Emergency Action Plan

Cascade Lake Dam
File No.: SJ02-281

March 8, 1994

Revised November 2019

EMERGENCY ACTION PLAN (EAP)
Cascade Lake Dam - Orcas Island, WA

Prepared in Accordance with Chapters 173-175 WAC
Washington State Dam Safety Regulations



Prepared for:

The Geiser Land Company

Prepared by:

HARZA NORTHWEST, INC.
March 1994

EMERGENCY ACTION PLAN (EAP)

Cascade Lake Dam

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INTRODUCTION

Purpose of Plan

This Emergency Action Plan (EAP) for Cascade Lake Dam defines responsibilities and provides procedures designed to:

- Identify unusual and extreme conditions which may endanger the dam.
- Initiate remedial actions to prevent or minimize the downstream impacts of a dam failure.
- Initiate emergency actions to warn downstream residents of impending or actual failure of the dam.

Project Information

Official Dam Name: Cascade Lake Dam

Location: Cascade Lake
Orcas Island, Washington
Section 31, Township 37 North, Range 01 West, W.M.

Dam Owner and Operator: Rosario Resort

Type of Dam: Concrete Arch Dam bolstered in 1993 with rockfill on downstream side

Dam Height: 21 feet

Crest Length: 179 feet

Crest Width: original concrete = 12 inches, plus 4 to 18 inches of reinforced shotcrete added in 1993

Reservoir Surface Area: 170 acres ***Normal Storage Volume:*** 2550 acre-feet

Downstream Flood Path: Cascade Lake to Cascade Bay

Downstream Hazard Classification: Significant, Class 2

Number of Homes in the Floodplain: 2 condominiums (23 and 24 units, respectively) and 1 single-family residence

Downstream Property Description: (See inundation map on page 5). Rosario condominium buildings 2100 and 2400, two single-family residence, and three roads are located within the floodway downstream of Cascade Lake Dam. Condominium No. 2100 is a 23-unit building. Condominium No. 2400 is a 24-unit building. The condominiums are managed by Rosario Resort as transient room rentals. County Road No. 216, adjacent to the dam, is commonly known as the Palisades Road. The private road intersecting County Road No. 216 close to the dam is Cascade Way. The private road looping around the condominiums is commonly known as Hacienda Road. All other property shown on the inundation map as being within the floodway is vacant land.

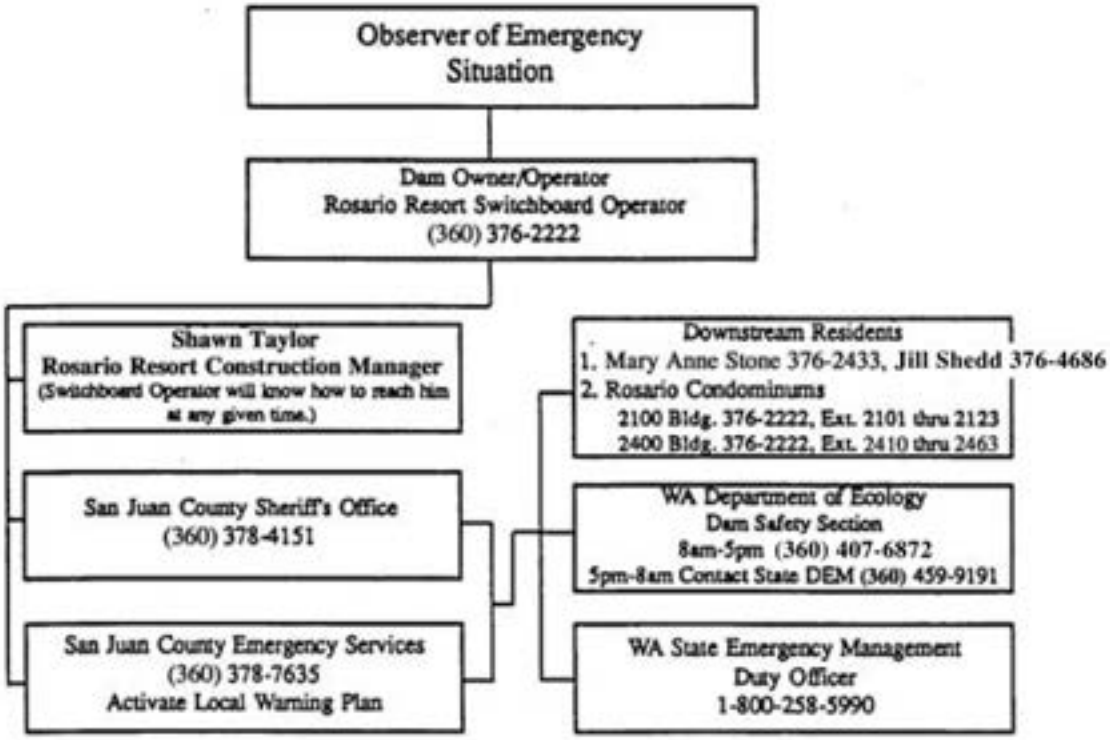
Owner/Operator Responsibilities

	Name	Phone
Day to day operation and maintenance of dam:	Shawn Taylor	w: 360-376-2222 c: 360-610-8461
	(Alternate) Scott Kantrud	w: 360-376-2222 c: 360-317-5950
Contacting County Emergency Services:		
Contacting the State Dam Safety Section:	Rosario Resort	360-376-2222
Contacting State Emergency Management Duty Officer:	Switchboard Operator	
Contacting County Sheriff:		
Implementation of Emergency Action Plan:		
Determining and identifying conditions or events that require emergency action:	**Christopher Peacock**	**w: 360-376-2152 x300** **after hours: x 310** **c: 360-317-6076** **h: 360-376-4787**
Obtaining emergency supplies and equipment:		
Informing press and news media:		
Coordinating activities at dam:		
Taking emergency measures at the dam to prevent failure:	**Scott Kantrud**	**w: 360-376-2222** **c: 360-317-5950**

