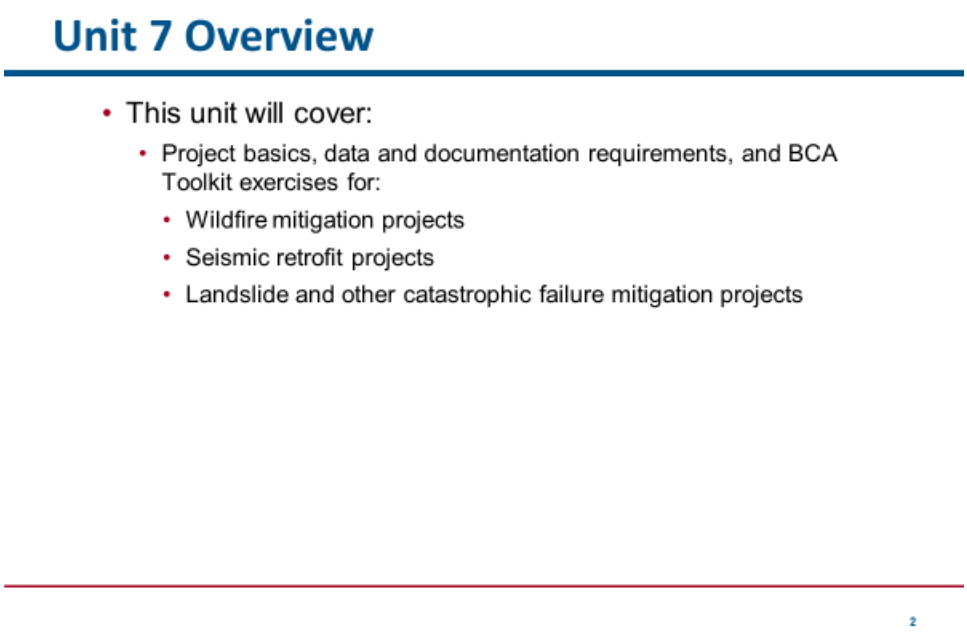
Unit 7

BCAs for Wildfire, Seismic, and Landslide/Catastrophic Failure Mitigation Projects

Unit 7 Overview

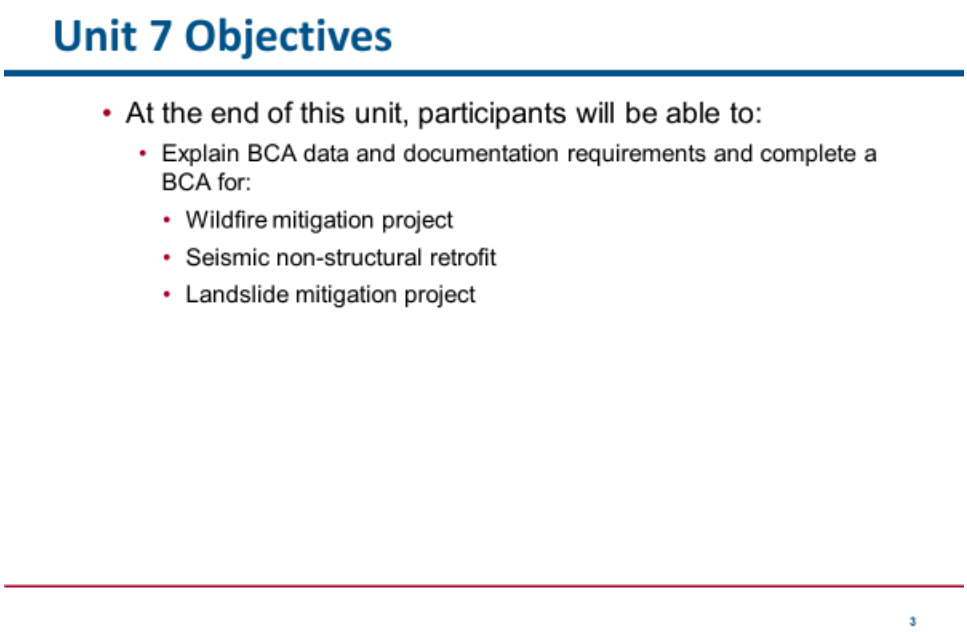


Visual 1: Unit 7 Overview

This unit will cover:

- Project basics, data and documentation requirements, and BCA Toolkit exercises for:
  - Wildfire mitigation projects
  - Seismic retrofit projects
  - Landslide and other catastrophic failure mitigation projects

Unit 7 Objectives



Visual 2: Unit 7 Objectives

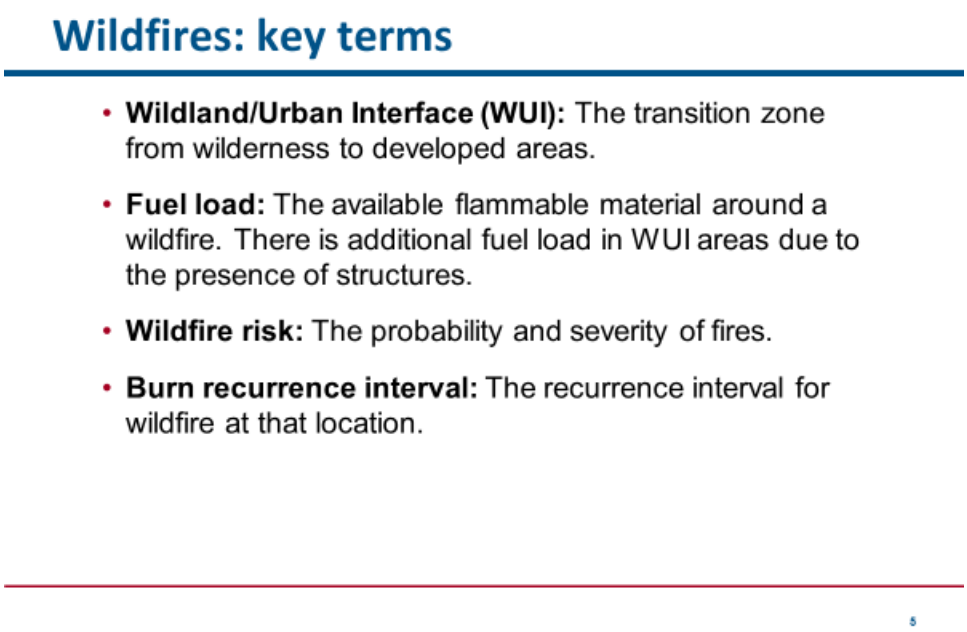
Unit 7 has several objectives. At the end of this unit, students should be able to:

- Explain BCA data and documentation requirements for wildfire mitigation, seismic retrofit, and landslide/catastrophic failure mitigation projects
- Complete a wildfire mitigation BCA
- Complete a seismic non-structural retrofit BCA
- Complete a landslide mitigation BCA

Wildfire mitigation projects

Wildfire Mitigation Projects

Wildfires: key terms



Visual 3: Wildfires: key terms

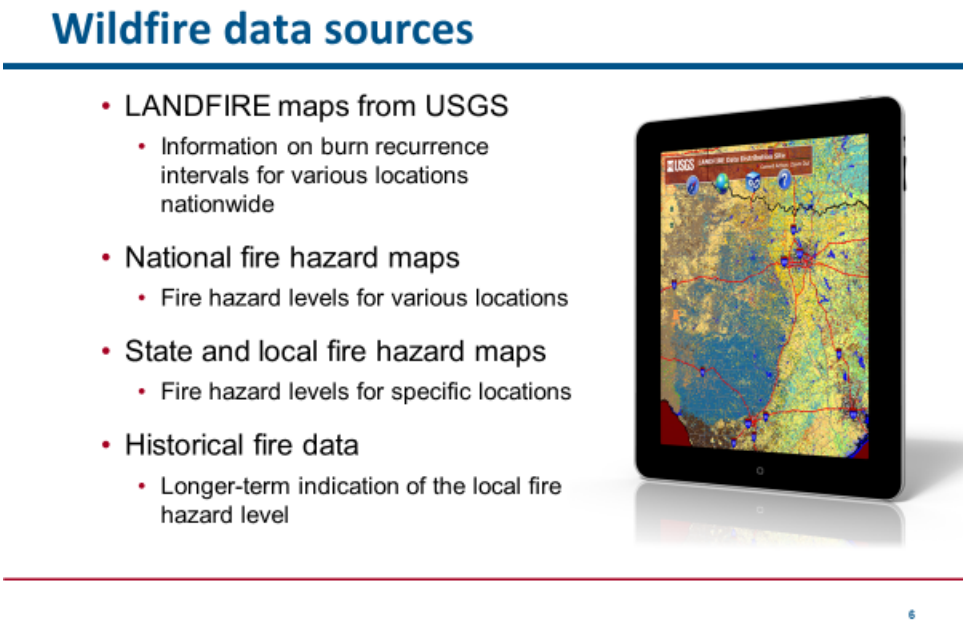
Wildland/Urban Interface (WUI): The transition zone from wilderness to developed areas.

Fuel load: The available flammable material around a wildfire. There is additional fuel load in WUI areas due to the presence of structures.

Wildfire risk: The probability and severity of fires.

Burn recurrence interval: The recurrence interval for wildfire at that location.

