

FEMA Benefit-Cost Analysis Overview

Specifics on BRIC Program

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Welcome and Introductions

- MEMA
- AECOM
- Communities



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Agenda

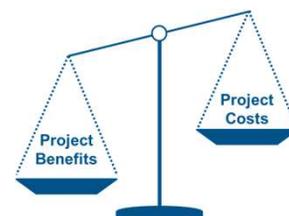
1. Benefit-Cost Analysis (BCA) Overview
2. Approaches: Pre-calculated vs. Project-Specific from BCA Software
3. Components: Costs, Benefits, Economic Calculations
4. Type of Benefits
5. Hazard Types
6. BCA Software Overview
7. BCA Info in FEMA GO
8. Tricks and Tips
9. Questions

Benefit Cost Analysis (BCA) Overview

Benefit-Cost Analysis (BCA) is the process of quantifying the advantages (benefits) of an action and comparing it to its drawbacks (costs).

If an action's benefits are greater than its costs, then it is considered **cost-effective**.

Once we add up the benefits for an action, we divide that value by the costs, which gives us the **Benefit-Cost Ratio (BCR)**. If the BCR is greater than or equal to **1.0**, then the action is cost-effective.



$$\frac{\text{Benefits}}{\text{Costs}} = \text{BCR}$$

Benefit Cost Analysis (BCA) Overview

Why do a BCA? It's the Law!

The Stafford Act (including the Disaster Recovery Reform Act (DRRA) Section 1234, which amends Section 203 of the Stafford Act for BRIC) says:

Projects must be cost-effective (BCR = 1.0 or greater)

In BRIC, only needed for Mitigation Projects

Robert T. Stafford Disaster Relief and Emergency Assistance Act,
Public Law 93-288, as amended,
42 U.S.C. 5121 et seq., and Related Authorities
United States Code, Title 42, The Public Health and Welfare, Chapter 68, Disaster Relief
NOTE: Non-Stafford Act sections appear in U.S. Code sequence for convenience.

Title I - Findings, Declarations and Definitions	
Sec. 101. Congressional Findings and Declarations (42 U.S.C. 5121)	1
Sec. 102. Definitions (42 U.S.C. 5122)	1
Sec. 103. References (42 U.S.C. 5123)	3
Title II - Disaster Preparedness and Mitigation Assistance	
Sec. 201. Federal and State Disaster Preparedness Program (42 U.S.C. 5131)	4
Sec. 202. Disaster Warnings (42 U.S.C. 5132)	5
Sec. 203. Postdisaster Hazard Mitigation (42 U.S.C. 5133)	5
Sec. 204. Emergency Task Force (42 U.S.C. 5134)	10
Title III - Major Disaster and Emergency Assistance Administration	
Sec. 301. Waiver of Administrative Conditions (42 U.S.C. 5141)	11
Sec. 302. Coordinating Officers (42 U.S.C. 5141)	11
Sec. 303. Emergency Support and Response Teams (42 U.S.C. 5144)	12
Sec. 304. Reimbursement of Federal Agencies (42 U.S.C. 5147)	12
Sec. 305. Notability of Federal Government (42 U.S.C. 5148)	13
Sec. 306. Performance of Services (42 U.S.C. 5149)	13
Sec. 307. Use of Local Plans and Individuals (42 U.S.C. 5150)	13
Sec. 308. Nondiscrimination in Disaster Assistance (42 U.S.C. 5151)	14
Sec. 309. Use and Coordination of Relief Organizations (42 U.S.C. 5152)	15
Sec. 310. Priority to Certain Applicants for Public Facility and Public Housing Assistance (42 U.S.C. 5153)	15
Sec. 311. Insurance (42 U.S.C. 5154)	16
Sec. 312. Prohibited Flood Disaster Assistance (42 U.S.C. 5154a)	16
Sec. 313. Duplication of Benefits (42 U.S.C. 5155)	18
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Sec. 316. Promotion of Employment (42 U.S.C. 5159)	20
Sec. 317. Recovery of Assistance (42 U.S.C. 5160)	20
Sec. 318. Audits and Investigations (42 U.S.C. 5161)	20
Sec. 319. Advance of New Federal Debt (42 U.S.C. 5162)	20
Sec. 320. Limitation on Use of Sibling Status (42 U.S.C. 5163)	21
Sec. 321. Rules and Regulations (42 U.S.C. 5164)	21
Sec. 322. Mitigation Planning (42 U.S.C. 5165)	21
Sec. 323. Minimum Standards for Public and Private Structures (42 U.S.C. 5165a)	22



