TWDB Guidance: Benefit-Cost Analysis Reporting for FIF Applications

Last Revised: February 6, 2024

BCA Requirements

Reiterating Flood IUP requirements

- Benefit Cost Ratio (BCR) should be equal to or above 1 and expressed to at least one decimal place (e.g. 1.0, 1.1)
  - If BCR is below 1, applicant must provide a narrative that includes qualitative and quantitative data demonstrating the benefits and cost-effectiveness of those that could not be quantified and therefore are not included in the BCR, see additional information on the following pages (page 5,6).

BCA Requirements

Reiterating Flood IUP requirements

- There are no specific Benefit Cost Analysis (BCA) tools that must be used in determining the BCR.
- Free BCA tools that can be utilized include the following:
  - FEMA BCA,
  - USACE tools,
  - TWDB BCA Input Tool that works with FEMA BCA tool
  - See later pages on various BCA methods (pages 11, 12).
- Applicant must provide a list of Key Assumptions/Parameters used to generate the BCR provided
- Applicant must provide all digital input files for BCA (e.g. Excel BCA Input Tool File [.xlsm] or additional calculations used in Excel or other formats)

Additional BCA Requirements

- Provide contact information of the individual responsible for the calculation. Does not have to be certified individual (e.g. PE, CFM, etc.)
- Documentation (e.g. table, list, report) of assumptions for each parameter in the BCA calculation. See example template on the following pages (pages 5,6).
- Describe sources or citations for each parameter assumption. See example template on the following pages (pages 5,6).

Example Template for BCA Documentation

- May vary in length, typically 1-2 pages
- Name, version and description of BCA tool used for calculations
- Overview of assumptions made for each input
- Description of sources for those assumptions (Red = Examples)

Template source: *Excerpt from FEMA Application Review Summary FY 2019*

Cost-Effectiveness

The benefit-cost analysis (BCA) for this project was completed in the Flood module for one property (_____) and in the Damage-Frequency Assessment (DFA) module for five properties (_____) using the FEMA BCA Tool Version 6.0. Based on the documentation used, the project is cost-effective.

The following assumptions were made in the BCA:

- *Project Useful Life:* The project useful life utilized was 30 years, which is consistent with the FEMA standard value for the project.
- *Project Cost:* The total project cost indicated in the BCA was $_____. The total project cost in the BCA includes _____.
- *Annual Maintenance Cost:* The annual maintenance cost is estimated at $0. The homeowners are responsible for long-term maintenance of their properties following the elevation project.
- *Lowest Floor Elevations:* LFEs were determined from the elevation certificates for four properties and an engineer report for two properties.
- *Flood Hazard Data:* The BFE for _____ was obtained from the elevation certificate. The streambed elevation, water surface elevations, and discharges for the 10-, 50-, 100-, and 500-year events were obtained from the preliminary Flood Insurance Study (FIS) for _____ County, Texas (effective revised date of June 2018). The streambed elevations and discharges were confirmed to be correct. However, the water surface elevations varied slightly from the FIS profiles.
- *Building Information:* The building sizes and building types were supported by property appraiser reports. The year built was specified as 1978 for structures that were built earlier than 1978. The default analysis duration and building replacement values were applied. The default building replacement value of $100/square foot was used for the structures analyzed in the flood module.
- *Building Occupancy:* The building occupancy in the BCA varied from one to five persons. The owners of the properties provided homeowner participation forms to support these numbers.
- *Before-Mitigation Damages:* For the five properties analyzed using the DFA module, before-mitigation damages were based on the provided flood claims data and confirmed to be entered correctly.
- *After-Mitigation Damages:* For the five properties analyzed using the DFA module, the after-mitigation damages were assumed to be the lowest value of flood claims to account for residual risk from flood.
- *Social Benefits:* For properties with a BCR greater than 0.75, social benefits were applied. Homeowner participation forms were used to support the number of residents for each structure.