DAM FAILURE
NOTIFICATION PROCEDURES

Dam failure procedures are necessary for three different types of situations, "Failure in Progress", "Failure Imminent", and "Slowly Developing Failure or Unusual Situation". Descriptions of each procedure are presented on the following page. Cascade Lake Dam is located in a rural area of San Juan County, where a dam failure could potentially affect only one single-family residence and two 23- and 24-unit condominiums. Therefore, a "ring-down" list is not necessary for dam failure notification purposes. Rather, if failure is in progress or imminent, the observer of the emergency situation should telephone the switchboard operator at the Rosario Resort, and the switchboard operator should telephone Mr. Shawn Taylor or the person assigned to carry out Mr. Taylor's responsibilities on days that he is not readily available. The switchboard operator should also notify either the San Juan County Sheriff's office or the San Juan County Emergency Services office. Whichever office is reached first will then make the remainder of the phone calls as depicted on the Notification Flowchart below. There is no phone at the dam site, but maintenance personnel do carry two-way radios while on duty. The base radio is the switchboard operator at the resort who can immediately contact emergency services.

Notification Flowchart



Failure in Progress

If a ***failure is in progress***, downstream evacuation of the floodplain must be started immediately by implementing the Notification Flowchart shown above.

Failure Imminent

If ***failure of the dam is imminent***, but has not yet begun, the following steps should be initiated immediately:

- Implement the Notification Flow Chart;
- Contact State Dam Safety Office and begin any recommended procedures;
- Take preventive actions described on pages 11-12 of this plan.

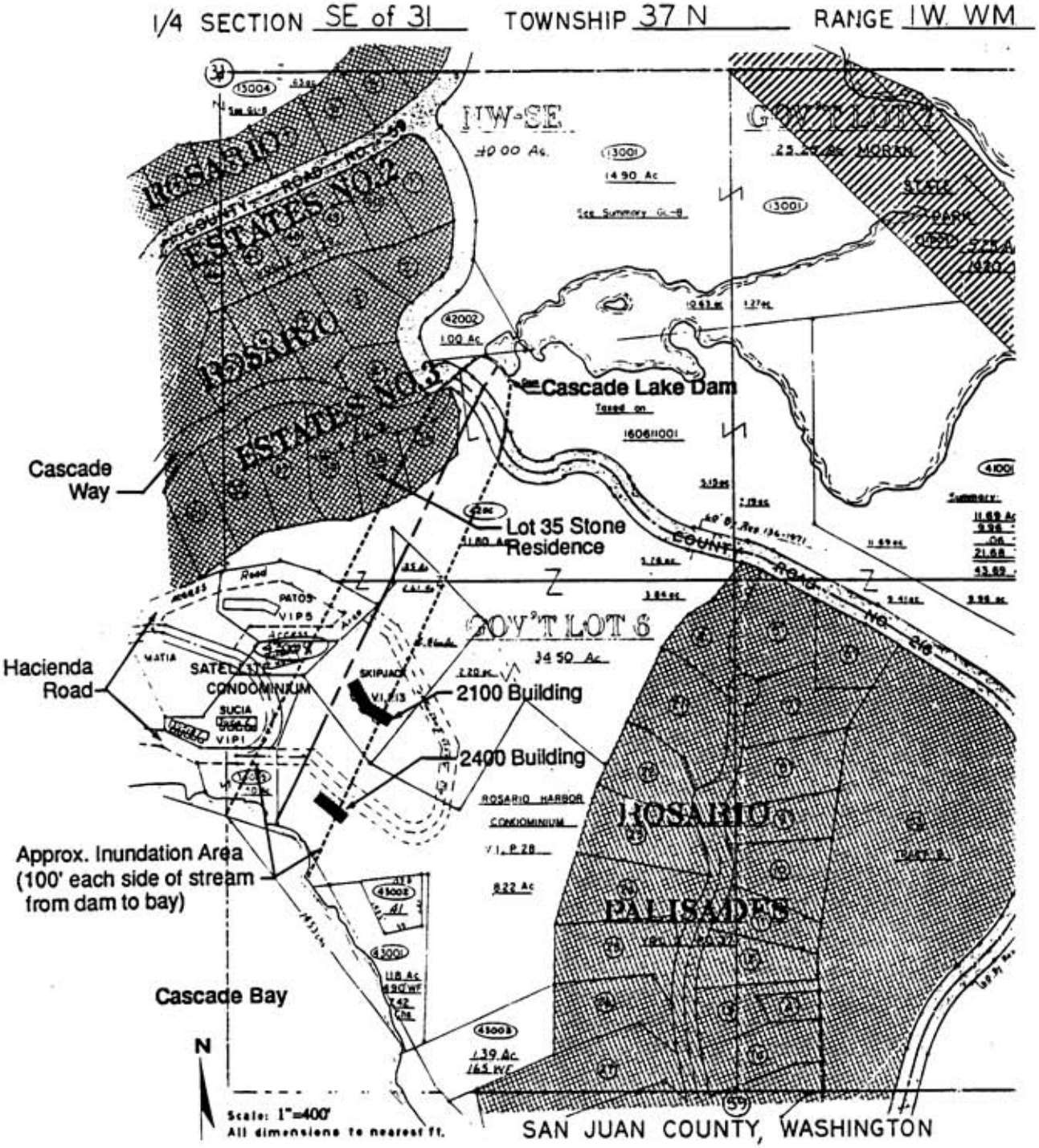
Slowly Developing Failure or Unusual Situation

If there is a ***slowly developing failure*** or ***unusual situation***, where failure is not imminent, but could occur if no action is taken, dam tending personnel should:

- Notify San Juan County Sheriff's Office (360) 378-4151, or if they are busy notify San Juan County Emergency Services (360)378-7635, of the potential problem and keep them advised of the situation.
- Contact the Washington State Department of Ecology, Dam Safety Section (DSS) at (360) 407-6872 to request that an evaluation of the dam be made.
- During these contacts, find out if there are any immediate actions that can be taken to reduce the risk of failure.
- If necessary, implement preventative actions described on pages 11-12 of this plan.

