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Proper Benefit Cost Analysis Key in Mitigation Grant Application

By Luanne Principe

In *Disaster Recovery Today* issue #4008, "Mitigation Funding in the FEMA Public Assistance Program," we explored FEMA's mitigation funding through the 404 and 406 programs — including their history, benefits and importance to communities.

Issue #4013, "Mitigation Measures Sound Investments in Disaster Recovery," addressed mitigation action plans and understanding the foundation of hazard mitigation. Alternative funding approaches were discussed in issue #4016, "Supplemental Funding Sources in Community Recovery."

IN THIS ISSUE

FEMA's Hazard Grant Mitigation Program is a powerful tool to help communities that have experienced a major natural disaster implement measures to reduce or eliminate the risk of suffering similar devastation in the future. Mitigation measures encompass risks to people and property.

Essential to applying successfully for a hazard mitigation grant is comparing the cost of the mitigation with the dollar value of the benefit(s) it is projected to deliver.

In this issue, Luanne Principe, Senior Disaster Recovery Manager with Adjusters International, reviews the many factors that must be considered in preparing this all-important Benefit Cost Analysis.

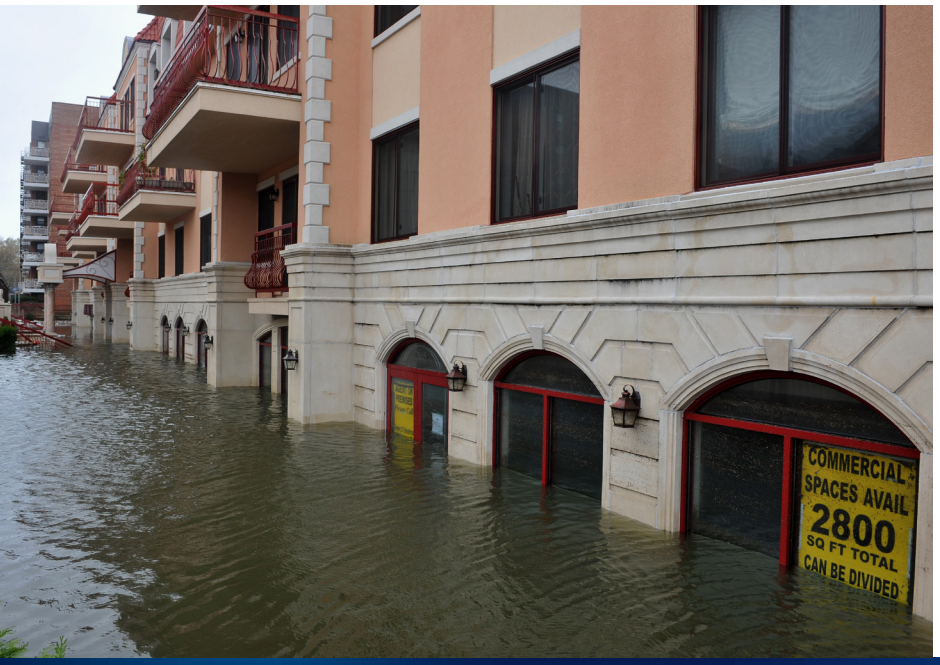
All of these efforts call for cost-effective projects that may be supported through an acceptable Benefit Cost Analysis (BCA). Preparing such a BCA is the subject of this issue of *Disaster Recovery Today*.

Requirement

The Robert T. Stafford Disaster Relief and Emergency Assistance Act requires that mitigation measures be deemed cost effective for funding to be available through the 404 and 406 programs.

The 404 program does not neccessarily apply to facilities damaged from a current disaster. It focuses on repetitive damages from past disasters and funds new or improved facilities.

In contrast, the 406 program focuses on a current disaster and the elements or systems damaged as a direct result of it. Under 406, FEMA will do more than fund the repair or replacement of the damaged facility to its pre-disaster design, function and capacity: it will also authorize additional funding to modify the damaged facility to mitigate potential future damage.



The Stafford Act gives FEMA the authority to fund the restoration of eligible facilities that have sustained damage due to a presidentially declared disaster. Section 406 of the Stafford Act contains a provision for the consideration of funding additional measures (further described in 44 CFR € 206.226) that will enhance a facility's ability to resist similar damage in future events. These mitigation measures must be cost effective. Under section 406 *Repair and Replacement of Damaged Facilities,* any one of the following means may be used to determine cost effectiveness:

- Mitigation measures may amount to up to 15 percent of the total eligible cost on the eligible repair work for a particular project.

