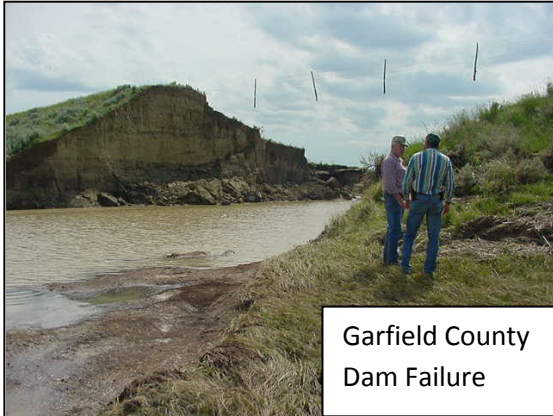


# Small Dam Hazard Assessment Inventory

**What would happen if your dam were to fail?** This is a question that most dam owners hope they will never have to answer. However it is a question you, as a responsible dam owner, should be prepared to answer. For large dams, complex computer models are used to estimate dam breach flood paths. However for smaller dams, it is possible to estimate the dam breach flood area using a few simplifying assumptions and making some basic calculations. (Under Montana laws a dam is considered to be “small” when it stores less than 50 acre feet). The use of this inventory will help the owner of a small dam estimate possible impacts from dam failure.



Garfield County  
Dam Failure

**What happens when a dam fails?** A dam failure can happen in a matter of minutes or it may take several hours. A dam with a history of seepage problems may fail the next time it is filled by snow melt runoff, or a dam in good shape may be overwhelmed by large inflows cause by a storm event. Dam failure time is dependent upon several factors based upon the condition of the dam, the amount of water impounded by the dam, the size of the inflows, and the weather. Generally, the faster a dam fails, the deeper the floodwaters will be below the dam.

During a sudden dam failure the water in the reservoir will rapidly rush into the downstream areas in the form of a wave. This wave of water may be a deep as 75% of the dam’s height, and it will contain a large amount of sediment and debris from the failed dam. These rapidly moving, highly erosive flows will scour the existing water course and sweep away anything in its path. Once the wave begins to slow down and gets smaller, all of the sediment and debris picked up nearer to the dam will be deposited in areas downstream of the dam. The flood waters from the dam failure may travel a short distance or a long distance depending upon the size of the dam and the drainage characteristics.



Lincoln County dam failure

There have been numerous small dam failures in Montana that have caused a great deal of damage. The costs of repairing flood damage or replacing lost materials is often more than the original cost to build the dam. In some cases the damage costs may become exorbitant. Therefore, one of the most important questions that you must ask is, “Does the estimated cost of the downstream damage exceed the cost of timely maintenance and repair costs of your dam?”

**What is located downstream of the dam that could be damaged?** One of the first steps needed to answer this question is to understand what is located in the drainage area below your dam that may be damaged. This Hazard Assessment Inventory will help you gain a better awareness of the areas downstream of their dams, and to identify structures that may be impacted flood water from a failure of your dam. This inventory is not intended to be a hazard classification of the dam nor is it intended to assess any damage that may be caused by a dam failure.

### **Dams or Reservoirs**

Are there any dams or reservoirs located in the drainage below your dam? If so, there may be a possibility that the failure of your dam will damage, or cause a structure of this type to fail. The flood waters from a dam failure are often too large and may overwhelm downstream structures of this type, causing a cascade of other failures.

### **Buildings**

Are there any buildings located within the drainage area that will be flooded if your dam were to fail? Is the structure residential, commercial, or an accessory structure such as a barn? Damage of these structures may range from flooded basements and crawlspaces, to knocking the structure off of the foundation, or destroying the building.

### **Crossings**

Are there any roads, driveways, railroads, bridges, culverts or raised crossings in the drainage below your dam that would be damaged if your dam were to fail? Is the roadway paved or is it gravel? Is the roadway the only access point for a subdivision, a single building, or property? Most crossings are only designed to handle small flows, not larger flows containing debris and sediment from a dam failure. Therefore crossings can be easily overtopped and washed out by the flood waters.



### **Land Use**

What type of land use is located in the drainage below your dam? The flood waters from a dam failure cause considerable erosion and carry a lot of debris that will be deposited in areas below your dam. The debris will contain soil, rock, trees and brush, trash and other materials that may have been swept away from upstream areas. If your dam fails do you think that the property owner will lose the ability to use the land, or lose crops? What is the cost to repair, rehabilitation, or replace the land, crops, or other uses?