Example Cost Effective Narrative

In order to provide enough data to estimate the project BCR, applicants should ensure they address the following questions:

- How often does the hazard being mitigated occur?
  - Example Project: Power outages occur at the Hazardtown fire station about once every 3-5 years.
- How many people benefit from the proposed mitigation project, and how was this number determined?
  - Example Project: The proposed mitigation project, installing a generator at the Hazardtown fire station, benefits the fire station's service population of 700 residents.
- What structures, infrastructure, and/or building contents, if any, will be damaged if the project is not implemented?
  - Example Project: If the proposed mitigation project is not implemented, Hazardtown Middle School will continue to experience flooding in the auditorium and classrooms on the north side of the building, damaging school equipment and resulting in costly mold remediation.
- What public services (including public safety, transportation, and utilities) and/or businesses, if any, would lose function during future hazard events if the project is not implemented?
  - Example Project: If the culvert under Overflow Road at Muddy Creek is not upsized, Overflow Road will continue to flood during intense rainfall events and impede access to the Muddy Creek Shopping Center.
- Are there any additional benefits directly attributable to the proposed project that are not captured elsewhere in the cost-effectiveness narrative?
  - Example Considerations: Would the project result in avoided injuries or deaths; reduced emergency management costs; reduced maintenance costs; protection of cultural, historical, or agricultural resources; reduced carbon emissions; or other economic benefits to the community?

Example above from FEMA Cost Effective Narrative. Please note the less than $1 million cost effective memo does not apply to the SFY 2024-2025 FIF IUP. A BCA is required for all construction-oriented projects, except for FME and FMS Category projects.

Resources for the FEMA BCA Toolkit

- FEMA BCA Calculator and Additional Resources
  - https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis
- FEMA BCA Training Materials
  - https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis/training
- Online Webinar using the FEMA BCA Toolkit (Nov. 2019). Starts at 15:55.
  - https://youtu.be/GoW-HvmW_q8?t=956

Resources for the TWDB BCA Input Tool

- TWDB site with BCA Input Tool download
  - https://www.twdb.texas.gov/flood/planning/planningdocu/2028/doc/BCA-Input-Workbook.xlsm
- TWDB BCA Training Materials
  - https://www.twdb.texas.gov/flood/planning/planningdocu/2028/doc/BCA-Model-Instructions.pdf
- Summary of TWDB BCA Input Tool Updates
  - https://www.twdb.texas.gov/flood/planning/planningdocu/2028/doc/BCA-Input-Tool-Updates-Memo.pdf

Examples of Data Requirements by Benefit Category

Benefit Category	Examples of Data Requirements* (For the Baseline and Project Alternative)
Flood Damages	• Flood elevations • Number, type, value, and elevation of structures • Debris totals
Loss of Function	• Flood elevations • Number of households and businesses • Impacted utilities (e.g. water, wastewater, electricity, internet, others)
Life and Safety	• Populations served and response times for emergency services • Estimated injuries or deaths due to flooding
Environmental	• Acres of habitat by type • Reduction in stormwater runoff and treatment costs
Travel Savings	• Traffic counts on streets that flood; • Detour routes

* Units vary based on the BCA tool used for analysis

Examples of Data Requirements by Benefit Category (Continued)

Benefit Category	Examples of Data Requirements* (For the Baseline and Project Alternative)
Agricultural	• Land use and cropping patterns • Acres of crops inundated • Expected crop yields and expenses
Recreation	• Number of recreational visitors • Type of recreation
Water Supply	• Annual or daily water supply yield • Regional water costs
Residual	• Construction costs • Component lifespans

* Units vary based on the BCA tool used for analysis

Features and Limitations of Existing BCA Software

Software	Features	Limitations	Benefit Types Captured
FEMA Hazus	• Includes default data, including general building stock and water levels • Can be used for large regions as well as specific project sites	• Requires the use of GIS • Default data may not be accurate at the parcel level	• Flood Damage • Loss of Function • Agricultural
FEMA BCA Toolkit	• Excel-based • Capable of including benefits calculated outside of the model • Can use historical damages	• Inputs may be data intensive	• Flood Damage • Loss of Function • Environmental
USACE HEC-FDA	• Detailed results	• Data-intensive • Software may be difficult to master	• Flood Damage
USACE HEC-FIA	• Detailed results	• Only measures one event; does not produce annualized results	• Flood Damage • Agricultural • Life & Safety