- Certain mitigation measures, under the Public Assistance 406 Mitigation Program, will be considered effective as long as the mitigation measure does not exceed the eligible cost of the eligible repair work on the project.

- For measures that exceed the eligible costs, the applicant must demonstrate — through an acceptable benefit cost analysis — that the measure is cost effective.

A Benefit Cost Analysis is a method for determining the potential positive effects of a mitigation measure and comparing them to the cost of the measure. The desired effect is a reduction in future damages. The BCA can also be used to evaluate alternative projects to determine which is the best alternative from a fiscal standpoint. The end result is a Benefit Cost Ratio (BCR), which is derived from a

project's total net benefits divided by its total cost.

The BCR is a numerical expression of the cost effectiveness of the project. BCRs of 1.0 or greater have more benefits than costs — and are therefore **cost effective.** The examples below demonstrate two scenarios — one cost effective and one not cost effective.

The development of BCAs came as a result of the impetus provided by the Federal Navigation Act of 1936, which required that the U.S. Army Corps of Engineers (USACE) carry out projects for the improvement of a waterway system when the total benefits of a project exceed the costs. Thus, USACE created a systematic method for measuring such benefits and costs. It wasn't until 20 years later, in the 1950s, that economists tried to provide a rigorous, consistent set of methods for measuring benefits and costs to decide whether a project is worthwhile.

"A Benefit Cost Analysis is a method for determining the potential positive effects of a mitigation measure and comparing them to the cost of the measure."

In the new millennium, the Disaster Mitigation Act of 2000 (DMA2K) focuses on taking action to reduce the impacts of hazards before disasters occur. The goal of DMA2K is to help federal and state reviewers evaluate mitigation plans from multiple jurisdictions in a fair and consistent manner, and to help states and local jurisdictions develop new mitigation plans or modify existing ones.[1]

EXAMPLE 1

COST EFFECTIVE

SUMMARY OF BENEFITS AND COSTS

	EXPECTED ANNUAL	PRESENT VALUE
Expected Annual Damages Before Mitigation	$5,431	$74,952
Expected Annual Damages After Mitigation	$3,913	$54,003
Expected Avoided Damages After Mitigation (BENEFITS)	$1,518	$20,949
PROJECT COSTS	$10,000	
PROJECT BENEFITS	$20,949	
BENEFITS MINUS COSTS	$10,949	
BENEFIT-COST RATIO	2.09	

EXAMPLE 2

NOT COST EFFECTIVE

SUMMARY OF BENEFITS AND COSTS

	EXPECTED ANNUAL	PRESENT VALUE
Expected Annual Damages Before Mitigation	$3,960	$54,645
Expected Annual Damages After Mitigation	$3,911	$53,969
Expected Avoided Damages After Mitigation (BENEFITS)	$49	$676
PROJECT COSTS	$10,000	
PROJECT BENEFITS	$676	
BENEFITS MINUS COSTS	($9,324)	
BENEFIT-COST RATIO	0.07	

SOURCE: FEMA *Benefit-Cost Analysis Re-Engineering (BCAR) Damage Frequency Assessment (DFA) Methodology Report* — May 2009 Version 4.5

[1] An often-overlooked section in DMA2K is: REDUCED FEDERAL SHARE — "The President shall promulgate regulations to reduce the federal share of assistance under this section to not less than 25 percent in the case of the repair, restoration, reconstruction, or replacement of any eligible public facility or private nonprofit facility following an event associated with a major disaster — (A) that has been damaged, on more than one occasion within the preceding 10-year period, by the same type of event; and (B) the owner of which has failed to implement appropriate mitigation measures to address the hazard that caused the damage to the facility."

To Pursue

It is beneficial to pursue discretionary cost-effective 406 hazard mitigation funding. FEMA will review the BCA for proposed mitigation projects submitted under FEMA's grant programs. That review will determine whether the information provided in the application demonstrates:

1. The BCA components are credible and well documented;
2. The BCA is prepared in accordance with accepted FEMA BCA practices;
3. The project is cost effective.

"... all benefits and costs of a project should always be measured in terms of their equivalent monetary value."

General Data Requirements

Computing many of the benefits and costs of a project is a straightforward process, but others are more difficult to measure. Therefore, some basic principles are needed as a guide.