Wildfire data sources



Visual 4: Wildfire data sources

LANDFIRE maps from USGS

- Information on burn recurrence intervals for various locations nationwide

National fire hazard maps

- Fire hazard levels for various locations

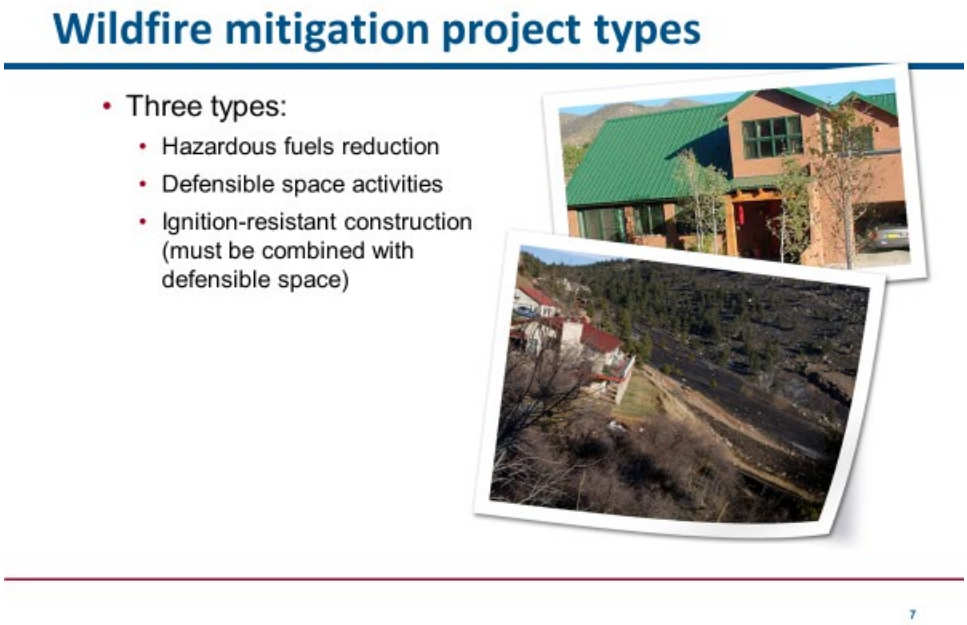
State and local fire hazard maps

- Fire hazard levels for specific locations

Historical fire data

- Longer-term indication of the local fire hazard level

Wildfire mitigation project types

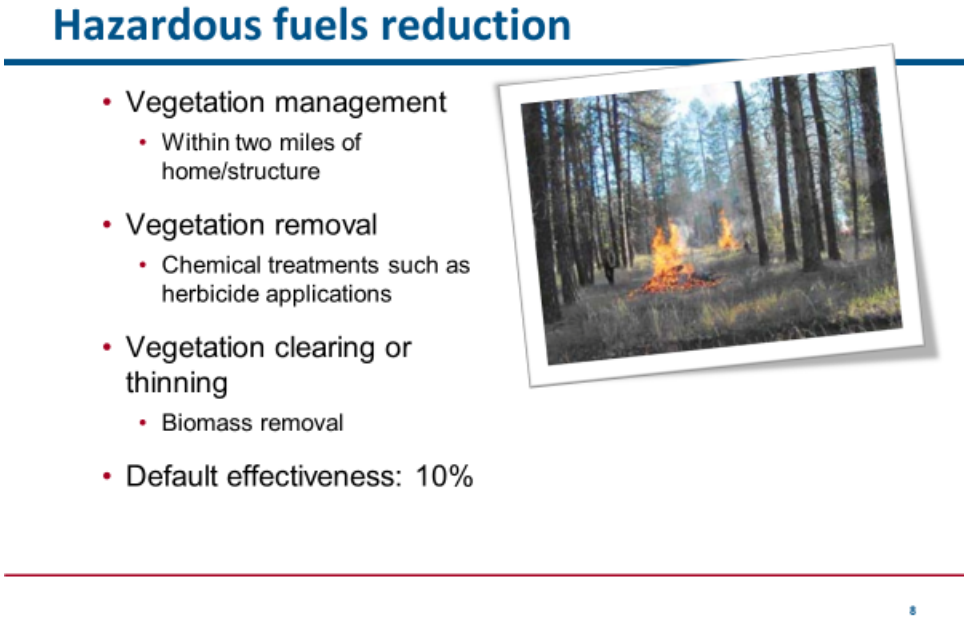


Visual 5: Wildfire mitigation project types

Three types:

- Hazardous fuels reduction
- Defensible space activities
- Ignition-resistant construction (must be combined with defensible space)

Hazardous fuels reduction



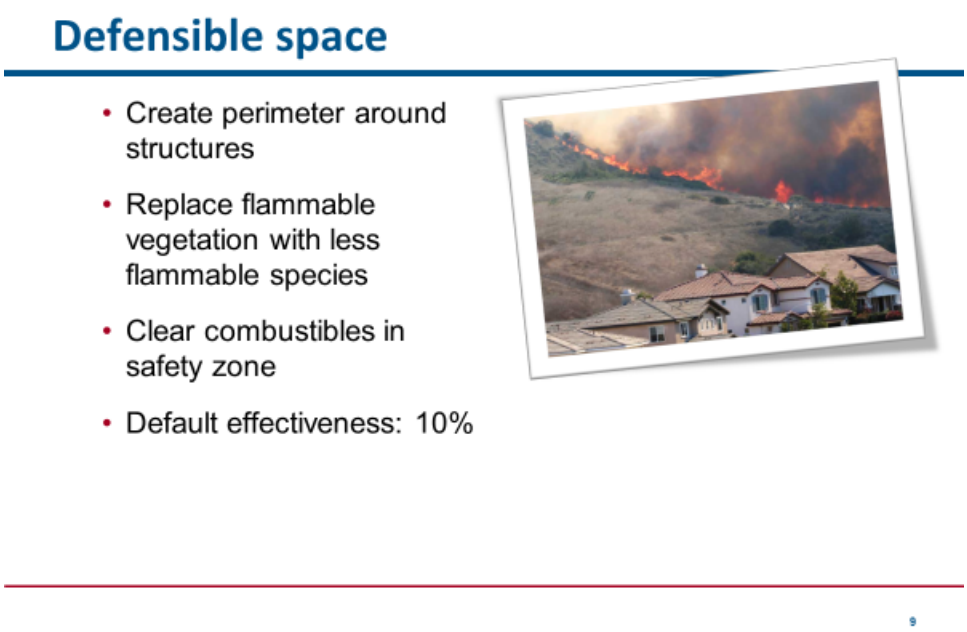
Visual 6: Hazardous fuels reduction

Hazardous fuels reduction can include the following:

- Vegetation management: Within two miles of home/structure
- Vegetation removal: Chemical treatments such as herbicide applications
- Vegetation clearing or thinning
- Biomass removal

The default project effectiveness for hazardous fuels reduction is 10%, meaning that the after-mitigation damages are expected to be 10% less than the before-mitigation damages.

Defensible space



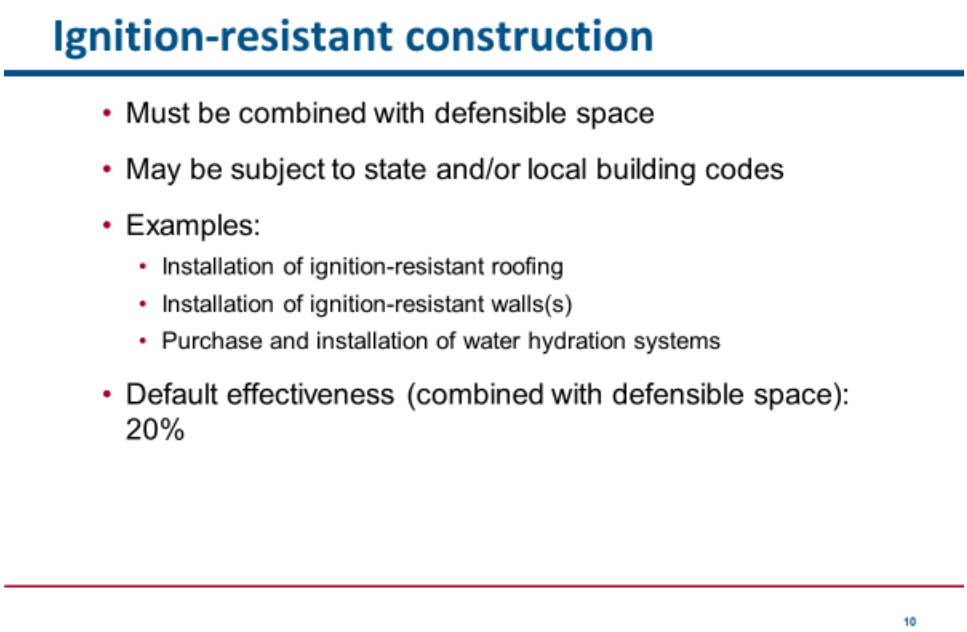
Visual 7: Defensible space

Defensible space projects:

- Create a perimeter around structures
- Replace flammable vegetation with less flammable species
- Clear combustibles in safety zone

The default project effectiveness for defensible space is 10%, meaning that the after-mitigation damages are expected to be 10% less than the before-mitigation damages.

