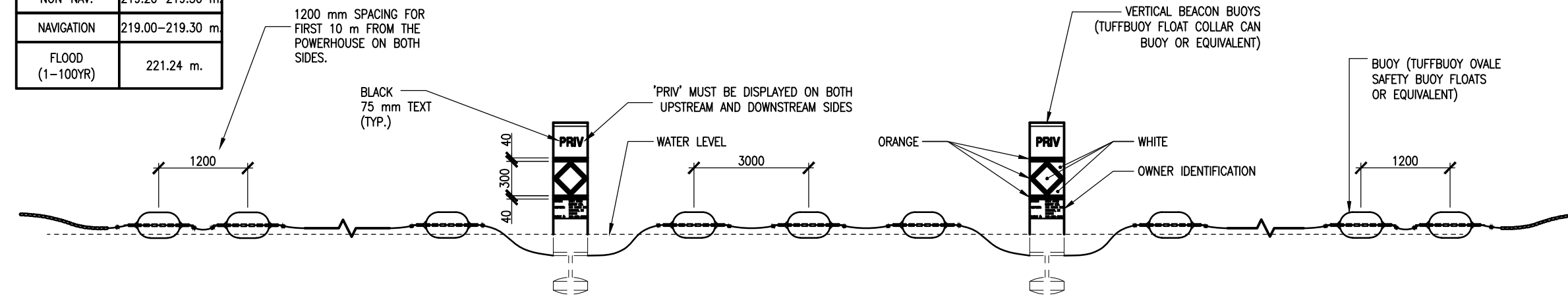
REV. M 0



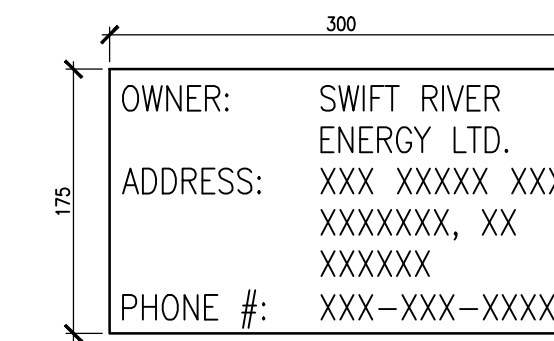
DOWNSTREAM SAFETY BOOM NOTES

- 1 GENERAL
 - A FINAL DOWNSTREAM SAFETY BOOM AND ANCHOR SHOP DRAWINGS MUST BE SUBMITTED FOR REVIEW AND APPROVAL BY ENGINEER.
 - B DOWNSTREAM SAFETY BOOM TO BE CONSTRUCTED OF NEW UNITS.
- 2 MATERIALS
 - A BUOYS
 - I BUOYS ARE TO BE 457 mm (18") x 762 mm (30") TUFTBOUY OVAL SAFETY BUOY FLOATS AND MUST BE YELLOW IN COLOUR
 - II BUOYS SHALL HAVE A MINIMUM OF 305 mm OF FREEBOARD IN STILL WATER CONDITIONS.
 - III BUOY MATERIALS SHALL BE UV-STABILIZED FOR LONG-TERM ENVIRONMENTAL EXPOSURE.
 - B VERTICAL BEACON BUOYS
 - I VERTICAL BEACON BUOYS ARE TO BE FLOAT COLLAR CAN TYPE WHERE THE MINIMUM VIEWABLE AREA IS 457 mm (18") DIAMETER x 762 mm (30") HEIGHT.
 - II VERTICAL BEACON BUOYS MUST BE WHITE IN COLOUR EXCEPT AS NOTED BELOW.
 - III VERTICAL BEACON BUOYS SHALL HAVE A MINIMUM OF 305 mm OF FREEBOARD IN STILL WATER CONDITIONS.
 - IV VERTICAL BEACON BUOYS MUST BE MARKED AS SHOWN. SYMBOLS MUST BE ORANGE IN COLOUR AND MADE OF RETROREFLECTIVE MATERIAL.
 - C SAFETY BOOM ASSEMBLY MUST SATISFY THE NAVIGATION PROTECTION ACT REQUIREMENTS.
 - D CONNECTIONS BETWEEN BOOM ELEMENTS TO BE DESIGNED BY SUPPLIER (WORTHINGTON PRODUCTS INC. OR APPROVED EQUIVALENT) AND MUST BE SUFFICIENT FOR THE DESIGN LOADS. HOT DIPPED GALVANIZED STEEL HARDWARE SHALL BE USED.
- 3 ASSEMBLY
 - A BUOYS TO BE SPACED AT 3000 mm CENTRE TO CENTRE MAXIMUM, EXCEPT FOR FIRST 10 m ON BOTH SIDES, FOR WHICH SPACING IS REDUCED TO 1200 mm.
 - B CONNECTIONS BETWEEN BUOYS ARE TO BE DESIGNED BY SUPPLIER.
 - C LENGTH OF BOOM REQUIRED IS 79M AND MUST BE IN THE SEMI-RECTANGULAR SHAPE SHOWN ON DRAWING 401.
 - D BOOM WILL BE ANCHORED TO GENERATING STATION WALL ON BOTH ENDS. A MINIMUM OF TWO IN-WATER ANCHORS IS REQUIRED. ANCHOR DESIGN WILL BE COMPLETED BY WSP BASED ON LOADING PROVIDED BY THE SUPPLIER. ADDITIONAL FLOATS AND WIRES MUST BE INCLUDED IN THE SUPPLIED PACKAGE AS REQUIRED TO ENSURE THE ANCHORAGE DOES NOT SUBMERGE THE BUOYS UNDER DESIGN CONDITIONS.
 - I DESIGN AVERAGE WATER DEPTH: 4.5 m
 - II DESIGN LOW WATER DEPTH: 3.5 m
 - III DESIGN HIGH WATER DEPTH: 6.4 m
 - IV DESIGN WATER SURFACE VELOCITY: 1.0 m/s
- 4 INSTALLATION
 - A DOWNSTREAM SAFETY BOOM WILL BE REMOVED DURING NON-NAVIGATION PERIOD FOR PROTECTION FROM ICE DAMAGE.
 - B NAVIGATION PERIOD IS ESTABLISHED FROM BEGINNING OF MAY TO END OF OCTOBER OF ANY YEAR AND SAFETY BOOM MUST BE INSTALLED AND OPERATIONAL DURING THIS PERIOD.

| OPERATION LEVELS DOWNSTREAM (WATER LEVEL) | |
|---|-----------------|
| NON-NAV. | 219.20-219.50 m |
| NAVIGATION | 219.00-219.30 m |
| FLOOD (1-100YR) | 221.24 m. |



DOWNSTREAM SAFETY BOOM PROFILE
N.T.S.



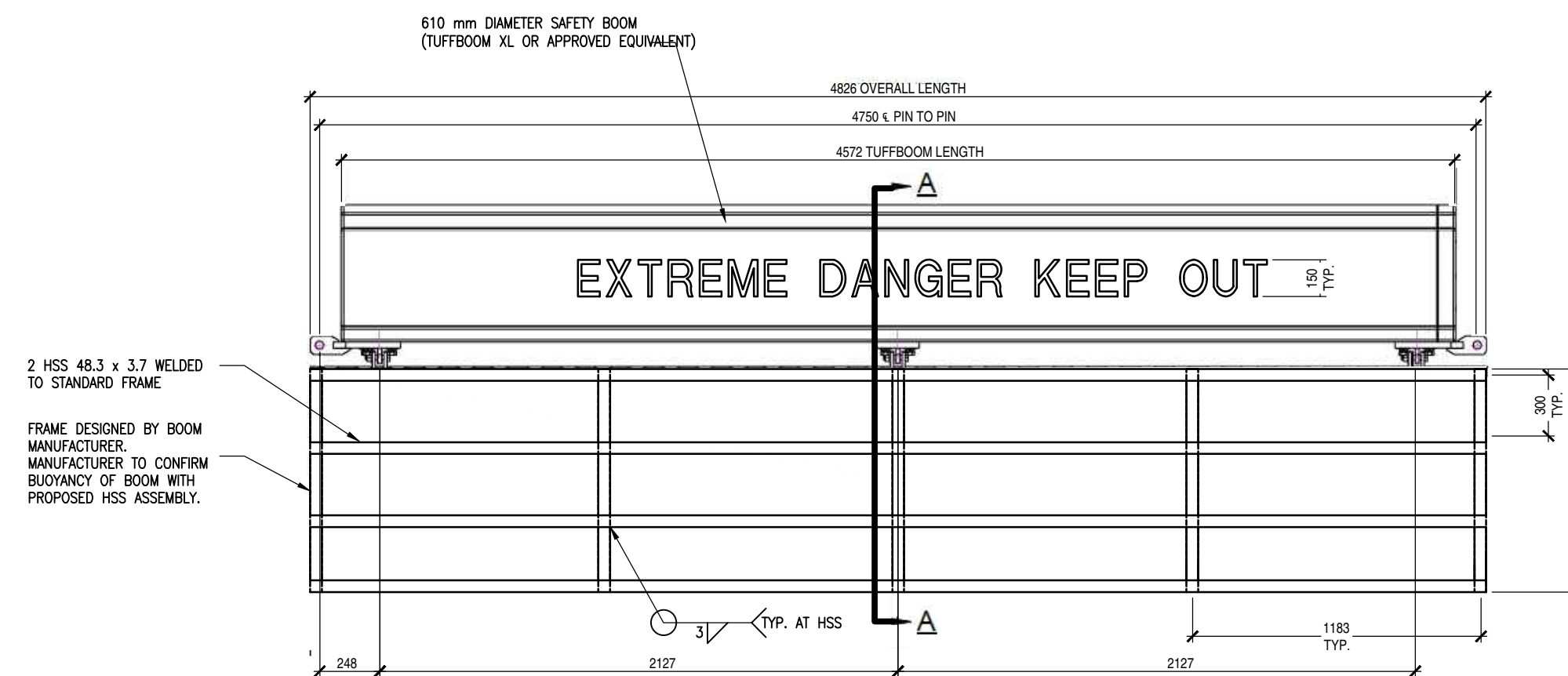
DETAIL - OWNER IDENTIFICATION
N.T.S.