To determine the BCA feasibility of a project, all of its aspects — both positive and negative — must be expressed in terms of a common unit. The most convenient unit is dollars. This means that all benefits and costs of a project should always be measured in terms of their equivalent monetary value.

FEMA has developed software, written materials and training that help simplify the process. A BCA Toolkit covering a range of major natural hazards is available at www.fema.gov/benefit-cost-analysis.

Applicants must use FEMA-approved methodologies and software to demonstrate the cost effectiveness of their projects. This ensures that the calculations and methods are standardized, facilitating the review process. Most federal agencies will follow similar methodologies and will require the same level of detail represented in the FEMA BCA Toolkit.

Key Considerations

All BCA data entries must be documented in the project description or scope of work. That documentation should include the source of the data (title, author, date) and a thorough description of the project and how the proposed action will mitigate future damages.

The data must be from a credible source. These include federal, state, county, regional or local agencies and/or qualified professionals such as engineers, architects and surveyors.

Mitigation project costs should be fully documented and supported with cost estimates from appropriate sources. For a BCA, the mitigation project costs should always be the total project mitigation cost before reductions of anticipated insurance proceeds and never be only the federal share. Mitigation project costs must include anticipated maintenance costs.

BCA is a net present value calculation that takes into account the useful life of mitigation projects and the time value of money. The amount of goods that can be purchased with a given amount of money decreases over time. Therefore, for all FEMA projects, the Office of Management and Budget (OMB) has a mandated discount rate of 7 percent that must be used for performing BCAs.

Since each data element of the BCA that affects the numerical BCR must be fully and carefully documented, it is recommended that standard FEMA methodology and default values be used when they apply. Some data inputs may be based on national or typical values, while many are project-specific and must be documented with local data.

The base year of costs for all damages used in the BCA must be identified and be consistent with any technical data provided. The base year for mitigation project costs refers to the year that the cost estimate was developed.

The level of protection — also known as the effectiveness of the project — must be included. The level of protection is important because it shows when residual damage would occur.

The project's useful life (length of time that the mitigation project will provide protection) must be consistent with FEMA's standards, which are explained in the BCA Toolkit.

In determining cost-effective mitigation projects, applicants are also encouraged to consider the idea of "risk" when identifying and analyzing projects. Risk is simply the threat to the property, infrastructure and people in terms of dollars. It depends on the type, frequency and severity of natural hazards, as well as the vulnerability of the infrastructure and people.

HAZARD EVENT (Frequency & Severity)	X	PROPERTY EXPOSED TO THE HAZARD	=	HAZARD RISK (Dollars $$)

Calculating Benefits and Costs

For every mitigation project, benefits are calculated by estimating future damages and losses under two scenarios — with and without undertaking the project.

There are two aspects of calculating benefits that are particularly important to keep in mind. First, mitigation projects might *reduce* future damages and losses — but not completely eliminate them. Acquisition of the property is the only type of mitigation project that completely eliminates future damages and losses.

Second, for every mitigation project, the greater the damages and losses are before mitigation, the greater the potential benefits become.

The benefits considered in BCAs include benefits to the community, not just the government entity or funding source. The OMB's Advisory Circular A-94, *Guidelines and Discount Rates for Benefit Cost Analysis of Federal Programs,* provides explicit guidance on what benefits to count. Conceptually, however, most of the benefits can be sorted into four main categories: Physical Damages, Loss of Function, Casualties and Emergency Management Costs.

1) **Physical Damages** are probably the easiest category to understand. For buildings, contents, infrastructure, vehicles and equipment that are damaged, the monetary damages are simply the costs to repair or replace the damaged property.

   Avoided physical damages are expressed in dollars. Damages are often expressed as a percentage of the replacement value of the damaged item.

2) **Loss of Function** pertains to losses and costs that are incurred when facilities are damaged to the point that normal function of the facility is disrupted. For critical community operations, the loss of function is often the most severe impact of a hazard event. Therefore, it is critically important to measure the potential losses and benefits correctly. (See adjoining chart.) →

   For the loss of function category, historical data and professional judgment are used to develop damage estimates. The loss-of-function impact of a disaster on a community often goes far beyond the physical damages alone. It encompasses the losses, costs and direct economic impact that occur when physical damages are severe enough to interrupt the function of a facility.