Ignition-resistant construction



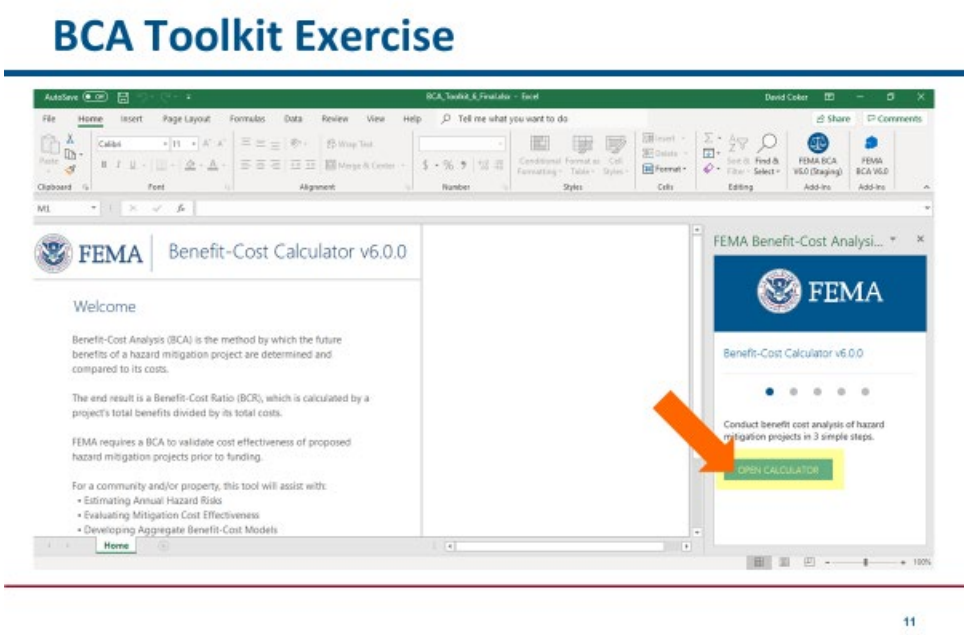
Visual 8: Ignition-resistant construction

Ignition-resistant construction:

- Must be combined with defensible space
- May be subject to state and/or local building codes
- Examples:
    - Installation of ignition-resistant roofing
    - Installation of ignition-resistant walls(s)
    - Purchase and installation of water hydration systems

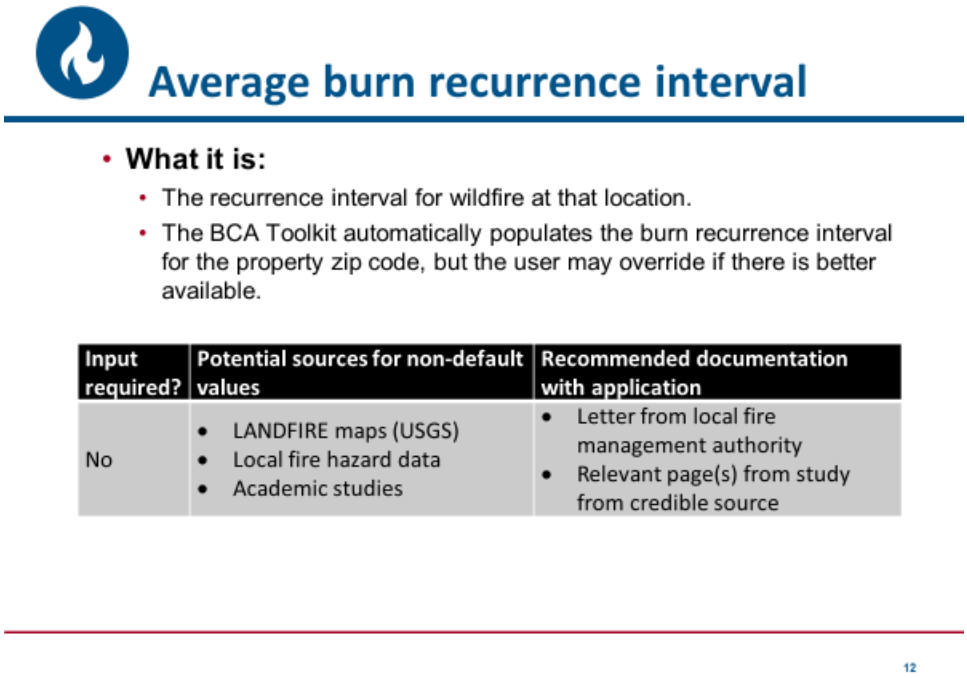
The default project effectiveness for ignition-resistant construction combined with defensible space is 20%, meaning that the after-mitigation damages are expected to be 20% less than the before-mitigation damages.

BCA Toolkit Exercise



We will now show how to complete a wildfire mitigation project in the BCA Toolkit. The following slides describe the data inputs, sources, and documentation requirements.

Average burn recurrence interval



Visual 9: Average burn recurrence interval

What it is:

- The recurrence interval for wildfire at that location.
- The BCA Toolkit automatically populates the burn recurrence interval for the property zip code, but the user may override if there is better available.

Why it's important:

- The burn recurrence interval is a key factor in estimating future losses (i.e. benefits) that would occur without the mitigation project.

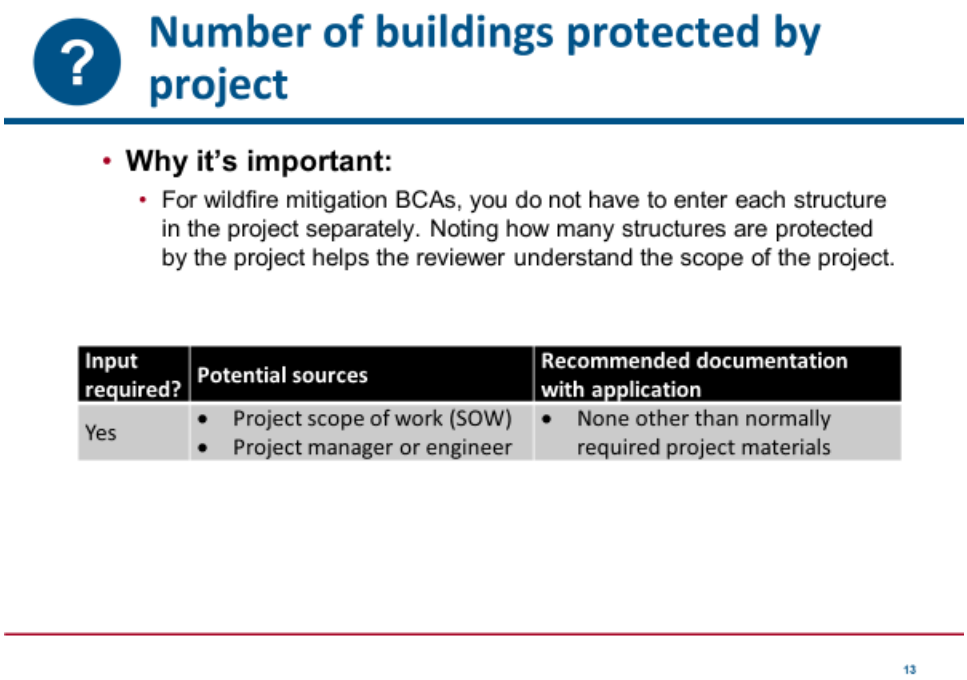
Source(s) for non-default value:

- LANDFIRE maps (USGS)
- Local fire hazard data
- Academic studies

Recommended BCA documentation with application:

- Letter from local fire management authority
- Relevant page(s) from study from credible source

Number of buildings protected by project



Visual 10: Number of buildings protected by project

What it is:

- The number of buildings protected by the wildfire mitigation project.

Why it's important:

- For wildfire mitigation BCAs, you do not have to enter each structure in the project separately. Noting how many structures are protected by the project helps the reviewer understand the scope of the project.

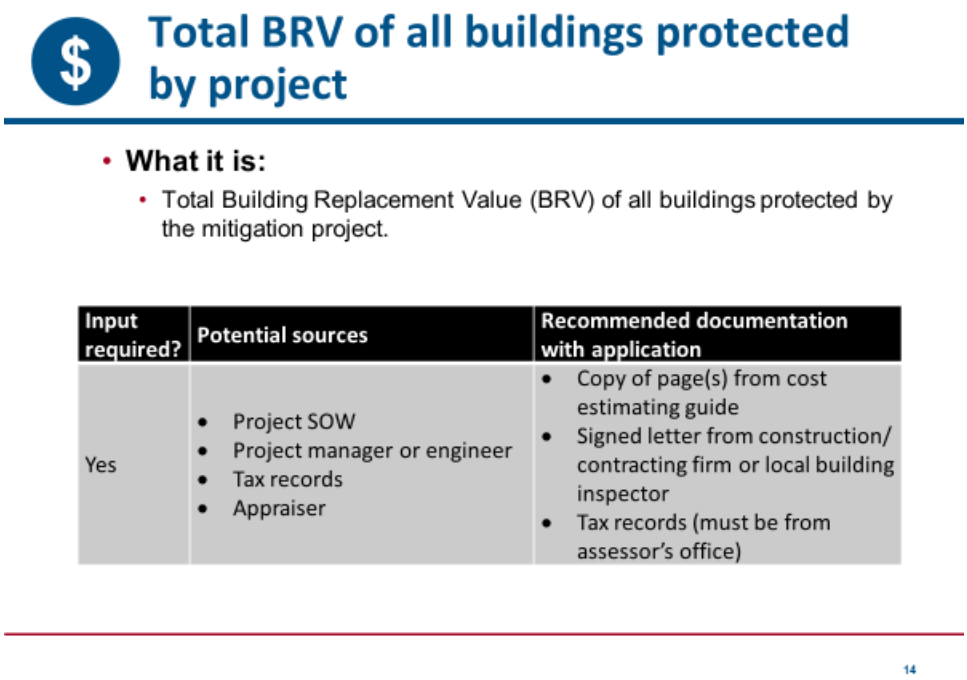
Source(s) for non-default value:

- Project scope of work (SOW)
- Project manager or engineer

Recommended BCA documentation with application:

- None other than normally required project materials

Total BRV of all buildings protected by project



Visual 11: Total BRV of all buildings protected by project

What it is:

- Total Building Replacement Value (BRV) of all buildings protected by the mitigation project.
- You can calculate the total BRV by adding up the square footage of all structures protected by the project and multiplying it by $100/square foot (the default BRV). If you have a higher BRV, you may use that but must document the source.

Why it's important:

- The BCA Toolkit uses the total BRV to determine the amount of losses that would occur without the mitigation project.