NOTE: CONFIRM INFO WITH OWNER PRIOR TO PROCUREMENT

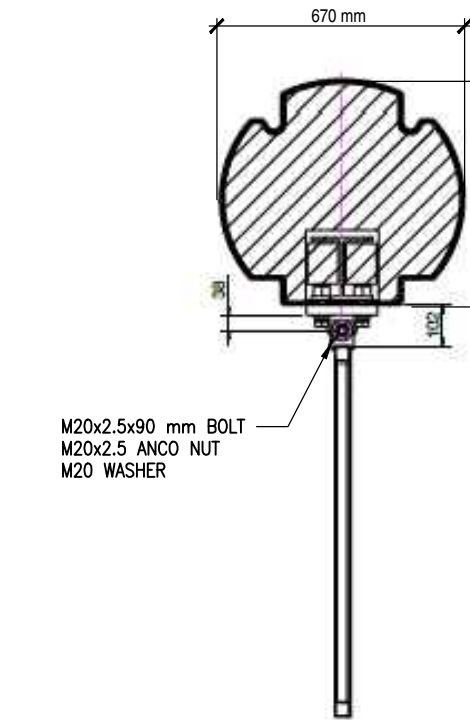
UPSTREAM SAFETY BOOM NOTES

- 1 GENERAL
 - A FINAL UPSTREAM SAFETY BOOM AND ANCHOR SHOP DRAWINGS MUST BE SUBMITTED FOR REVIEW AND APPROVAL BY ENGINEER.
 - B UPSTREAM SAFETY BOOM TO BE CONSTRUCTED OF NEW UNITS.
- 2 MATERIALS
 - A SAFETY BOOM MUST BE YELLOW IN COLOUR AND SATISFY THE NAVIGATION PROTECTION ACT REQUIREMENTS.
 - B SAFETY BOOM SEGMENTS
 - I SAFETY BOOM SEGMENTS TO BE 610 mm DIAMETER TUFTBOOM XL UNITS, OR APPROVED EQUIVALENT, AND MUST INCLUDE RECESSED LONGITUDINAL RIBBING WHICH EXTENDS THE FULL LENGTH ON BOTH FRONT AND BACK SIDES AND FUNCTIONS AS HAND HOLDS AS SHOWN ON DRAWING 402.
 - II SAFETY BOOM SEGMENTS SHOULD HAVE A MINIMUM OF 305 mm OF FREEBOARD IN STILL WATER CONDITIONS.
 - III SAFETY BOOM SEGMENTS SHALL CONTAIN AN INTERNAL STRUCTURAL STEEL MEMBER THAT EXTENDS THE FULL LENGTH OF THE INTERIOR OF THE BOOM ENCASUREMENT.
 - IV SAFETY BOOM SEGMENTS SHALL CONTAIN A FOAM CORE TO MAINTAIN BUOYANCY. IF PUNCTURED, THEY SHALL MAINTAIN THEIR ORIGINAL FREEBOARD. THE BUOYANCY OF THE BOOM SHALL BE 2,250 lbs.
 - V MATERIALS SHALL BE UV-STABILIZED FOR LONG-TERM ENVIRONMENTAL EXPOSURE.
 - C CONNECTIONS BETWEEN BOOM ELEMENTS
 - I CONNECTIONS ARE TO BE DESIGNED BY SUPPLIER (WORTHINGTON PRODUCTS INC. OR APPROVED EQUIVALENT) AND MUST BE SUFFICIENT FOR THE DESIGN LOADS.
 - II HOT DIPPED GALVANIZED STEEL HARDWARE SHALL BE USED.
 - III CONNECTIONS SHALL PERMIT FULL FREEDOM OF MOTION SIMULTANEOUSLY IN HORIZONTAL AND VERTICAL PLANES
 - IV WIRE ROPE CONNECTIONS MUST MEET MINIMUM BREAKING STRENGTH REQUIREMENT OF 150,000 lbs.
 - V GRAPHICS ARE TO BE AS SHOWN ON THE DRAWING AND ARE TO BE 150 mm IN HEIGHT, MILLENNIUM TYPE MOLD-IN GRAPHICS, ARIAL FONT, ALL CAPS, BLACK, BOLD FACED FONT AND SHALL BE PLACED ON THE UPSTREAM FACE OF THE BOOM UNIT.
 - E STANDARD TUFTBOOM XL DEBRIS SCREEN ASSEMBLY TO BE MODIFIED SUCH THAT 2x HSS 48.3 x 3.7 ARE WELDED TO THE STANDARD FRAME AS SHOWN. ASSEMBLY OF FRAME AND HSS IS TO BE GALVANIZED.
- 3 ASSEMBLY
 - A LENGTH OF BOOM REQUIRED IS 65M AND MUST BE IN A V-SHAPE AS SHOWN ON DRAWING 401.
 - B ON SOUTH SHORE EXISTING ANCHOR IS TO BE RE-USED. SUPPLIER TO CONFIRM CONNECTION.
 - C ON NORTH SHORE ONE NEW ANCHOR IS REQUIRED ON LAND. ONE IN-WATER ANCHOR IS REQUIRED TO CREATE V-SHAPE. ANCHOR DESIGN TO BE COMPLETED BY SUPPLIER. ADDITIONAL FLOATS AND WIRES MUST BE INCLUDED IN THE SUPPLIED PACKAGE AS REQUIRED TO ENSURE THE ANCHORAGE DOES NOT SUBMERGE THE BUOYS UNDER DESIGN CONDITIONS.
 - I DESIGN AVERAGE WATER DEPTH: 7.8 m
 - II DESIGN LOW WATER DEPTH: 6.6 m
 - III DESIGN HIGH WATER DEPTH: 8.0 m
 - IV DESIGN WATER SURFACE VELOCITY: 1.0 m/s
- 4 INSTALLATION
 - A UPSTREAM SAFETY BOOM MUST BE IN PLACE PRIOR TO STARTING THE GENERATING UNIT AT BALA G.S. THE EXISTING SAFETY BOOM IS TO BE LEFT IN PLACE UNTIL THE NEW SAFETY BOOM CAN BE INSTALLED.
 - B UPSTREAM SAFETY BOOM WILL BE IN PLACE YEAR-ROUND.

| OPERATION LEVELS UPSTREAM | |
|---------------------------|---------------------|
| NORMAL OPERATION | 224.60 TO 225.75 m. |
| IDF LEVEL | 225.97 m. |



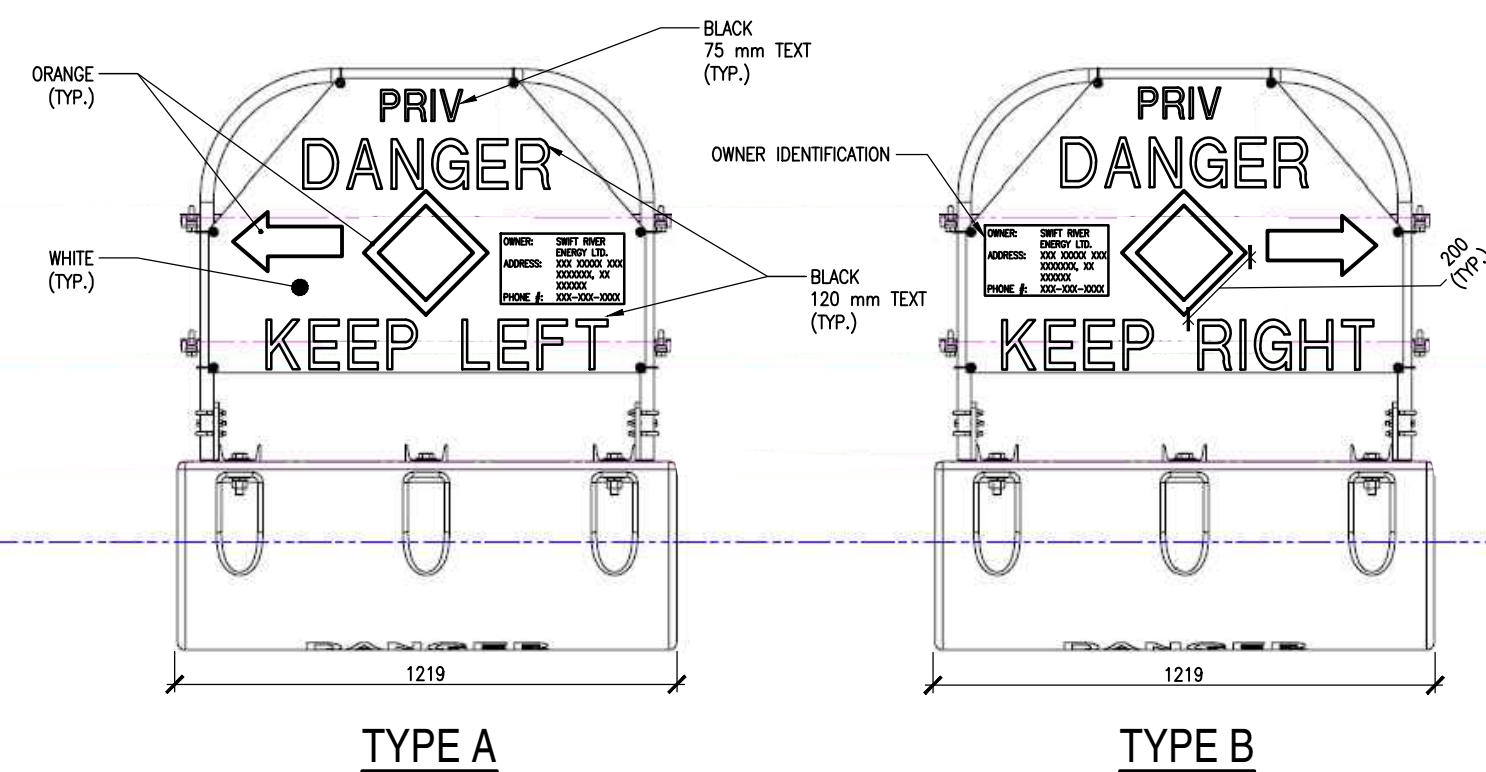
UPSTREAM SAFETY BOOM PROFILE (SINGLE SEGMENT)
N.T.S.



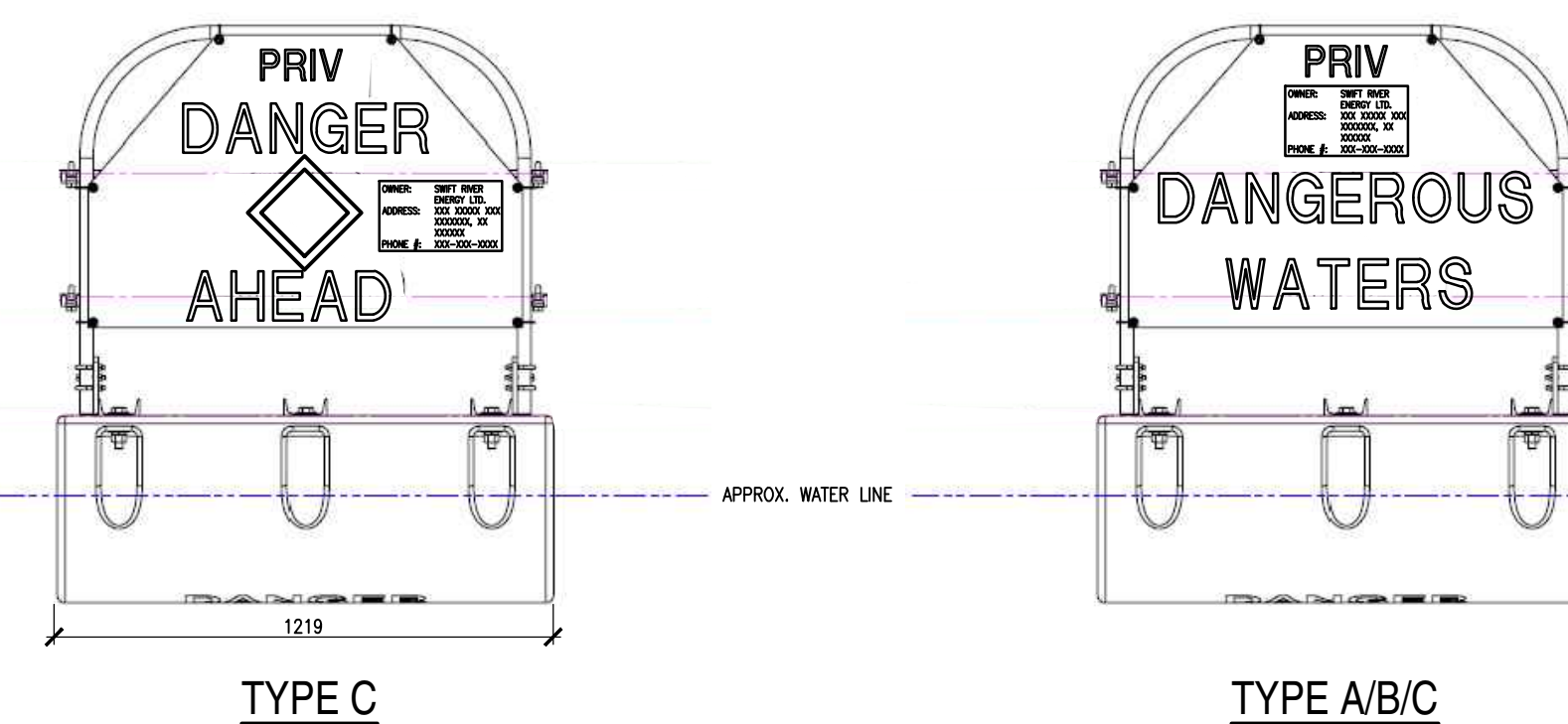
SECTION A-A
N.T.S.

WARNING BUOY NOTES

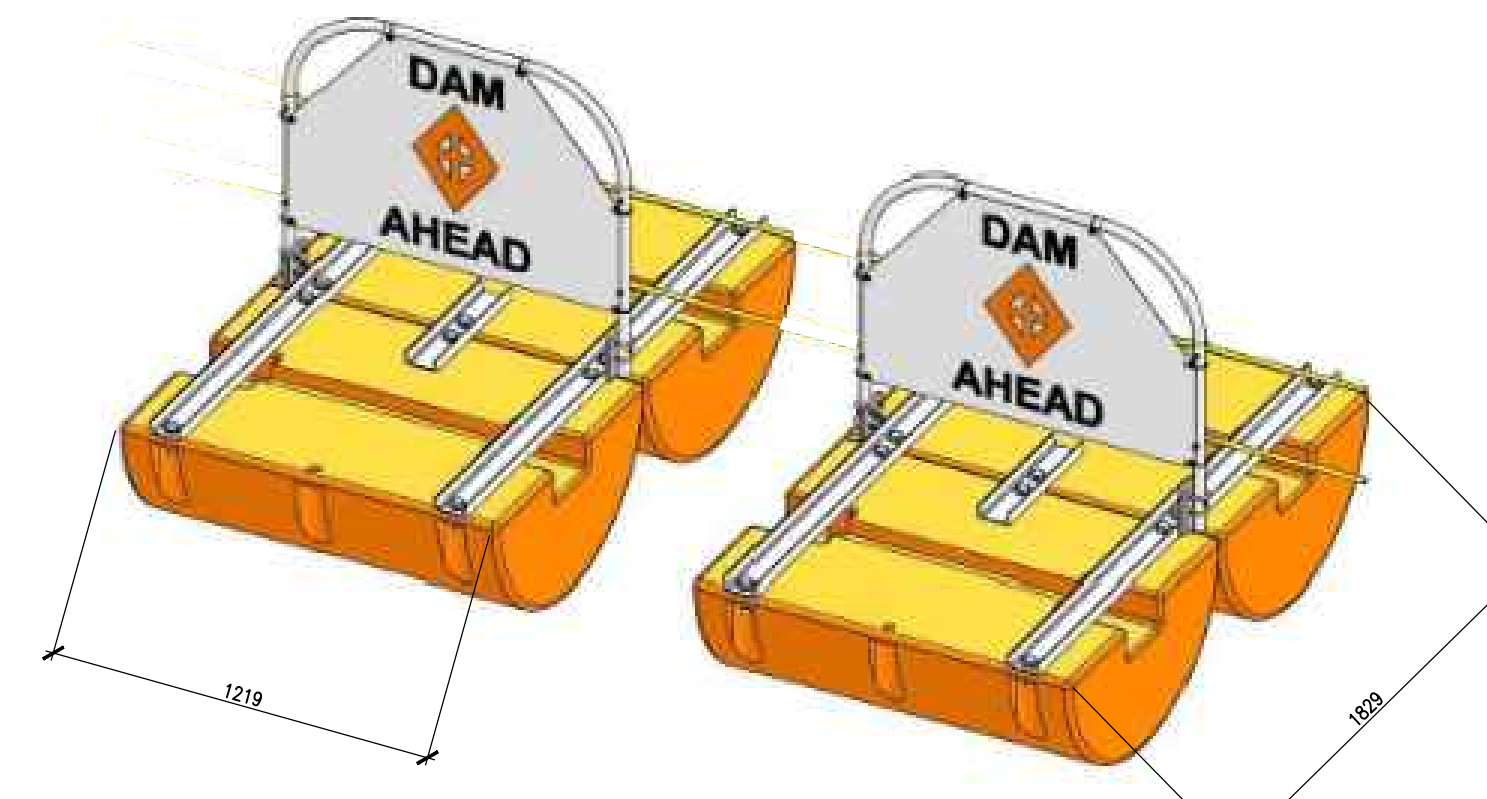
- 1 GENERAL
 - A FINAL WARNING BUOY AND ANCHOR SHOP DRAWINGS MUST BE SUBMITTED FOR REVIEW AND APPROVAL BY ENGINEER.
 - B WARNING BUOYS TO BE NEW UNITS.
- 2 MATERIALS
 - A BUOYS ARE TO BE 1829 x 1219 mm TUFTBOOM BUOYS, OR APPROVED EQUIVALENT, WHICH ARE TO BE ORANGE IN COLOUR.
 - B BUOYS SHOULD HAVE A MINIMUM OF 305 mm OF FREEBOARD IN STILL WATER CONDITIONS.
 - C BUOYS ARE TO INCLUDE A BUOYANT PLATFORM WHERE AN INDIVIDUAL IN THE WATER COULD PULL THEMSELVES OUT OF THE WATER AND AWAIT RESCUE.
 - D SIGMAGE TO BE AS SHOWN ON DRAWING WHERE THE SYMBOLS ARE ORANGE IN COLOUR, THE TEXT IS BLACK IN COLOUR, AND THE SIGN IS WHITE.
 - F ORANGE SYMBOLS ARE TO BE MADE OF ORANGE RETROREFLECTIVE MATERIAL.
- 3 ASSEMBLY
 - A ANCHOR DESIGN TO BE COMPLETED BY SUPPLIER. A MINIMUM OF TWO IN-WATER ANCHORS SHOULD BE PROVIDED FOR EACH BUOY TO ENSURE THAT THE ORIENTATION OF THE SIGNS CAN BE MAINTAINED AS INDICATED.
 - I DESIGN AVERAGE WATER DEPTH: 5.8 m
 - II DESIGN LOW WATER DEPTH: 4.6 m
 - III DESIGN HIGH WATER DEPTH: 6.0 m
 - IV DESIGN WATER SURFACE VELOCITY: 0.8 m/s
- 4 INSTALLATION
 - A BUOYS ARE TO BE IN PLACE YEAR ROUND
 - B BUOYS ARE TO BE ANCHORED INDIVIDUALLY AND ARE NOT TO BE CONNECTED TO ONE ANOTHER.
 - C BUOYS ARE TO BE SPACED AS SHOWN ON DRAWING 401