INUNDATION MAP

A major flood caused by a sudden breach of Cascade Lake Dam could potentially result in loss of life and property damage at one single-family residence, two condominium units, and portions of three roads (see inundation map below). Flood waters would reach the single-family residence and the condominium units within minutes of the dam failure.



POSSIBLE EMERGENCY CONDITIONS

Listed below are some, not necessarily all, of the events which can lead directly to the failure of the dam. Included after each one is a brief outline of steps to take in trying to stabilize the situation.

Earthquake

An earthquake of Richter Magnitude 5.0 or greater has been reported in the vicinity, or the responsible individual(s) has felt ground motions and experienced damage from a large earthquake characterized by the following:

"Felt by all. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc. knocked off shelves. Furniture moved or overturned. Weak plaster and masonry cracked. Trees bushes shaken visibly, or heard to rustle."

1) Immediately conduct a general overall visual inspection of the dam.

2) If the dam is failing, immediately implement the instructions in the section **FAILURE IN PROGRESS** (p. 4 of this EAP).

3) If the dam is damaged to the extent that there is increased flow passing downstream, immediately implement **FAILURE IMMINENT** procedures (p. 4 of this EAP).

4) Check the dam crest for settlement. If the dam crest has dropped more than 0.5 feet, lower the reservoir pool level the same amount as the settlement. If the outlet works are damaged, it may be necessary to install siphon pipes or pumps to lower the pool level. The pool should remain drawn down until the dam can be examined by the DSS or other qualified professional engineers.

5) Otherwise, if damage has occurred, but is not judged serious enough to cause failure of the dam, quickly observe the nature, location, and extent of the damage, and evaluate the potential for failure. Then contact the Department of Ecology, Dam safety Section at (360) 407-6628, or if after hours, contact the Department of Community Development (DCD), Emergency Management Division Duty Officer at 1-800-258-5990 for further instructions. A description of slides, sloughs, new or increased seepage, and sudden subsidence, including the location, extent, rate of

subsidence, effects on adjoining structures, springs or seeps, reservoir elevation, prevailing weather conditions, and other pertinent facts would also be helpful.

6) If there appears to be no imminent danger of dam failure, Shawn Taylor of Rosario Resort should thoroughly inspect the following:

   a) both faces of the dam for cracks, settlement, or seepage;
   b) drains and seeps for any turbidity, muddy water or increased flow;
   c) spillway structure for continued safe operation;
   d) reservoir and downstream areas for landslides.

Report all findings to the DSS and all other agencies that had been contacted earlier during the emergency. Also make sure to keep close watch on the dam for the next two to four weeks as some damage may not show up immediately after the quake.

Flooding

Routing of the inflow design flood indicates that the spillway will handle the expected runoff without problems. However, if during a major flood event something should happen to cause the reservoir level to rise within 3 feet of the dam crest, or elevation 353 feet, contact the DSS and County Emergency Services immediately to report the following:

a) current reservoir elevation and freeboard;
b) rate the reservoir is rising;
c) weather conditions - past, present, predicted;
d) discharge conditions of the creek downstream;
e) the rate of seepage from the drains.

****** ANY TIME THE WATER IN THE RESERVOIR EXCEEDS THE MAXIMUM SAFE LEVEL OF OPERATION, OR ELEVATION 356 FEET, DAILY INSPECTIONS OF THE DAM ARE REQUIRED ******

If the reservoir level reaches within 1.5 feet of the dam crest, or elevation 354.5 feet, immediately implement the following procedures:

a) Contact Local Emergency Management Services (San Juan County Sheriff at 360-378-4151, or San Juan County Emergency Services at 360-378-7635) and the Washington Department of Ecology Dam Safety Section 360-407-6628.

b) Gradually increase discharge through the spillway and/or outlet works, if possible.

c) Try to notify downstream residents of the increases in discharge, and increase the discharge in stages to avoid trapping downstream residents. (Shawn Taylor is responsible for operating the outlet to release the floodwaters.)

d) Check downstream toe and abutments and rockfill for any new seepage or abnormal internal drain leakage and report to DSS.

e) Check for increased/decreased seepage due to a change in water level.

f) Check for cracks, movement of dam or rockfill buttress or other distress signals near the dam abutment or crest. Primary consideration should be given to the concrete dam not the rockfill buttress.

Report any unusual conditions to the DSS and await further instructions. Be prepared to implement **FAILURE IMMINENT** procedures (p. 4 of this EAP), if necessary.

Cracking of the Dam or Abutment

Determine the location, size of the affected area(s) (height, width, and depth) severity, estimated seepage discharge, clear or cloudy seepage, and the reservoir and tailwater elevations. If failure appears likely, immediately implement **FAILURE IMMINENT** procedures (p. 4 of this EAP); otherwise, contact the Dam Safety Section for instructions.