Based upon the results of your Hazard Assessment Inventory you may want to pursue more information. If the result of the inventory contains several items of concern, you may want to contact your local DNRC Dam Safety representative. The DNRC may be able to help you gain a better understanding of your hazards, provide you with educational materials, or assist you with deciding what your next step should be.

# Small Dam Hazard Assessment Inventory Worksheet


## Inventory guidelines


In order to complete that inventory the following assumptions and guidelines should be used:

1. The reservoir impounded by the dam is at the top of dam when it fails.
2. The flood water depths below the dam are 75% of the dam height. Experience with other dam failures has shown this rule of thumb to be quite accurate. The flood water depths will lessen as the flood wave travels downstream. The dissipation occurs sooner when the area below the dam is flat and gentle, as opposed to steep and narrow. Note that vegetation and debris in floodways will increase water depth. For the purposes of this inventory, we assume depths are 75% of dam height.
3. Flood damage becomes minimal 5 miles downstream (for small dams)
4. Dams and reservoirs located downstream are full to their spillway crest. It is reasonable to assume that downstream reservoirs and dams are at their maximum normal operating level, especially during a runoff event.

## YOUR DAM

<b>A</b>	<b>Height of dam</b> (feet)	
<b>B</b>	<b>Height of dam x 75%</b> (feet)	
<b>C</b>	<b>Capacity of Reservoir</b> (acre ft) <i>(height of dam X surface area with reservoir at top of dam in acres X 0.4)</i>	

 THIS IS YOUR  
MAXIMUM FLOOD  
HEIGHT

 THIS IS YOUR  
MAXIMUM FLOOD  
VOLUME

Comments

## **DOWNSTREAM RESERVOIRS**

<b>D</b>	<b>Distance below dam (miles)</b>	
<b>E</b>	<b>Height of downstream dam (feet)</b>	
<b>F</b>	<b>Height of downstream dam's spillway (feet)</b>	
<b>G</b>	<b>Capacity of reservoir to top of dam (ac ft)</b> <i>( height of dam X surface area with reservoir at top of dam in acres X 0.4)</i>	
<b>H</b>	<b>Capacity of downstream reservoir to spillway (ac ft)</b> <i>(height of dam to spillway crest X surface area with reservoir at spillway crest in acres X 0.4)</i>	
<b>I</b>	<b>Available capacity to store dam breach (ac ft)</b> <i>(capacity of reservoir to top of dam minus capacity of reservoir to spillway crest - Row G minus Row H)</i>	

Is the available capacity to store dam breach in the downstream reservoir less than the capacity of your reservoir (Row I < Row C)? Is this reservoir located less than 5 miles downstream? If so, then this downstream reservoir is at risk.

Comments

## **BUILDINGS**

<b>J</b>	<b>Distance below dam (miles)</b>	
<b>K</b>	<b>Is the building located in the bottom of the drainage, or the stream or ditch that flows out of your dam?</b>	
<b>L</b>	<b>What is the vertical difference between the bottom of the drainage, stream, or ditch and the first floor of the building?</b>	
<b>M</b>	<b>Does this building have a livable basement?</b>	

Is the distance from the first floor of the building to the bottom of the stream channel less than the maximum flood height (Row L < Row B)? Is this building located less than 5 miles downstream? If so, this building is at risk.

Comments

## **CROSSINGS**

<b>N</b>	Distance below dam (miles)	
<b>O</b>	Does the crossing have any bridges or culverts?	
<b>P</b>	Is this crossing the only access to the building, subdivision, or is it a county road?	
<b>Q</b>	What type crossing is it? (Paved Road, Gravel Road, Railroad)	
<b>R</b>	What is the height from channel bottom to top of crossing? (feet)	
<b>T</b>	Is there much vegetation in the channel?	

Is the distance from the channel bottom to top of crossing less than the maximum flood height (Row R < Row B)? Is this crossing located less than 5 miles downstream? If so, then this crossing is at risk. More so if there is much vegetation in the drainage; bridges and culverts easily clog with debris during a dam breach.

### Comments

## **Land Use**

What type of land uses are below your dam? Describe possible impacts of flooding.

## **Other**

For more information visit the DNRC Dam Safety Program website:

[http://dnrc.mt.gov/wrd/water\\_op/dam\\_safety](http://dnrc.mt.gov/wrd/water_op/dam_safety)

DNRC Dam Safety Program 406-444-6613