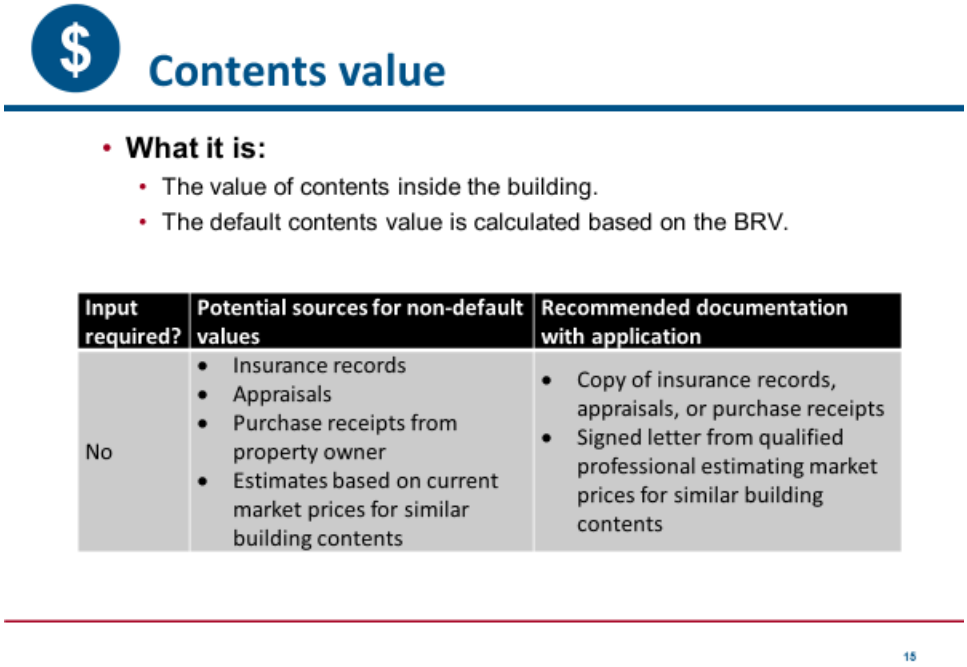
Source(s):

- Project SOW
- Project manager or engineer
- Tax records
- Appraiser

Recommended BCA documentation with application:

- Copy of page(s) from cost estimating guide (if using BRV other than $100/sf)
- Signed letter from construction/ contracting firm or local building inspector
- Tax records (must be from assessor's office)

Contents value



Visual 12: Contents value

What it is:

- The value of contents inside the building.
- The default contents value is calculated based on the BRV.

Why it's important:

- The BCA Toolkit uses the contents value to determine the amount of losses.

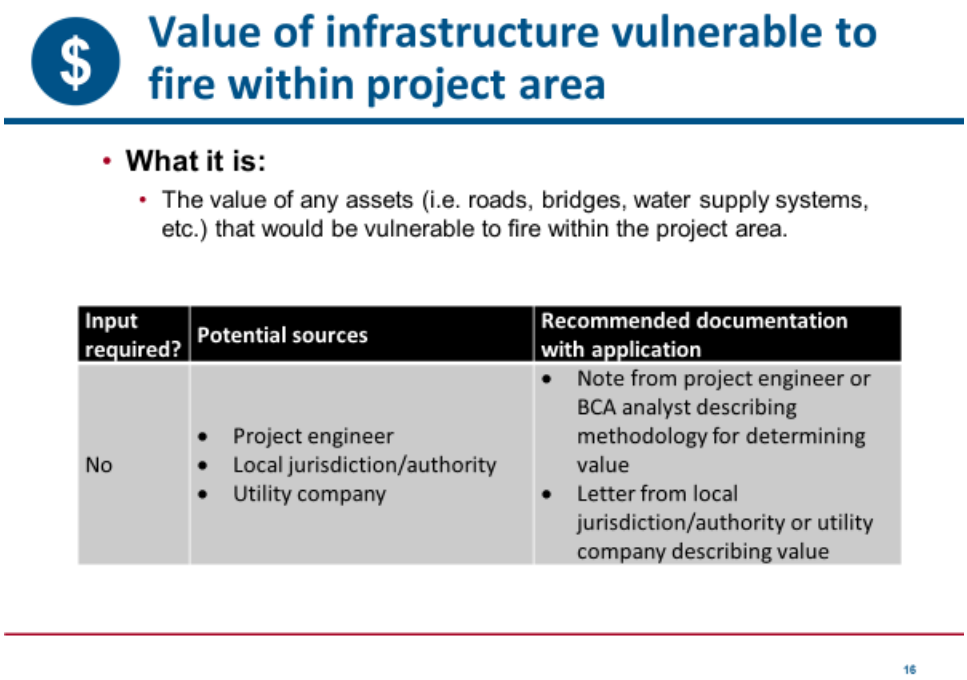
Source(s) for non-default values:

- Insurance records
- Appraisals
- Purchase receipts
- Current market prices for similar building contents

Recommended BCA documentation with application:

- Copy of insurance records, appraisals, or purchase receipts
- Signed letter from qualified professional estimating market prices for similar building contents

Value of infrastructure vulnerable to fire in project area



Visual 13: Value of infrastructure vulnerable to fire in project area

What it is:

- The value of any assets (i.e. roads, bridges, water supply systems, etc.) that would be vulnerable to fire within the project area.

Why it's important:

- The BCA Toolkit uses the value of infrastructure to determine the amount of losses that would occur without the mitigation project.

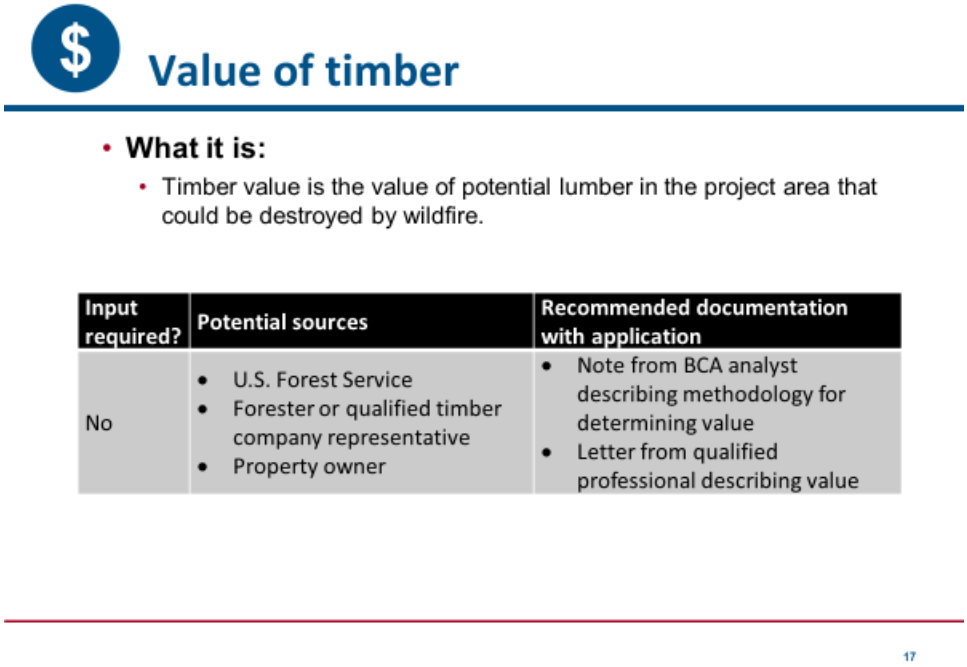
Source(s):

- Project engineer
- Local jurisdiction/authority
- Utility company

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing methodology for determining value
- Letter from local jurisdiction/authority or utility company describing value

Value of timber



Visual 14: Value of timber

What it is:

- Timber value is the value of potential lumber in the project area that could be destroyed by wildfire.

Why it's important:

- The BCA Toolkit uses the value of timber to determine the amount of losses that would occur without the mitigation project.

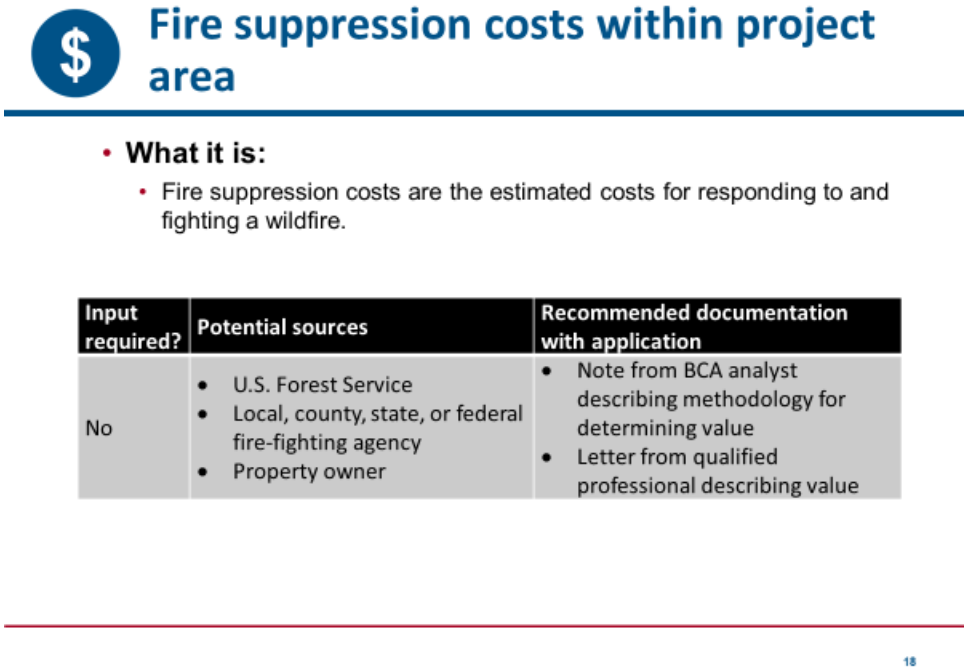
Source(s):

- U.S. Forest Service
- Forester or qualified timber company representative
- Property owner

Recommended BCA documentation with application:

- Note from BCA analyst describing methodology for determining value
- Letter from qualified professional describing value

Fire suppression costs within project area



Visual 15: Fire suppression costs within project area

What it is:

- Fire suppression costs are the estimated costs for responding to and fighting a wildfire.