   Types of losses have varying impacts, depending on the type of facility being evaluated. Some sub-categories of the loss-of-function impact are more difficult to understand and calculate than obvious physical

Loss of Function Impact

TYPE OF FACILITY	LOSS OF FUNCTION IMPACT	DATA INPUTS
BUILDING (residential, commercial, public)	Displacement costs	• Displacement time • Rent for temporary quarters • Other monthly costs • One-time costs
BUILDING (residential and commercial)	Rental income losses	• Displacement time • Monthly rent
BUILDING (commercial)	Business income losses Wage losses	• Functional downtime • Net business income per month • Wages and benefits per month
BUILDING (residential)	Disruption costs	• Disruption time • Economic value per person per hour
BUILDING (public, ordinary services)	Loss of public services	• Functional downtime • Operating budget
BUILDING (public, critical services)	Economic impact of loss of public service	• Functional downtime • Operating budget • Continuity premium*
UTILITIES	Economic impact of loss of public services	• Functional downtime • Economic impact per capita per day
ROADS AND BRIDGES	Economic impact of road and bridge closures	• Functional downtime • Delay or detour time • Daily traffic load • Economic value per person per hour

Revised Methodology of Existing Benefits
The methodology for calculating residential displacement costs has changed from a standard per-square-foot value, per month, to the lodging and meals per diem rates for the community as determined by the General Services Administration (GSA) or Department of Defense. The non-residential displacement costs methodology is unchanged.

*Continuity premium is a multiplier on the ordinary value of services that applies to services critical to immediate disaster response and recovery.

SOURCE: FEMA's *"What is a Benefit" Guidance on Benefit Cost Analysis of Hazard Mitigation Projects* Draft Rev 2 — May 2001

damage. The most common are:

- Displacement costs for temporary quarters
- Loss of income (residential or business)
- Lost wages
- Disruption time for residents
- Loss of public services
- Economic impact of loss-of-utility services
- Economic impact of road/bridge closures

For the economic impact of road and bridge or utility interruptions, FEMA applies specific rates. A per-vehicle, per-hour rate is applied to detours and a per-person, per-day rate to utility interruptions.

3) **Casualties** include deaths, injuries and illnesses. Whenever a specific mitigation project demonstrably reduces the potential for future casualties, it is proper and necessary to count the benefits of reduced casualties.

   While there is discomfort in placing a dollar value on human life, it is sometimes necessary to valuate the cost of saving lives. Economists recognize that it is impossible to fund every project that has the potential to save a life and that a rational basis is needed to select which such projects are approved and which are turned down. Understanding up front that reducing the risk of death stands to be a project benefit can defuse these controversies (see Statistical Standard Values or Willingness to Pay table).

Statistical Standard Values or Willingness to Pay

Natural disasters commonly result in casualties — including deaths, injuries and illnesses. Casualties are the most devastating impact of a disaster. Like other benefits, the benefits of avoided casualties are calculated as the difference in casualties occurring before and after mitigation. FEMA uses statistical values to place a monetary value on the benefits of avoided casualties. FEMA Benefit Cost Analysis statistical standard values were derived from 2008 FAA "Willingness to Pay" values. In Version 4.8 (dated 2009) they were as follows:

Death	$ 5,800,000.00
Hospitalized	$ 1,088,000.00
Treat & Release	$ 90,000.00
Self Treat	$ 12,000.00

(FEMA will update these values periodically)

Updated Life Safety Benefit Values

For 2015, the Value of Statistical Life (VSL) equivalent was increased to $6.6 million. The economic value of injuries avoided is calculated differently in the BCA modules, which include casualty values but are scaled off of this new fatality rate.

SOURCE: FEMA's *BCA Toolkit 4.8* — 2009

4) **Emergency Management Costs** include a range of disaster response and recovery costs that may be incurred by communities during and immediately after a disaster.

Disasters commonly result in a range of emergency management costs for affected communities. These include the costs of emergency operations centers, evacuation and/or rescue, security, temporary emergency protective measures, debris removal, and other costs associated with response and recovery. If a mitigation project under evaluation significantly reduces these costs, then the benefits should be counted.

One example is the belowground Waste Water Lift Stations in New Orleans damaged by Hurricane Katrina. Damage to eight lift stations resulted in the federal government funding pumping and hauling wastewater for several years (Category B Grants). The hazard mitigation was determined to be cost effective. The future benefits were based on federal benefits that avoid costs by the federal government that will not have to be paid because of the mitigation. The repair and other avoided costs are the only benefits that were used in determining the cost effectiveness of repair-related mitigation.