WARNING BUOY ELEVATION - FROM UPSTREAM
N.T.S.



WARNING BUOY ELEVATION - FROM DOWNSTREAM
N.T.S.



BOOM ISOMETRIC VIEW
N.T.S.

NOTE: THIS VIEW IS FOR DIMENSIONS ONLY. ORIENT SIGMAGE TO FACE UPSTREAM. TEXT TO BE AS SHOWN IN ELEVATION VIEW. BUOYS TO BE ANCHORED INDIVIDUALLY AND NOT CONNECTED TO EACH OTHER.



CLIENT: ...
CLIENT REF: ...

NOTES:
OWNER: SWIFT RIVER ENERGY LTD.
ADDRESS: XXX XXXXX XXX XXXXXX, XX XXXXXX
PHONE #: XXX-XXX-XXXX

DISCLAIMER: THIS DRAWING AND DESIGN IS COPYRIGHT PROTECTED WHICH SHALL NOT BE USED, REPRODUCED OR REVISED WITHOUT WRITTEN PERMISSION BY WSP. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND UTILITY LOCATIONS AND REPORT ALL ERRORS AND OMISSIONS PRIOR TO COMMENCING WORK. THIS DRAWING IS NOT TO BE SCALED.

SEAL:

| ISSUE | DATE | DESCRIPTION |
|-------|------------|-----------------------------|
| 1 | 2019-08-13 | PUBLIC SAFETY MEASURES PLAN |
| 2 | 2019-06-17 | PUBLIC SAFETY MEASURES PLAN |
| 3 | 2019-04-18 | PUBLIC SAFETY MEASURES PLAN |
| 4 | 2019-03-22 | PUBLIC SAFETY MEASURES PLAN |
| 5 | 2019-03-08 | PUBLIC SAFETY MEASURES PLAN |
| 6 | 2019-02-20 | FOR REVIEW |
| 7 | 2019-01-18 | FOR REVIEW |
| 8 | 2016-11-11 | FOR LRIA |
| 9 | 2016-10-14 | ADDENDUM 1 |

| ISSUE | DATE | DESCRIPTION |
|-------|------------|-----------------------------|
| 1 | 2019-08-13 | PUBLIC SAFETY MEASURES PLAN |
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| 6 | 2019-02-20 | FOR REVIEW |
| 7 | 2019-01-18 | FOR REVIEW |
| 8 | 2016-11-11 | FOR LRIA |
| 9 | 2016-10-14 | ADDENDUM 1 |

PROJECT:
NORTH BALA SMALL HYDRO PROJECT



DISCIPLINE: CIVIL
DESIGNED BY: KARINA SETO, P. ENG.
DRAWN BY: ADAM UNGAR
CHECKED BY: HARVEY WALSH, P. ENG.

TITLE:
PERMANENT PROPOSED CONDITIONS - PUBLIC SAFETY MEASURES - SECTIONS AND DETAILS

SCALE: AS SHOWN
SHEET: 131-13550-00-C-402

ISSUE: PUBLIC SAFETY MEASURES PLAN
DATE: 2019-08-13



CLIENT REF: -

NOTES:
 A. DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
 B. ELEVATION VALUES ARE IN METERS.
 C. HORIZONTAL DATUM: SPECIFIED CONTROL POINTS (SCPP) AND OBSERVED REFERENCE POINTS (ORP) (UTM ZONE 17, BY WEST LONGITUDE) (NAD83) (CSRS (1997) COORDINATES TO URBAN ACCURACY PER SEC. 14 (2) OF REG. 216/01).
 D. VERTICAL DATUM: CANADIAN GEODETIC VERTICAL DATUM (CGVD28).
 E. POSITION OF PROPERTY LIMIT IS FROM TULLOCH ENGINEERING DRAWING (14-554-000-2016-02-10.dwg).
 F. SURVEY BATHYMETRY IS FROM GLOBAL SURVEYING SERVICES (G.S.S.) 2008 (OFFSET OF 1.657 m NORTHING AND 1.460 m EASTING TO MATCH THE HORIZONTAL DATUM OF TULLOCH SURVEY).
 G. LOCATIONS OF EXISTING UTILITIES SHOWN ON THIS DRAWING ARE FOR INFORMATION ONLY. CONTRACTOR IS RESPONSIBLE TO VALIDATE THESE ITEMS ON SITE PRIOR TO CONSTRUCTION WORKS.
 H. SIGNAGE TO BE CONSTRUCTED OF ALUMINUM MATERIAL WITH A SAFETY RADIUS FOR THE CORNERS OF THE SIGN. NOMINAL THICKNESS FOR SIGN IS 3.0MM.
 I. SIGNAGE TO BE VISIBLE ENHANCED IN LOW LIGHT CONDITIONS THROUGH REFLECTIVE BACKGROUND AND LETTERING (3M DIAMOND GRADE OR SIMILAR).
 J. RED COLOUR SIMILAR TO PANTONE 485 RED. YELLOW COLOUR SIMILAR TO PANTONE 123 YELLOW.
 K. SIGNAGE AND FASTENING SYSTEM SHOP DRAWINGS ARE TO BE APPROVED BY THE ENGINEER PRIOR TO FABRICATION.

THIS DOCUMENT SHALL NOT BE USED FOR CONSTRUCTION (OR FABRICATION OR INSTALLATION)

DISCLAIMER: THIS DRAWING AND DESIGN IS COPYRIGHT PROTECTED WHICH SHALL NOT BE REPRODUCED OR REVISED WITHOUT WRITTEN PERMISSION BY ENGINEER. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND UTILITY LOCATIONS AND REPORT ALL ERRORS AND OMISSIONS PRIOR TO COMMENCING WORK. THIS DRAWING IS NOT TO BE SCALED.

| ISSUED FOR - REVISION | DATE | DESCRIPTION |
|-----------------------|------|--|
| A | 0 | 2019-03-08 PUBLIC SAFETY MEASURES PLAN |

PROJECT: NORTH BALA SMALL HYDRO PROJECT



DISCIPLINE: CIVIL
 DESIGNED BY: KARINA SETO, P. ENG.
 DRAWN BY: ADAM UNGAR
 CHECKED BY: HARVEY WALSH, P. ENG.

TITLE: PERMANENT PROPOSED CONDITIONS - PUBLIC SAFETY MEASURES - STANDARD DETAILS AND SIGNAGE

SCALE: AS SHOWN
 SHEET: 131-13550-00-C-403

ISSUE: PUBLIC SAFETY MEASURES PLAN
 DATE: 2019-03-08
 SHEET: A 0

| Post/Frame Member Type | OD | Post Length Standard Retaining Walls m | Wall Thickness m | Nominal Weight kg/m (Note 2) |
|----------------------------------|-------|--|------------------|------------------------------|
| Line post | 60.3 | 2.6 | 2.0 | 3.91 |
| Terminal Post | 88.9 | 2.9 | 2.3 | 5.49 |
| Gates (Single 3.0m, Double 6.0m) | 88.9 | 2.6 | n/a | 5.49 |
| Frame Members | 42.2 | n/a | n/a | 3.56 |
| Gates (Single 4.5m, Double 9.0m) | 114.3 | 2.9 | n/a | 6.02 |
| Frame Members | 48.3 | n/a | n/a | 3.68 |
| Line Post | 88.9 | n/a | 0.455 | 5.49 |
| Terminal Post | 114.3 | n/a | 0.455 | 6.02 |

ONTARIO PROVINCIAL STANDARD DRAWING Nov 2012 Rev 0
 FENCE, CHAIN-LINK DETAILS AND TABLE
 OPSD 972.132

ONTARIO PROVINCIAL STANDARD DRAWING Nov 2012 Rev 2
 FENCE, CHAIN-LINK INSTALLATION - CONCRETE BARRIER
 OPSD 972.131

NOTE: WALL CROSS-SECTION DESIGN IS PENDING AND MAY VARY FROM SHOWN. NOTE: CONFIRM WITH STRUCTURAL ENGINEER PRIOR TO PROCUREMENT.

ONTARIO PROVINCIAL STANDARD DRAWING Nov 2012 Rev 2
 FENCE, CHAIN-LINK INSTALLATION - ROADWAY
 OPSD 972.130

SIGN A: 457 mm x 603 mm. 75 mm TEXT. 40 mm TEXT.

SIGN B: 2440 mm x 1220 mm. 275 mm TEXT (SIGNS B & C). 120 mm TEXT (SIGNS B & C).

SIGN C: 2440 mm x 1220 mm.

SIGNS DESCRIPTION USING CDA STANDARDS. N.T.S.

APPENDIX

B

SAMPLE
PUBLIC
SAFETY
INCIDENT
REPORT

Appendix B: Sample Public Safety Incident Report (CDA, 2007)