BCA Approaches

How to do a BCA? Typically project specific using the FEMA BCA software, but some can use pre-calculated BCA

- Acquisitions and Elevations in the Special Flood Hazard Area (SFHA)
- Residential Hurricane Wind Retrofits
- Non-Residential Hurricane Wind Retrofits
- Individual Tornado Safe Rooms
- Hazard Mitigation Grant Program Post Wildfire
- **Substantial Damage in SFHA (assumed BCR = 1.0)**



Pre-Calculated BCA

Project Type	Maximum Project Cost	Notes
Acquisitions in SFHA	\$276,000/property	Property must be in SFHA. See memo for details.
Elevations in SFHA	\$175,000/property	Property must be in SFHA. See memo for details.
Residential hurricane wind retrofits (Portions of Wicomico and Worcester Counties)	Ranges from \$13,153-\$52,018/property	Only certain states and counties eligible. Maximum cost depends on type of work being performed; see Job Aid for details.
Non-residential hurricane wind retrofits	10% of Building Replacement Value (BRV)	See memo for details.
Residential tornado safe rooms (no values for Maryland)	Ranges from \$3,936-\$20,067/property	Maximum cost depends on state; see Job Aid for details.
Post-wildfire mitigation	\$5,250/acre	See Policy Clarification for details.



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BCA Components

- Cost
- Benefits
- Economic Calculations
 - Discount rate
 - Project Useful Life (PUL)
 - Project Design/Recurrence interval (RI) associated with project effectiveness



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BCA Costs (not always same as project cost)

Costs of a mitigation project include:

- Construction/acquisition costs
- Any other project-related costs such as title searches, permits, etc.
- **Maintenance costs**
- Any in-kind contributions or match from the recipient or subrecipient



Benefits

Benefits are any future costs or losses that can be avoided by completing a mitigation project.

$$\textbf{Benefits} = \textbf{Losses Before Mitigation} - \textbf{Losses After Mitigation}$$

Most projects are not 100% effective to avoid all hazard losses, so Losses After Mitigation usually not \$0.

BCA Economic Calculations

- Costs given as net present value (lump sum)
- Benefits derived as difference in annual losses before and after mitigation
- BCR needs to compare benefits and cost by same basis
- How do we convert annual benefits into net present value?
- Economic Calculations (similar to house mortgage and car payments)
- Need to know rate and years (number of payments)



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Discount Rate

The rate at which benefits decline in value each year is the **discount rate**.

Federally-funded mitigation projects must use a discount rate of **7%**, which is set by the U.S. Office of Management and Budget (OMB).

This is NOT the inflation rate (prices going up, typically).

Time value of money: If we could achieve a rate of return on our money equal to the discount rate, then \$1,000 today would be worth \$1,070 a year from now.



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Project Useful Life (PUL)

Project Useful Life (PUL) is the estimated amount of time (in years) that the mitigation action will be effective.

PUL is based on how long the mitigation measures will physically last, not the design of the measures.

Based on materials, wear down and maintenance of components, especially moving parts

Project Type	Useful Life	
	Standard Value	Acceptable Limits (documentation required)
Acquisition / Relocation		
Acquisition / Relocation	100	100
Building Elevation		
Residential Building	30	30-50
Non-Residential Building	25	25-50
Public Building	50	50-100
Historic Buildings	50	50-100
Mitigation Reconstruction		
Mitigation Reconstruction	50	50



Project Effectiveness

Project Effectiveness is the concept of how the mitigation project is designed to eliminate or reduce hazard-specific damages to a certain threshold, represented by a recurrence interval (RI).

Example 1: A highway box culvert may be designed to eliminate damages up to flood flows from 25-yr RI (4%-annual-chance) event, but has a PUL of 50 years.

Example 2: A residential house elevation is designed to raise the first floor elevation to the 500-yr RI flood elevation, but only have a PUL of 30 years.



BCA Benefit Types

- Physical Damages: Building and Contents, Infrastructure components
- Displacement Cost
- Loss of service/function
- Life Safety (avoided injuries or death)
- Emergency management
- Environmental/ecosystem benefits (no longer has BCR limits)
- Social benefits



Modeling BCA: Structure and Hazard Types

Select Structure Type...

