# *FEMA BCA Checklist*

**Appendix II**
**FEMA BCA Checklist**
*Last Updated June 28, 2006*

## 1.0 INTRODUCTION

**FEMA will review the benefit-cost analyses (BCAs) that are required for all proposed mitigation projects submitted under the FEMA grant programs. The 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.**

A prospective Applicant or Sub-applicant should use this checklist as a guide for preparing a complete, well-documented grant application. The information that follows is grouped by category and meant to help Applicants and Sub-applicants submit a complete and technically supported BCA that can be properly reviewed for the criteria listed above.

**Notes:**

1. Technical assistance for BCA questions can be obtained by calling the FEMA BCA toll-free Helpline at **866-222-3580** or via e-mail at **bchelpline@dhs.gov**. Responses are provided within 48 business hours. The *FEMA Mitigation BCA Toolkit* CD can be ordered through the Helpline.

2. All technical support data (reports, maps, calculations, design plans, engineering drawings, etc.) from previous applications should be resubmitted with all new applications.

3. All applications should include the appropriate FEMA Data Documentation Template (or DDT, found on the *FEMA Mitigation BCA Toolkit* CD) as a self-check for and verification of documentation and credibility of the data provided in support of the BCA.

## 2.0 BCA DATA REQUIREMENTS

### 2.1 General Data Requirements

2.1.1 All BCA data entries (other than FEMA standard or default values) MUST be documented in the project description or project Scope of Work (SOW) that accompanies the grant application. The documentation should include:

(a) The source of the data (title, author, date).

(b) A full description of the data, the project, and how the proposed measure will mitigate future damage.

(c) The data MUST be from a credible source. Credible sources include federal, state, county, regional, and local government agencies or qualified professionals such as licensed architects, engineers, and surveyors. Credible sources will vary depending on the data item.

(d) Data obtained from sources other than those in (c) above MUST include a complete discussion of the methodology used and how it was applied for the proposed mitigation project to establish data credibility.

2.1.2 Complete copies should be provided for all reports, technical bulletins, engineering analyses, or guidance documents cited in the application as technical support data. It is recommended that Applicants or Sub-applicants identify the page numbers from the report used as data support.

2.1.3 Detailed project costs MUST be broken out and certified with a signature for all major construction components, including, but not limited to, materials, labor, excavation, soil brought to or removed from the site, concrete, hazardous materials testing and disposal, equipment such as pumps, and site restoration.

2.1.4 The FEMA required **Discount Rate of 7%** MUST be used in all BCA module runs.

2.1.5 The **Base Year of Costs** for all damages used in the BCA MUST be identified in the BCA module run and be consistent with any technical support data provided with the application. The Base Year of Costs for the Mitigation Project Costs refers to the year that the cost estimate was developed. For example, if the cost estimate was completed in August of 2005, the year 2005 would be entered into the module.

2.1.6 The **Hazard** (flood, wind, seismic, etc.), **Risk**, and **Frequency** of the hazard MUST be provided and supported based on historical information from damage curves or previous disasters. This information MUST also be consistent among the application, BCA module runs, and technical data or reports submitted in support of the application.

2.1.7 **Project Useful Life** (i.e., the length of time that the mitigation project will provide protection) MUST be consistent with Project Useful Life table provided on the last page of this checklist. Additional guidance is provided in the FEMA publication, *How to Determine Cost-Effectiveness of Hazard Mitigation Projects* (Interim Edition, December 1996). This document is also known as the FEMA Yellow Book (due to the color of the cover), and useful life information can be found in Appendix A, on pages A4 and A5. This document is included in the BCA Tools main folder of the *FEMA Mitigation BCA Toolkit* CD. Documentation is required for values that differ from the FEMA standard values listed in the Project Useful Life table.

2.1.8 The **Level of Protection** (also known as the effectiveness of a mitigation project) MUST be specified for the hazard identified in the application. Examples are

protection "up to 50-year flood" for a flood mitigation project or "up to a wind speed of 120 mph" for a tornado or hurricane shelter project. The Level of Protection is important because it shows when residual damage (i.e., future damage that will occur after a mitigation project is in place) would occur.

2.1.9 Data provided in support of **daily traffic counts** for damages associated with traffic delays or detours should be signed by a professional engineer, a planner, or a county Department of Transportation (DOT) manager with signature authority. Costs associated with traffic delays or detours MUST be consistent with guidance provided in Section 7 of the *FEMA "What is a Benefit?"* document (found on the *FEMA Mitigation BCA Toolkit* CD).