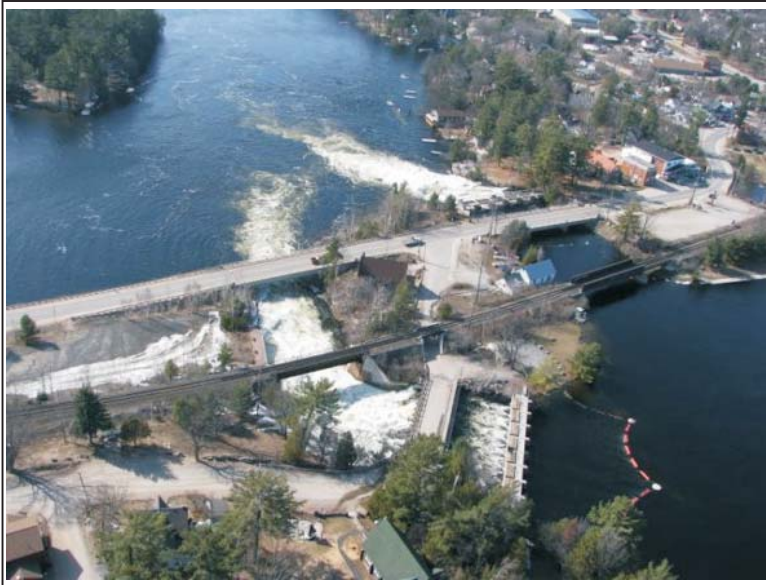
| Public Safety Incident Report | | | |
|--|---|---|--|
| 1.0 INCIDENT IDENTIFICATION | 1.1 Site or Dam Name: | 1.2 Incident Date (dd mm yyyy) | 1.3 Incident Time: <input type="checkbox"/> AM <input type="checkbox"/> PM |
| | 1.4 River Name: | | |
| | 1.5 Location of Incident: | | |
| | <input type="checkbox"/> Upstream (specific location) <input type="checkbox"/> Penstock <input type="checkbox"/> Authorized public access <input type="checkbox"/> Headpond <input type="checkbox"/> Spillway <input type="checkbox"/> Boat Ramps(s) <input type="checkbox"/> Dam (e.g. Crest, Roof, Deck) <input type="checkbox"/> Intakes <input type="checkbox"/> Tailrace (designated dangerous area) <input type="checkbox"/> Roadway(s) <input type="checkbox"/> Downstream (specific location) <input type="checkbox"/> Other: | | |
| | 1.6 Incident Type | | |
| | <input type="checkbox"/> Fatality (not suicide or homicide) <input type="checkbox"/> Trespassing, otherwise entering into a dangerous area <input type="checkbox"/> Injury <input type="checkbox"/> Failure of a physical control measures <input type="checkbox"/> Stranding/ rescue <input type="checkbox"/> Failure to follow operating procedures <input type="checkbox"/> Other: | | |
| | 1.7 Names of Individuals Involved (if known): | | 1.8 Names of Eyewitnesses: |
| | 1.9 Name of First Aid Responder: | | |
| 1.10 Name of Hospital/ Clinic: | | | |
| 1.11 Name of Responding Police Officer: | | 1.12 Police Report Number (if applicable): | |
| 2.0 DESCRIPTION OF INCIDENT | 2.1 Incident Description: | | |
| | 2.2 Describe the sequence of events leading to the incident and any injuries that resulted: <i>(Include observations by staff at site, resultant discussion with member(s) of the public, if any etc.)</i> | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|--|--|---|---|---------------------------------------|---|---|--|--|--|---|--|---|--|--|--|---|---|-----------------------------------|---|---|---------------------------------|--|---|----------------------------------|---|---------------------------------------|---|---|--|---------------------------------|----------------------------------|--------------------------------------|--|
| 3.0 ACTIVITIES | <p>3.1 What was the Person(s) doing at the time of the injury/ incident?</p> <p><i>From Water/ Ice</i></p> <table border="0"> <tr> <td><input type="checkbox"/> Fishing from Boat</td> <td><input type="checkbox"/> Boating (under power)</td> <td><input type="checkbox"/> Sailing</td> </tr> <tr> <td><input type="checkbox"/> Windsurfing</td> <td><input type="checkbox"/> Canoeing/ Kayaking/ Rowing</td> <td><input type="checkbox"/> Waterskiing</td> </tr> <tr> <td><input type="checkbox"/> Swimming</td> <td><input type="checkbox"/> Jet Ski</td> <td><input type="checkbox"/> Scuba Diving</td> </tr> <tr> <td><input type="checkbox"/> Swimming/ Diving</td> <td><input type="checkbox"/> Skating</td> <td><input type="checkbox"/> Ice Fishing</td> </tr> <tr> <td><input type="checkbox"/> Snowmobiling</td> <td><input type="checkbox"/> Other:</td> <td><input type="checkbox"/> Unknown</td> </tr> </table> <p><i>From Shore/ Structure</i></p> <table border="0"> <tr> <td><input type="checkbox"/> Fishing from shore</td> <td><input type="checkbox"/> Walking</td> <td><input type="checkbox"/> Climbing</td> </tr> <tr> <td><input type="checkbox"/> Picnicking</td> <td><input type="checkbox"/> ATV/ Dirt Biking</td> <td><input type="checkbox"/> Hiking</td> </tr> <tr> <td><input type="checkbox"/> Skiing</td> <td><input type="checkbox"/> Snowshoeing</td> <td><input type="checkbox"/> Driving</td> </tr> <tr> <td><input type="checkbox"/> Biking</td> <td><input type="checkbox"/> Scuba Diving</td> <td><input type="checkbox"/> Swimming/ Diving</td> </tr> <tr> <td><input type="checkbox"/> Accessing electrical equipment</td> <td><input type="checkbox"/> Accessing mech. equipment</td> <td><input type="checkbox"/> Other:</td> </tr> <tr> <td><input type="checkbox"/> Unknown</td> <td><input type="checkbox"/> Trespassing</td> <td></td> </tr> </table> | | | <input type="checkbox"/> Fishing from Boat | <input type="checkbox"/> Boating (under power) | <input type="checkbox"/> Sailing | <input type="checkbox"/> Windsurfing | <input type="checkbox"/> Canoeing/ Kayaking/ Rowing | <input type="checkbox"/> Waterskiing | <input type="checkbox"/> Swimming | <input type="checkbox"/> Jet Ski | <input type="checkbox"/> Scuba Diving | <input type="checkbox"/> Swimming/ Diving | <input type="checkbox"/> Skating | <input type="checkbox"/> Ice Fishing | <input type="checkbox"/> Snowmobiling | <input type="checkbox"/> Other: | <input type="checkbox"/> Unknown | <input type="checkbox"/> Fishing from shore | <input type="checkbox"/> Walking | <input type="checkbox"/> Climbing | <input type="checkbox"/> Picnicking | <input type="checkbox"/> ATV/ Dirt Biking | <input type="checkbox"/> Hiking | <input type="checkbox"/> Skiing | <input type="checkbox"/> Snowshoeing | <input type="checkbox"/> Driving | <input type="checkbox"/> Biking | <input type="checkbox"/> Scuba Diving | <input type="checkbox"/> Swimming/ Diving | <input type="checkbox"/> Accessing electrical equipment | <input type="checkbox"/> Accessing mech. equipment | <input type="checkbox"/> Other: | <input type="checkbox"/> Unknown | <input type="checkbox"/> Trespassing | |
| <input type="checkbox"/> Fishing from Boat | <input type="checkbox"/> Boating (under power) | <input type="checkbox"/> Sailing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Windsurfing | <input type="checkbox"/> Canoeing/ Kayaking/ Rowing | <input type="checkbox"/> Waterskiing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Swimming | <input type="checkbox"/> Jet Ski | <input type="checkbox"/> Scuba Diving | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Swimming/ Diving | <input type="checkbox"/> Skating | <input type="checkbox"/> Ice Fishing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Snowmobiling | <input type="checkbox"/> Other: | <input type="checkbox"/> Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Fishing from shore | <input type="checkbox"/> Walking | <input type="checkbox"/> Climbing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Picnicking | <input type="checkbox"/> ATV/ Dirt Biking | <input type="checkbox"/> Hiking | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Skiing | <input type="checkbox"/> Snowshoeing | <input type="checkbox"/> Driving | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Biking | <input type="checkbox"/> Scuba Diving | <input type="checkbox"/> Swimming/ Diving | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Accessing electrical equipment | <input type="checkbox"/> Accessing mech. equipment | <input type="checkbox"/> Other: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Unknown | <input type="checkbox"/> Trespassing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.0 CONTROL MEASURES | <p>4.1 Select Physical Measures in place at the time of the incident:</p> <table border="0"> <tr> <td><input type="checkbox"/> Signage</td> <td><input type="checkbox"/> Public Education (local)</td> <td><input type="checkbox"/> N/A</td> </tr> <tr> <td><input type="checkbox"/> Safety Booms</td> <td><input type="checkbox"/> Video Surveillance</td> <td><input type="checkbox"/> Safety Buoys</td> </tr> <tr> <td><input type="checkbox"/> Fencing</td> <td><input type="checkbox"/> Vehicle Barricades</td> <td><input type="checkbox"/> Visual Danger Signal Device</td> </tr> <tr> <td><input type="checkbox"/> Audible Danger Signaling Devices</td> <td><input type="checkbox"/> Operational Control Procedure</td> <td><input type="checkbox"/> Security Patrols</td> </tr> <tr> <td></td> <td></td> <td><input type="checkbox"/> Other:</td> </tr> </table> | | | <input type="checkbox"/> Signage | <input type="checkbox"/> Public Education (local) | <input type="checkbox"/> N/A | <input type="checkbox"/> Safety Booms | <input type="checkbox"/> Video Surveillance | <input type="checkbox"/> Safety Buoys | <input type="checkbox"/> Fencing | <input type="checkbox"/> Vehicle Barricades | <input type="checkbox"/> Visual Danger Signal Device | <input type="checkbox"/> Audible Danger Signaling Devices | <input type="checkbox"/> Operational Control Procedure | <input type="checkbox"/> Security Patrols | | | <input type="checkbox"/> Other: | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Signage | <input type="checkbox"/> Public Education (local) | <input type="checkbox"/> N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Safety Booms | <input type="checkbox"/> Video Surveillance | <input type="checkbox"/> Safety Buoys | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Fencing | <input type="checkbox"/> Vehicle Barricades | <input type="checkbox"/> Visual Danger Signal Device | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Audible Danger Signaling Devices | <input type="checkbox"/> Operational Control Procedure | <input type="checkbox"/> Security Patrols | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <input type="checkbox"/> Other: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.0 ENVIRONMENTAL | <p>5.1 Select the Physical/ Environmental Factor(s) relevant to the incident:</p> <p><i>Physical</i></p> <table border="0"> <tr> <td><input type="checkbox"/> Slope Instability</td> <td><input type="checkbox"/> Rapid Water Rise</td> <td><input type="checkbox"/> Inaccessible/ Awkward Location</td> </tr> <tr> <td><input type="checkbox"/> Steep Slopes</td> <td><input type="checkbox"/> Sudden Release of Water</td> <td><input type="checkbox"/> Exposed Mech/ Elec Equipment</td> </tr> <tr> <td><input type="checkbox"/> Uneven Surfaces</td> <td><input type="checkbox"/> Remote Release of Water</td> <td><input type="checkbox"/> Sharp Objects</td> </tr> <tr> <td><input type="checkbox"/> Slippery Surface</td> <td><input type="checkbox"/> Ramped Release of Water</td> <td><input type="checkbox"/> Structural Failure</td> </tr> <tr> <td><input type="checkbox"/> Strong Currents/ Undertow</td> <td><input type="checkbox"/> Floating Debris</td> <td><input type="checkbox"/> Energized Equipment</td> </tr> <tr> <td><input type="checkbox"/> Failure of Vehicle or Vessel</td> <td><input type="checkbox"/> Failure of Ice Cover</td> <td><input type="checkbox"/> Other:</td> </tr> </table> <p><i>Environment</i></p> <table border="0"> <tr> <td><input type="checkbox"/> Cold Environment</td> <td><input type="checkbox"/> Windy Conditions</td> <td><input type="checkbox"/> Other:</td> </tr> <tr> <td><input type="checkbox"/> Hot Environment</td> <td><input type="checkbox"/> Dark, Night Conditions</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Rainy Conditions</td> <td><input type="checkbox"/> Low Lighting</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Snow/ Ice</td> <td><input type="checkbox"/> Low Visibility</td> <td></td> </tr> </table> | | | <input type="checkbox"/> Slope Instability | <input type="checkbox"/> Rapid Water Rise | <input type="checkbox"/> Inaccessible/ Awkward Location | <input type="checkbox"/> Steep Slopes | <input type="checkbox"/> Sudden Release of Water | <input type="checkbox"/> Exposed Mech/ Elec Equipment | <input type="checkbox"/> Uneven Surfaces | <input type="checkbox"/> Remote Release of Water | <input type="checkbox"/> Sharp Objects | <input type="checkbox"/> Slippery Surface | <input type="checkbox"/> Ramped Release of Water | <input type="checkbox"/> Structural Failure | <input type="checkbox"/> Strong Currents/ Undertow | <input type="checkbox"/> Floating Debris | <input type="checkbox"/> Energized Equipment | <input type="checkbox"/> Failure of Vehicle or Vessel | <input type="checkbox"/> Failure of Ice Cover | <input type="checkbox"/> Other: | <input type="checkbox"/> Cold Environment | <input type="checkbox"/> Windy Conditions | <input type="checkbox"/> Other: | <input type="checkbox"/> Hot Environment | <input type="checkbox"/> Dark, Night Conditions | | <input type="checkbox"/> Rainy Conditions | <input type="checkbox"/> Low Lighting | | <input type="checkbox"/> Snow/ Ice | <input type="checkbox"/> Low Visibility | | | | |
| <input type="checkbox"/> Slope Instability | <input type="checkbox"/> Rapid Water Rise | <input type="checkbox"/> Inaccessible/ Awkward Location | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Steep Slopes | <input type="checkbox"/> Sudden Release of Water | <input type="checkbox"/> Exposed Mech/ Elec Equipment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Uneven Surfaces | <input type="checkbox"/> Remote Release of Water | <input type="checkbox"/> Sharp Objects | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Slippery Surface | <input type="checkbox"/> Ramped Release of Water | <input type="checkbox"/> Structural Failure | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Strong Currents/ Undertow | <input type="checkbox"/> Floating Debris | <input type="checkbox"/> Energized Equipment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Failure of Vehicle or Vessel | <input type="checkbox"/> Failure of Ice Cover | <input type="checkbox"/> Other: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Cold Environment | <input type="checkbox"/> Windy Conditions | <input type="checkbox"/> Other: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Hot Environment | <input type="checkbox"/> Dark, Night Conditions | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Rainy Conditions | <input type="checkbox"/> Low Lighting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Snow/ Ice | <input type="checkbox"/> Low Visibility | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.0 CORRECTIVE MEASURES | <p>6.1 Describe any Immediate Action(s) Taken as a result of the incident. (i.e. Corrective actions, warnings issued, charges laid, control measure repaired or upgraded, procedures written/ amended)</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.0 CONTACT INFORMATION | <p>7.1 Contact person on site</p> <hr/> | <p>7.2 Submitted by:</p> <hr/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

APPENDIX

C

PUBLIC
SAFETY
MEASURES
PLAN FOR
THE BALA
FALLS DAM

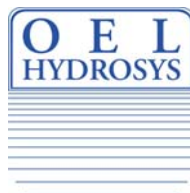


PUBLIC SAFETY MEASURES PLAN

BALA FALLS DAMS

PREPARED FOR:

ONTARIO MINISTRY OF NATURAL RESOURCES
SOUTHERN REGION
300 WATER STREET
FOURTH FLOOR, SOUTH TOWER
PETERBOROUGH, ON K9J 8M5



WATER
SAFETY

FINAL REPORT

PUBLIC SAFETY MEASURES PLAN

BALA FALLS DAMS

Prepared for:

The Ontario Ministry of Natural Resources
Southern Region
300 Water Street
Fourth Floor, South Tower
Peterborough, ON K9J 8M5

ATTN: Mr. Dave Burritt, P.Eng.