FEMA funded $279 million worth of work to replace eight lift stations with the same function and capacity, relocating them above the flood plain and the flood of record, on their original sites as cost-effective hazard mitigation measures to avoid future costs to the federal government. More information can be found at www.fema.gov.

Other Considerations

Additional considerations for BCAs are just now coming into use. Recipients must remember to document and support environmental, social and other non-traditional benefits.

- Environmental Benefits — for acquisition/relocation projects, environmental benefits (or ecosystem services) for a parcel being acquired may be included in certain situations.
- Social Benefits — for the cost of mental health treatment and lost productivity for BCA modules that did not already include a value for this calculation (i.e., flood, hurricane and wind).
- Non-Traditional Benefits — other benefits now applicable to certain mitigation projects traditionally outside of BCA guidelines include:
    - Volunteer Costs — projects that will result in future reduction in volunteer costs can now include this benefit. For example, costs for volunteers who fight floods or do sandbagging around a water treatment plant can be included as a benefit for a mitigation project that reduces or eliminates the

need for flood-fighting efforts.

- Street Maintenance Costs — for larger acquisition or relocation projects, benefits can now be included for future street maintenance costs that are avoided if the infrastructure is removed.
- NFIP Administration and Claim Costs — for general administration and cost to administer a regular and Increased Cost of Compliance (ICC) claim for each policy. Any flood mitigation project that eliminates the need to carry a flood insurance policy or reduces the claim administration burden can utilize this benefit.

Also of Note

Other published studies conducted or recognized by states, territories or tribes can be utilized, but must be provided as part of the project application for verification. These new methods will facilitate better preparation of a BCA for Hazard Mitigation Assistance, Grant Applications and recognizing additional benefits not previously considered.

ADDRESSING FLOODS AND RELATED ISSUES

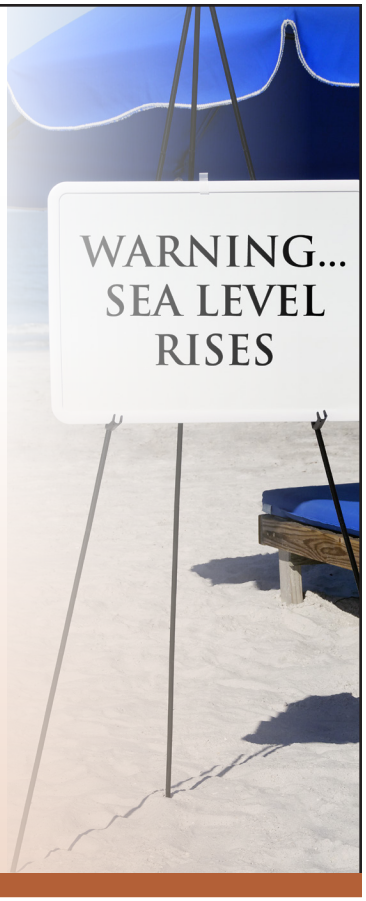
Latest Toolkit Measures Sea Level Rise

FEMA's latest Toolkit (version 5.1) includes a Sea Level Rise (SLR) measurement. The new kit provides a place for users to enter the estimated Sea Level Rise for their project location. The estimated sea level rise elevation will be added to the current 10-, 25-, 50-, and 100-year flood elevations for the area in the Toolkit.

There is no mandate for the inclusion of estimated Sea Level Rise for HMA applications, but a relative SLR can be included in flood elevations when conducting BCAs in coastal areas, using a full-data flood module. When performing structure elevation projects that have freeboard requirements, SLR estimates should be added to the freeboard requirements that may have been adopted in local or state building codes. Freeboard is a safety factor usually expressed in feet above flood level for the purpose of floodplain management.

