



Emergency Action Plan

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(West Lagoon Dike)

Emergency Action Plan



Project Name: City of Ferndale WWTP West Lagoon Dike

Dam Safety Office File Number: WH01514

Location: Ferndale, Whatcom, Nooksack River

Owner: City of Ferndale

Issue Date: 2/13/1997

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Introduction

Why is an Emergency Action Plan (EAP) so important? If an emergency situation arises, you do not want to be scrambling to figure out what to do. Your completed EAP will be an invaluable resource during an unusual event or emergency. It will help you to act quickly and strategically, thereby reducing the risk of injury or loss of life and minimizing property damage.

For those of you unfamiliar with the language of dams, two diagrams and a glossary are provided in the Appendix. There are also some tips to get you started on your EAP.

Ecology's Dam Safety Office (DSO) is always available to help and assist you. But remember that as the dam owner, you are ultimately responsible for the maintenance and safety of your dam.

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Dam Basics: impacted area and dam description

Potentially impacted downstream area:

(What would be impacted if there was a dam failure?)

Please describe the property(s) downstream of the dam (agricultural, residential, industrial, critical wildlife habitat, etc.): There are inhabited structures associated with agricultural land south of the lagoon.

Additional information on impacted areas, if available:

Located on: within 800 feet West of Nooksack River

Downstream flood path: Nooksack River to Bellingham Bay

Description of the dam

(Refer to graphic of typical dam and Glossary in Appendix, if needed.)

Official dam name: City of Ferndale WWTP – West Lagoon Dike

State I.D. number: WH01-0514

Dam owner and/or operator: City of Ferndale

Owner and/or operator contact numbers: (360) 384-4607, (360) 384-4301

E-mail address: mikeolinger@cityofferndale.org

Section 30SE Township 39N Range 2E (or) Latitude: 48.837 Longitude: 122.599

County: Whatcom

Type of dam (ex: earthfill, concrete, rockfill): Lined WWTP Lagoon, Earth Embankment

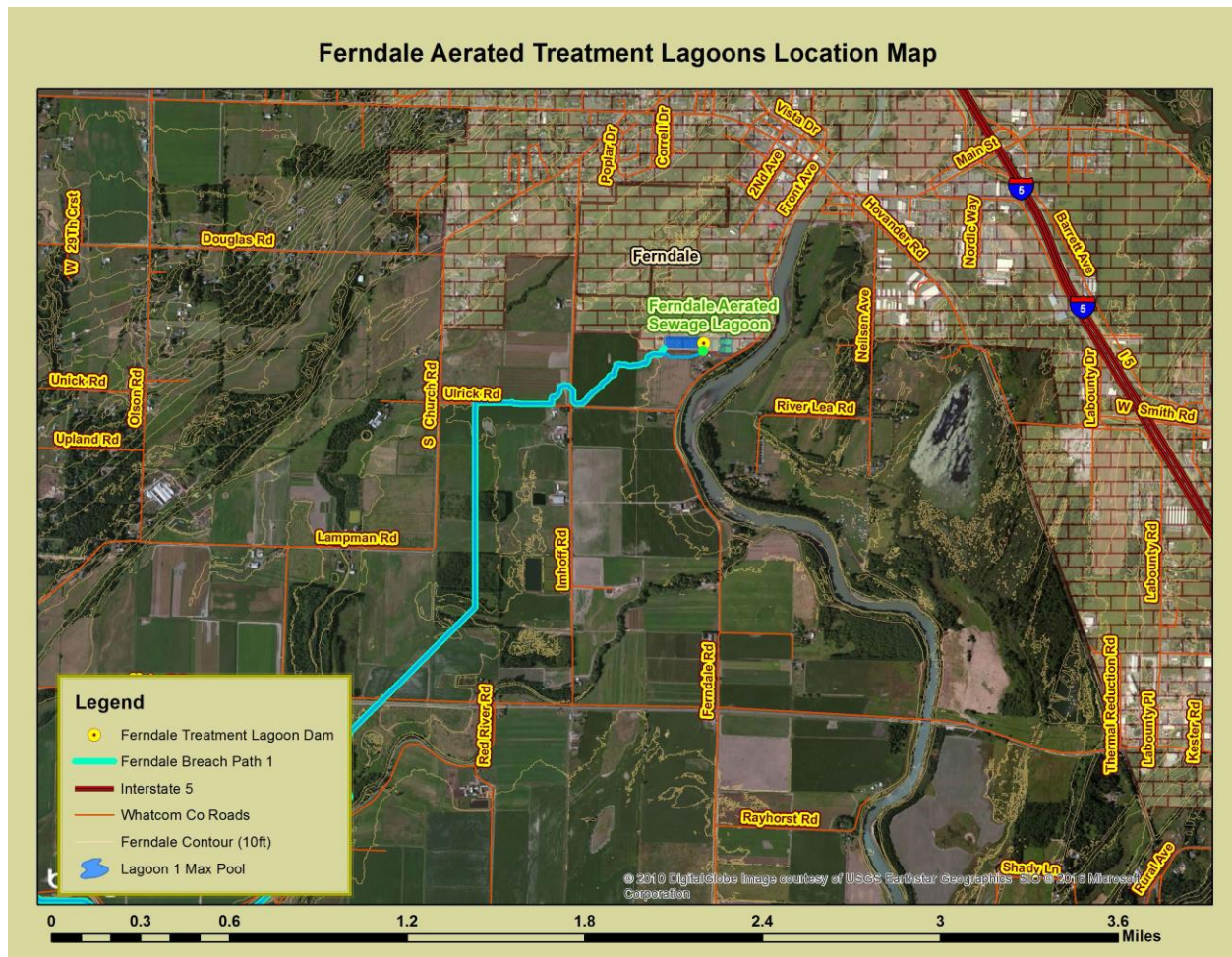
Dam height: 16'6" Crest length: 710', 1920' Perimeter, Crest width: 13'

Maximum storage: 47.6 acre feet. Normal storage: 34.7 acre feet.