Prepared by:



WESA Inc.
OEL-HydroSys Inc.
Box 430, 3108 Carp Road
Carp (Ottawa), ON, K0A 1L0
613-839-3053
www.wesa.ca

WESA File No. OE7935-12

March 2011

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1.0 PURPOSE

In June 2009, WESA Inc. was contracted by the Ontario Ministry of Natural Resources to conduct a Public Safety Assessment (PSA) at the Bala Falls Dams (North Dam and South Dam) and produce a Public Safety Measures Plan (PSMP) documenting findings and recommendations.

The key considerations of the project include understanding and documenting any potentially significant public safety hazards that are either known or anticipated to occur due to public interactions with the dam structures, or due to their operations. The Ministry of Natural Resources' *Technical Guidelines and Requirements for Approval Under the Lakes and Rivers Improvement Act, Volume Four - PUBLIC SAFETY AROUND DAMS (DRAFT)*, September 2009 was used as the policy framework to systematically identify any such hazards, and evaluate methods by which the Ministry could eliminate or mitigate them.

The dam hazard identification exercise and the public safety assessment were conducted in accordance with the *MNR Risk Assessment Tool*, March 2010. The assessment is based on the current operating strategy as defined in the Ministry's *Muskoka River Dam Operation Manual* (2007). Identification of various risks to the public dictates the need for the development of a Public Safety Measures Plan for the Bala Falls dams.

This PSMP documents the existing site conditions and operational practices as well as the identified public safety hazards, risk assessment results, recommended measures to either eliminate or mitigate the risks and suggested practices for raising public awareness of the hazards, all related specifically and only to the dams and their operation. It does not address any other potential hazards at or around the site, whether naturally occurring or man-made which are not directly related to the dam structures or their operation.

Prepared by:



Richard Poole, CRSP

Health & Safety Specialist, WESA Inc.

March 30, 2011

2.0 ACCOUNTABILITY

Roles and responsibilities for public safety for the structure include:

Dam Owner: Ontario Ministry of Natural Resources

The Dam Owner must ensure that:

- policy for public safety around dams is established and implemented;
- accountability to the policy is defined;
- all personnel responsible for the management and operation of the structure are trained in the requirements of the PSMP and aware of their responsibilities, including both the identification of hazards and reporting of incidents (occupational and involving the public);
- progress with the recommendations and standards of this Public Safety Measures Plan is made and monitored;
- any change in site conditions is managed and addressed in subsequent versions of this PSMP;
- every incident at the site is investigated to minimise the risk of recurrence;
- The PSMP review is conducted on schedule and findings are reported to MNR decision makers.

Dam Operator: Ontario MNR, Parry Sound District Water Resources, Bracebridge office

The Dam Operator must ensure that:

- all personnel responsible for the operation of the structure are trained in the requirements of the PSMP and aware of their responsibilities, including both the identification of hazards and reporting of incidents (occupational and those involving the public);
- dam operation, inspection and maintenance is in accordance with the recommendations and standards of this Public Safety Measures Plan;
- public education and communication protocols are adhered to and updated as required;
- every incident at the site is investigated to minimise the risk of recurrence.

PSMP Development: WESA Inc.

The PSMP for Bala Falls Dams was developed to:

- provide assistance to the owner in defining accountabilities;
- identify hazards to members of the public;
- document a public safety risk assessment;
- provide recommendations to assist the owner in management of the identified risks.

At the time of the public safety assessment, there were no known third parties who may have authorization to access the site and or impact its operations.

3.0 SITE DESCRIPTION

The Balls Falls site is located in the township of Muskoka Lakes, Village of Bala, and District of Muskoka and consists of a dam on each of the bifurcated channels on the Moon/Musquash River maintaining water levels on Lake Muskoka at Bala Bay. A third outlet discharging from Lake Muskoka is channeled through a small hydroelectric generating station some distance north of the North Dam. The North Dam is located on Lot 14, Concession A, Medora Township. The South Dam is located on Lot 33, Concession 7, Wood Township.

Details of existing site arrangements are shown on the following figures in Appendix A:

- Figure 1. Public Safety Measures Site Plan - Bala Falls North Dam
- Figure 2. Public Safety Measures Site Plan - Bala Falls South Dam
- Figure 3. Dangerous Water Areas, Bala Falls

Site descriptions were prepared based on a review of MNR supplied dam information, interviews with MNR dam operators and staff familiar with the site, and a site visit on July 8, 2009. A photo log of the site visit is provided in Appendix B. For the purposes of this report all location descriptions are oriented in an upstream facing direction. A description of the dams and their operations as well as the surrounding area and any known public interactions around the structures is provided below:

Bala Falls North Dam

A detailed map showing the location of the dam and its associated appurtenant facilities and surrounding area is included as Figure 1 in Appendix A. The Bala Falls North Dam is located at the top of “Bala Falls” on the historic natural outlet from Lake Muskoka.

The Bala Falls North Dam is a concrete structure with six sluiceways; two of the sluiceways are equipped with seven stoplogs, the remaining sluiceways have eight stoplogs. The dam operation details for this dam are provided in Section 29 of the Muskoka River Dam Operation Manual (MRDOM).

The Muskoka District Road 169 and Canadian Pacific Railway (CPR) bridges cross the channel upstream of the dam; a public parking lot is located on the left bank. An orange ‘TUFFBOOM’ safety boom is located approximately 30 metres upstream of the dam and is anchored to each bank. The dam has mesh panels applied to guardrails at each end which are gated and locked; bilingual signage reading “DANGER Dam No Trespassing” (red with white lettering) is fastened

to each gate. Larger English-language signs reading “DANGER Fast Water Keep Away” are located on both faces of the dam, mounted to the railings. All signage was MNR standard issue and was observed to be in good condition. The view of the DANGER sign mounted on the upstream face was obstructed by the road bridge.

Bala Falls South Dam

A detailed map showing the location of the dam and its associated appurtenant facilities and surrounding area is included as Figure 2 in Appendix A.

The Bala Falls South Dam is a concrete structure with eight sluiceways each containing eight stoplogs. The dam operation details for this dam are provided in Section 29 of the MRDOM. The Bala “South” channel is man-made and is considered to be the main spillway for the South Dam.

The Bala Falls Road, CPR, and District Road 169 bridges cross the channel downstream of the dam; there is a gravel parking lot on the left bank adjacent to the dam. An orange ‘TUFFBOOM’ safety boom is located approximately 38 metres upstream of the dam with two in-stream concrete crib anchors. The boom is secured to the banks with concrete anchors. The dam has guardrails and is gated and locked at each end; there is no measure to prevent persons climbing on, or ducking under, the gate or guardrails. Bilingual signage reading “DANGER Dam No Trespassing” (red with white lettering) is fastened to each gate. Larger English-language signs reading “DANGER Fast Water Keep Away” are located on both faces of the dam, mounted to the railings facing upstream and downstream. All signage was MNR standard issue and was observed to be in good condition. The wood stoplog gain covers on the deck were not secured. Stoplogs were observed on the dam deck at the time of the visit.

Operating Practices and Procedures

The operational strategy for the Bala North and South dams is described in the Muskoka River Dam Operating Manual, 2007 (MRDOM). Stoplogs are added or removed at either dam by Ministry staff in order to stay within the normal operating zone and as close to the target operating level as possible. Most of the flow is directed through the South Dam, resulting in calmer water above the North Dam.

Although not documented, the operators report that they routinely drive over the road bridges on both Bala Falls Road and District Road 169 on the approach to the Bala Dams to view the entire channels that will be affected by dam operations. If individuals are in the water or on rocks in the areas to be affected, the operator warns them of the impending hazard and waits until they are clear before proceeding to operate the dam.

Informal site inspections are conducted during operational site visits; formal Ministry inspections are conducted yearly. As part of the formal inspection, the safety boom, guardrails, gates and signage are inspected.

According to the MRDOM Section 4.1., Paragraph 11, Ministry staff contact Ontario Power Generation (OPG) before and after all stoplog changes at Bala to allow for operational changes at OPG's Moon River Dam downstream.

Public Interaction

In the May to October open-water season activities include recreational boating, paddling, swimming, fishing and picnicking around the site with the summer holiday period (July and August) experiencing the highest level of public activity around the dams. Off season (November to April) activities are greatly reduced to mostly local residents who are considered more familiar with the waterway and dam water flow conditions than the peak summer and non-resident day users. No information was available regarding early spring, late fall and winter activities in the area but these might include cross-country skiing, skating, ice fishing, walking and snowmobiling.

During the site visit (July 2009), wading and swimming was observed adjacent to the parking lot immediately upstream of the South Dam safety boom on the left bank; no signage is posted in this area. An interview with the Dam Operator revealed that white water kayakers frequent the waters in the downstream channel below the South Dam, usually during high flow conditions. Media photographs posted on websites indicate that kayak paddlers navigate through the sluiceways at Bala South Dam.

A boat rental and convenience retail outlet business is located above the North Dam on the upstream right bank between the safety boom and a rail bridge. During the site visit swimmers and kayak paddlers were observed using a footpath which extends from the top of the rocky right bank just downstream of the dam, past the right hand side of the dam and over the Hwy 169 bridge to the boat rental business, upstream of the existing safety boom. Another footpath travels along the top of the rocky left bank downstream of the dam, extending along the east side of Hwy 169 Bridge, to the shoreline at the parking area, under the rail bridge and around the shoreline to the park docks. Kayak activity, swimming and wading was observed downstream of the falls; wading was also observed in fast flows on the rocky falls immediately downstream of the dam. Staff at the rental outlet reported that members of the public access the

rail bridge to dive/jump from the structure and swim in the waterway upstream of the safety boom.

There are no documented operating practices or procedures at the Bala Falls Dams to enhance public safety and dam operation awareness at the site. None of the existing signage identifies the Ministry as the dam owner or provides incident/emergency contact numbers.

There are no current initiatives (beyond the Operator reconnaissance prior to dam operation maneuvers) to promote public awareness of dam operations at Bala Falls. Ministry staff do not contact neighbouring private property owners prior to dam operations.

4.0 PUBLIC SAFETY ASSESSMENT DISCUSSION

The assessment of public safety at the Bala Falls dams included a meeting between MNR staff and WESA Group Inc. staff at Bracebridge MNR office in Bracebridge, Ontario and the completion of a site visit to the Bala Falls Dams site at Bala, Ontario on July 8, 2009. A number of assumptions were made in the completion of this assessment. These assumptions are documented in the Risk Assessment Tool in Appendix D. It is important to note that the assessment only documents hazards which are directly related to the dams or their operation.

The completion of this Public Safety Measures Plan addressing site conditions and recommendations will assist the Ministry, as the Dam Owner, to satisfy the principles established in the Ministry's Draft *Technical Guideline Volume 4 – Public Safety Around Dams* (September, 2009) document and, when recommendations are implemented, will ensure the Ministry demonstrates due diligence.

A summary of the hazards identified is listed in Tables 1 and 2 below for each dam. The identified hazards are also displayed on Figures 1 and 2 in Appendix A. Figure 3 in Appendix A shows the approximate dangerous water areas for the Bala Falls Dams site.

While flow conditions at the dams vary due to natural seasonal and climatic fluctuations, operational changes can result in short term changes in flows upstream and downstream of the structures which may pose an additional hazard to the public. The upstream and downstream dangerous water area, defined as those areas which may exhibit fast flowing and/or turbulent conditions as a result of dam operations, is shown in Figure 3. In lieu of a hydrological assessment, the determination of the approximate extent of the upstream dangerous water areas were based on Transport Canada's Point of No Return Calculations and discussions with Ministry staff. An examination of photos of the Bala Falls site under high flow conditions and discussions with Ministry staff has resulted in an approximation of the downstream dangerous water areas.

Table 1: North Dam Identified Hazards

| Hazard Number on Site Plan (Figure 1) | Hazard Description |
|---------------------------------------|---|
| 1 | Trespass onto dam, Falls |
| 2 | Swimming in upstream dangerous water area, Drowning |
| 3 | Wading / swimming in downstream dangerous water area, Drowning |
| 4 | Paddling through the dam, Capsize, Drowning |
| 5 | Swimming in upstream dangerous water area upstream of safety boom, Drowning |

Table 2: South Dam Identified Hazards

| Hazard Number on Site Plan (Figure 2) | Hazard Description |
|---------------------------------------|---|
| 1 | Trespass onto dam, Falls |
| 2 | Swimming in upstream dangerous water area, Drowning |
| 3 | Wading / Swimming in areas upstream of existing boom yet within the calculated dangerous water area, Drowning |
| 4 | Wading / swimming in downstream dangerous water area (spillway), Drowning |
| 5 | Paddling through dam, Drowning |

Risk Analysis and Priority Ranking

Based on the probability and consequence identification, the dam owner must ensure that a competent person assess the relative risk posed by each hazard which has the potential to cause a risk to public safety. Seasonal changes in public use around the dam structure and the risk posed by seasonal operating changes must also be taken into account in the risk analysis. Based on the methodology used to determine risk, this public safety assessment priority ranks interaction events from highest risk to lowest risk and includes recommendations for measures to assist the Ministry to better plan its actions with regards to public safety and hazard prevention.

The following tables summarize the risk analysis of public safety at the Bala Falls Dams sites. The risks were determined following the MNR's *Risk Assessment Tool*, March 2010 (See Appendix D). The risk assessment evaluation and scoring criteria are presented in Tables 3, 4 and 5. Tables 6 and 7 present the results of the risk assessment and recommended measures for the north and south dams respectively.