- Residential Building
- Non-Residential Building
- Critical Facility Building
- Utilities
- Roads & Bridges
- Other

Select Hazard Type...

- Riverine Flood
- Coastal A Flood
- Coastal V Flood
- Coastal Unknown Flood
- Hurricane Wind
- Hurricane Safe Room
- Tornado Safe Room
- Wildfire
- Drought
- Landslide
- Seismic
- Dam/Levee Break
- Extreme Temperature
- Infrastructure Failure
- Severe Storm
- Tsunami
- Volcano
- Winter Storm
- Uncategorized



Flood BCA: Projects

- Acquisitions:
Flood Modeled Damages
- Elevations:
Flood Modeled Damages
- Flood Control:
Flood Historical/
Professional Expected
Damages

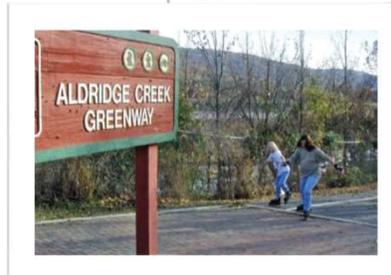
Residential Building	▼
Riverine Flood	▼
Select Mitigation Action...	▼
Select Mitigation Action...	
Acquisition	
Elevation	
Floodproofing Measures	
Drainage Improvement	
Floodplain and Stream Restoration	
Floodwater Diversion and Storage	
Other	

<input checked="" type="radio"/> Modeled Damages	<input type="radio"/> Historical Damages	<input type="radio"/> Professional Expected Damages
--	--	---



Acquisition Projects

- The purchase and demolition or relocation of a building. Future damage is eliminated because the project site is deed-restricted as open space.
- Many communities utilize the open space as wildlife habitat, active-use parks, or multi-use greenways.





Lowest floor elevation (LFE)

- **What it is:**

- The LFE is the elevation (in feet) of the lowest floor of the structure.

Input required ?	Potential sources	Recommended documentation with application
Yes	<ul style="list-style-type: none"> • Elevation certificate • LIDAR data • Signed, sealed, and dated structure elevation survey • Building permit 	<ul style="list-style-type: none"> • Elevation certificate signed by a qualified professional • Signed, sealed, and dated structure elevation survey • Copy of building permit

Elevation Projects

- Elevation projects raise the lowest floor elevation (LFE) of the structure above the Base Flood Elevation (BFE).
- The number of feet above the BFE the LFE is raised is known as freeboard.
- Freeboard requirements vary by jurisdiction.





Number of feet the first floor is being raised

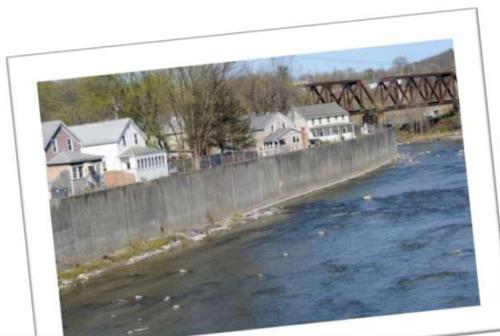
- **Why it's important:**

- The number of feet the first floor is raised helps determine the expected damages after mitigation.

Input required ?	Potential sources	Recommended documentation with application
Yes	<ul style="list-style-type: none"> • Project scope of work (SOW) • Project engineer • Engineering designs 	<ul style="list-style-type: none"> • None other than normally required project materials

Flood Control Projects

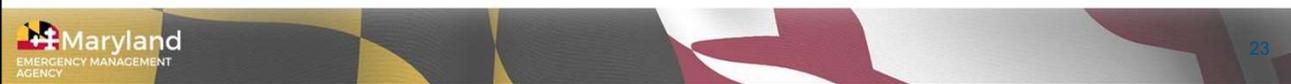
- The term “flood control” refers to systemic projects designed to reduce flood damage to a facility or area.
- For example:
 - Culverts
 - Floodplain & stream restoration
 - Drainage improvements
 - Floodwater diversion & storage
 - Floodwalls
 - Levees
 - Pumping stations





Damages before mitigation, historical

Input	Input required?	Potential sources
Damage Year	Yes*	<ul style="list-style-type: none"> Property owner or facility operator Insurance claims FEMA Project Worksheets (PWs) Newspaper articles from credible source
Recurrence Interval (years)	Yes**	<ul style="list-style-type: none"> National Weather Service Precipitation Frequency Data Server USGS stream gauge data Qualified engineer or other professional
Damages (\$) or Impact (Days)	Yes	<ul style="list-style-type: none"> Property owner or facility operator Insurance claims FEMA Project Worksheets (PWs) Estimates using flood depths and DDFs Qualified engineer or other professional Newspaper articles from credible source



Hurricane Wind BCA: Projects

- Shutters
- Load Path
- Roof retrofit
- Code Plus

Residential Building ▼

Hurricane Wind ▼

Select Mitigation Action... ▼

Select Mitigation Action...