Why it's important:

- The BCA Toolkit uses fire suppression costs to calculate future costs that could be avoided by the mitigation project.

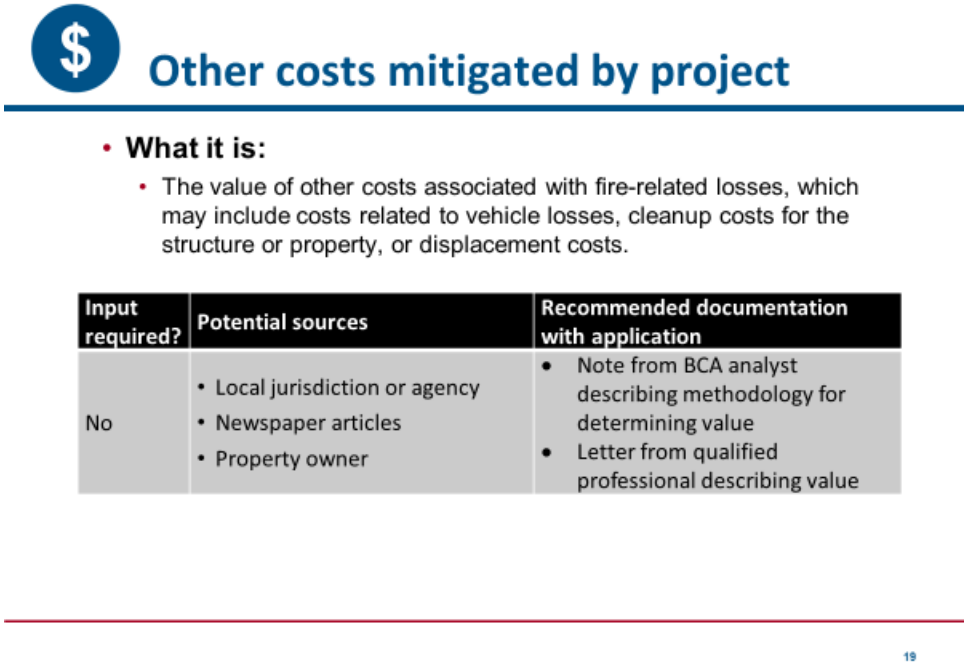
Source(s):

- U.S. Forest Service
- Local, county, state, or federal fire-fighting agency
- Property owner

Recommended BCA documentation with application:

- Note from BCA analyst describing methodology for determining value
- Letter from qualified professional describing value

Other costs mitigated by project



Visual 16: Other costs mitigated by project

What it is:

- The value of other costs associated with fire-related losses, which may include costs related to vehicle losses, cleanup costs for the structure or property, or displacement costs.

Why it's important:

- The BCA Toolkit uses these costs to calculate future costs that could be avoided by the mitigation project.

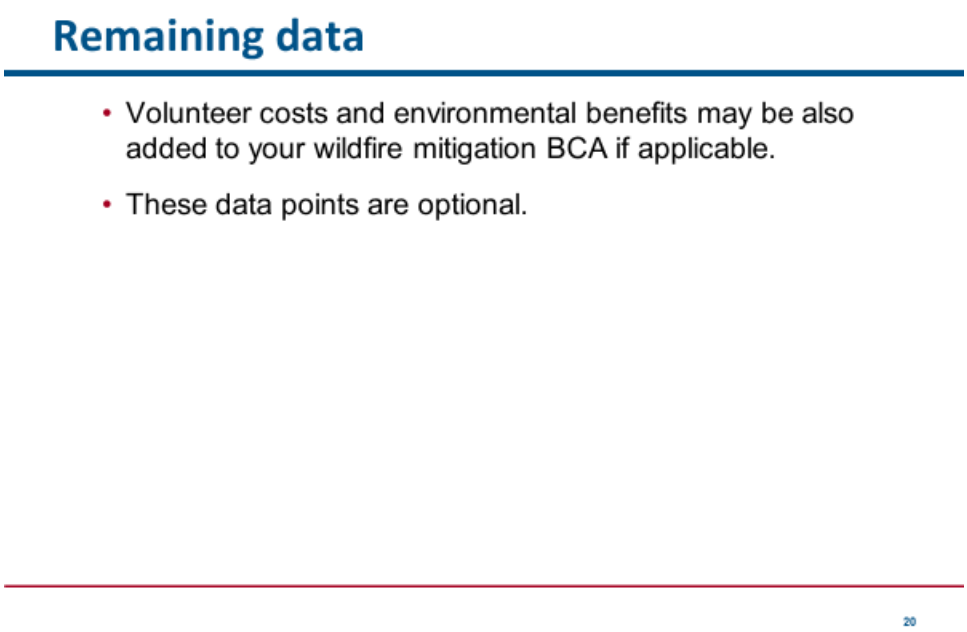
Source(s):

- Local jurisdiction or agency
- Newspaper articles
- Property owner

Recommended BCA documentation with application:

- Note from BCA analyst describing methodology for determining value
- Letter from qualified professional describing value

Remaining data



Visual 17: Remaining data

Volunteer costs and environmental benefits may be also added to your wildfire mitigation BCA if applicable.

To add environmental benefits to your wildfire project, a qualified professional needs to provide a clear explanation (in your project application) of how the proposed work preserves or improves the economic benefits that are counted in the environmental benefits.

These data points are optional.

Seismic mitigation projects

Seismic Mitigation Projects

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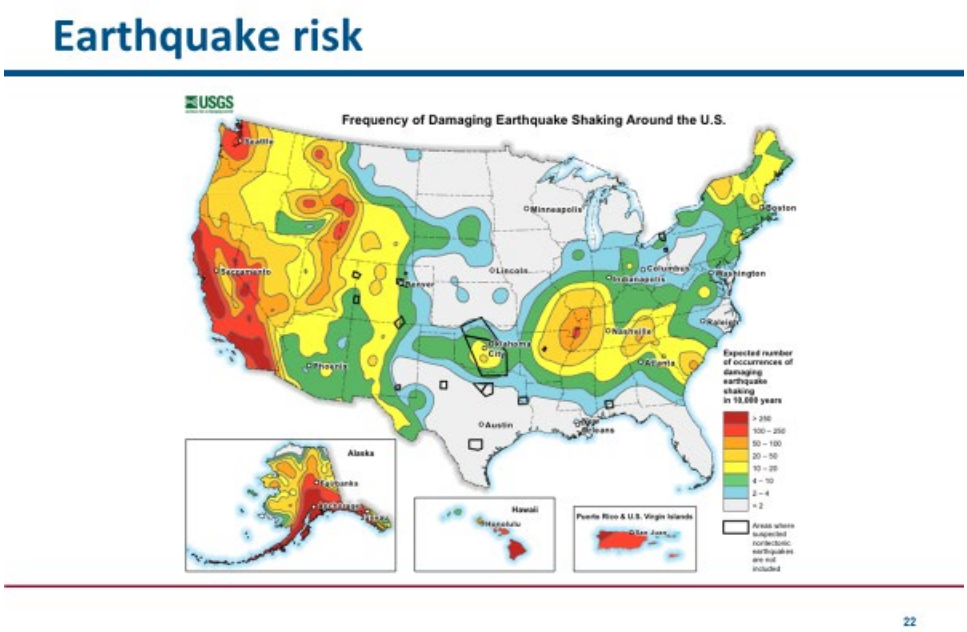
Earthquake risk

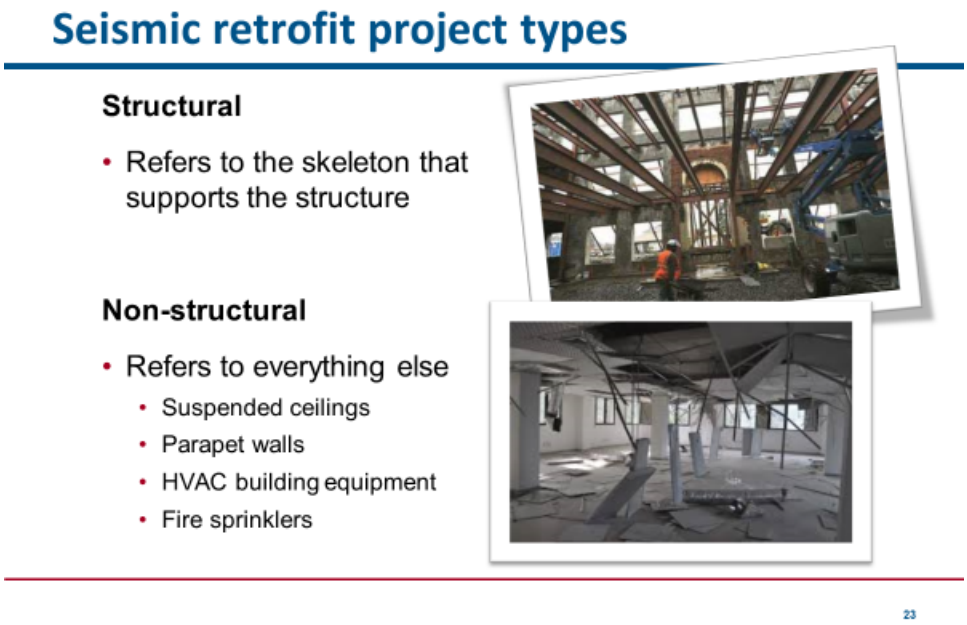


Visual 18: Earthquake risk

The image in the slide shows the earthquake risk in the United States.