A grantee or applicant may use any valid source that is based on recognized SLR estimation methods. There are several federal government sources of relative SLR data along coastal areas, including:

- NOAA Center for Operational Oceanographic Products and Services Mean Annual SLR Trend Data
- USACE Climate Change Adaption Sea Level Change Curves
- Globalchange.gov provides data more specific to New Jersey and New York



SOURCE: FEMA FAQ sheet – *Incorporating Sea Level Rise into Hazard Mitigation Assistance (HMA) BCA FAQs* — December 2013

Conclusion

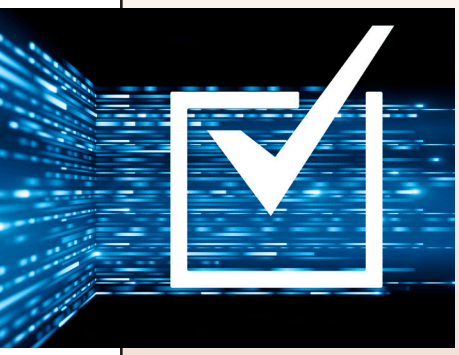
Whether you know it as a benefit cost analysis or a cost benefit analysis, conducting one is critical to any hazard mitigation project. When you perform a BCA, you make a comparative assessment of all the benefits you anticipate receiving from your project and all the costs associated with introducing it, completing it and addressing the challenges the project brings.

A BCA finds, quantifies and adds all the positive factors. These are the benefits. Then it identifies, quantifies and subtracts all the negatives. Those are the costs. The difference between the two indicates whether the planned measure is advisable. Even though the project may be deemed ineligible, it may still be prudent to forge forward. The trick to doing a BCA well, is making sure you include all the costs and all the benefits — and properly quantify them.

Regardless of which grant program a sub-applicant is applying to, the application must present the project's clear benefit(s) if it is to be successful.

FEMA Benefit Cost Analysis Re-Engineering (BCAR)

FEMA's decision to re-engineer the existing BCA software was made to meet the technical needs of today's user and address advances in hazard assessment methodology, as well as in FEMA policy. To accomplish these objectives, FEMA met with more than 300 users to gather data, feedback and comments. This input contributed to an integrated software package that provides current information and user guidance to a once-complex process. It has also resulted in a streamlined approach for meeting FEMA's cost-effectiveness requirements for hazard mitigation projects.



The goals were to develop methodologies that are based on well-defined scientific and engineering principles, that accurately represent structural performances, and that simplify the analysis process for the average user. The intent of the BCA module remains the same.

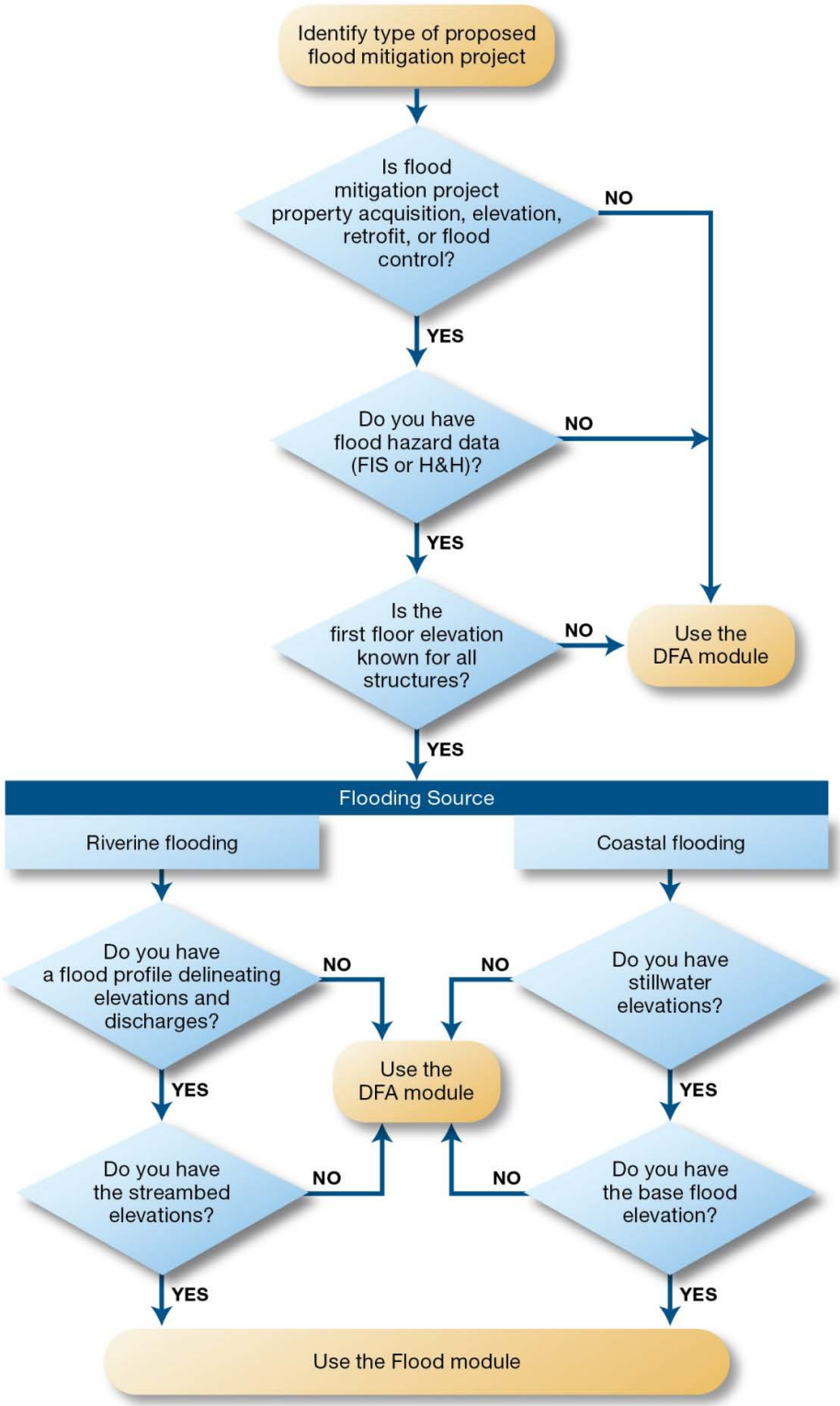
Also re-engineered was the Limited Data module. It was replaced with the Damage Frequency Approach (DFA) module, which is more flexible than the flood module and therefore the most frequently used module for FEMA's Hazard Mitigation Assistance (HMA) grant applications.