2.1.10 The values for **minor injuries, major injuries, and deaths** that exceed the FEMA standard values used in the Limited Data (only for flash floods and some non-flood hazards), Seismic, Tornado, and Wildfire modules MUST be fully documented and from credible sources. Use the Inflation Calculator (located in the BCA Tools main folder) to inflate values from the 2001 values listed in Section 2.3 of the *FEMA "What is a Benefit?"* document ($2,710,000 for a death, $15,600 for major injury, and $1,560 for minor injury) to the current year. If the FEMA standard values are over-ridden, the application will need to include documentation on the source of the data and justification of why these values are more appropriate than the standard values. However, if the default values for injuries and deaths are only adjusted to the current year values, no documentation is required.

2.1.11 The Very Limited Data (VLD) module can only be used for screening purposes and **cannot be used to support cost-effectiveness** of a Pre-Disaster Mitigation (PDM) grant application.

2.1.12 The FEMA Region and FEMA Headquarters mitigation staff MUST approve alternative BCA software or methodologies in writing prior to submittal of an application.

2.1.13 Paper copies of BCA module runs require the same level of documentation as electronic copies of the module runs.

## 2.2 BCA Damage Data

2.2.1 The data should be well documented for each event that resulted in damage. The data should also be consistent with the type of mitigation project proposed (e.g., flood damage data should be provided in support of a proposed flood mitigation project). If damage was recorded for multiple events, the estimated frequency and the associated damage MUST be documented and provided for each event to support the damage analyses in the BCA.

2.2.2 Data used in place of FEMA standard or default values in the BCA modules MUST be documented. The documentation should include justification of why it is more

appropriate than the FEMA values. Even minor changes in data will be considered incorrect if it is not fully documented or lacks justification for its use.

2.2.3 When using the Wildfire module, the "burn data" (sample area size, acres burned, type of fuel, burn recurrence interval, timber value, fire suppression costs, mitigation project life) MUST be provided, documented, and obtained from a credible source.

**Note:** Specific BCA Damage Data requirements are organized by hazard type (flood, seismic, wind, etc.) and discussed in more detail in the DDTs found on the *FEMA Mitigation BCA Toolkit* CD.

### 2.3 BCA Benefits Data

Because benefits are considered to be damages prevented, the Applicant and Sub-applicant MUST demonstrate the following:

2.3.1 All benefits claimed MUST be fully documented and the sources cited in the Applicant's and Sub-applicant's project overview.

2.3.2 The damages prevented MUST be consistent with the damage history provided in 2.2.1 above and with the proposed level of protection.

2.3.3 The Applicant and Sub-applicant MUST demonstrate that the proposed mitigation measure protects up to the proposed level of protection. For floods, this could be shown by elevation data, such as: "the lowest height of an elevated structure is 0.5 foot above the elevation of a 25-year flood."

2.3.4 The Applicant and Sub-applicant should identify and quantify residual damages. These refer to expected future damages that remain after a mitigation project is in place. Some types of mitigation projects, such as elevation or floodproofing, do not eliminate all flood damages. A lack of a discussion on residual damages or failure to include appropriate residual damages in the BCA may result in the BCA being considered incomplete.

2.3.5 When using the Limited Data module, the Applicant and Sub-applicant may not extrapolate damages from documented longer return period (lower frequency) events to damages with unknown, shorter return periods (higher frequency) events. For example, do not extrapolate damages from a known 20-year event down to a 2-, 5-, or 10-year event. This is not an approved methodology for determining benefits at higher frequency events.

2.3.6 The **Loss of Function** (value of services that cannot be provided due to damage) and the **Functional Downtime** (length of time in days that the loss of function is in effect) MUST be reasonable, defensible, and documented.

2.3.7 The **Displacement Costs** (costs incurred for moving to temporary quarters while repairs are made) and **Displacement Time** (the length of time in days that the displacement costs are incurred) MUST be reasonable and documented.

2.3.8 A **Continuity Premium**, which is a multiplier on the value of services to account for critical services, can only be used for services contributing to disaster recovery that are in immediate need after a disaster, such as police, fire, and emergency services.

**Note:** Specific BCA Benefits Data requirements are organized by hazard type (flood, seismic, wind, etc.) and discussed in more detail in the Data Documentation Templates (DDTs) found on the *FEMA Mitigation BCA Toolkit* CD.