Table 3: Incident Likelihood (Probability) - L

Definition: Expected level of public interaction for the activity and associated hazards present (either known or estimated)

| Level | Descriptor | Example Description |
|-------|-------------------------|---|
| 5 | Almost Certain to Occur | is expected to occur in most circumstances |
| 4 | Likely | will probably occur in most circumstances |
| 3 | Possible | will occur at some time |
| 2 | Unlikely | might occur at some time |
| 1 | Rare | may occur only in exceptional circumstances |


Table 4: Incident Severity (Consequence) - C


Definition: Most likely outcome of the potential interaction that could reasonably be experienced as a result of dam operations or interaction with MNR facilities by a member of the public engaging in that activity


| Level | Descriptor | Example Description |
|-------|---------------|--|
| 1 | Insignificant | no 1st aid required |
| 2 | Minor | 1st aid may be required (by non-EMS personnel) |
| 3 | Moderate | could result in medical treatment or rescue |
| 4 | Major | critical injury is possible (EMS services are required) |
| 5 | Catastrophic | fatality or permanent total disability is likely to result (drowning, severe trauma) |

Table 5: Public Safety Risk Rating

Classify the risk rating for the particular activity, according to Low, Medium or High Risk:

 **LOW Risk** - A **LOW RISK** would not require further reduction but reasonable and obvious measures should be implemented as appropriate.

 **MEDIUM Risk** - A **MEDIUM RISK** determination means that the Ministry should evaluate all reasonable means to reduce risks as a 2nd priority.

 **HIGH Risk** - A **HIGH RISK** determination requires the Ministry to take all reasonable measures to mitigate this risk as a 1st priority.

| RISK RATING | | | Incident Consequences | | | | |
|---------------------|----------------|---|-----------------------|-------|----------|-------|--------------|
| | | | Insignificant | Minor | Moderate | Major | Catastrophic |
| | | | 1 | 2 | 3 | 4 | 5 |
| Incident Likelihood | Almost Certain | 5 | M | M | H | H | H |
| | Likely | 4 | L | M | H | H | H |
| | Possible | 3 | L | M | M | H | H |
| | Unlikely | 2 | L | L | M | M | H |
| | Rare | 1 | L | L | L | L | M |

Table 6: Risk Analysis of Hazards at the North Dam
 For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

| HAZARD NUMBER | Step 1 IDENTIFY | | | Step 2 L LEVEL (1,2,3,4,5) | Step 3 C LEVEL (1,2,3,4,5) | Step 4 RISK RATING (High/Medium/Low) | Step 5 RECOMMENDED CONTROLS |
|---------------|------------------------------|-------------------|--|----------------------------|----------------------------|--------------------------------------|---|
| | ACTIVITY | HAZARD | EXISTING CONTROLS | | | | |
| 1 | Trespass on dam | Falls | “No Trespass” Signage, locked gate and mesh | 1 | 4 | Low | Maintain at each end of the dam: Gate and Guardrail mesh infill panels, and; “No Trespass” signs. Maintain on each face of the dam: Guardrails with part mesh infill at each end, and; Danger signs. Install at each end of dam: Signage with name of dam owner and contact information. |
| 2 | Swimming upstream | Drowning | “Danger” Signage at dam; safety boom; “No Swimming” sign installed by third party on left bank between dam and Road 169 bridge | 3 | 5 | High | Redesign, install and maintain: Safety Boom and components (requires Qualified Engineer); Install: New “Danger” sign on upstream side of Road 169 bridge; Physical barrier on accessible banks along upstream dangerous water area. |
| 3 | Wading / swimming downstream | Drowning | “Danger” Signage at dam | 2 | 5 | High | Install: Warning signage downstream of the dam to warn of potential changes in flows; Document practice of conducting visual inspections of downstream dangerous water area prior to removing stoplogs to ensure communication to all MNR personnel (revise MRDOM). Consider increasing amount of normal discharge. |
| 4 | Paddling through dam | Capsize, Drowning | “Danger” Signage at dam; safety boom | 1 | 5 | Medium | Install: New “Danger” sign on upstream side of Road 169 bridge. Maintain: Safety Boom. Consider vessel operation restriction. |
| 5 | Swimming / Wading upstream | Drowning | “Danger” Signage at dam; Safety Boom | 2 | 5 | High | As Hazard 2 above and; Ensure physical barriers deter access to the water between the dam and the safety boom. |

Table 7: Risk Analysis of Hazards at the South Dam
 For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

| HAZARD NUMBER | Step 1 IDENTIFY | | | Step 2 L LEVEL (1,2,3,4,5) | Step 3 C LEVEL (1,2,3,4,5) | Step 4 RISK RATING (High/Medium/Low) | Step 5 RECOMMENDED CONTROLS |
|---------------|--|-------------------|---|----------------------------|----------------------------|--------------------------------------|---|
| | ACTIVITY | HAZARD | EXISTING CONTROLS | | | | |
| 1 | Trespass on dam | Trips / Falls | “No Trespass” Signage; locked gate | 2 | 4 | Medium | Install at each end of the dam: Gate and Guardrail mesh infill panels; “No Trespass” signs; Signage with name of dam owner and contact information. Secure stoplog gain covers. Maintain on each face of the dam: Guardrails. |
| 2 | Swimming upstream | Drowning | “Danger” Signage at dam; safety boom | 3 | 5 | High | Redesign, Install and maintain: Safety Boom and components (requires Qualified Engineer) |
| 3 | Swimming / Wading upstream | Drowning | “Danger” Signage at dam; Safety Boom | 2 | 5 | High | As Hazard 2 above and; Install physical barrier and “Danger” signage on left bank between dam and new left bank boom anchor. |
| 4 | Swimming / wading / fishing downstream | Drowning | “Danger” signage at dam; Uninviting flows | 2 | 5 | High | Install: “Danger” signage on downstream road bridges; Physical barriers at fall hazards on accessible banks along downstream dangerous water area. Liaise with landowners on downstream banks as necessary. |
| 5 | Paddling through dam | Capsize, Drowning | Signage at dam, Safety Boom | 1 | 5 | Medium | Redesign, install and maintain: Safety Boom and components (requires Qualified Engineer). Consider vessel operation restriction. |

5.0 RECOMMENDATIONS

In light of the public safety assessment undertaken for this site and in accordance with draft guidelines that indicate that a PSMP must be undertaken for a dam where public safety hazards exist, recommended measures to mitigate the risks to public safety are described below. In most cases, full elimination of the risks assessed is not possible.

The objective of a PSMP is to ensure hazards are controlled to minimize risks to public safety around dams and appurtenances through public safety measures, recommended in accordance with the following hierarchy:

- Eliminate the hazard wherever possible;
- Install safeguard devices to restrict access by the public to hazardous areas;
- Install warning devices;
- Install illumination and surveillance devices;
- Install protective devices to allow for response to incidents and emergencies;
- Support the development and delivery of information, education and training programs for the public.

The rationale for recommendations is based primarily upon the principles set out in the MNR *Technical Guidelines Volume Four - PUBLIC SAFETY AROUND DAMS (DRAFT)*, September 2009. Recommendations were identified by the Public Safety Assessment above in Tables 6 and 7 and are summarised in the Section 7.0 Conclusions and Priorities for Implementation.

Due to the aesthetic appeal of the Bala Falls area, the MNR specifies the use of aesthetically pleasing fencing to discourage public access to areas of the water near dams that are considered dangerous. While the banks do not directly relate to the dam structures or their operations and do not pose a hazard to the public, they may provide easy and attractive access for the public to dangerous water areas.

One area where a physical barrier is recommended is the left bank upstream of the South Dam extending to the proposed safety boom anchor location (see hazard (3) South Dam). Further, physical barriers are required along accessible banks upstream of the North Dam extending to the safety boom. Design of physical barriers should consider the fact that this area is an established public access point for parking, swimming and wading and that fencing should be designed to deter climbing over or passing under the barrier.

Trespass onto the dam decks is potentially hazardous to members of the public. The Bala North Dam has mesh panels applied to guardrails and gates at each end of the dam. It is recommended that similar measures be applied to the Bala South Dam. Stoplog gain covers of the Bala South

Dam should be secured to prevent unauthorized removal. It is recommended that galvanized steel mesh gain covers, similar to those located on the Bala North Dam, be installed on the Bala South Dam.

Mandatory signage for navigation and to warn against trespass is present at both dams. However, the North Dam upstream navigation DANGER sign, while situated in a location that is visible from the road bridge, is not visible to upstream navigation due to obstruction by the low deck of the road bridge. Consideration should be given to adding an identical sign to the upstream side of the Hwy 169 Bridge and additional visual cues, such as buoys, upstream of the rail bridge.

Warning signage is recommended along both shorelines of the North Dam (see Figure 1) to safely guide the public around hazardous areas;

- downstream of the dam at points where the public is known to access the waterway within the approximate dangerous water area for wading, fishing and paddling (see Figure 3).

At the South Dam site warning signs are recommended (see Figure 2);

- on both shorelines along the dangerous water areas where vegetation is not dense enough to deter public access or where no other structures are present to restrict entry to the water's edge.

Educational interpretive signage that may include an introduction to the history of the site, but also communicates hazards associated with the Bala Falls is recommended at access points near both dams.

It is recommended that in addition to identifying the dangers associated with waterway use, signage should also warn of hazards associated with changing flow conditions around dams. The upstream and downstream dangerous water areas are considered as those areas which may exhibit fast flowing and/or turbulent conditions as a result of dam operations. While it is recognized that flows are not altered frequently and that flow patterns stabilize quickly after the stoplogs are manipulated at the dams, operational changes may still result in flows that are significantly stronger than natural conditions alone. These factors may not be immediately apparent to the casual visitor, hence the need for danger, warning and educational signage to augment warnings by operators prior to dam operations.

The extent of Dangerous Water Area upstream of the dams was evaluated by application of the Point of No Return (PoNR) concept as defined by Transport Canada.

PoNR exclusion zone calculations were completed for the site using the two-yr (2-yr) return period flow, which was derived from historical flow data downstream at the Moon River stream gauge (Environment Canada station # 02EB006). The resulting Method 2 (Drawdown Distance) calculation determined that the dangerous water area extends for a distance of 50.1 meters upstream of the North Dam, and 37.6 meters upstream of the South Dam (See Appendix E).

The existing orange ‘TUFFBOOM’ safety boom at the North Dam is positioned within the exclusion zone as defined by Transport Canada Point of No Return (PoNR) calculations and directs self-rescue towards an informal boat launch on Crown Land on the right hand shoreline. The existing orange ‘TUFFBOOM’ safety boom at the South Dam is positioned within the exclusion zone as defined by Transport Canada PoNR calculations but directs self-rescue to safe areas at either shoreline. Therefore, the safety booms at both Bala Dams meet the *NWPA* standards and MNR draft provincial guidelines for visual cue and self-rescue but not for distance.

The navigation safety booms should be designed at the recommended distance to be compliant with the PoNR requirements.

Under typical operating conditions, water levels and flows at the site are maintained within the limits of the normal operating zone (i.e. remain steady along a flat target operating level range for the busy summer recreation period and are adjusted gradually during transitional periods). Most of the operational changes occur during periods of decreased public use outside of this flat summer range. Further, the dam operators currently ensure the downstream areas are clear of people prior to removing stop logs. Thus, the risk assessment has determined that, if the operator’s current practice is documented and communicated, operational hazards at the site are not significant and no mitigating operational procedures are recommended for the site while operations remain within the normal operating zone.

For those operating procedures initiated in response to rising water levels in anticipated flood conditions (flood control zone on rule curve), operational changes may result in an increase in risk of hazardous conditions in the dangerous water areas downstream of the dam (see Figure 3). For this scenario the identified operational change, identified hazard and the recommended mitigating measure are presented in Table 8.

Table 8: Mitigation Measure for Hazards Identified Due to Operational Change

| Operational Change | Identified Hazard | Mitigating Procedure |
|--|---|--|
| Respond to flood control zone conditions by removing stoplogs to pass the flood flow | Dangerous water areas in the dam spillways and Moon River downstream of the spillways; areas are described on Figure 3. | MNR personnel continue the operational practice that prior to operational changes, visual surveillance to ensure no persons are in the dangerous water area and to warn persons to stay clear while changes affecting water flow and level are made. |

The mitigation procedure outlined in Table 8 above should be added to the operating procedure in the MRDOM to ensure that all operators follow the same practice.

In order to increase visibility of the dangerous water area downstream of the North Dam, the Ministry should consider modifying the operational regime at the Bala Falls Dams in such a way that a portion of the flows typically passed by the South Dam is diverted through the North Dam. This operational change would ideally result in higher flows at the North Dam which would act as a visual deterrent to members of the public and potentially reduce the use of the falls immediately downstream of the dam for wading and swimming. Public entry to the waterway immediately downstream of the South Dam is less likely due to the restricted access from banks.

Sirens and warning lights are not recommended for the Bala Falls Dams as stoplogs rather than gates are in use and are manually operated at the site by an operator (not a remotely controlled site).

Recommendations were selected with respect to local sensitivities and the aesthetic appeal of the area wherever possible. For example, the selection of physical barriers will have to consider visual impact. Signage recommendations were kept to a minimum for similar reasons, particularly where the hazard is very apparent.

Signage is required to ensure that Emergency Response Protocols are communicated to the public. There was no sign posted on site to identify the owner/operator of the dam. The Ministry reported that an internal review with respect to the information to be placed on the signage was with the Regional Dam Safety Forum at the time of writing. It is understood that recommendations from this group will be implemented as required.