New Springs, Seeps, Sandboils, Increased Leakage, or Sinkholes

If there is a rapid increase in old seeps, an increase in the rockfill internal drain flow, or if new springs, seeps, or bogs appear, then one should determine the location, size of the affected area, estimated discharge, nature of the discharge (clear or cloudy), and reservoir and tailwater elevations (a map of the area may be helpful to illustrate where the problem is located). If failure appears likely, implement **FAILURE IMMINENT** procedures (p. 4 of this EAP); otherwise, report all findings to the Dam Safety Section and wait for further instructions.

Landslides

Any landslide having the capability to rapidly displace large volumes of water, could generate large waves that would move into the outlet works, spillway, or reservoir. Landslides or potential landslides into the downstream channel which may impound water or impede downstream flow are also of concern. All landslides should be reported to the Dam Safety Section. However, before contacting the DSS, determine the size, possible cause, degree of effect on the operation, probability of additional movement of the disturbed area and other slide areas, development of new slide areas, and anything else that seems important.

Sudden Water Releases

In case of sudden, planned or unplanned, large water releases from the outlet works or spillway (e.g., opening gates or valves, pulling stoplogs), notify downstream residents and the appropriate agencies of the increased flow.

Abnormal Instrumentation Readings

After taking any instrumentation reading, compare the current readings to previous readings of the same reservoir level. If the reading appears abnormal, John Cavalli is responsible for:

1) Determining:
   a) changes from the normal readings;
   b) reservoir and tailwater elevation;
   c) weather conditions;
   d) other pertinent facts.

2) Contacting the Washington Department of Ecology Dam Safety Section.

Other Problems

In case of other problems occurring that might pose a threat to the dam safety, contact the DSS and explain the situation as best as possible.

End of Emergency Situation and Follow-Up Actions

Once conditions indicate that there is no longer an emergency at the dam site and the proper authorities (e.g., Department of Ecology - Dam Safety Section, or a professional engineer after consultation with the Department of Ecology - Dam Safety Section) have declared the dam safe, the local emergency management authorities should be contacted, who will then terminate the emergency situation.

Reporting of Incidents

Shawn Taylor must report by telephone to the Dam Safety Section on any condition affecting the safety of the project or whenever an incident has occurred. The initial oral report must be made as soon as practicable after the condition is discovered or following an incident.

PREVENTATIVE ACTIONS TO BE TAKEN

The following actions describe some of the steps that could be taken at the dam to prevent or delay failure after an emergency is first discovered. **These actions should only be performed under the direction of the Washington Department of Ecology - Dam Safety Section, or other qualified professional engineers after consultation with WDOE-DSS.**

Overtopping by Flood Waters

a) Open the 20-inch butterfly valve on the lower emergency spillway pipe to its maximum safe capacity. This is the only way to lower the reservoir level more quickly, as the open spillway has no control.

b) Provide erosion-resistant protection to the downstream slope by placing protective materials over eroding areas below the rockfill buttress.

c) Divert flood waters around the reservoir basin if possible.

d) Contact Washington Department of Ecology - Dam Safety Section to request an evaluation prior to resuming normal operation.

Seepage or Leakage through the Dam, Foundation, or Abutments

a) Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir).

b) Lower the water level until the flow decreases or stops.

c) Continue lowering the water level until a safe elevation is reached.

d) Continue frequent monitoring for signs of dam cracking or concentrated seepage.

e) Continue operating at a reduced level until repairs are made.

f) Contact Washington Department of Ecology - Dam Safety Section to request an evaluation prior to resuming normal operation.

Failure of an Appurtenant Structure Such as an Outlet or Spillway

a) Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.

b) Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.

c) Lower the water level to a safe elevation. If the outlet is inoperable, pumping, siphoning, or a controlled breach may be required.

d) Contact Washington Department of Ecology - Dam Safety Section to request an evaluation prior to resuming normal operation.

Mass Movement of the Dam on its Foundation

a) Immediately lower the water level until excessive movement stops.

b) Continue lowering the water level until a safe level is reached.

c) Continue operation at a reduced level until repairs are made.

d) Contact Washington Department of Ecology - Dam Safety Section to request an evaluation prior to resuming normal operation.

Loss of Abutment Support or Extensive Cracking in Concrete Dam

a) Lower the water level in the reservoir by releasing it through the lower emergency spillway pipe. The valve for this emergency spillway pipe is located in the valve box within the rockfill.

b) Implement notification flow chart.

c) Attempt to block water movement through the dam by placing plastic sheets on the upstream face.

d) Lower water to a safe level.

e) Contact Washington Department of Ecology - Dam Safety Section to request an evaluation prior to resuming normal operation.

CONTACTS FOR ACCESSING SUPPLIES AND RESOURCES

In an emergency situation, equipment and supplies might be needed on short notice. Earthmoving equipment, sand and gravel, sandbags, pumps, pipe and laborers would all be obtained from **Island Excavating, Eastsound, Washington (360-376-5700)**. The contact person at Island Excavating is Paul Vierthaler.

UPDATING OF EAP

Updating information in the Emergency Action Plan should be done annually and/or when major changes have occurred. Information to be updated should include:

- Phone numbers;
- Housing developments;
- Supplies and their location;
- Personnel changes;
- EAP locations;
- Changes made to the dam;

as well as other items that might come to one's attention throughout the year.

DATES UPDATED

September 2013		
November 2019		

POSTING NOTIFICATION FLOWCHART AND DISTRIBUTING EAP'S

The EAP Notification flowchart, found on page 3 of this EAP, should be posted at prominent locations at the dam, at the operator's office and residence, and the owner's office or residence. A complete copy of the EAP should be made available to all dam tenders, emergency operations center personnel, and local officials. The locations of all Cascade Lake Dam EAP's are listed below. When changes are made, all EAP's should be updated.