## 2.4 BCA Building Data

2.4.1 All mitigation projects involving the elevation or protection of residential or commercial buildings should include completed FEMA Elevation Certificates for each building in the application. The Elevation Certificates should be signed, sealed, and dated by an engineer or surveyor licensed to practice in the state where the mitigation project is to be built.

2.4.2 Data for building type, number of stories, and total size in square feet (the number of stories multiplied by the square footage of each story) should be included in the application in accordance with the requirements of the BCA module for a specific hazard. Photocopies of tax records, hard copies of photographs, or electronic "jpg" files of images are sufficient to meet this data requirement.

2.4.3 The method and source for determining the building replacement value (BRV) unit cost or the total BRV MUST be provided with the application.

2.4.4 When using assessed tax values as the basis for a BRV, the multiplier and method used to develop the BRV MUST be documented and from a credible source such as the county tax assessor.

2.4.5 The **amount of damage** (as a percent of the before-mitigation damage BRV) **that will result in demolition** of the structure MUST be provided in the BCA. The application MUST contain documentation to support the use of a value if different from the FEMA standard value of 50%.

2.4.6 All claims for contents values in excess of the FEMA standard value of 30% of the before-mitigation damage BRV MUST be fully documented, including an itemized list of contents and the estimated or insured value of each item.

2.4.7 For occupancy values, note that the **Tornado module requires the design occupancy** for the proposed shelter, while the two **Seismic modules require the average daily occupancy** (including weekends and holidays) over the course of one year.

## 3.0 POSSIBLE PROBLEMS AND PROPOSED SOLUTIONS

### 3.1 General Questions

- Has the hazard been properly identified for the project site?
- Has the risk to the structure been described and clearly documented?
- Does the application describe all hazards for which mitigation is proposed?
- Is the BCA fully documented and accompanied by technical support data?
- Is there any residual risk to the facility after the proposed mitigation is implemented?

Following are several examples of common project types and relevant information to include with the application.

### 3.2 Riverine Flood Control Project

3.2.1 Identify the source of the flood hazard data:

(a) A copy of the Flood Insurance Study (FIS), marked up to show the project location, should be submitted with the application. Data should include the Flood Insurance Rate Map (FIRM) title block and map scale and the appropriate flood profile from the FIS report.

(b) If flood data from another agency is used, provide the agency name, the report title, the name of the watercourse studied, and the date of the report. (A photocopy of the report cover may be submitted to provide some of this information.)

(c) If flood data were developed by an engineer or hydrologist, provide the name, registration number (for an engineer), date of the analyses, and methodology used (hand calculations or a specific computer model such as TR-20 or HEC-RAS).

3.2.2 Provide an SOW for the project that is consistent with the information provided in the grant application and for the engineering review.

3.2.3 Describe the existing flood conditions for the project site.

3.2.4 Briefly describe how the proposed mitigation project will provide protection for the facility.

3.2.5 Identify the proposed level of flood protection for the mitigation project (i.e., “The project will protect the pump station for up to a 50-year flood event on Smith Creek.”). This value MUST be included in the project application to verify the effectiveness of the mitigation project.

3.2.6 Provide a detailed work schedule and breakdown of the complete project costs, disregarding who will pay the costs (FEMA or another state or local funding source).

### 3.3 Projects Based on the Limited Data Module

3.3.1 Verify that use of the Limited Data module is appropriate for the proposed mitigation project. The Limited Data module is required when one or more of the following conditions are met:

(a) Flood mitigation projects where the FIS or comparable documented flood data from another agency, engineer, or hydrologist are not available.

(b) Flood mitigation projects where the First Floor Elevation (FFE) of the structure is not documented.

(c) Flood mitigation projects related to flash flooding, alluvial fan flooding, debris or mud flows, and landslides.

(d) Flood, wind or earthquake hazard mitigation projects for non-building facilities such as culverts, roads, bridges, and utility systems.

3.3.2 Provide an SOW for the project that is consistent with the information provided in the grant application and for the engineering review.

3.3.3 Describe the existing flood conditions for the project.

3.3.4 Briefly describe how the proposed mitigation project will provide protection for the facility.

3.3.5 Provide detailed documentation of damages at the project site for two or more hazard events of known frequency. The following requirements must be met when compiling hazard event data:

(a) For two or more events with similar frequencies, use an average damage amount per event and an average frequency. Do not use an average of two or more events with widely varying frequencies.

