



Analyzing the Dam Failure Hazard in the Hazard Mitigation Assistance (HMA) Program Benefit Cost Analysis (BCA)

Where can I find a copy of FEMA's Eligibility of Flood Risk Reduction Measures under the Hazard Mitigation Assistance (HMA) Programs Policy FP-204-078-112-1 and how does it impact the HMA programs?

A copy of FEMA's Eligibility of Flood Risk Reduction Measures under the HMA Programs dated June 27, 2014, is available in the [FEMA Media Library](#).

This policy clarifies that any long-term flood hazard mitigation measures, including major flood risk reduction projects, including construction, demolition, and repair of dams, which are cost-effective, feasible, and designed to substantially reduce risk of future damage and loss of life from flooding, are eligible for consideration under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM).

Mitigation activities funded by the HMA programs are required by FEMA regulations to be cost effective. The determination of cost-effectiveness is typically demonstrated by the calculation of a benefit cost ratio, dividing the total annualized project benefits by total annualized project cost.

Projects where benefits exceed costs are generally considered cost-effective. Benefits may include avoided damages, loss of function and displacement. Written materials and training to help applicants are available on the [FEMA Benefit-Cost Analysis page](#).

What is the risk of a dam failing?

For dam failure, risk is the product of the annual probability of dam failure from a particular failure mode and the magnitude of the resulting consequences. A potential failure mode for a dam is defined as a way that dam failure can occur (i.e., the full sequence of events from initiation to failure) for a given loading condition (such as flood, earthquake, etc.). Credible failure modes must be determined for each individual dam. Further information on risk management for dams is available in the FEMA P-1025 [Federal Guidelines for Dam Risk Management](#).

What are the consequences of dam failures?

Dam failure is a hazard that has resulted in consequences such as damages to existing public and private buildings, damage to infrastructure, loss of services from utilities, loss of government services (including fire and police), loss of business income, displacement of individuals and businesses, loss of crops and livestock, emergency services (including road closure and evacuations), and loss of life. Future conditions are not taken into account.

What could be a dam mitigation project under HMA?

The HMA project types that could apply to dam failure include, but are not limited to, the following:

- **Property Acquisition and Structure Demolition**

- The voluntary acquisition of an existing floodprone structure and, typically, the underlying land, and conversion of the land to open space through the demolition of the structure. (For dam failure, this would be the structures in the dam breach inundation zone.)
- The property must be deed-restricted in perpetuity to open space uses to restore and/or conserve the natural floodplain functions. (The area in the dam breach dam zone would need to be deed-restricted as well to ensure that buildings are not constructed in the zone that would increase the hazard.)
- Removing structures in the dam breach inundation zone and restricting future development in these areas could lower the hazard classification of the dam from high to significant or low. It would also reduce the consequences of dam failure for calculating risk.

- **Property Acquisition and Structure Relocation**

- The voluntary physical relocation of an existing structure to an area outside of a hazard-prone area, such as the Special Flood Hazard Area (SFHA) or a regulatory erosion zone and, typically, the acquisition of the underlying land. (For dam failure, this would be the structures in the dam breach inundation zone)
- Relocation must conform to all applicable State and local regulations. The property must be deed-restricted in perpetuity to open space uses to restore and/or conserve the natural floodplain functions. (The area in the dam breach dam zone would need to be deed-restricted as well to ensure that buildings are not constructed in the zone that would increase the hazard.)
- Relocating structures from the dam breach inundation zone and restricting future development in these areas could lower the hazard classification of the dam from high to significant or low. It would also reduce the consequences of dam failure for calculating risk.

- **Localized Flood Risk Reduction Projects**

- Projects to lessen the frequency or severity of flooding, and decrease predicted flood damage, within an isolated and confined drainage or catchment area that is not hydraulically linked or connected to a larger basin.
- These projects include but are not limited to installation or modification of culverts and other stormwater management facilities; construction or modification of retention and detention basins; and construction or modification of floodwalls, dams, and weirs.
- Modifications must be for the purpose of increasing risk reduction capabilities of the existing structures and cannot constitute only repairs. This could include extending the height, reinforcing the toe, or increasing the spillway capacity of the dam.