Downstream hazard classification: Low, class 2

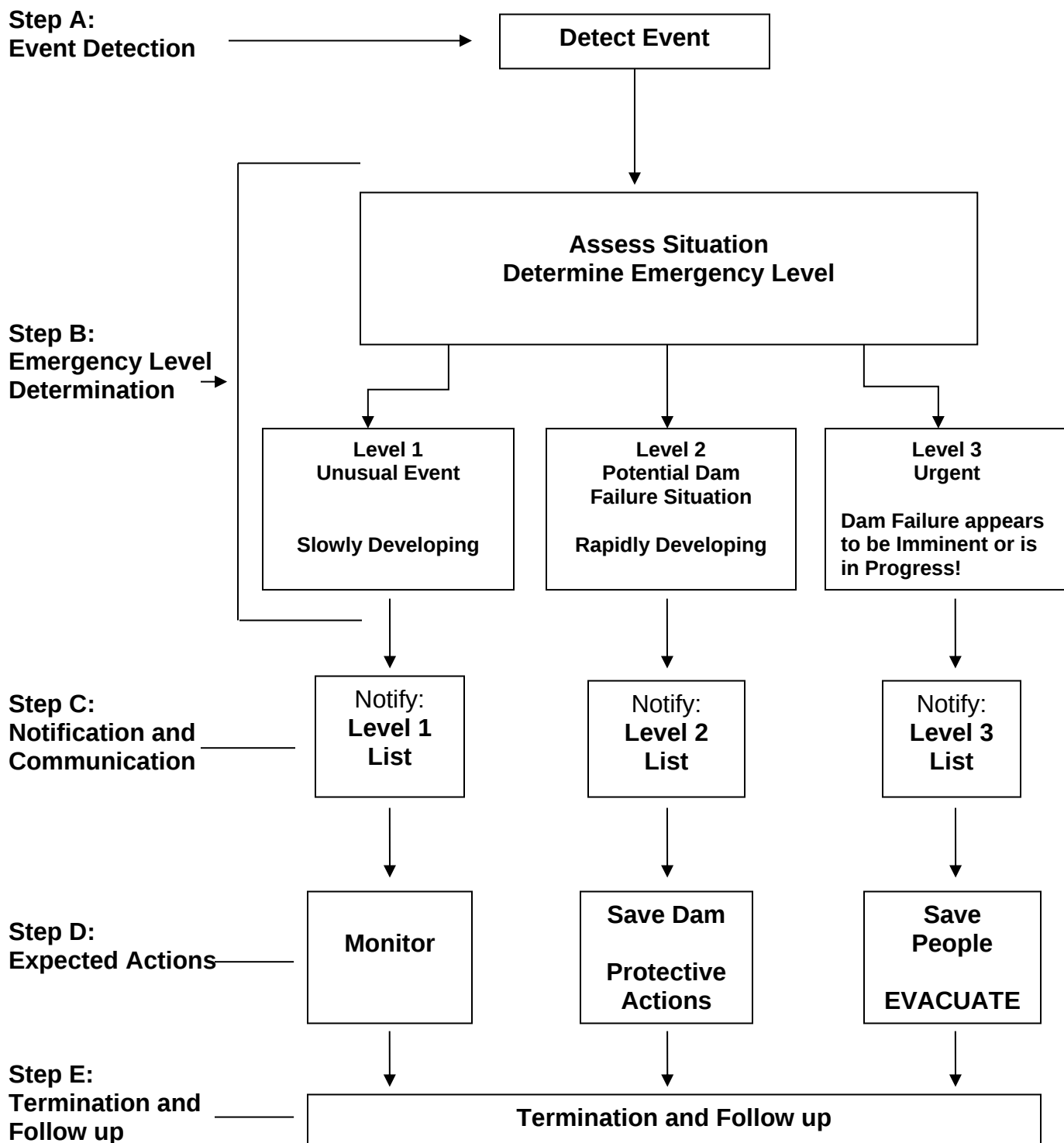
Number of homes in the dam break floodplain (the number of homes that would be in the path of flood water if the dam should fail): 2

Directions to the dam (note any locked gates or other access issues): The dam can be accessed through a gate located at 5405 Ferndale Rd. Public works will provide access.



Emergency Action Plan Overview: Steps A - E

This flowchart presents the basic steps to take in an unusual event or emergency. Details on each step follow.



STEP A: Detect/recognize the event

Unusual or emergency events can be detected by:

- Observations made at or near the dam.
- Earthquakes felt or reported at or near the dam.
- Other conditions that can cause an unusual or emergency event at the dam. For example, forecasts of a severe weather event, a flash flood, upstream dam failures or releases.

STEP B: Determine the Emergency Level (1-3)

You need to evaluate the potential extent of the emergency *before* you notify the appropriate people/agencies. The Emergency Level determines your next steps. Responding to a slowly developing event clearly requires a different response than an imminent dam failure, for example.

The Guidance table on the next page is a quick reference guide to events, situations and levels. For more detailed examples, see Appendix.

Emergency Level 1 - Unusual event, slowly developing

This event is not normal but has not yet threatened the operation or structural integrity of the dam. This event could affect the structural integrity of the dam if left unchecked.