EAP LOCATIONS

Name	Telephone
Rosario Resort	
• Front Desk	(360) 376-2222
• Shawn Taylor	(360) 610-8461
• Scott Kandrud	(360) 317-5950
• Christopher Peacock	(360) 317-6076
• Dam Site	(no phone)
San Juan County Sheriff's Office	(360) 378-4151
San Juan County Emergency Services	(360) 378-7635
Washington Department of Ecology Dam Safety Section	(360) 407-6872
Washington State Emergency Management	1-800-258-5990

ACCEPTANCE OF THE PLAN

The undersigned persons have reviewed the Emergency Action Plan and concur with the proposed notification procedures.

		DATE SIGNED
Dam Owner:	Mark N. Nisit	2/8/94
Dam Operator:	John C. Cargill	2/21/94
San Juan County Sheriff's Office:	W. Cranney	2/7/94
San Juan County Emergency Services:		2/10/94
WDOE Dam Safety Section:	Douglas I Johnson	1/19/94

Updated September 2013:

Dam Owner Representative:		9/19/13
Dam Operator:		9/19/13

2018

Emergency Contact information for your Emergency Action Plan and O&M

1. **9-1-1**
2. Call State Division of Emergency Management
    a. Call the Duty Officer (available 24 hours/day) at **1-800-258-5990**
    b. Clearly state that this is a "**dam safety emergency**"

3. If it is during *regular office hours*, contact the Ecology Dam Safety Office, (360) 407-6872.

For additional inquiries, you may always contact Joe Witczak P.E. Dam Safety Supervisor at jwit461@ecy.wa.gov or by calling (360) 407-6603 office, or (360) 972-4426 cell

or:

Gustavo Ordonez P.E., Geotechnical Engineer at gord461@ecy.wa.gov or (360) 407-6619 office or (360) 742-7925 cell

Department of Ecology
Dam Safety Office
PO Box 47600
Olympia WA 98504

DEPARTMENT OF ECOLOGY
State of Washington

Wildfire Impacts on Dams

Please read, then insert into the Emergency Action Plan (EAP) for your dam.

Emergency Level 1 - Non-emergency, unusual event; needs response to reduce risk or likelihood of a Level 2 incident

- Incident: **Wildfire at the dam or in the upstream watershed.**
  Responses:
  - o Inspect and assess damage to dam, spillways, and appurtenant facilities.
  - o Assess whether access to the dam may be vulnerable to blockage by debris flows.
  - o Assess whether spillways may be vulnerable to blockage by debris flows or by floating debris in the reservoir.
  - o Assess increased hydrologic risk. Watershed assessment by a qualified engineer or engineering hydrologist. See Burned Watershed guidance from the Dam Safety Office at http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs.html
  - o Determine access routes and procedures for safe access to the dam during adverse conditions, and communications procedures to activate the EAP.

- Incident: **Forecast for rain** in the vicinity of the dam or upstream watershed.
  Responses:
  - o Observe for actual rainfall, be prepared to respond.

- Incident: **Flash Flood Watch** (not Warning) issued by National Weather Service for the vicinity of the dam or upstream watershed.
  Responses:
  - o Observe for actual rainfall, be prepared to respond.

- Incident: **Actual rain** in the vicinity of the dam or upstream watershed.
  Responses:
  - o Observe rnnoff and spillway performance, be prepared to respond.

Emergency Level 2 - potential failure situation; needs timely response to reduce risk or likelihood of a dam failure

- Incident: **Forecast for heavy rain** in the vicinity of the dam or upstream watershed. .
  Responses:
  - o Observe for actual rainfall, be prepared to respond.

- Incident: **Flash Flood Warning** issued by National Weather Service for the vicinity of the dam or upstream watershed.
  Responses:
  - o Observe for actual rainfall, be prepared to respond.

- Incident: **Heavy rain or thunderstorm** in the vicinity of the dam or upstream watershed.
  Responses:
  - o Observe runoff and spillway performance, be prepared to respond.

Publication No. 15-11-015 July 2015

Wildfire Impacts on Dams (con't)

Emergency Level 3 - urgent; dam failure is imminent

- Incident: Spillway begins to erode
  Response:
  - Follow Level 3 protocol in your EAP.

- Incident: Dam overtopping
  Response:
  - Follow Level 3 protocol in your EAP.

OPERATION AND MAINTENANCE MANUAL
Cascade Lake Dam - Orcas Island, WA

Prepared in Accordance with Chapters 173-175 WAC
Washington State Dam Safety Regulations

Prepared for:

The Geiser Land Company

Prepared by:

HARZA NORTHWEST, INC.
January 1994

OPERATION AND MAINTENANCE MANUAL

Cascade Lake Dam

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SECTION I
General Information

This Operation and Maintenance Manual (O&M Manual) provides the information and guidance needed to assure thorough and complete operation and maintenance of Cascade Lake Dam. It will also allow people knowledgeable in reservoir operation, but unfamiliar with the conditions at this particular dam, to operate the dam and reservoir when regular operators cannot perform their duties. Ultimately, with correct operation and maintenance, the safety of those living below the dam will be maintained, and the dam will operate with maximum efficiency.

General Description of the Project

Cascade Lake Dam, located in Section 31, Township 37 North, Range 01 West on Orcas Island, Washington, was built at the westernmost tip of Cascade Lake sometime between 1884 and 1915 by shipping tycoon and former mayor of Seattle, Robert Moran. The dam provided power and water to his nearby mansion, which is now the Rosario Resort, owned by Rosario Signal, LLC. The dam is now also owned and operated by the Rosario Resort, and continues to function as a source of supplemental power and water for the resort. In 1993 the 21-foot high, 179-foot long concrete arch dam was reinforced with 4 to 18 inches of shotcrete on the originally 12-inch thick downstream face and bolstered with rockfill on the downstream side of the shotcrete.