- **Non-localized Flood Risk Reduction Projects**

- Projects that lessen the frequency or severity of flooding, and decrease predicted flood damage, within an area that is hydraulically linked or connected to a drainage basin that is regional in scale.
- These projects reduce flood hazards in areas larger than that of localized flood reduction projects and may include the construction, demolition, or rehabilitation of dams; construction or modification of dikes, levees, floodwalls, seawalls, groins, jetties, breakwaters, and stabilized sand dunes; and large-scale channelization of a waterway.
- Modifications must be for the purpose of increasing risk reduction capabilities of the existing structures and cannot constitute only repairs. This could include upgrading dams to current safety standards.

For further information on these project types, program requirements, and other information, please see the [FEMA HMA website](#) for the latest HMA guidance.

Can the FEMA BCA module reflect dam failure for an HMA project?

A dam failure could be analyzed using the Damage Frequency Assessment (DFA) Module in the BCA software. The DFA Module allows a user to analyze a mitigation project using Historical Damages or Expected Damages.

- **Historical Damages:** Documentation could include a letter from a local official, a copy of a newspaper account, a copy of a technical study, etc. This could include incurred damages from an event at the dam that did not cause failure.
- **Expected Damages:** Documentation could include engineering reports, technical studies, etc. Damages could include repair or replacement costs for items directly related to a breach or failure of the dam if the mitigation action is not implemented. Damages include structure damages to the dam, public buildings, businesses, residences, or infrastructure; loss of services from utilities or government services (including fire and police); loss of business income; displacement of individuals and businesses; loss of crops and livestock; emergency services (including road closure and evacuations); and loss of life. Documentation must be provided for all damages.

Damages from dam failure must be analyzed before mitigation (existing conditions) and again after mitigation (residual risks). The difference between the after mitigation damages and the before mitigation damages is the mitigation provided by the project.

At a minimum, one damage event with a known recurrence interval is required for the DFA module. Documentation for the known recurrence interval must be provided. If there are no known recurrence intervals, three damage events in different years are required for the DFA module.

For Technical Assistance regarding FEMA's BCA software, please contact the BC Helpline (Phone: 1-855-540-6744; Email: bchelp@fema.dhs.gov) or contact your FEMA Regional BCA Liaison.

What are the Environmental and Historic Preservation (EHP) considerations for a FEMA HMA project?

A condition of HMA grants is the requirement to comply with all applicable environmental and historic preservation laws and regulations. It is the responsibility of the project applicant to obtain necessary permits and approvals prior to the start of construction. All HMA grants must undergo an EHP review for compliance with a variety of federal, tribal, state and local EHP laws, regulations, Executive Orders (EO), etc. This broad EHP review considers a wide variety of natural and cultural resources including floodplains, wetlands, archaeological sites, historic structures, protected coastal areas, endangered and threatened species, critical wildlife habitats, soils, clean air and water and children, minority and low-income populations. Failure to obtain and comply with federal, tribal, state and local laws, regulations, EO, permit & project conditions, etc., could jeopardize FEMA funding.

Additional information regarding EHP Guidance for FEMA Grant Applicants is available on the [FEMA website](#). For EHP Technical Assistance, please contact the EHP Helpline (Phone: 1-866-222-3580; Email: ehhelpline@dhs.gov) or contact your FEMA Regional EHP Office.

What additional References and Resources are available?

FEMA and DHS offer the following references and resources. In addition, each state dam safety program may have additional guidance and requirements.

- For dam breach inundation modeling and mapping, reference FEMA P-946 [Federal Guidelines for Inundation Mapping of Flood Risks Associated with Dam Incidents and Failures](#).
- For a seismic hazard study, reference FEMA P-65 [Federal Guidelines for Dam Safety: Earthquake Analyses and Design of Dams](#).
- For a hydrologic hazard study, reference FEMA P-94 [Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams](#).
- For analytic tools, reference FEMA P-1016 [Selecting Analytic Tools for Concrete Dams Address Key Events Along Potential Failure Mode Paths](#).
- For consequences, DHS offers the following:
 - [Dams Sector: Estimating Economic Consequences for Dam Failure Scenarios](#) and
 - [Dams Sector: Estimating Loss of Life for Dams Sector for Dam Failure Scenarios](#).