Emergency Level 2 - Potential dam failure, rapidly developing

This event may eventually lead to dam failure and potential flooding downstream, but there is not an immediate threat of dam failure. This emergency level also applies when uncontrolled flow through the dam's spillway has or is likely to result in flooding of downstream areas, but is not yet affecting buildings or roads, or posing a significant risk to health, safety, or welfare.

Emergency Level 3 - Urgent; dam failure appears imminent or is in progress

This is an urgent event, where a dam failure is occurring or is clearly about to occur and cannot be prevented. Flash flooding will occur downstream of the dam. The amount of flooding and resulting damage will be dependent upon several factors, such as the water level in the reservoir and the time of year.

- If the breach occurs during the dry season when the water level in the reservoir level is low, the escaped water will flood a significantly smaller area than when the breach occurs at the time the dam's reservoir is full.
- If a breach occurs when the dam's reservoir is full, the entire area shown on the Inundation Map (last page of this document) will be flooded.

This event level is also applicable when flow through the dam's spillway is flooding buildings or roads. The dam owner **will contact 911** and the **responsible Emergency Services** to evacuate people at risk and close roads in the flood path if necessary.

Guidance for Determining the Emergency Level

(more detailed examples in Appendix; also graphics of typical dam and possible dam failures)

Emergency Level 1: Non-emergency, unusual event, slowly developing.

Emergency Level 2: Potential dam failure situation, rapidly developing.

Emergency Level 3: Urgent; dam failure appears to be imminent or is in progress.

Event	Situation	Emergency Level
Earthquake	Measurable earthquake felt or reported within (50) miles of the dam	1
	Earthquake resulting in visible damage to the dam or appurtenances	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Embankment cracking	New cracks in the embankment greater than 1/2-inch wide and greater than 2-feet deep, without seepage	1
	Cracks in the embankment with seepage emerging	2
Embankment movement	Visual movement/slippage of the embankment slope	1
	Sudden or rapidly proceeding slides of the embankment slopes	2
Flooding	National Weather Service issues a flood warning for the area	1
	The reservoir elevation reaches the predetermined notification trigger elevation of 6 inches below dam crest	2
	The reservoir elevation reaches the predetermined notification trigger elevation of 3 inches below dam crest	3
	Spillway flow is flooding roads and people downstream	3
	Flood flows are overtopping the dam	3
Instruments	Instrumentation readings beyond predetermined values	1
Sabotage/Vandalism	Damage to the dam or appurtenances with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	1
	Damage to the dam or appurtenances that has resulted in seepage flow	2
	Damage to the dam or appurtenances that has resulted in uncontrolled water release	3
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Seepage	New seepage areas in or near the dam	1
	Boils observed downstream of dam	1
	Boils observed downstream of dam with cloudy discharge	2
	New seepage areas with cloudy discharge or increasing flow rate	2
	Cloudy flow and one or more of the following (with constant reservoir level): accelerating rate of flow, expanding flow at exit point, or buildup of soils	3
Sinkholes	Observation of new sinkhole in reservoir area or on embankment	2
	Rapidly enlarging sinkhole	3
Spillways	Principal spillway severely blocked with debris or structurally damaged	1
	Principal spillway leaking with muddy flows	1
	Principal spillway blocked with debris and pool is rapidly rising	2

Step C: Notification and communication

Once you have determined the Emergency Level (in Step B), follow the appropriate notification steps below. How you proceed will depend on the identified Emergency Level. Your prepared list of “Owner/operator contact numbers” and individual responsibilities follows.

Emergency Level 1: Slowly developing failure or unusual situation

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

1. Contact the appropriate persons associated with your dam. Your list is on the next page, “Owner/operator contact numbers”.
2. Notify Whatcom County Emergency Services at: **(360) 676-6650** of the potential problem and keep them advised of the situation.
 - Be sure to ask if there are any immediate actions you can take to reduce the risk of failure.
3. If the event is *during office hours*, call the Ecology Dam Safety Office, (360) 407-6872 for an evaluation of the dam.
 - Be sure to ask if there are any immediate actions you can take to reduce the risk of failure.
4. If necessary, implement the preventative actions described under **Step D** of this plan, under the direction of a professional engineer.
5. **If the situation deteriorates**, be prepared to notify downstream residents (“List of people, structures and roads at greatest risk” follows next page).

Emergency Level 2: Potential dam failure, rapidly developing

If there is a potential dam failure, contact the appropriate authorities immediately *in the order listed below*.

1. Call 9-1-1
2. Contact the appropriate persons associated with your dam. Your list is on the next page, “Owner/operator contact numbers.”
3. Call County/City Emergency Services or Sheriff

Name	Position	Phone
1. <u>Mike Olinger</u>	<u>WWTP Chief Operator</u>	(360)815-1508
2. <u>Kevin Renz</u>	<u>Public Works Director</u>	(360)384-4006
3. <u>Bill Elfo</u>	<u>Whatcom Co. Sheriff</u>	(360)676-6650
4. Call the 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**”
5. If the event is *during office hours*, call the Ecology Dam Safety Office, (360) 407-6872.
6. **If the situation deteriorates**, be prepared to notify downstream residents (“List of people, structures and roads most at risk”, after next page).

Emergency Level 3: Urgent; dam failure appears imminent or is in progress

If a dam failure is imminent or in process, immediately contact the appropriate authorities *in the order listed below*.

1. Call 9-1-1
2. Contact the appropriate persons associated with your dam. Your list is at the bottom of this page, “Owner/operator contact numbers.”
3. Notify persons immediately downstream from the dam of the failure (“List of people, structures and roads most at risk” on next page). Refer also to the Inundation Map, on last page of document.