Shutters

Load Path

Roof

Acquisition

Code Plus

Shutters, Load Path

Shutters, Roof

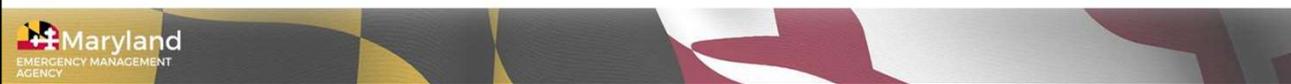
Load Path, Roof

Shutters, Load Path, Roof

Modeled Damages

Historical Damages

Professional Expected Damages



Shutters

- Designed to protect all windows and doors
- Must meet the debris impact and wind pressure design requirements of the International Residential Code/ International Building Code
- Assumes all openings of a building will be protected



Building properties before and after mitigation

- **What it is:**
 - Existence/type of roof, shutters, load path, etc. of the structure before and after the mitigation project.

Input required ?	Potential sources	Recommended documentation with application
Yes	<ul style="list-style-type: none"> • Property owner • Contractor • Building inspector • Project engineer 	<ul style="list-style-type: none"> • Note from project engineer or BCA analyst • Photos



Other Hazard and Project Types

Select Structure Type...

- Residential Building
- Non-Residential Building
- Critical Facility Building
- Utilities
- Roads & Bridges
- Other

Select Hazard Type...

- Riverine Flood
- Coastal A Flood
- Coastal V Flood
- Coastal Unknown Flood
- Hurricane Wind
- Hurricane Safe Room
- Tornado Safe Room
- Wildfire
- Drought
- Landslide
- Seismic
- Dam/Levee Break
- Extreme Temperature
- Infrastructure Failure
- Severe Storm
- Tsunami
- Volcano
- Winter Storm
- Uncategorized

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BCA Toolkit

The screenshot shows the FEMA Benefit-Cost Calculator v6.0.0 interface. The main window has a 'Welcome' section with the following text:

Benefit-Cost Analysis (BCA) is the method by which the future benefits of a hazard mitigation project are determined and compared to its costs.

The end result is a Benefit-Cost Ratio (BCR), which is calculated by a project's total benefits divided by its total costs.

FEMA requires a BCA to validate cost effectiveness of proposed hazard mitigation projects prior to funding.

For a community and/or property, this tool will assist with:

- Estimating Annual Hazard Risks
- Evaluating Mitigation Cost Effectiveness
- Developing Aggregate Benefit-Cost Models

The sidebar on the right shows a 'FEMA Benefit-Cost Analysis' window with a blue header and a button labeled 'OPEN CALCULATOR'.

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BCA Toolkit: Basic Inputs

-  **Project title**
-  **Property location**
-  **Property structure type**
-  **Hazard type**
-  **Mitigation action type**
-  **Hazard data, damage history, or expected damages estimated by a qualified professional**
-  **Project cost estimate**
-  **Project useful life**



BCA Toolkit: Help (default values)

PROJECT CONFIGURATION	
COST ESTIMATION	The purpose of this section is to establish the Total Mitigation Project Cost. This is done by adding the Initial Project Costs and the discounted value of Annual Maintenance Costs. The Total Mitigation Project Cost is the "C" in the BCA.
Project Useful Life	The Project Useful Life Summary Tables below provide the Standard Values for hazard and project types. The tables also show the Acceptable Limits of the PUL value. If a value other than the Standard Value is used, documentation and justification are required. For example, a generator vendor could provide documentation to demonstrate that the PUL is longer than the standard value (19 years). Even with documentation, a PUL value cannot be higher than the highest Acceptable Limits value. The higher the PUL, the higher the BCR since project benefits will be considered further into the future.
Initial Project Costs	
Number of Maintenance Years	
Annual Maintenance Costs	
Total Mitigation Project Cost	