We recommend that improving public safety awareness at MNR Dam sites would benefit both the Ministry and the Ontario community. Measures that increase public safety awareness include;

- public safety awareness events (i.e. at existing community events)
- local radio, billboard, website, or newspaper public service announcements at the start of the boating/tourist season
- educational signage at public interaction points

The Ministry is advised to liaise with the community (i.e. municipality, OPG, local emergency services) in creating a Public Safety Awareness Plan.

6.0 INSPECTION AND MAINTENANCE REQUIREMENTS

Inspection and maintenance requirements are specific to each dam site. The inspection and maintenance requirements for maintaining public safety measures at the Bala Falls Dams site include, but will not be limited to:

During Informal Inspections

Inspect:

1. Both upstream and downstream channels - ensure no person will be endangered by dam operations.
2. Barriers – ensure fences are not damaged and look for signs of entry to the water in dangerous locations.
3. Signage – ensure all signs are present, in good condition, and free of graffiti.
4. Safety boom – visual check that boom is secured and not damaged.
5. Dam infrastructure – visually check site for signs of damage/trespass.

During Formal Inspections

In addition to items 1-5 above, inspect:

6. Guardrails – check structural integrity, signs of rust, loose bolts, damage.

Inspection and maintenance schedules are established by the Ministry for each dam site. The record keeping template currently in use by the Ministry should be updated with the implementation of any new measures or changes to existing measures at the site. If damage is observed during an inspection, the Dam Inspector should assess whether he/she can perform a temporary repair with high-visibility mesh fencing or simply highlight the hazard with tape. All damage and /or deterioration must be reported to the Inspector's Supervisor for initiating permanent work to remedy any damage as soon as reasonably possible, dependant on the risk to the public.

7.0 CONCLUSIONS AND PRIORITIES FOR IMPLEMENTATION

WESA Inc. was commissioned in June 2009 to conduct a Public Safety Assessment at the Bala Falls Dams (North Dam and South Dam) and produce a Public Safety Measures Plan documenting findings and recommendations.

The Bala Falls site, located in the township of Muskoka Lakes, Village of Bala, and District of Muskoka, consists of a dam on each of the bifurcated channels on the Moon/Musquash River maintaining water levels on Lake Muskoka at Bala Bay.

The project included understanding and documenting the existing site conditions; identifying hazards associated with each dam structure, appurtenant facilities and the associated operational activities which may affect the public during their interaction around each dam site.

Following inspection of the Bala Falls North and South Dam sites and further consideration of the risks to public safety, WESA Inc. recommends this Public Safety Measures Plan for acceptance by the Ministry. WESA Inc. further recommends that the Ministry adopt the measures identified in Section 5.0 of this report and summarised in priority order in Tables 9 & 10 below.

A PSMP Review, Reporting and Amendments Schedule and Record are included in Appendix C. We recommend that the Bala Falls PSA and PSMP be reviewed and amended as necessary, specifically whenever physical and/or operational changes are implemented that may affect public safety and at least at the frequency of formal inspections at the dams.

Table 9: Bala North Dam – Prioritized Recommendations

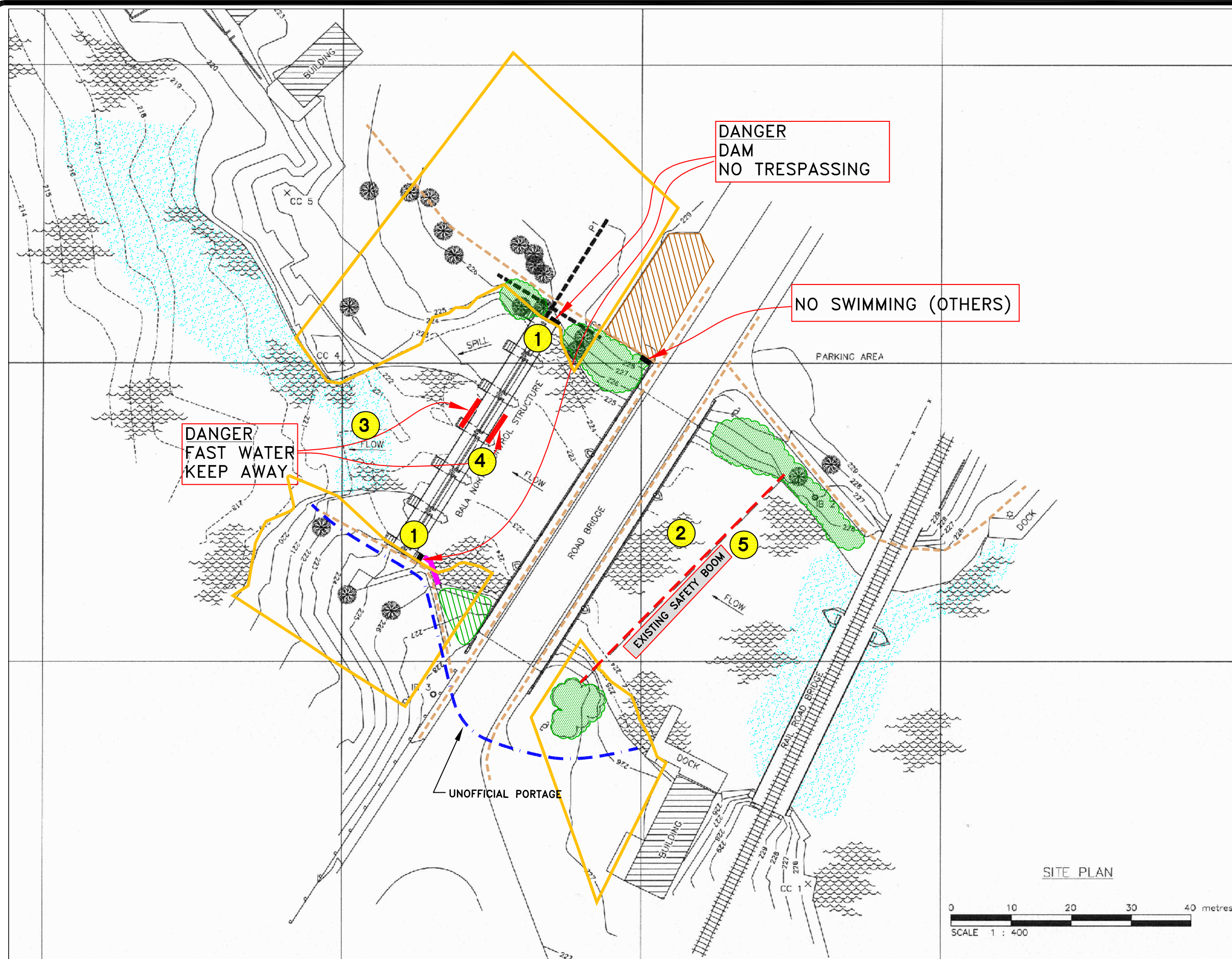
| Identified Hazard Number (Figure 1) | Activity | Hazard | Risk Rating | Recommended Measures |
|-------------------------------------|---|-------------------|-------------|--|
| 2 | Swimming upstream | Drowning | High | <ul style="list-style-type: none"> • Redesign and maintain: <ul style="list-style-type: none"> ○ Safety Boom and components (requires Qualified Engineer) • Install “Danger” sign on upstream side of Road Bridge to improve visibility. • Install physical barrier(s) on accessible banks along upstream dangerous water area. |
| 5 | Swimming upstream of existing safety boom | Drowning | | |
| 3 | Wading / swimming downstream | Drowning | High | <ul style="list-style-type: none"> • Install “Warning” signage downstream of the dam warning of potential change in flows due to operations. • Install Educational/Interpretive signage at entry points on both banks. • Document practice of conducting visual inspections of downstream dangerous water area prior to removing stoplogs to ensure communication to all MNR personnel (revise MRDOM). |
| 4 | Paddling through dam | Capsize, Drowning | Medium | <ul style="list-style-type: none"> • Redesign and maintain: <ul style="list-style-type: none"> ○ Safety Boom and components (requires Qualified Engineer) • Maintain “Danger” signage • Consider application to Transport Canada for a vessel operation restriction. |
| 1 | Trespass on dam | Falls | Low | <ul style="list-style-type: none"> • Maintain at each end of the dam: <ul style="list-style-type: none"> ○ Gate and Guardrail mesh infill panels, and ○ No Trespassing signs • Maintain on each face of the dam: <ul style="list-style-type: none"> ○ Guardrails with part mesh infill at each end, and ○ Danger signs • Install at each end of the dam: <ul style="list-style-type: none"> ○ Signage including name of dam owner and contact information |

Table 10: Bala South Dam – Prioritized Recommendations

| Identified Hazard Number (Figure 2) | Activity | Hazard | Risk Rating | Recommended Measures |
|-------------------------------------|--|-------------------|-------------|---|
| 2 | Swimming upstream | Drowning | High | <ul style="list-style-type: none"> • Redesign and maintain: <ul style="list-style-type: none"> ◦ Safety Boom and components (requires Qualified Engineer) • Install fence and “Danger” signage on upstream left bank between dam and proposed safety boom anchor. • Install educational/interpretive signage in parking area |
| 3 | Swimming / Wading upstream | Drowning | | |
| 4 | Swimming, wading or fishing downstream | Drowning | High | <ul style="list-style-type: none"> • Install: <ul style="list-style-type: none"> ◦ “Danger” signage on downstream road bridges ◦ Physical barriers at fall hazards on accessible banks along downstream dangerous water area • Liaise with downstream landowners to ensure all occupants understand the dangers of fast flowing water and changing conditions following dam operations. |
| 1 | Trespass on dam | Falls | Medium | <ul style="list-style-type: none"> • Install at each end of the dam: <ul style="list-style-type: none"> ◦ Gate and guardrail mesh infill panels similar to those on the North dam, and ◦ Meshed, secured stoplog gain covers, and ◦ “No Trespass” signs, and ◦ Signage including name of dam owner and contact information. • Maintain on the dam: <ul style="list-style-type: none"> ◦ Gates and guardrails on structure, and ◦ Danger signs. • Secure stoplog gain covers. |
| 5 | Paddling through dam | Capsize, Drowning | Medium | <ul style="list-style-type: none"> • Redesign and maintain: <ul style="list-style-type: none"> ◦ Safety Boom and components (requires Qualified Engineer) • Maintain “Danger” signage • Consider application to Transport Canada for a vessel operation restriction. |

APPENDIX A

Site Plans



LEGEND

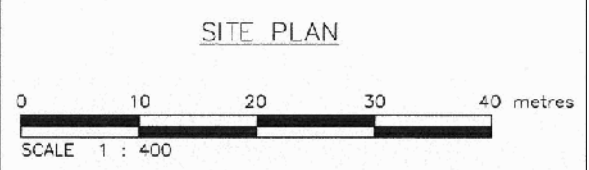
- PUBLIC PARKING
- WADING/SWIMMING
- VEGETATION
- BANK - PLANTING RECOMMENDED
- GUARD RAIL
- SAFETY BOOM
- PUBLIC FOOTPATH
- UNOFFICIAL PORTAGE
- HAZARDS - SEE PSMP SECTION 4.0 FOR DESCRIPTION
- LAND TENURE BOUNDARY (PLAN REFERENCE: PLAN 35R - EJWilliams Surveying Limited - May 2008)

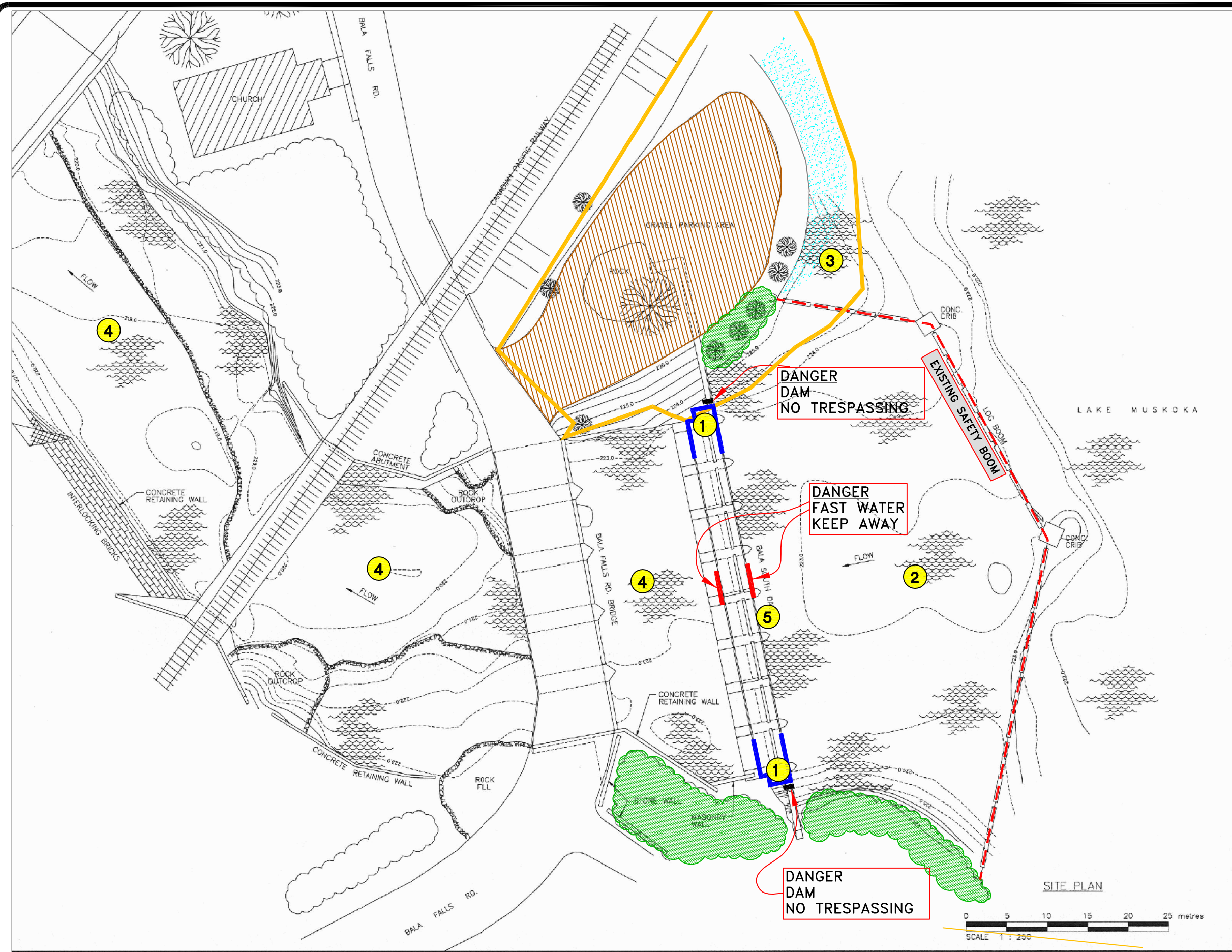
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 PLAN REFERENCE: MINISTRY OF NATURAL RESOURCES MARCH 2000