(b) Estimates of damage between events of two known frequencies may be permitted if the estimates are reasonable and documented. However, estimates of damage based on extrapolation from events of two known frequencies are not recommended. Extrapolation of damages to more frequent events from one or more known less frequent events is not permitted.

## 3.4 Coastal Flood Protection Projects

The FEMA Coastal A- or V-Zone BCA modules should be used for evaluating and determining the cost-effectiveness of coastal flood protection projects. Data for coastal projects are based on information similar to that used in the FEMA Riverine Full Data module and the requirements described in Section 2.0. The text below discusses the data differences between the two modules.

**Coastal A-Zone Mitigation Projects**

3.4.1 The **Flood Hazard Data** is based on information provided in the "Summary of Stillwater Elevation Tables" from a FEMA FIS. This table provides the stillwater elevations for the 10-, 50-, 100- and 500-year flood events. The *FEMA Mitigation BCA Toolkit* CD contains the manual for the Coastal A-Zone module. Page 7-2 in the Coastal A-Zone Manual states, "the '1-year' flood elevation data entry may be estimated from the highest expected (normally anticipated) annual tide level or from other local flood gauge data." The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services Web site (http://tidesandcurrents.noaa.gov/) contains tidal prediction data that may be useful. Use the interactive map to find the tide predictions.

**Coastal V-Zone Mitigation Projects**

3.4.2 The **Building Data** for a building in a V-Zone considers whether the building has an obstruction (i.e., wall or structural member) below the elevation of the lowest floor or horizontal member.

3.4.3 For **Building Data**, the elevation of the lowest floor is based on the lowest horizontal structural member.

3.4.4 Similar to the Coastal A-Zone **Flood Hazard Data,** the Coastal V-Zone data are based on information provided in the "Summary of Stillwater Elevation Tables" from the FIS. This table provides the stillwater elevations for 10-, 50-, 100-, and 500-year flood events. Based on the data, the BCA module will automatically compute the elevations with the wave height. Depending on the location of the project, the module allows for a user-entered elevation for the 100-year flood, which may be determined from the FIRM. The 1-year flood elevation data entry may be estimated from the highest expected (normally anticipated) annual tide level or from other local flood gauge data. The NOAA Center for Operational Oceanographic Products and Services Web site (http://tidesandcurrents.noaa.gov/) contains tidal prediction data that may be useful. Use the interactive map to find the tide predictions.

## 3.5 Hurricane Wind Projects

3.5.1 The **Building Type** is one of the most critical data elements for determining an accurate Benefit-Cost Ratio (BCR). This should be based on design drawings and determined by a building official, a registered professional engineer, or a licensed

architect. In the Hurricane Wind module, select "Other" for the Building Type in the Level One Data section. Follow the instructions in the Wind Hazard and Damage Function software (located in the Hurricane Software folder in the main BCA Software and Technical Manual folder on the *FEMA Mitigation BCA Toolkit* CD*)* and select the building type that is most similar to the project building.

3.5.2 The **Building Site** (and zip code) should be identified on a map, showing the coast, submitted with the application. The value for Building Site (miles inland) in the Level One Data section of the Hurricane Wind module may be any value from 1 to 125 miles inland. This value is no longer critical when the new Wind Hazard Damage Function table is used because the analyst should enter the same wind speed data in both the "Coast" and "125 miles inland" columns for the specific building site. Obtain the wind hazard data for the project site (by zip code) from the Wind Hazard and Damage Function software and enter that into the Wind Hazard Data section of the Hurricane Wind module.

3.5.3 The **Wind Hazard Data** requires the wind speed at the project site be entered in both the "Coast" and "125 miles inland" columns for the 10-, 25-, 50-, 100-, and 2000-year events. This wind speed data can be obtained by zip code by using the Wind Hazard and Damage Function software located in the Hurricane Software folder in the main BCA Software and Technical Manual folder on the *FEMA Mitigation BCA Toolkit* CD. These data have been developed using the FEMA HAZUS-MH software for the 48 contiguous states. The values provide updated (2005) wind speed data that should be used in the Hurricane Wind module.

3.5.4 The Wind Hazard Data for U.S. islands or territories outside the 48 contiguous states (Hawaii, Puerto Rico, the U.S. Virgin Islands, etc.) are provided in Figure 7-3 of the BCA Hurricane Technical Manual. The wind speeds are identical at the coast and 125-miles inland due to the relatively small landmass of islands.