Source: United States Geological Survey (USGS)

Seismic retrofit project types



Visual 19: Seismic retrofit project types

Structural

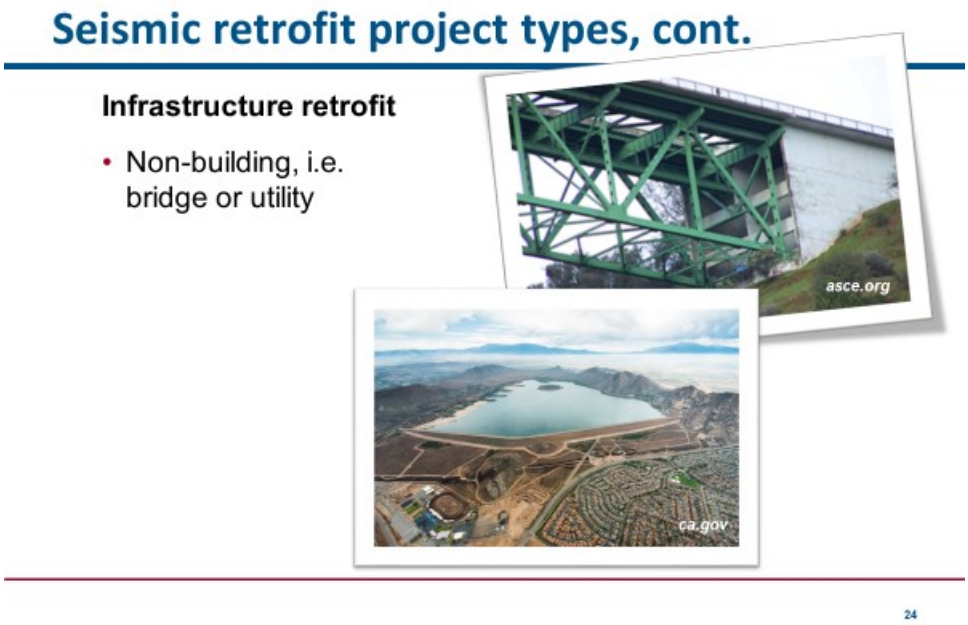
- Refers to the skeleton that supports the structure

Non-structural

- Refers to everything else
  - Suspended ceilings
  - Parapet walls
  - HVAC building equipment
  - Fire sprinklers

This course does not cover the structural seismic retrofit BCAs because they are highly technical.

Seismic retrofit project types



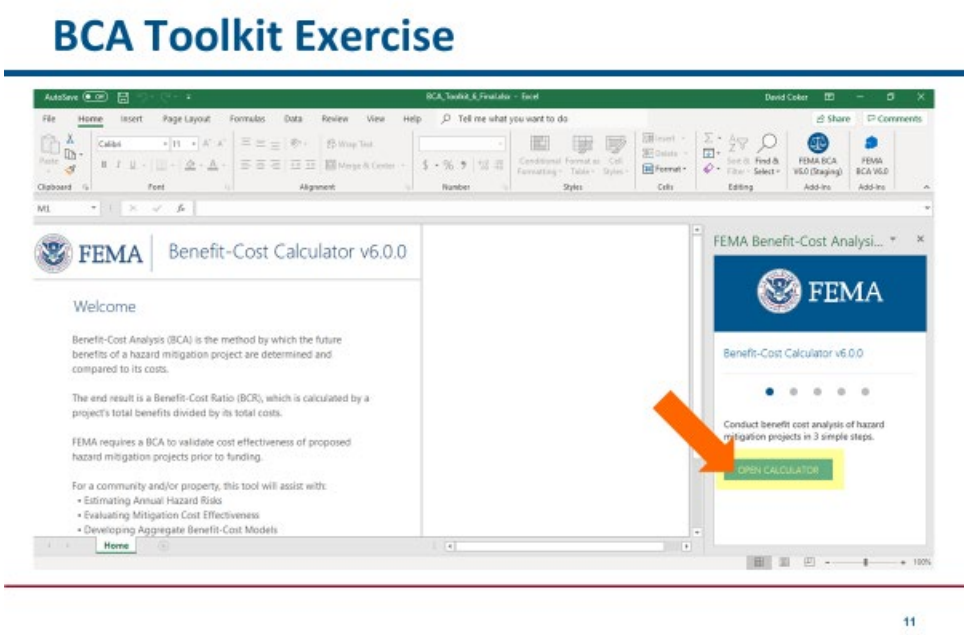
Visual 20: Hurricane wind retrofits , cont.

Infrastructure retrofit

- Non-building, i.e. bridge or utility

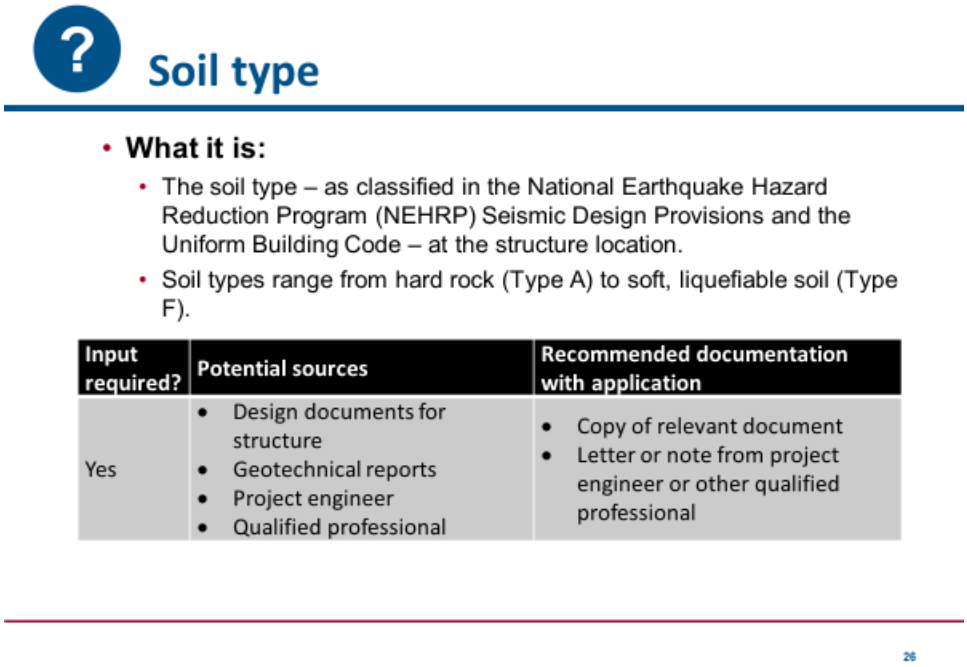
For a seismic infrastructure retrofit, you will either use the Historical Damages or Professional Expected Damages methodology.

BCA Toolkit Exercise



We will now show how to complete a non-structural seismic retrofit BCA in the BCA Toolkit. The following slides show the data inputs, sources, and documentation requirements.

Soil type



Visual 21: Soil type

What it is:

- The soil type – as classified in the National Earthquake Hazard Reduction Program (NEHRP) Seismic Design Provisions and the Uniform Building Code – at the structure location.
- Soil types range from hard rock (Type A) to soft, liquefiable soil (Type F).

Why it's important:

- Ground conditions (soil type) can amplify or de-amplify spectral acceleration depending on the level of ground shaking.

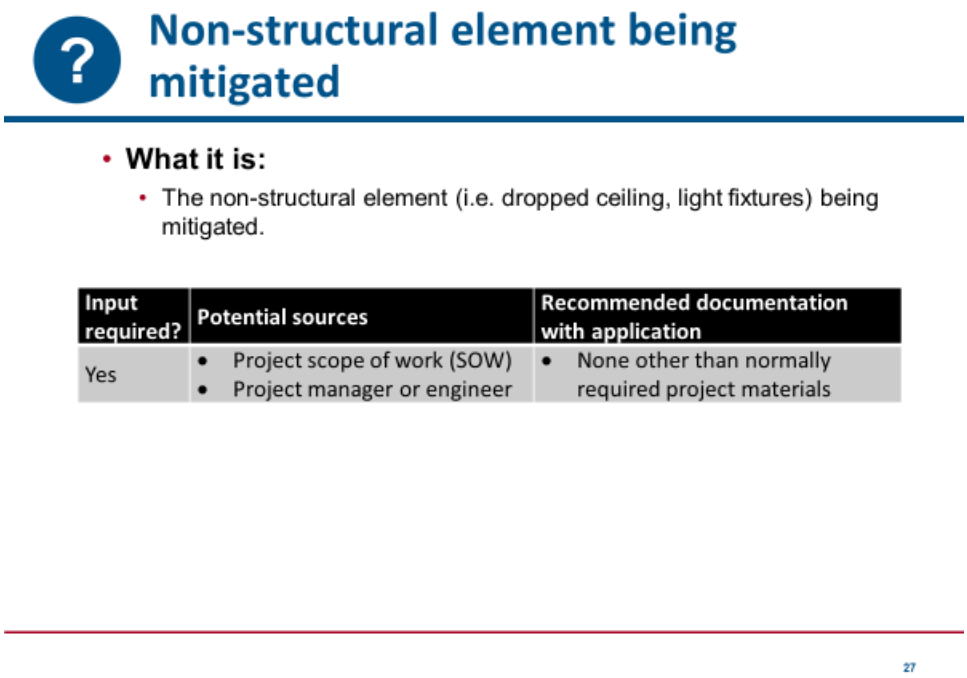
Source(s):

- Design documents for structure
- Geotechnical reports
- Project engineer
- Qualified professional

Recommended BCA documentation with application:

- Copy of relevant document
- Letter or note from project engineer or other qualified professional

Non-structural element being mitigated



Visual 22: Non-structural element being mitigated

What it is:

- The non-structural element (i.e. dropped ceiling, light fixtures) being mitigated.