The DFA module analyzes proposed mitigation projects based on damages (either historical or anticipated) and the future damages that would be avoided. This is extremely helpful when no FEMA Flood Insurance Study is available. The DFA module is commonly used to analyze storm water management and drainage improvement projects, but may also be used to analyze a wide range of hazards including floods, landslides, snow/ice storms and earthquake mitigation for utility projects. The DFA module is recommended in place of the flood module when key structural information such as the base flood elevation (BFE) and/or Flood Insurance Rate Map (FIRM) is not available.

Another important use for the DFA module is the secondary analysis for mitigation projects that do not result in a BCR of 1.0 or greater in the flood module. If the BCR in the flood module is less than 1.0 for a project but 1.0 or greater using the DFA module, the complete and well-documented DFA module may be submitted in a project grant application. An explanation of why the DFA module was used in lieu of the full flood module should be provided.

SOURCE: FEMA's *BCA Reference Guide* 2009

Selecting Between the DFA and Flood Modules for a Flood Mitigation Project



SOURCE: "Supplement to the Benefit-Cost Analysis Reference Guide," fema.gov — June 2011 (FIS-Flood Insurance Study; H&H — Hydrologic and Hydraulic)

Getting Started

To complete a comprehensive BCA for a flood mitigation project, it is important to obtain a current Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS). These documents will define the special hazard area of the project, flood elevation data and profiles, streambed elevations, and flood discharges.

DOCUMENTS	SOURCE (typical)
Base flood or first-floor flood elevation	Professional engineer or surveyor
Building Replacement Value (BRV)	Tax records, building inspector, contractor or an estimate derived from a national cost estimating guide
Building area (square footage)	Tax records, property appraiser, real estate listing
Flood hazard data	Flood Insurance Study (FIS) or hydrology study
Building contents data	Receipts, itemized insurance policy and/or FEMA default of 50 percent of BRV
Displacement costs	Advertisements, rental agreements and/or FEMA default cost per square foot (per month)
Flood frequency data	Flood Insurance Study, hydrology study, historical records, flood depths, damage costs
Before mitigation data	Flood Insurance Study or hydrology study, insurance claims, receipts, newspaper articles
After mitigation data	Statement from engineer or professional
Document loss of function	Traffic counts from engineer or state department of transportation
Project cost	Cost estimate breakdown and maintenance costs

REFERENCES:

FEMA BCA Reference Guide 508 Final – June 2009
FEMA Supplement to the BCA Reference Guide 508 – June 2011
Natural Hazards Review – ASCE November 2007
HMA Unified Guidance – 2013
FEMA BCA Toolkit 5.1

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