3.5.5 A detailed project description should be provided to demonstrate **Project Effectiveness**. In addition to the design wind speeds, this information should also identify which building components will be replaced or retrofitted as part of the project. The Wind Hazard and Damage Function software is used to determine the appropriate *percent damage* (Wind Damage Functions) for both before- and after-mitigation using the available options. The Wind Damage Function data is then entered into the appropriate Level Two Data tables in the BCA module.

### 3.6 Tornado Mitigation Project

3.6.1 Verify that the Tornado module has been installed properly (complete installation instructions are on the *FEMA Mitigation BCA Toolkit* CD).

(a) For Windows 95 and 98, follow the directions that appear on the screen for installation.

(b) For Windows 2000, ME, XP, and XT, follow the instructions until a prompt states that there is a "version conflict." Then follow the instructions on the *FEMA Mitigation BCA Toolkit* CD to finish the installation.

3.6.2 The Building Information, Tornado Hazard Information, and Mitigation Project Information sections of the module are extremely important to developing a good BCA based on appropriate and defensible data. The data must be complete in each section to develop an accurate BCA.

3.6.3 Tornado Building Information section:

(a) The project state and county are necessary for running the Tornado module properly.

(b) The longest structure length and width are keys for determining the likelihood of the structure being affected by a tornado.

(c) The proposed shelter area within the building (in square feet), shelter construction type, and shelter occupancy are important in determining the performance effectiveness and cost-effectiveness of the mitigation measure.

3.6.4 Tornado Hazard Information section:

The module database must have a sufficient number of past tornadoes to determine the probability of tornado occurrence in a selected county. Because it is unlikely that a single county will have a sufficient number of tornadoes for meaningful statistics, the sample area of counties must be large enough to be representative of the hazard. The module contains a database with data for all counties.

Note: Some states that have an insufficient history of tornadoes may need to expand the sample area beyond the state to include counties from neighboring states.

3.6.5 Mitigation Project Information section:

(a) Mitigation projects using the Tornado BCA module MUST also include:
- longest length of the building
- longest width of the building
- square footage of the proposed shelter area within the building
- shelter construction type (i.e., construction materials)
- site location referenced by county and state

(b) For design wind speeds other than those found in FEMA 361, *Design and Construction Guidance for Community Shelters* Figure 2-2 or American Society of Civil Engineers (ASCE) 7-98, Minimum Design Loads for Buildings and Other Structures, the application will need to include documentation on the source of the data and justification of why the design wind speeds used are more appropriate than the standard sources.

(c) For FEMA statistical values for injuries and deaths, use the Inflation Calculator (located in the BCA Tools main folder) to inflate values from the 2001 values listed in Section 2.3 of the *FEMA "What is a Benefit?"* document ($2,710,000 for a death, $15,600 for major injury, and $1,560 for minor injury) to the current year. If the FEMA standard values are over-ridden, the application will need to include documentation on the source of the data and justification of why the data is more appropriate than the standard data. However, if the default values for injuries and deaths are only adjusted to the current year values, no documentation is required.

### 3.7 Seismic Mitigation Project

3.7.1 A seismic structural engineer should be consulted for designing structural or non-structural seismic mitigation projects.

3.7.2 The Limited Data module for non-structural seismic hazard mitigation projects allows users to evaluate mitigation projects for common non-structural items including:

- Equipment
- Cable Elevators
- Contents
- Chimneys
- Ductwork
- Fire Sprinklers
- Electrical Junction Boxes
- Generators
- HVAC Fans
- Library Shelves
- Parapet Walls
- Storage Racks
- Suspended Ceilings

The following precautions must be taken when using this module:

(a) Verify and document values related to building occupancy rates, estimated dollar value of deaths, and value of lost services per day. This is critical because most benefits for non-structural mitigation projects are due to avoided deaths and avoided loss of function.

(b) In the **Seismic Hazard** section, input the expected annual number of earthquakes with values from the Earthquake Full Data Structural module. Include documentation to support user-entered values not derived through the Earthquake Full Data Structural module.

(c) For FEMA statistical values for injuries and deaths, use the Inflation Calculator (located in the BCA Tools main folder) to inflate values from the 2001 values listed in Section 2.3 of the *FEMA "What is a Benefit?"* document ($2,710,000 for a death, $15,600 for major injury, and $1,560 for minor injury) to the current year. If the FEMA standard values are over-ridden, the application will need to include documentation on the source of the data and justification of why the data is more

appropriate than the standard data. However, if the default values for injuries and deaths are only adjusted to the current year values, no documentation is required.