PROJECT CONFIGURATION			
COST ESTIMATION			
The purpose of this section is to establish the Total Mitigation Project Cost. This is done by adding the Initial Project Costs and the discounted value of Annual Maintenance Costs. The Total Mitigation Project Cost is the "C" in the BCA.			
Project Useful Life			
The Project Useful Life Summary Tables below provide the Standard Values for hazard and project types. The tables also show the Acceptable Limits of the PUL value. If a value other than the Standard Value is used, documentation and justification are required. For example, a generator vendor could provide documentation to demonstrate that the PUL is longer than the standard value (19 years). Even with documentation, a PUL value cannot be higher than the highest Acceptable Limits value. The higher the PUL, the higher the BCR since project benefits will be considered further into the future.			
PUL Summary Tables			
Flood			
Project Type	Standard Value	Useful Life Acceptable Limits (documentation required)	Comment
Acquisition / Relocation			
Acquisition / Relocation	100	100	
Building Elevation			
Residential Building	30	30-50	
Non-Residential Building	25	25-50	
Public Building	50	50-100	
Historic Buildings	50	50-100	
Mitigation Reconstruction			
Mitigation Reconstruction	50	50	
Infrastructure Projects			
Major Infrastructure (dams, levees)	50	35-100	
Concrete infrastructure, flood walls, roads, bridges, major drainage system	50	35-50	
Culverts (concrete, PVC, CMP, HDPE, etc.)	30	25-50	Culvert with end treatment (i.e., wing walls, end sections, Culverts (concrete, PVC, CMP, HDPE, head walls, etc.)
	10	5-20	Culvert without end treatment (i.e., wing walls, end sections, head walls, etc.)
Pump stations, substations, wastewater systems, or equipment such as generators	50	50	Major (power lines, cable, hardening gas, water, sewer lines, etc.)
	5	5-30	Minor (backflow valves, downspout disconnect, etc.)



BCA Toolkit: Comments

The image shows two overlapping forms from the BCA Toolkit. The top form, 'Project Configuration', includes fields for Project Title, Property Location (with latitude/longitude and state/county dropdowns), Property Structure Type, Hazard Type, Mitigation Action Type, and Property Title. The bottom form, 'Cost Estimation', includes fields for Project Useful Life (years), Initial Project Costs (\$), Number of Maintenance Years, Annual Maintenance Costs (\$), and Total Mitigation Project Cost (\$). A red box highlights a small icon in the top right corner of the Cost Estimation form.

This dialog box prompts the user to 'Add Justification for Mitigation Project Cost'. It contains a large text area with the placeholder text 'Detailed project cost provided in cost estimate attached to grant application.' and a 'Save' button at the bottom right.



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BCA Toolkit: Export Project

The screenshot shows the FEMA Benefit-Cost Calculator interface. At the top, it says 'FEMA Benefit-Cost Calculator V.6.0 (Build 20200924.1405)'. Below this are navigation buttons: '+ Add Project', '← Import Projects', 'Export Projects' (highlighted with a red box), and 'Delete Projects'. A table below lists project data:

Select	Project Title	County, State	Benefits (B)	Costs (C)	BCR (B/C)
<input checked="" type="checkbox"/>	test	Montgomery, null	\$ 396,569	\$ 250,000	1.59
<input checked="" type="checkbox"/>	Test Project	Caroline, MD	\$ 0	\$ 400,014	0.00
TOTAL (SELECTED)			\$ 396,569	\$ 650,014	
TOTAL			\$ 396,569	\$ 650,014	

The 'Export' dialog box offers two options: 'Export As File' and 'Export As Text'. Under 'Export As File', the 'xlsx' format is selected, and a 'Download' button is present. Under 'Export As Text', there is a text area containing '[object Blob]' and a 'Click to Copy Export Text' button at the bottom.



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BCA Toolkit: Project Report

The left screenshot shows the FEMA Benefit-Cost Calculator interface with the 'View Report' button highlighted in red. The right screenshot shows a detailed report for a property, including a map, a table of costs and benefits, and property configuration details.