4. Call County/City Emergency Services or Sheriff

Name	Position	Phone
1. <u>Mike Olinger</u>	<u>WWTP Chief Operator</u>	(360)815-1508
2. <u>Kevin Renz</u>	<u>Public Works Director</u>	(360)384-4006
3. <u>Bill Elfo</u>	<u>Whatcom Co. Sheriff</u>	(360)676-6650

5. 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**”
6. If it is during *regular office hours*, contact the Ecology Dam Safety Office, (360) 407-6872.
7. Begin any recommended procedures; take preventative actions as described in **Step D** of this plan under the direction of a professional engineer.

Owner/operator contact numbers

It is important that no one person becomes overwhelmed during an unusual event or an emergency. The following list indicates who is responsible for each predetermined duty.

Name	Phone	Email	Responsibility
1. Mike Olinger	(360) 815-1508	mikeolinger@cityofferndale.org	On Location Coordinator
2. Kevin Renz	(360) 384-4006	kevinrenz@cityofferndale.org	Coordination of Response
3. Bo Westford	(360) 815-1510	bowestford@cityofferndale.org	Coordination of Equipment / Labor

List of people, structures and roads at greatest risk

In order of proximity to the dam (also refer to Inundation Map at end of document)

Type of structure (residence/business/ road/other) Parcel number	Name and address	Phone number	Approximate depth & time flood may arrive
Residence	5347 Ferndale Rd Ray Anderson Jim Anderson *This is their preferred contact number – cell.	(360) 303-9840 () -	Depth: < 3 feet Time: 1 minute
Residence	5347 Ferndale Rd. Ray Anderson Jim Anderson *Secondary contact.	(360) 384-4568 () -	Depth: < 3 feet Time: 1 minute
Residence	5249 Imhoff Road Hal Hovander	(360) 389-1734 () -	Depth: < 1 foot Time: 7 minutes
Business	Silver Reef Casino Slater Road Gary James – Head of Security	(360) 603-6190 (360) 543-7125	Depth: Time:
		() - () -	Depth: Time:
		() - () -	Depth: Time:

Step D: Expected actions: take preventative actions

The following actions may help to prevent or delay a dam failure after an emergency is first discovered. **These actions should only be performed under the direction of the Dam Safety Office, or other qualified professional engineers.** This list includes some of the more likely issues; it is not intended as a comprehensive list. (See Appendix for graphics of typical dam and possible failures.)

Your list of supplies and resources, which may be needed to carry out the necessary actions, follows the examples.

1. Erosional seepage or leakage (piping) through the embankment, foundation, or abutments

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir).
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a blanket filter (a protective sand and gravel filter) over the exit area to hold materials in place.
- Continue lowering the water level until the reservoir reaches a safe elevation.
- Continue operating at a reduced level until repairs are complete.

2. Excessive seepage and high level saturation of the embankment

- Lower the water to a safe level.
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage.
- Continue operations at a reduced level until repairs are complete.

3. Excessive settlement of the embankment

- Lower the water level by releasing it through the outlet, or by pumping or siphoning.
- If necessary, restore freeboard, preferably by placing sandbags.
- Lower water to a safe level.
- Continue operating at a reduced level until repairs can be made.

4. Failure of an appurtenant structure such as an outlet or spillway

- Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.
- Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.
- Lower the water level to a safe elevation. If the outlet is inoperable, pumping, siphoning, or a controlled breach may be required.

5. Mass movement of the dam on its foundation (spreading or mass sliding failure)

- Immediately lower the water level until excessive movement stops.
- Continue lowering the water level until a safe level is reached.
- Continue operation at a reduced level until repairs are complete.

6. Overtopping by flood waters

- Open outlet to its maximum safe capacity.
- Place sandbags along the dam crest to increase freeboard and force more water through the spillway and outlet.
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas.
- Divert flood waters around the reservoir basin if possible.

7. Reduction in freeboard and/or loss of dam crest width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion.
- Lower the water level to an elevation below the damaged area.
- Restore freeboard with sandbags or earth and rock fill.
- Continue close inspection of the damaged area until the storm is over.

8. Slide on the upstream or downstream slope of the embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning, or a controlled breach may be required.
- Restore lost freeboard by placing sandbags or fill in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel.

9. Spillway back cutting threatening reservoir evacuation

- Reduce the flow over the spillway by fully opening the main outlet.
- Provide temporary protection at the point of erosion by placing sandbags, rip rap materials, or plastic sheets weighted with sandbags.
- When inflow subsides, lower the reservoir to a safe level.
- Continue operating at a lower water level to minimize spillway flow.

Supplies and resources

In an emergency situation, equipment and supplies (such as sandbags, fill materials, equipment and laborers) may be needed on short notice. The table below lists supplies and how to access them.

Item	Contact	Location
	Bo Westford (360) 815-1510	
Earthmoving Equipment	City of Ferndale	City Utilities Shop
Sand and Gravel	City of Ferndale	City Utilities Shop
Sandbags	City of Ferndale	City Utilities Shop
Pumps	City of Ferndale	City Utilities Shop
Pipe	City of Ferndale	City Utilities Shop
Laborers	City of Ferndale	City Utilities Shop
Other	City of Ferndale	City Utilities Shop

Step E: Termination and follow-up

Your responsibilities do not end once the immediate crisis is over; you must still do a formal termination and follow-up.

Termination responsibilities for Level 1 unusual event

If you have activated the EAP, you must take actions to conclude the EAP once the event is over and you have followed all the needed procedures.