## 4.0 COMMON SHORTCOMINGS

4.1 Submitting an incomplete, illegible, or unreadable BCA.

4.2 Incomplete documentation.

4.3 Inconsistencies between data in the application, the BCA module runs, and reports and other data sources submitted as technical support.

4.4 Lack of technical support data (especially reports referenced in the application but not provided).

4.5 Lack of a detailed cost breakdown for mitigation project costs.

4.6 Use of project costs that do not include all project items, such as costs for administration, design and engineering, property acquisition, etc.

4.7 Use of a discount rate other than the FEMA standard of 7%.

4.8 Lack of documentation for Loss of Function or Functional Downtime.

4.9 Use of base year costs or damages without updating to current year.

4.10 Use of undocumented traffic counts and detour times for traffic delay data.

4.11 Use of hourly traffic delay costs that are higher than the FEMA standard of $32.23/hour/vehicle.

4.12 Overriding the FEMA default values without providing documentation or justification.

4.13 Lack of information or data on building type, size, number of stories, and value.

4.14 Lack of documentation and identified data sources for FFE data.

4.15 Lack of documentation, basis, and multiplier for determining BRV based on tax data.

4.16 Poor documentation or credibility regarding the frequency-damage relationship when using the Limited Data module.

4.17 Using or extrapolating damages or benefits for higher or lower flood frequencies in the Limited Data module.

4.18 Using the Very Limited Data (VLD) Screening Tool to determine a BCR when it should be used only for screening purposes.

4.19 Use of incorrect project useful life. Many Applicant and Sub-applicants incorrectly assume that all projects have a useful life of 100 years; however, useful lives can range from 2 years (vegetation management) to 100 years (acquisition and relocation). The only project type with a useful life of 100 years is acquisition and relocation. All other project types have useful lives of 50 years or less. The following table contains standard values and ranges of acceptable useful lives for different project types.

**Note:** Project useful lives other than the Standard Value (see Table) require documentation and must fall within the range of Acceptable Limits listed in the table.

# *FEMA BCA Checklist*

## Project Useful Life Summary Table

| Project Type | Useful Life (years) | | Comment |
|---|---|---|---|
| | **Standard Value** | **Acceptable Limits** (documentation required) | |
| **Acquisition / Relocation** | | | |
| All Structures [1] | 100 | 100 | |
| **Elevation** | | | |
| Residential building [1,2] | 30 | 30 | |
| Non-Residential Building [1,2] | 25 | 25-50 | |
| Public Building [2] | 50 | 50-100 | |
| Historic Buildings | 50 | 50-100 | |
| **Structural / Non-Structural Building Project** | | | |
| Residential Building Retrofit | 30 | 30 | |
| Non-Residential Building Retrofit | 25 | 25-50 | |
| Public Building Retrofit | 50 | 50-100 | |
| Historic Building Retrofit | 50 | 50-100 | |
| Roof Retrofit | 30 | 30 | Roof hardening and roof clips |
| Tornado Shelter | 30 | 30-50 | Residential and non-residential Shelters |
| Non-Structural Building Elements | 30 | 30 | |
| Non-Structural Major Equipment | 15 | 15-30 | Depends on type of equipment |
| Non-Structural Minor Equipment | 5 | 5-20 | Depends on type of equipment |
| **Infrastructure Projects** | | | |
| Major Infrastructure [1,2] (dams, levees) | 50 | 35-100 | |
| Concrete infrastructure, flood walls, roads, bridges, major drainage system [1] | 50 | 35-50 | |
| Culverts (concrete, PVC, CMP, HDPE, etc.) | 30 | 25-50 | Culvert **with** end treatment (i.e., wing walls, end sections, 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 [1] | 50 | 50 | Structures |
| | 5 | 5-30 | Equipment |
| Hurricane Storm Shutters | 15 | 15-30 | Depends on type of storm shutter |
| Utility Mitigation Projects | 50 | 50-100 | Major (power lines, cable, hardening gas, water, sewer lines, etc.) |
| | 5 | 5-30 | Minor (backflow values, downspout disconnect, etc.) |
| **Miscellaneous Equipment Projects [1]** | | | Depends on type of equipment |
| Equipment purchases [1] | 2 | 2-10 | Small, portable equipment such as a computer |
| | 30 | 5-30 | Heavy equipment |
| **Vegetation management** | 2 | 2-15 | Depends on the maintenance plan and schedule |

**References:**

1. Yellow Book (1996), Appendix A, page A-5.
2. Riverine Technical Manual, Chapter 6, page 6-20.