Project Data

1. *General*

State I.D. No.	SJ02-281
Owner and Operator	Rosario Resort
Location	Orcas Island, Section 31, Township 37 North, Range 01 West
Year Constructed	1884 to 1915 (Not certain)
Purpose	Water Supply and Hydroelectric
Downstream Hazard Potential	Hazard Class 2, Significant

2. *Reservoir Data*

Watershed	Cascade Creek
Drainage Area	3.42 Square Miles

Surface Area at Spillway Crest (Elevation 351.1, Datum MSL)	170 Acres
Active Storage at Spillway Crest	1700 Acre-Feet
Active Storage at Dam Crest (Elevation 356)	2550 Acre-Feet

3. *Cascade Lake Dam*

Type of Structure	Concrete Arch Dam bolstered in 1993 with rockfill on downstream face
Structural Height	21 Feet
Hydraulic Height	17 Feet
Crest Elevation	356 feet, Datum MSL
Crest Length	179 feet
Dam Thickness	Original concrete 12 inches, plus 4 to 18 inches of reinforced shotcrete added in 1993.

4. *Principal Spillway*

Type	Rectangular slot through dam 6.5 feet long by 1.8 feet high
Location	Center of dam, Invert El.351.1, 4.9 feet from dam crest
Controls	None

5. *Outlet Works*

Type	10-inch outside diameter steel penstock
Location	Valve house at downstream base, Center of dam, Invert El. 338.8 feet
Controls	Gate Valve

6. *Emergency Spillways*

(1) Type	Uncontrolled 21-inch outside diameter steel pipe
Location	Adjacent to principal spillway, Invert El. 351.8 feet
(2) Type	Butterfly valve controlled 20-inch diamter cast iron pipe
Location	Partially within rockfill, Invert El. 345.3 feet

Operating Personnel Responsibilities

Operation and maintenance tasks at Cascade Lake Dam include the following:

- Overall Responsibility for Project
- Equipment Operation at Dam
- Setting Reservoir Levels
- Performing Weekly Inspection
- Performing Annual Inspection
- Routine Maintenance Work

Mr. Shawn Taylor, the Construction Manager for Rosario Resort, has ***primary responsibility*** for each of these tasks. His work phone is 360-376-2222. His home phone is (360) 610-8461, Scott Kantrud the Director of Engineering for Rosario Resort, has secondary responsibility for equipment operation at the dam, and for performing monthly inspections and routine maintenance work.

SECTION II
Project Operation

Operating Instructions for Reservoir (Rule Curve)

The pool level of the lake is not normally controlled. The open spillway, at elevation 351.1 feet, has no control. During high run-off periods, it is normal for the level of the lake to be above the spill by approximately 6 inches. If, in an emergency, the pool level has to be lowered, the 20-inch butterfly valve on the lower emergency spillway pipe (Invert El. 345.3 feet), can be opened. This valve, located in valve box within the rockfill (see Figure 1, next page), is normally closed. The butterfly valve would also be used in the event an upstream inspection was required, or if there was excessive spillway flow (more than spill plus 7 or 8 inches), or as an excercise in management of downstream flooding.

The water supply used for power generation, irrigation and fire suppression is controlled by the 10-inch gate valve located in the concrete barrel vault at the base of the dam (Figure 1, next page). This valve is normally in the full open position, but can be shut down when work has to be performed on the generator line. This gate valve opens counter-clockwise and closes clockwise.

Operating Instructions for Control Mechanisms

20-Inch Butterfly Valve Operating Instructions: TO OPEN: using a 2-inch square-head wrench*, turn the control counter-clockwise until fully opened. Water will start to pour out of the open pipe which is located about 8 feet downstream. TO CLOSE: turn control clockwise until fully closed. (*Note: all personnel qualified to use dam controls carry a 2-inch square head wrench. No wrench is left on site due to possible vandalism).

10-Inch Gate Valve Operating Instructions: TO OPEN: turn the control wheel counter-clockwise only until air starts to be released from the air-vac valve, located 10 feet downstream from the control valve. Released air indicates that the line is filling. Allow 20 minutes for the line to fill, and then open the control valve one more full turn. Allow another 20 minutes and repeat procedure until the line is full, at which time the air-vac valve will stop releasing air. TO CLOSE: Turn valve clockwise until closed.