- Contact Ecology's Dam Safety office and your dam engineer to further investigate the situation and recommend corrective actions if necessary.
- Document the situation with photographs and/or video, note times and conditions.
- Inspect the full length of the upstream slope, crest, downstream slope, and downstream toe of the dam. Check the reservoir area, abutments, and downstream channel of the dam.

Termination responsibilities for Level 2 or 3 emergencies

Your Local Emergency Manager is responsible for terminating the EAP operations for a Level 2 or Level 3 emergency, and relaying this decision to the dam owner.

- The Washington State Dam Safety Engineer must assure the dam is inspected to determine if any hazardous conditions exist.
- If it is determined that hazardous conditions no longer exist, the Washington State Dam Safety Supervisor will advise the Local Emergency Manager to terminate EAP operations.
- The person who made the original calls must inform each person contacted that the emergency has ended.

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APPENDIX

- I. Why this plan is important -- and some initial preparation guidance
- II. Examples of emergency situations – to help determine Emergency Level (1-3)
- III. Dam diagram and possible dam failures (graphics)
- IV. Glossary and Water Equivalents Table
- V. Final plan approval and signatures
- VI. For more information
- VII. Inundation map

I. Why this plan is important -- and some initial preparation guidance

Why is this plan so important? If an emergency situation arises, you do not want to be scrambling to figure out what to do. Your completed Emergency Action Plan (EAP) will be an invaluable resource during an unusual event or emergency. It will help you to act quickly and strategically, thereby reducing the risk of injury or loss of life and minimizing property damage.

Ecology's Dam Safety Office (DSO) is always available to help and assist you. But remember that as the dam owner, you are ultimately responsible for the maintenance and safety of your dam.

Your EAP defines responsibilities and provides procedures designed to:

- Identify conditions that may endanger the dam.
- Begin remedial actions to prevent or minimize the downstream impacts of a dam failure.
- Notify local emergency personnel and effectively communicate conditions.
- Warn downstream residents of impending or actual failure of the dam.
- Conclude the response to the unusual or emergency event.

What do I need to do?

Your EAP will only be as useful as the quality of the information included. You, as dam owner or representative, need to do your homework **before** an emergency. You are responsible for researching and filling out the following designated sections (the Dam Safety Office can help):

1. Front page and Dam Basics (including Location Map)
2. Notification and communication: One of most essential parts of your plan.

When you are preparing, or revising, your notification lists:

- Determine **who** is responsible for notifying persons in the flood path if an evacuation is necessary. This information will be determined by your local police or sheriff (use the non-emergency phone number) and the State Division of Emergency Management at (800) 562-6108 or by e-mail: www.emd.wa.gov/myn/myn_contact_info.shtml.
- Contact information for local and county emergency response officials can be found at the website maintained by the Department of Ecology and the Local Emergency Planning Committees within Washington State (LEPC): <http://www.ecy.wa.gov/epcra/lepclist.html>
- For assistance in completing your "List of people, structures and roads at greatest risk", contact local emergency personnel.

3. Supplies and resources
4. Approval of Emergency Action Plan
5. Inundation map

Read through the whole plan before it's needed, so you know what is included and understand the general emergency process. For example, it is important to become familiar with the three different emergency levels and situations before an event occurs. After an unusual or emergency event is detected or reported, the dam owner or representative is responsible for classifying the event into one of the three emergency levels.

II. Examples of Emergency Situations

To help you determine the Emergency Level (1-3)

Assessing the Emergency Level is essential for proceeding in a strategic and effective way in a potential emergency. We urge you, the dam owner, to use conservative judgment in determining whether a condition at the dam constitutes an emergency. (Refer to Appendix, graphics of typical dam and possible dam failures.)

Some of the conditions that usually constitute an emergency situation include:

- Dam failure due to aging, or design and construction oversights.
- Significant flow through the emergency spillway or overtopping of the embankment due to extreme weather events (weather conditions that may exceed design expectations).
- Accidental or intentional damage to the dam.

The examples below identify some of the more likely emergency level conditions, presented for guidance only:

1. Embankment movement and cracking
2. Embankment overtopping
3. Emergency spillway flows
4. Seepage and sinkholes
5. Wildfire impacts
6. Other problems

1. Embankment Movement and Cracking

Emergency Level 2 - Potential dam failure; rapidly developing:

- Settlement of the crest, slopes, abutments and/or foundation of the dam that may eventually result in breaching of the dam.
- Significant increase in length, width, or offset of cracks in the crest, slopes, abutments, and/or foundation of the dam, which may eventually result in breaching of the dam.

Emergency Level 3 - Urgent; dam failure is imminent or in progress:

- Sudden or rapid progression of slides, settlement, or cracking of the embankment crests, slopes, abutments, and/or foundation, where breaching of the dam appears imminent or is in progress.

2. Emergency Spillway Flows

Emergency Level 2 - Potential dam failure; rapidly developing:

- Significant erosion or head cutting of the spillway is occurring, but a breach of the spillway crest (that would result in an uncontrolled release from the reservoir) does *not* seem imminent.
- Flow through the emergency spillway *is likely to* cause flooding that threatens harm to any person, home, or road downstream from the dam.

Emergency Level 3 – Urgent; dam failure is imminent or in progress:

- Significant erosion or head cutting of the spillway is occurring at a rapid rate and a breach of the control section appears imminent.
- Flow through the emergency spillway is causing flooding that threatens harm to any person, home, or road downstream from the dam.

3. Embankment Overtopping

Emergency Level 2 - Potential dam failure; rapidly developing:

- The reservoir level has reached the top of the dam and is projected to continue to rise.
- Flow is occurring over the embankment, but it is not eroding the embankment slope, and the reservoir is expected to recede.