Map Marker	Mitigation Title	Property Type	Insured	Benefits (B)	Costs (C)	BCR (B/C)
1	Acquisition @ 38.9003320 - 75.8150030	Residential Flood		\$ 0	\$ 400,000	0.00
TOTAL (SELECTED)				\$ 0	\$ 400,000	0.00
TOTAL				\$ 0	\$ 400,000	0.00

Property Configuration

Property Title: Acquisition @ 38.9003320 - 75.8150030
 Property Location: 7802 Carolina Maryland



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BCA Toolkit: Data Documentation

- Subapplication needs to include checklist and detailed description of data sources of **every input value**
- Use FEMA defaults whenever possible, included in help info
- FEMA guidance lists trusted sources for each critical input
- Do this for every project, every structure

Project Type	Useful Life	
	Standard Value	Acceptable Limits (documentation required)
Acquisition / Relocation		
Acquisition / Relocation	100	100
Building Elevation		
Residential Building	30	30-50
Non-Residential Building	25	25-50
Public Building	50	50-100
Historic Buildings	50	50-100



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FEMA GO

The screenshot shows the 'Project Example' form in the FEMA GO system. The 'Cost-effectiveness' section is active, with the following questions and options:

- How was cost-effectiveness determined for this project?**
 - BCA completed in FEMA's BCA toolkit
 - Pre-calculated benefits
 - Substantial Damage in Special Flood Hazard Area
 - Other BCA methodology approved by FEMA in writing
 - Not applicable
- What are the total project benefits? (\$)**
\$
- What is the total project cost? (\$)**
\$
- What is the benefit-cost ratio (BCR) for the entire project?**
/
- Was sea level rise incorporated into the flood elevations in the BCA?**
 - Yes
 - No
- Were environmental benefits added to the project benefits?**
 - Yes
 - No
- Were social benefits added to the project benefits?**
 - Yes
 - No

The left sidebar lists various review information categories, including National Historic Preservation Act, Endangered Species Act, and Clean Water Act.



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FEMA GO

The screenshot shows the final part of the 'Project Example' form. The questions and options are:

- Was sea level rise incorporated into the flood elevations in the BCA?**
 - Yes
 - No
- Were environmental benefits added to the project benefits?**
 - Yes
 - No
- Were social benefits added to the project benefits?**
 - Yes
 - No
- Does the mitigation measure incorporate nature-based solutions?**
 - Yes
 - No
- Please provide any additional comments below (optional).**
- Attachments**
 - Attach a document (Maximum file size: 1 GB)

Filename	Date uploaded	Uploaded by	File size	Description	Action
----------	---------------	-------------	-----------	-------------	--------

A 'Continue' button is visible at the bottom of the form.



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FEMA GO

The screenshot shows the 'Project Example' form in the FEMA GO system. The left sidebar contains a navigation menu with categories: L. Other Environmental/Historic Preservation Laws or Issues, E. Executive Order 11988 (Floodplain Management), F. Coastal Zone Management Act, G. Farmland Protection Policy Act, H. Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (Hazardous and Toxic Materials), I. Executive Order 12898, Environmental Justice for Low Income and Minority Populations, J. Other Environmental/Historic Preservation Laws or Issues, K. Summary and Cost of Potential Impacts, Evaluation, Comments & attachments, Location, Project location, Project benefiting area, Project impact area, Project site inventory, Assurances and certifications, and Review subapplication. The main content area is titled 'Project Example' and includes a 'Status: Pending submission' indicator. The 'Introduction' section is followed by the 'Project location' section, which asks for a detailed description of the proposed project's location and includes input fields for Latitude and Longitude. Below this is the 'Attachments' section, featuring an 'Attach a document' button and a table with columns for Filename, Date uploaded, Uploaded by, File size, Description, and Action. The 'Project benefiting area' section asks for a detailed description of the proposed project's benefiting area.



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FEMA GO

The screenshot shows the 'Project site inventory' form in the FEMA GO system. The left sidebar is identical to the previous slide. The main content area is titled 'Project site inventory' and contains several questions and input fields. The first question is 'Does this project subapplication propose to mitigate a property/structure(s)?' with radio buttons for Yes and No. The second question is 'Do you know the location of the structure?' with radio buttons for Yes and No. Below this is a text input field for 'Enter the location of the property/structure.' and a dropdown menu for 'Select a method for adding property/structure(s)'. There are three blue buttons: '+ Add a building', '+ Add infrastructure/utility/other', and '+ Add vacant land'. At the bottom of the form is a 'Continue' button.



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For More Information

- MEMA: <https://mema.maryland.gov/community/Pages/grant-subapplicant-resources.aspx>
- FEMA BCA: <https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis>
- FEMA GO: <https://www.fema.gov/grants/guidance-tools/fema-go>



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Maryland
EMERGENCY MANAGEMENT
AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

Mitigation.mema@Maryland.gov



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