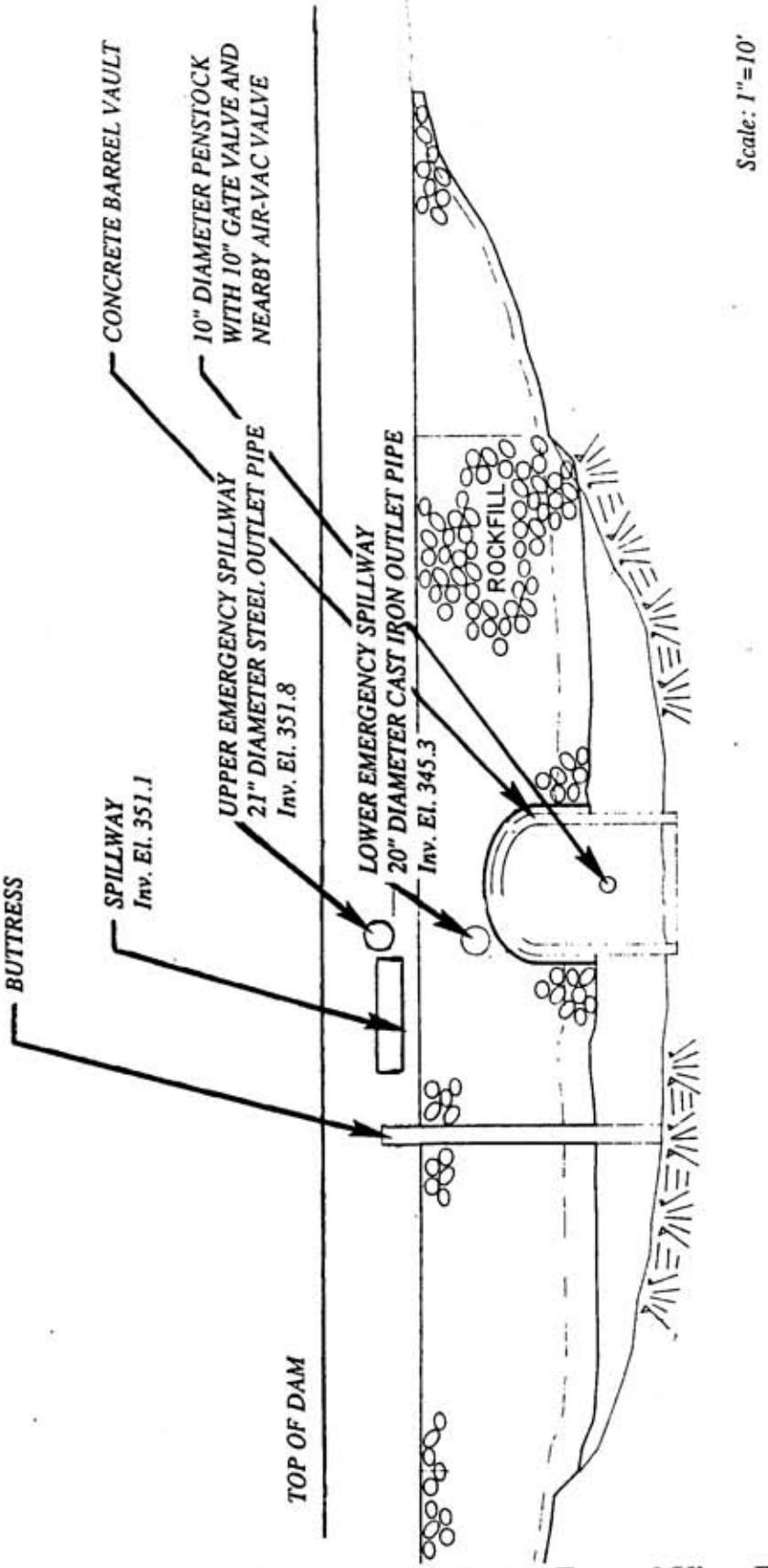


FIGURE 1
Cascade Lake Dam - Frontal View Facing Upstream

SECTION III
Maintenance

Scheduled and Monitored Maintenance

A maintenance plan addressing both scheduled and monitored maintenance tasks at Cascade Lake Dam is presented on the following pages. The maintenance plan lists all regularly scheduled maintenance tasks (servicing equipment, replacing parts, performing routine tasks, etc.) and monitored maintenance tasks (periodic surveillance and testing of equipment , repairs, modifications, etc.), as well as detailed instructions for performing each task.

Unscheduled Maintenance

In addition to the scheduled and monitored maintenance tasks, maintenance to correct unexpected deficiencies must be performed on an as-needed basis. The need for unscheduled maintenance may be identified during the performance of preventative maintenance, as a result of dam safety or O&M inspections, or after an unusual event such as a flood. Examples of unscheduled maintenance would include:

- Repairing and reseeding eroded areas and gullies on embankment dams.
- Repairing defective gates, valves and other equipment discovered during inspections.
- Repairing damage to an earth lined emergency spillway following a flood.

Although unscheduled maintenance cannot be planned for in a maintenance plan, the need for repair or rehabilitation of unexpected deficiencies should be anticipated by the owner and maintenance personnel at Cascade Lake Dam. As the need for this type of repair or rehabilitation becomes apparent, the dam owner in consultation with an engineer, should devise a project specific plan for conducting the work. Major repairs or improvements would necessitate review and approval by Washington Department of Ecology, Dam Safety Section, and could also necessitate obtaining certain federal, state or local permits.

MAINTENANCE PLAN FOR CASCADE LAKE DAM

Element	Frequency	Description
ROCKFILL BUTTRESS	Monthly	Inspect rockfill for integrity and repair any problem areas as soon as practical.
	Annually	Remove small trees and brush from the base and on the top and the slope of the rockfill. **DO NOT REMOVE TREES LARGER THAN SIX INCHES IN DIAMETER WITHOUT ADVICE FROM A PROFESSIONAL ENGINEER!**
SPILLWAY		
Opening	Weekly	Remove any obstructions or debris from the spillway opening.
Wooden Chute	Weekly	Remove all debris and maintain the chute's alignment and supports as needed.
Culvert under Road	Weekly	Inspect culvert and notify San Juan County Department of Public works if any clearing is necessary.
OUTLET WORKS		
Gates and Valves	Annually	Lubricate and test gates and valves for proper operation and leakage.
	As specified	Gates and valves are to be maintained according to the manufacturers' instructions. Follow the guidelines specified by the manufacturer.
Intake Structure	5 Years	Lower reservoir level or hire divers to inspect intake for low level outlet works. Clear debris from trashrack. Apply protective coating to metalwork. Repair concrete as needed.
Conduit	Annually	Visually inspect conduit from downstream end for corrosion, leakage, or other significant problems.
	5 Years	Inspect entire conduit interior either manually or via remote control camera. Repair or reline as needed.

SECTION IV
Inspection

Both routine and annual inspections should be performed at Cascade Lake Dam, as described below. If any adverse conditions (such as the presence of cloudy or muddy seepage, or an unusual increase in seepage over time) are detected during an inspection, the Washington Department of Ecology Dam Safety Section (360-407-6628) should be notified.