Emergency Level 3 - Urgent; dam failure is imminent or in progress:

- Flow is occurring over the embankment and is causing erosion damage to the embankment slope.
- The reservoir level has exceeded the top of the dam and is expected to continue to rise.

4. Seepage and Sinkholes

Emergency Level 2 - Potential dam failure; rapidly developing:

- Cloudy seepage or soil deposits are observed at seepage exit points or from internal drain outlet pipes.
- New or increased areas of wet or muddy soils are present on the downstream slope, abutment, and/or foundation of the dam, and there is an easily detectable and unusual increase in volume of downstream seepage.
- Significant new or enlarging sinkhole(s) on or near the dam.
- Reservoir level is falling without apparent cause.
- The following known dam defects are or soon will be inundated by a rise in the reservoir:
 - 1) Sinkhole(s) located on the upstream slope, crest, abutment, and/or foundation of the dam; or
 - 2) Transverse cracks extending through the dam, abutments, or foundation.

Emergency Level 3 - Urgent; dam failure is imminent or in progress:

- Rapid increase in cloudy seepage or soil deposits at seepage exit points, to the extent that failure appears imminent or is in progress.
- Rapid increase in volume of downstream seepage, to the extent that failure appears imminent or is in progress.
- Water flowing out of holes in the downstream slope, abutment, and/or foundation of the dam, to the extent that failure appears imminent or is in progress.
- Whirlpools or other evidence exists indicating that the reservoir is draining rapidly through the dam or foundation.
- Rapid enlargement of sinkhole(s) is forming on the dam or abutments, to the extent that failure appears imminent or is in progress.
- Rapid increase in flow through crack(s) which is eroding materials, to the extent that failure appears imminent or is in progress.

5. **Wildfire Impacts on Dams**

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:

- Inspect and assess damage to dam, spillways, and appurtenant facilities.
- Assess whether access to the dam may be vulnerable to blockage by debris flows.
- Assess whether spillways may be vulnerable to blockage by debris flows or by floating debris in the reservoir.
- 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>
- 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:

- 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:

- Observe for actual rainfall, be prepared to respond.

- Incident: **Actual rain** in the vicinity of the dam or upstream watershed.

Responses:

- Observe runoff 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:

- 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:

- Observe for actual rainfall, be prepared to respond.

- Incident: **Heavy rain or thunderstorm** in the vicinity of the dam or upstream watershed.

Responses:

- Observe runoff and spillway performance, be prepared to respond.

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.

6. Other Problems

In case of other problems occurring that might pose a threat to the dam safety, contact the Dam Safety Office and explain the situation as well as possible.

III. Dam Diagram and Possible Dam Failures

A quick look at some dam basics: a typical dam labeled with common terms, and graphic with some of the more common types of failures shown.

Dam Diagram

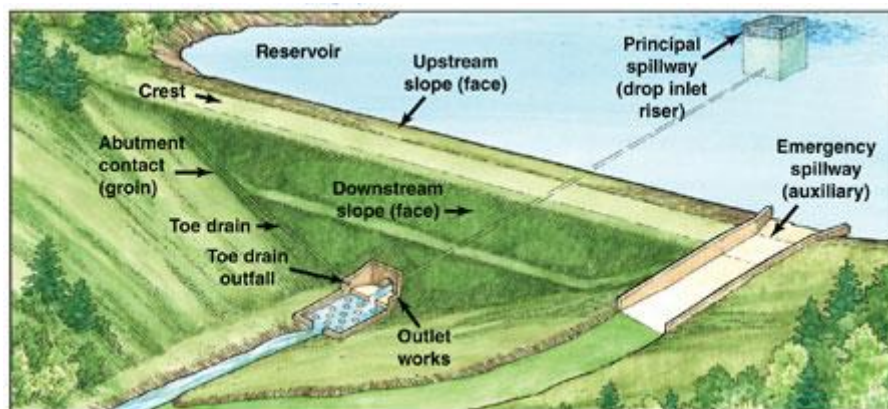


Figure 1—Typical dam diagram showing common terms.

Possible Dam Failures

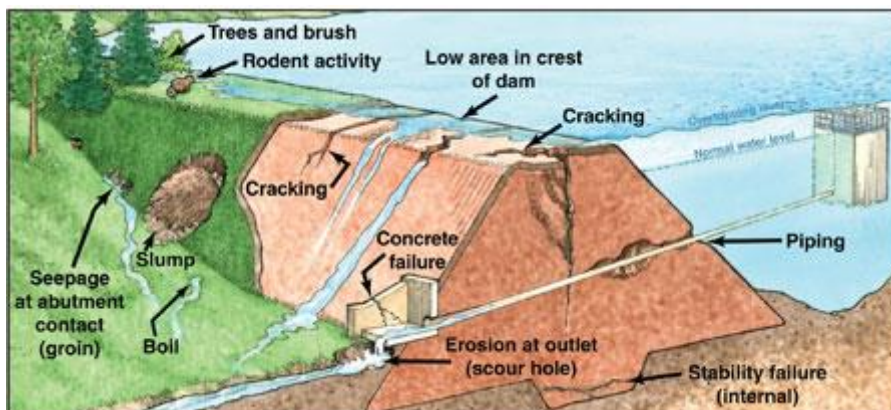


Figure 2—Some causes of dam failures.