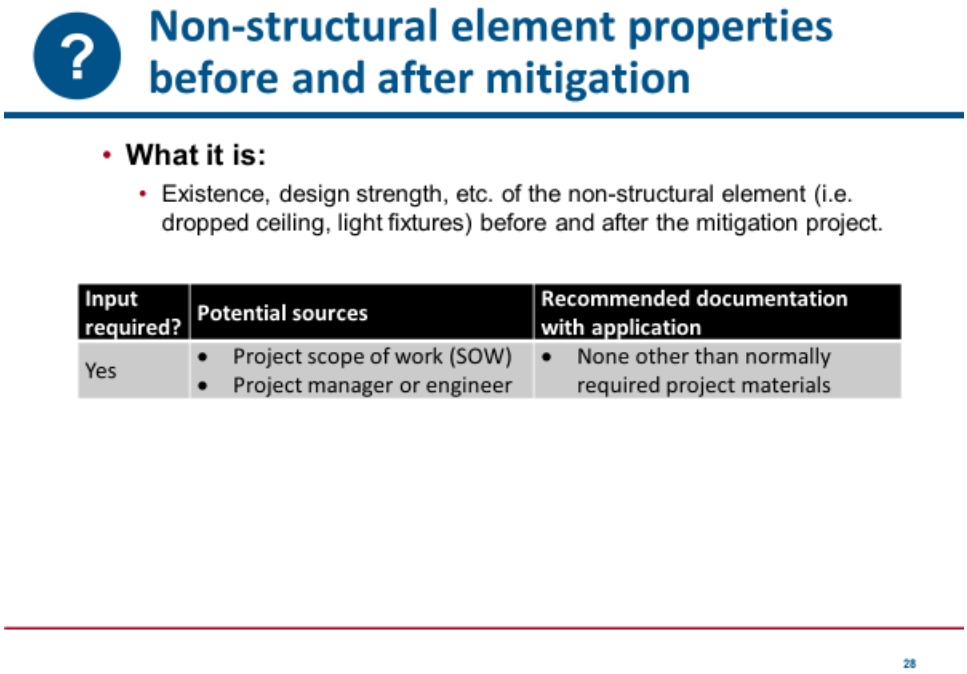
Source(s):

- Project scope of work (SOW)
- Project manager or engineer

Recommended BCA documentation with application:

- None other than normally required project materials

Non-structural element properties before and after mitigation



Visual 23: Non-structural element properties before and after mitigation

What it is:

- Existence, design strength, etc. of the non-structural element (i.e. dropped ceiling, light fixtures) before and after the mitigation project.

Why it's important:

- The BCA Toolkit compares estimated losses before mitigation to estimated losses after mitigation. These are the benefits of the project.

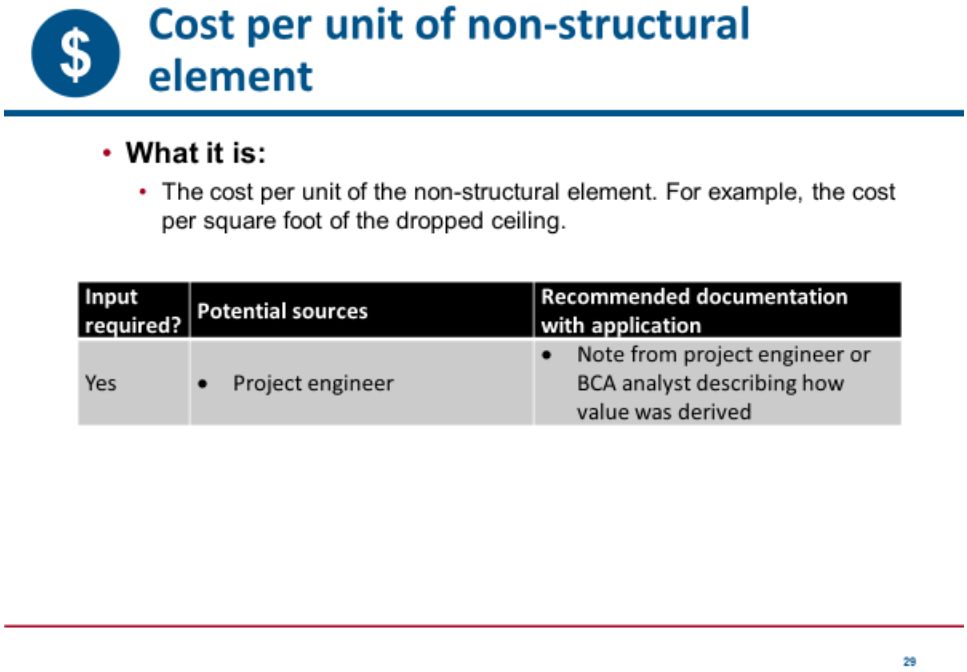
Source(s):

- Project scope of work (SOW)
- Project engineer

Recommended BCA documentation with application:

- None other than normally required project materials

Cost per unit of non-structural element



Visual 24: Cost per unit of non-structural element

What it is:

- The cost per unit of the non-structural element. For example, the cost per square foot of the dropped ceiling.

Why it's important:

- The BCA Toolkit compares estimated losses before mitigation to estimated losses after mitigation. These are the benefits of the project.

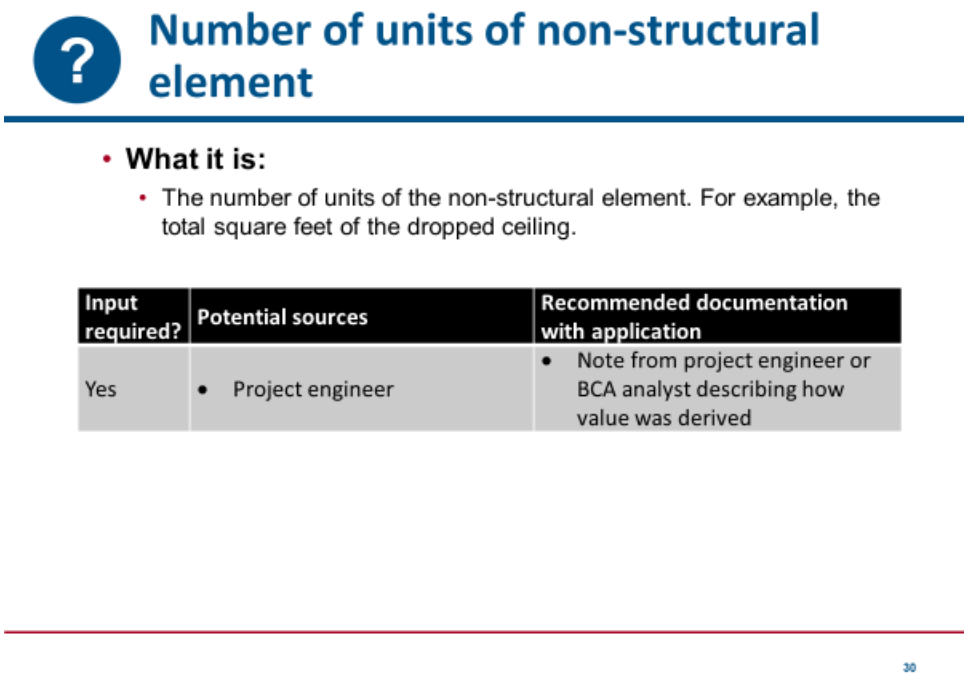
Source(s):

- Project engineer

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived

Number of units of non-structural element



Visual 25: Number of units of non-structural element

What it is:

- The number of units of the non-structural element. For example, the total square feet of the dropped ceiling.

Why it's important:

- The BCA Toolkit compares estimated losses before mitigation to estimated losses after mitigation. These are the benefits of the project.

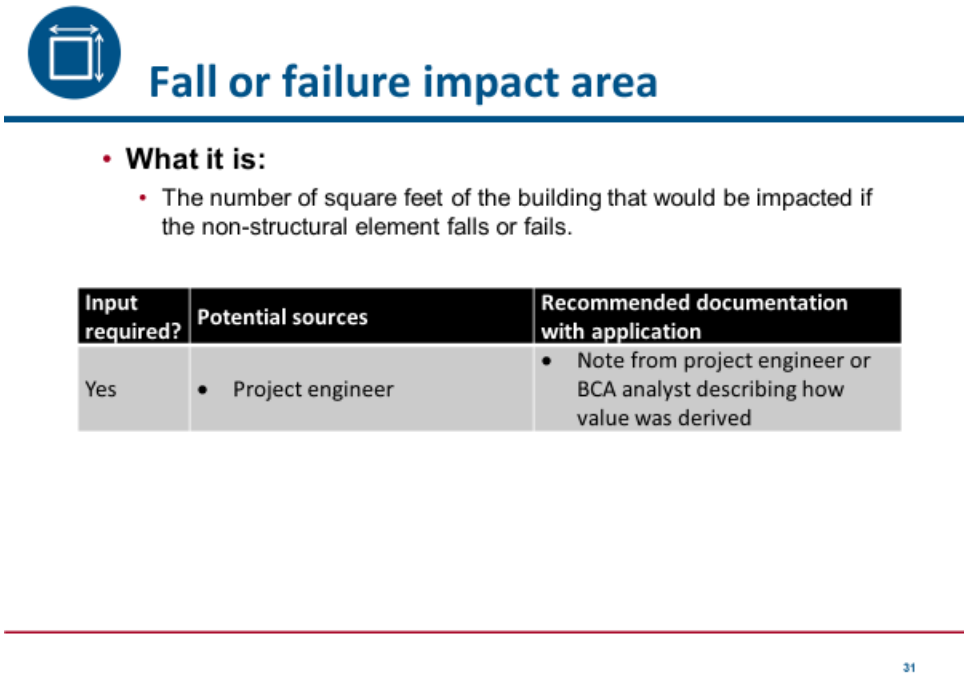
Source(s):

- Project engineer

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived

Fall or failure impact area



Visual 26: Fall or failure impact area

What it is:

- The number of square feet of the building that would be impacted if the non-structural element falls or fails.