Routine Inspections

Routine inspections should be performed once per month at Cascade Lake Dam. The routine inspection should include a brief visual inspection of the major project features to observe if any obvious changes which may threaten dam safety (e.g. seeps, bogs, settlement, sinkholes, debris, etc.) have occurred. All pertinent information should be recorded on a copy of the form provided in Appendix A of this O&M Manual, and completed forms should be kept at Rosario Resort's office of the Director of Engineering and at the General Manager's office. Each of the items listed below should be included in the monthly inspection plan for Cascade Lake Dam.

1. Record Reservoir Level
2. Record Outlet Flow
3. Make Required Changes in Gates and Valves
4. Visually Examine Condition of:
   a. Dam Crest
   b. Upstream and Downstream Faces
   c. Spillway Opening, Wooden Chute and Culvert under the Road
   d. Outlet Works
5. Check Spillway Opening, Wooden Chute and Culvert under the Road for Debris
6. Check Foundation Seepage Area
7. Check Trashrack for Debris

Annual Inspections

An annual inspection is a more detailed inspection, during which all features and equipment at the facility are evaluated. The inspection may be performed by the owner, or an agent of the owner. All information from the annual inspection should be recorded on a copy of the inspection form included in Appendix B of this O&M Manual, and completed forms should be kept at Rosario Resort's office of the Director of Engineering and at the General Manager's office. The annual inspection plan for Cascade Lake Dam includes the following:

1. Perform detailed inspection of all project elements and for all parameters described on the monthly inspection form provided in Appendix A, herewith.
2. Review inspection information from the past year for development of any adverse conditions such as vertical or horizontal movement of dam or rockfill, or increased seepage.
3. Test operate all backup operating equipment.
4. Check corrosion protection on all exposed metalwork.
5. Review and update Emergency Action Plan (EAP).

SECTION V
Instrumentation & Monitoring

Instrumentation and monitoring equipment at Cascade Lake Dam is limited to a staff gauge on the upstream face of the dam for measuring reservoir levels. The dam was reinforced with shotcrete and rockfill in 1993 to eliminate a seepage problem. As described in Section IV of this O&M Manual, evidence of any seepage is to be documented during the monthly visual inspection of the dam crest, the upstream and downstream dam faces, the rockfill, the spillway, and the outlet works. On an annual basis, the monthly inspection forms are to be reviewed for development of any adverse conditions such as vertical or horizontal movement of dam or rockfill, or increased seepage. Should seepage appear to be continually increasing, a method for measuring the quantity could be devised that is appropriate for the location at which the seepage has been noted.

SECTION VI
Updating

Updating information in the Operation and Maintenance Manual should be done annually or when major changes have occurred. Things to consider when updating include:

- Update names and phone numbers of operating personnel;
- Increase/Decrease the frequency of an examination or the maintenance routine based on the performance at the time of the observation;
- Add/Subtract operation and maintenance information as changes are made at the dam;
- Change the operation and/or maintenance procedure(s) based on its/their performance at the time of the observation;
- Alterations to the project data due to changes at the dam.

Updated information should be distributed to copies of O&M Manual located at:

- Rosario Resort Office of the Director of Engineering
- Rosario Resort Office of the General Manager
- Dam Site
- Washington State Department of Ecology, Dam Safety Section

APPENDIX A

Monthly Inspection Form

CASCADE LAKE DAM
Monthly Inspection Form

DAM OWNER: **Rosario Resort**
1400 Rosario Road
Eastsound, WA 98245
360-376-2222

DATE OF INSPECTION: _____

INSPECTION PERFORMED BY: _____

WEATHER CONDITIONS: _____

RESERVOIR LEVEL: _____ **(feet below dam crest)**

OUTLET FLOW: _____ **(cfs or gpm)**

CHANGES MADE TO GATES OR VALVES: _____

_____

CONDITION OF DAM:

Concrete Crest: _____

_____

_____

(Check for: surface cracking, vertical and horizontal alignment)

Upstream and Downstream Concrete Face: _____

_____

_____

(Check for: surface cracking and alignment)

Downstream Rockfill: _____

_____

_____

(Check for: wet areas [note flow], seepage [note location], slides, slumps, scarps, change in slope, animal burrows, erosion, unusual movement, trees, brush, water loving vegetation)

Spillway Opening, Wooden Chute and Culvert under Road: _____

(Check for: obstructions, debris, alignment, and proper passage of flows)

Outlet Works: (visible elements) _____

(Examine: intake structure, trashrack, control mechanism, outlet pipes. Check for: debris, leakage, corrosion)

Maintenance Deficiencies: _____

Additional Comments: _____

APPENDIX B
Annual Inspection Form

CASCADE LAKE DAM
Annual Inspection Form

DAM OWNER: **Rosario Resort**
1400 Rosario Road
Eastsound, WA 98245
360-376-2222

Date of Inspection: _____

Inspection Performed by: _____

Weather Conditions: _____

Monthly Inspection Tasks: All monthly inspection tasks were completed as part of this annual inspection. A completed Monthly Inspection Form (found in Appendix A of the O&M Manual) is attached. _____
(Initials of Inspector)

Review Monthly Inspection Information: _____

_____

_____

(Describe any evidence, from the past year's Monthly Inspection Form, that any adverse dam safety conditions may be developing.)

Check 20" Butterfly Valve and 10" Gate Valve: _____

_____

_____

(Verify that valves are in good operating condition.)

Corrosion: _____

_____

_____

(Describe condition of exposed metalwork.)

Emergency Action Plan: The Emergency Action Plan for Cascade Lake Dam was reviewed. Updating was, was not (circle one) necessary at this time. All copies were last updated on _____.
(Date)