Source: USDA Forest Service; <http://www.fs.fed.us/t-d/pubs/htmlpubs/htm12732805/page02.htm>

IV. Glossary

Abutment	That part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking in the <i>downstream</i> direction from the dam.
Acre-foot	The volume of one acre of surface area to a depth of one foot. One acre-foot is equal to 43,560 cubic feet or 325,850 gallons. It is enough water to cover an acre of land, about the size of a football field, one foot deep.
Appurtenances	Structures associated with, but secondary to, a dam. Examples include outlets, spillways, tunnels, etc.
Berm	A nearly horizontal step in the sloping profile of an embankment dam. Also a step in a rock or earth cut.
Boil	A disruption of the soil surface due to water discharging from below the surface. Eroded soil may be deposited in the form of a ring (miniature volcano) around the disruption.
Breach	An opening through a dam that allows the uncontrolled draining of a reservoir. A controlled breach is a constructed opening. An uncontrolled breach is an unintentional opening caused by discharge from the reservoir. A breach is generally associated with the partial or total failure of the dam.
Conduit	A closed channel (round pipe or rectangular box) that conveys water through, around, or under the dam.
Crest of dam:	See “Top of dam”
Dam	A man-made barrier, together with appurtenant structures, constructed above the natural surface of the ground for the purpose of impounding (holding) water. Water may contain any substance in combination with sufficient water to exist in a liquid or slurry state.
Dam failure	The uncontrolled release of a dam’s impounded water.
Dam owner	Any person, private or non-profit company, special district, federal, state, or local government agency, or any other entity in direct routine control of a dam and reservoir, and/or directly involved in the physical operation and maintenance of a dam.

Downstream	Situated or moving in the direction in which a stream or river flows.
Drawdown	The difference between a water level and a lower water level in a reservoir within a particular time.
Emergency	A condition that develops unexpectedly, endangers the structural integrity of the dam and/or downstream human life and property, and requires immediate action.
Emergency Action Plan	A written document prepared by the dam owner, describing a detailed plan of actions for response to emergency or unusual events, including alerting and warning emergency officials in the event of a potential or imminent dam failure or other emergency related to the safety of the dam and public.
Emergency Level	Levels 1-3 (low to high); used to assess the potential extent of the emergency. Once assessed, the Level determines your next steps.
Embankment	A wall or bank of earth built to prevent a river flooding an area.
Engineer	A Professional Engineer registered and licensed in the State of Washington. The engineer must be sufficiently qualified and experienced in the design, construction, and safety evaluation of the type of dam under consideration.
Filter	One or more layers of granular material graded (either naturally or by selection) which allow seepage through or within the layers while preventing the migration of material from adjacent zones.
Floodplain	An area adjoining a body of water or natural stream that may be covered by floodwater. Also, the downstream area that would be inundated or otherwise affected by the failure of a dam or by large flood flows.
Freeboard	The vertical dimension between the crest (or invert) of the emergency spillway and the crest of the dam.
Hazard Classification	The placement of a dam into one of three categories (High, Significant & Low) based on the hazard potential derived from an evaluation of the probable adverse consequences due to failure or improper operation of the dam.

Impoundment	A body of water confined within an enclosure, such as a reservoir; impound (v.) to confine within an enclosure or within limits.
Instrumentation	An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and appurtenant structures.
Inundation Map	A map depicting the area downstream from a dam that would reasonably be expected to be flooded in the event of a failure of the dam.
Local Emergency Manager	Person(s) responsible for developing, organizing, and exercising a community's emergency operations plan. Typically, City Police or Fire Department, or County Sheriff's Department personnel act as the Local Emergency Manager.
Overtopping	When water rises over the sides of the dam.
Outlet	A conduit (usually regulated by gates or valves) used for controlled or regulated releases of water from the reservoir.
Piping	The progressive development of internal erosion by seepage.
Reservoir	A body of water impounded by a dam and in which water can be stored.
Rip rap	Loose stone used to form a foundation for a breakwater or other structure.
Seepage	The natural movement of water through the embankment, foundation, or abutments of the dam.
Sinkhole	A cavity in the ground caused by erosion and providing a route for surface water to disappear underground.
Slide	The movement of a mass of earth down a slope on the embankment or abutment of the dam.
Spillway	An appurtenant structure that conducts overflows from a reservoir.
Spillway (principal)	The overflow structure designed to limit or control the operating level of a reservoir, and first to be activated in runoff conditions.

Spillway (emergency)	The appurtenant structure designed to pass the Inflow Design Flood in conjunction with the routing capacity of the reservoir and any principal or service spillway(s).
Spillway crest	The lowest level at which water can flow over or through the spillway.
State Dam Safety Engineer	For purposes of this EAP, the Washington State Department of Ecology Dam Safety Office engineer(s) responsible for safety inspections, plan review and determining the safe reservoir storage level of assigned dams.
Toe of dam	The junction of the downstream slope or face of a dam with the ground surface; also referred to as the downstream toe. The junction of the upstream slope with ground surface is called the upstream toe.
Top of dam (dam crest)	The elevation of the uppermost surface of a dam, usually a road or walkway, excluding any parapet wall, railings, etc.
Upstream	Moving or situated in the opposite direction from that in which a stream or river flows; nearer the source.

Water Equivalents Table

Water is measured under two conditions: at rest and in motion. Water at rest is measured by volume. Water in motion uses units of flow – a unit of volume for a specified period of time.

acre-foot: covers one acre of land, to a depth of one foot

cfs: cubic feet per second

gpd: gallons per day

gpm: gallons per minute

Volume units

1 cubic foot.....7.48 gallons..... 62.5 lbs of water

1 acre foot.....43,560 cubic feet..... 325,851 gallons

Flow units

1 cfs..... 7.48 (gps)

1 cfs..... 448.8 gpm 646,272 gpd 1.98 acre-ft./day

1,000 gpm..... 2.23 cfs..... 4.42 acre-ft./day

1 million gpd..... 694 gpm..... 1.55 cfs

V. Final Plan approval and signatures

Once you have completed your plan, it needs to go through several review processes.