Features and Limitations of Existing BCA Software, continued

Software	Features	Limitations	Benefit Types Captured
USACE HEC-LifeSim	• Includes life loss benefits	• Data-intensive • Difficult software to master • Only applicable to events that include evacuation	• Flood Damage • Life & Safety
USACE Beach-fx	• Detailed results	• Data-intensive • Difficult software to master	• Flood Damage
Global Mapper COastal Adaptation to Sea level rise Tool (COAST)	• Does not require H&H modeling for coastal analyses • Incorporates sea level rise projections	• Depending on user skill set, expert level assistance may be required • Some assumptions and methodologies are unclear	• Flood Damage
TWDB Flood BCA Calculator	• Developed specifically for TWDB flood planning process • Designed to minimize data requirements for users	• Some project may require FEMA BCA Toolkit inputs	• Flood Damage • Loss of Function • Life & Safety • Agricultural • Environmental
Individually-Developed Excel Workbooks	• Customizable • Can include all benefit types appropriate for the project	• Non-standard submittal can be harder to review and higher chance of calculation errors	• All the benefits identified by user including the ones captured above

TWDB BCA Guidance - Ongoing Effort

- TWDB is working with a consultant to develop a BCA guidance that supplements this existing guidance
- TWDB BCA guidance is anticipated for public review in Spring 2024 with publication in Summer 2024
- TWDB BCA guidance document will include:
  - Scalable approaches
  - Range of new Damage-Benefit tables (Ag loss, loss of function, etc.)
  - Detailed BCA (projects) to Broader BCA (planning)
  - Sensitivity of BCA to parameters (discount rate, useful life, etc.)
- For additional details please refer to the Benefit Cost Analysis Guidance Document Summary:
  - https://www.twdb.texas.gov/flood/research/benefit-cost-analysis-guidance/index.asp

Glossary/Relevant Terms

- **Benefit-Cost Analysis (BCA)**: A method for determining the potential positive effects of a mitigation measure and comparing them to the cost of the measure. With the FEMA BCA modules, the positive effect is a reduction in future damages from natural hazards. This is the benefit of mitigation. The BCA can also be used to compare alternative projects to determine the best alternative from a fiscal standpoint.
- **Benefit-Cost Ratio (BCR)**: This ratio is the present value of net project benefits divided by the project costs and is the result of a BCA. A ratio of 1.0 or greater indicates the project is cost effective; a ratio of less than 1.0 indicates the project is not cost effective.
- **Benefits**: Future losses prevented or reduced by a mitigation project. The benefits counted in a BCA are the present value (in dollars) of the sum of the expected annual avoided damages over the project useful life.
- **Cost Effective:** In the context of Benefit-Cost Analysis, when the benefits of a hazard mitigation project exceed the project costs (i.e., BCR $\geq$ 1.0).
- **Direct Benefits:** The reduction or prevention of future losses to buildings, contents, or public facilities from natural hazards.
- **Discount Rate:** Used in FEMA Benefit-Cost Analysis to determine the "Net Present Value" of benefits. Discounting facilitates accurate comparisons of benefits that may occur in the future to the costs of a project that most often occur immediately or in the near term. For FEMA-funded projects, the rate is set by the Office of Management and Budget (OMB).
- **HAZUS:** Hazards-United States. FEMA software for hazard analyses based on GIS mapping.
- **Indirect Benefits:** In the context of hazard mitigation, the reduction in damages from natural hazard events that are not directly caused by the event itself.
- **Project Cost:** The total cost of a mitigation project, including an applicant's share. These costs include such items as land or right-of-way acquisitions, construction and materials, design, testing, permits, project management, and equipment. In most Benefit-Cost Analysis, all future benefits are counted, so all project costs should be counted as well.
- **USACE**: United States Army Corps of Engineers

Adapted from: https://www.fema.gov/sites/default/files/2020-04/fema_bca_reference-guide.pdf

Contact Us

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