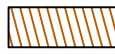
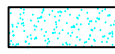







| | | |
|------------------------|-------------------------------|-------------------|
| PROJECT NUMBER: OE7935 | DRAWN BY: C.M.R. | DESIGNED BY: R.P. |
| DATE: 17 DEC. 2010 | CHECKED BY: | |
| SCALE: AS SHOWN | CAD FILE NO.: OE7935-BALA DAM | |

FIGURE: 1
PUBLIC SAFETY MEASURES
SITE PLAN
 BALA FALLS NORTH DAM





LEGEND

-  PUBLIC PARKING
-  WADING/SWIMMING
-  VEGETATION
-  GUARD RAIL
-  SAFETY BOOM
-  PUBLIC FOOTPATH
-  DAM DECK VULNERABLE TO TRESPASS
-  HAZARDS – SEE PSMP SECTION 4.0 FOR DESCRIPTION
-  LAND TENURE BOUNDARY

(PLAN REFERENCE: PLAN 35R – EJWilliams Surveying Limited – May 2008)

N



PLAN REFERENCE: MINISTRY OF NATURAL RESOURCES
MARCH 2000

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|------------------------|-------------------------------|-------------------|
| PROJECT NUMBER: OE7935 | DRAWN BY: C.M.R. | DESIGNED BY: R.P. |
| DATE: 17 DEC. 2010 | CHECKED BY: | |
| SCALE: AS SHOWN | CAD FILE NO.: OE7935-BALA DAM | |


FIGURE: 2
**PUBLIC SAFETY MEASURES
 SITE PLAN**
 BALA FALLS SOUTH DAM



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LEGEND

 UPSTREAM DANGEROUS WATER AREA

NOTE:

The approximate extent of the upstream dangerous water areas are based on Transport Canada's Point of No Return Calculations.

The downstream waterway areas that may be influenced by dam operations can be conservatively estimated to roughly correspond to the white water areas immediately downstream of the dam structures and extending out into the Moon River under high flow conditions.

| | | |
|------------------------|-------------------------------|-------------------|
| PROJECT NUMBER: OE7935 | DRAWN BY: C.M.R. | DESIGNED BY: R.P. |
| DATE: 17 DEC. 2010 | CHECKED BY: | |
| SCALE: AS SHOWN | CAD FILE NO.: OE7935-BALA DAM | |

FIGURE: 3
DANGEROUS WATER AREAS
 BALA FALLS

APPENDIX B

Photographs



FROM DAM, DOWNSTREAM



FROM UPSTREAM, DAM SHOWING OBSCURED DANGER SIGN



FROM HIGHWAY 169 ROAD BRIDGE SHOWING DANGER SIGN



FROM UPSTREAM, DAM SHOWING MESHED GUARDRAIL ENDS AND DANGER SIGNS



LEISURE USE DOWNSTREAM AND LIFE RING ON SOUTH SHORE



PORTAGE/FOOTPATH ON SOUTH BANK PAST DAM

PHOTOGRAPHS - PACKAGE B
BALA FALLS NORTH DAM



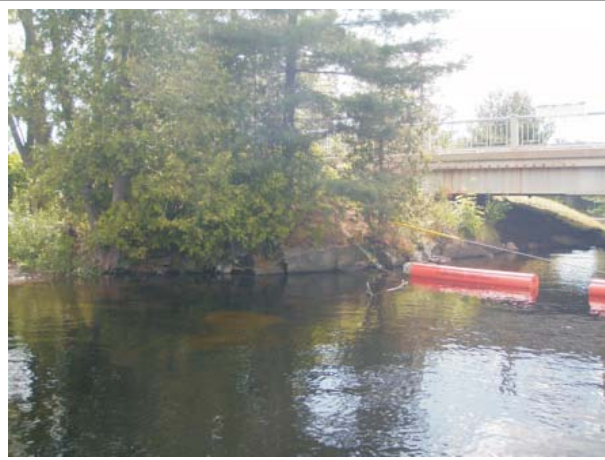
LEISURE USE DOWNSTREAM



LEISURE USE DOWNSTREAM



MESHED GUARDRAIL AND DANGER SIGN, NORTH END



SAFETY BOOM, SOUTH BANK ANCHOR



SAFETY BOOM



RAIL BRIDGE AT UPSTREAM END OF NORTH CHANNEL, NORTH ANCHOR OF SAFETY BOOM IN BACKGROUND

PHOTOGRAPHS - PACKAGE B
BALA FALLS NORTH DAM



FROM DAM, UPSTREAM NORTH BANK



FROM DOWNSTREAM, DAM DANGER SIGN



RAILING/BARRIER AROUND DAM DECK



DAM DECK WITH UNSECURED STOPLOG GAIN COVERS



DOWNSTREAM SOUTH



FROM BALA FALLS ROAD



SAFETY BOOM FROM

PHOTOGRAPHS - PACKAGE B
BALA FALLS SOUTH DAM

APPENDIX C
PSA/PSMP Review

APPENDIX D

MNR Risk Assessment Tool – March 2010

MNR RISK ASSESSMENT TOOL

Mar 2010

I) Guiding Principles/ Planning Assumptions

This process is subjective and qualitative. However, decision-making should be as realistic as possible (i.e. avoid being overly conservative).

Any public safety initiatives and/or measures present at the time of the assessment must be identified and included in the risk analysis.

Public Safety initiatives should consider hazards produced as a result of water control structures and their operations. Natural hazards which are located on Crown Land should not be included as hazards, except where the MNR is encouraging or licensing uses (e.g. trails).

When assessing sites where existing measures are in place, consider:

Physical barriers are intended to act as deterrents and are not designed to prevent access from those seeking to unlawfully gain access to an owner's property or controlled areas.

Physical barriers are not intended to address naturally occurring hazards: both water based (e.g. rapids, submerged boulders, etc.) and landforms (e.g. cliffs); that occur on lakes and rivers and at dam sites and waterpower facilities.

Recreational use of waterways (e.g. boating, swimming, etc.) is assumed to occur during periods of the year when the reservoir/river is ice free (i.e. does not occur when there is floating ice in the waterway).

Partially open water and cracked ice is part of the normal river/reservoir conditions from late fall through spring seasons and no special protective measures are required to address these hazards.

Illumination of signs and barriers is intended to come from the motorized vehicles and watercraft which may be operated outside of daylight hours or other periods of low visibility

Evaluation of public interaction must include interviews with the water control structure operators.

The upstream dangerous water zone is to be established using MNR and Transport Canada (TC) criteria and guidelines.

Risk Assessment must consider the difference between intentional and unintentional/accidental interactions with hazard areas.

Risk Assessment must be completed using a standard, formalized risk assessment process. Risk must be classified as Low, Medium, and High Risk.

LOW Risk - A LOW Risk would not require further reduction but reasonable and obvious measures should be implemented as appropriate.

MEDIUM Risk - A MEDIUM RISK determination means that the Ministry should evaluate all reasonable means to reduce risks as a 2nd priority.

HIGH Risk - A HIGH RISK determination requires the Ministry to take all reasonable measures to mitigate this risk as a 1st priority.

It must be recognized that residual risk may still occur for a particular interaction in spite of all best efforts to eliminate or mitigate an identified risk.

II) RISK ANALYSIS

Incident Likelihood (Probability)

Expected level of public interaction for the activity and associated hazards present (either known or estimated)

| Level | Descriptor | Example Description |
|-------|-------------------------|---|
| 5 | Almost Certain to Occur | is expected to occur in most circumstances |
| 4 | Likely | will probably occur in most circumstances |
| 3 | Possible | will occur at some time |
| 2 | Unlikely | might occur at some time |
| 1 | Rare | may occur only in exceptional circumstances |

Incident Severity (Consequence)

Most likely outcome of the potential interaction that could reasonably be experienced as a result of dam operations or interaction with MNR facilities by a member of the public engaging in that activity

| Level | Descriptor | Example Description |
|-------|---------------|--|
| 1 | Insignificant | no 1st aid required |
| 2 | Minor | 1st aid may be required (by non-EMS personnel) |
| 3 | Moderate | could result in medical treatment or rescue |
| 4 | Major | critical injury is possible (EMS services are required) |
| 5 | Catastrophic | fatality or permanent total disability is likely to result (drowning, severe trauma) |

III) Risk Assessment

Classify the risk rating for the particular activity, according to Low, Medium or High Risk

| RISK RATING | | | Incident Consequences | | | | |
|---------------------|-------------------------|---|-----------------------|-------|----------|-------|--------------|
| | | | Insignificant | Minor | Moderate | Major | Catastrophic |
| | | | 1 | 2 | 3 | 4 | 5 |
| Incident Likelihood | Almost Certain to Occur | 5 | M | M | H | H | H |
| | Likely | 4 | L | M | H | H | H |
| | Possible | 3 | L | M | M | H | H |
| | Unlikely | 2 | L | L | M | M | H |
| | Rare | 1 | L | L | L | L | M |

Legend:

| | |
|--|-------------|
| | Low Risk |
| | Medium Risk |
| | High Risk |

To score a risk, use the matrix like a look-up table. Example: for Likelihood = 1 and Consequence = 5 --> Risk = Medium (bottom right corner)

NOTE: OPG format with WESA/MOE wording

The Risk analysis process is conducted for all known activities and for each component of the facility/property. A summary table lists all risks for the site which can then be assessed for appropriate mitigation measures

The implementation of control measures is expected to reduce site specific risks. The measure chosen should target the specific hazard/public interaction using a phased approach

Reference Documents:

Draft Criteria Tables , WESA Inc., February 26, 2010 (adapted from MOE Drinking Water Systems Risk Assessment tools)

Final Draft, Public Safety Measures Plan, Bala Falls Dams , WESA Inc., November 2009

Risk Assessment for Waterways Public Safety , Document No: DS-LP-PRO-007, Ontario Power Generation, Hydro, June 17, 2009

APPENDIX E

Transport Canada Point of No Return (PoNR) Calculations

Transport Canada Point of No Return Calculations

| | | Values |
|-------|--|--------|
| PoNR | Point of no return | |
| Q2 | Two Year flow return level (Q= flow) | = 117 |
| hw | Water surface elevation above the weir or spillway | = 1.67 |
| dez | Exclusion Zone | |
| DV1 | Warning Zone - 3 times the exclusion zone | |
| DV2 | Warning Zone - 2 times the exclusion zone | |
| ddraw | 3 x hw at Q2 | = 5.01 |
| fs | # of YES + # of unknown (method2) | = 10 |
| Ww | Weir width | = 46 |

Method 1 - Point of No Return (dez1)

Used where waterflow spans the entire width of the river, and is not notched

$$\text{PoNR} = \frac{Q2}{hw@Q2} \quad \text{PoNR} = 70.05988 \text{ m}$$

$$\text{dez1} = 1/2\text{PoNR} \quad \text{dez1} = 35.02994 \text{ m}$$

Method 2 - Drawdown distance (dez2)

Answer

| | | |
|----|--|---|
| 1 | Is the structure obscured or difficult to see from upstream (low head dam, bend in river, vegetation??) | 1 |
| 2 | Does the river constrict by more than 1/2 the river width within 5 times the river width upstream? | 1 |
| 3 | Do powered recreational vessels use the waterway? | 1 |
| 4 | Do unpowered vessels use the waterway? | 1 |
| 5 | Do commercial vessels use the waterway? | 1 |
| 6 | Are there entry points to the waterway (boat launch, portage route, parking lots) within 1 river width of the structure? | 1 |
| 7 | Is the flow such that a small vessel or person is likely to be drawn into the hazardous zone? | 1 |
| 8 | Is the prevailing wind in the direction of water flow? | 0 |
| 9 | Will impingement on the dam or passing over the dam likely result in capsizing, injury or death? | 1 |
| 10 | Have any accidents, near accidents, or incidents occurred at the site? | 0 |
| 11 | Do vessels use the area at night? | 1 |
| 12 | Are there any other hazards, obstructions or instream structures in the vicinity? | 1 |
| 13 | Is any part of the dam operation done remotely? | 0 |
| 14 | Is access to emergency rescue restricted (remote location, bank vegetation, steep slopes?) | 0 |

$$\text{dez2} = \text{ddraw} \times \text{fs} \quad \text{dez2} = 50.1 \text{ m}$$

Method 3 - Spillway Width (dez3)

$$\text{dez3} = Ww \quad \text{dez3} = 46 \text{ m}$$

GREATEST DISTANCE = 50 m per Method 2
DISTANCE VARIES FROM 35-50m
BOOM CURRENTLY ABOUT 35m FROM DAM