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

Dam Owner:

City of Ferndale Public Works Director Kevin Renz

Dam Operator:

City of Ferndale Public Utilities Superintendent: Mike Olinger

Local Emergency Services: Whatcom County Sherriff Bill Elfo

Ecology Dam Safety Office:

VI. For more information

This form is a simplified emergency action plan template provided by the Washington State Department of Ecology (Form #ECY 070-37; originally published January 2003; last revised: June 2016).

Also available is the comprehensive *Emergency Action Plan* template and the accompanying *Guidelines for Developing Dam Emergency Action Plans*.

You can request a copy of these, or any other Ecology publication, by calling 360-407-6872, or by emailing us at ecypub@ecy.wa.gov.

Websites

Association of State Dam Safety Officials (ASDSO): <http://www.damsafety.org/>

Ecology dam safety emergency response:
<http://www.ecy.wa.gov/programs/wr/dams/Emergency.html>

Ecology general dam safety information: <http://www.ecy.wa.gov/programs/wr/dams/dss.html>

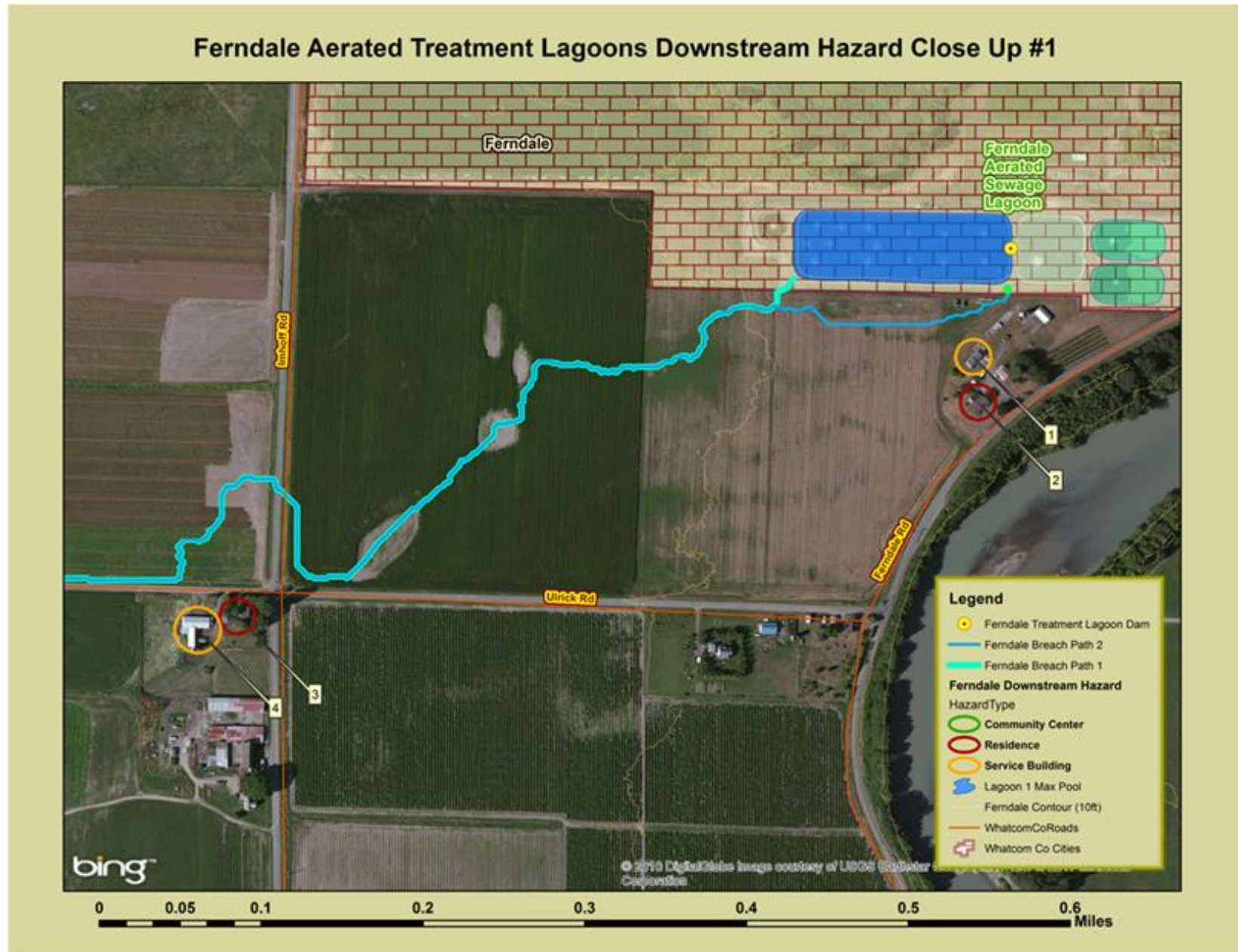
Federal Emergency Management Agency (FEMA) Dam Safety: <http://www.fema.gov/dam-safety>

Special accommodations

To request ADA accommodation for disabilities, call Ecology's Water Resources Program at 360-407-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

VII. Inundation map

Two homes could be affected by a major flood caused by a sudden breach of the dam. These homes are marked on the following inundation map. Flood waters would reach the first home approximately two minutes after the dam failure. Also note businesses and roads that could be affected.



Ferndale Aerated Treatment Lagoons Downstream Hazard