Why it's important:

- The BCA Toolkit compares estimated losses before mitigation to estimated losses after mitigation. These are the benefits of the project.

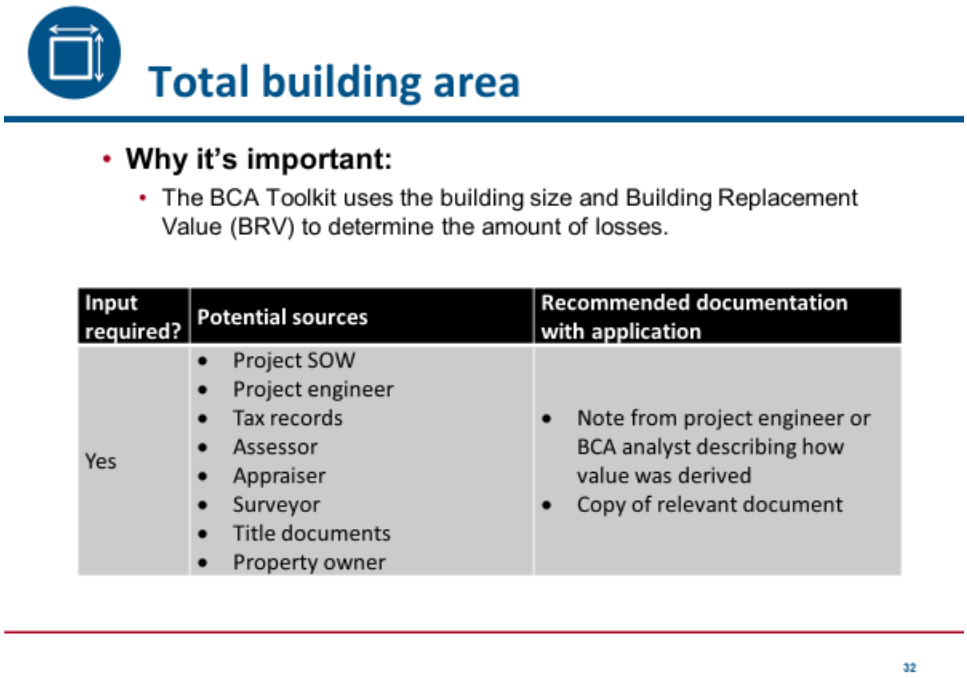
Source(s):

- Project engineer

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived

Total building area



Visual 27: Total building area

What it is:

- The total square footage of the building being mitigated.

Why it's important:

- The BCA Toolkit uses the building size and Building Replacement Value (BRV) to determine the amount of losses.

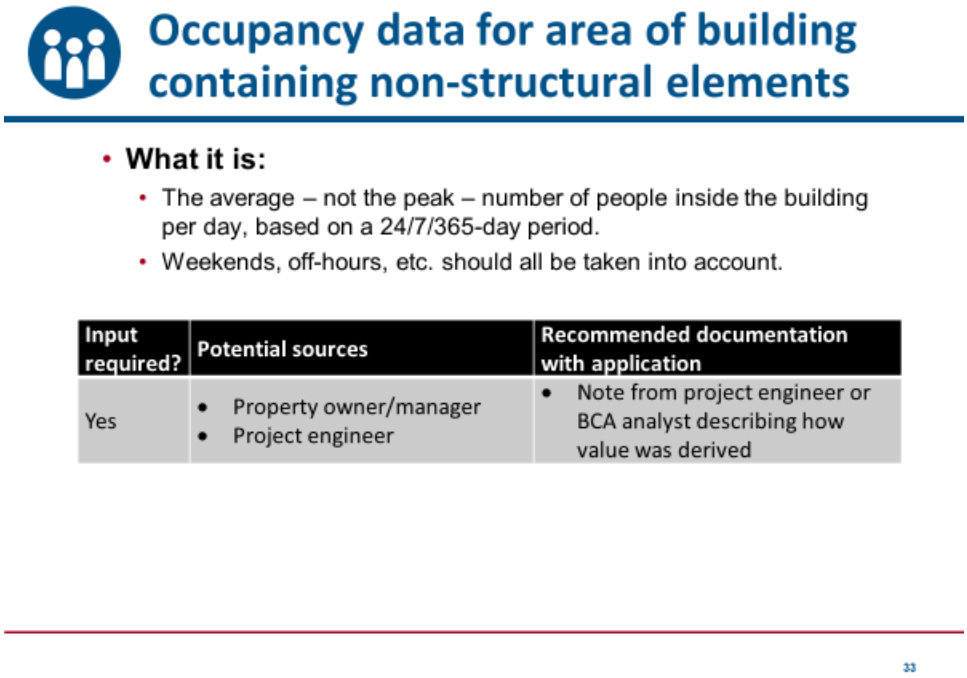
Source(s):

- Project SOW
- Project engineer
- Tax records
- Assessor
- Appraiser
- Surveyor
- Title documents
- Property owner

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived
- Copy of relevant document

Occupancy data for area of building containing non-structural elements



Visual 28: Occupancy data for area of building containing non-structural elements

What it is:

- The average – not the peak – number of people inside the building per day, based on a 24/7/365-day period.
- Weekends, off-hours, etc. should all be taken into account.

Why it's important:

- The average occupancy is used to calculate the estimated casualty rates.

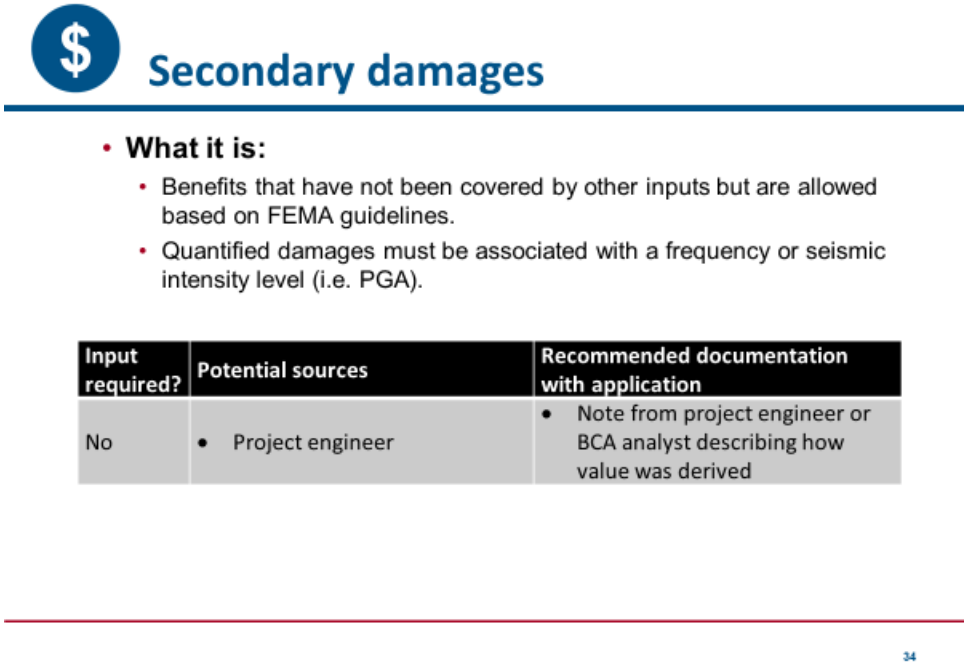
Source(s):

- Property owner/manager
- Project engineer

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived

Secondary damages



Visual 29: Secondary damages

What it is:

- Benefits that have not been covered by other inputs but are allowed based on FEMA guidelines.
- Quantified damages must be associated with a frequency or seismic intensity level (i.e. PGA).

Why it's important:

- Any avoided damages are benefits of the mitigation project.

Source(s):

- Project engineer

Recommended BCA documentation with application:

- Note from project engineer or BCA analyst describing how value was derived

Landslide and Other Catastrophic Failure Mitigation Projects

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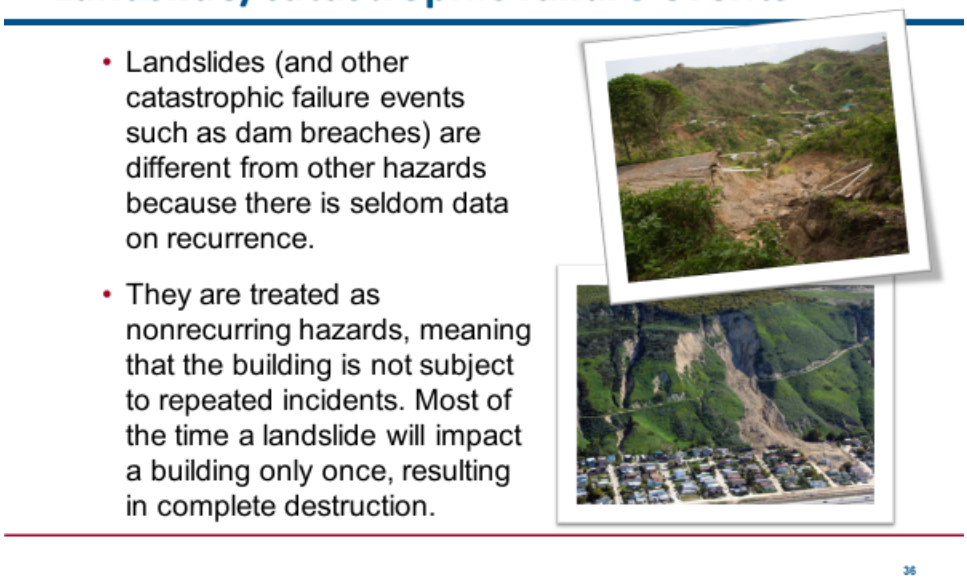
Landslide/catastrophic failure events

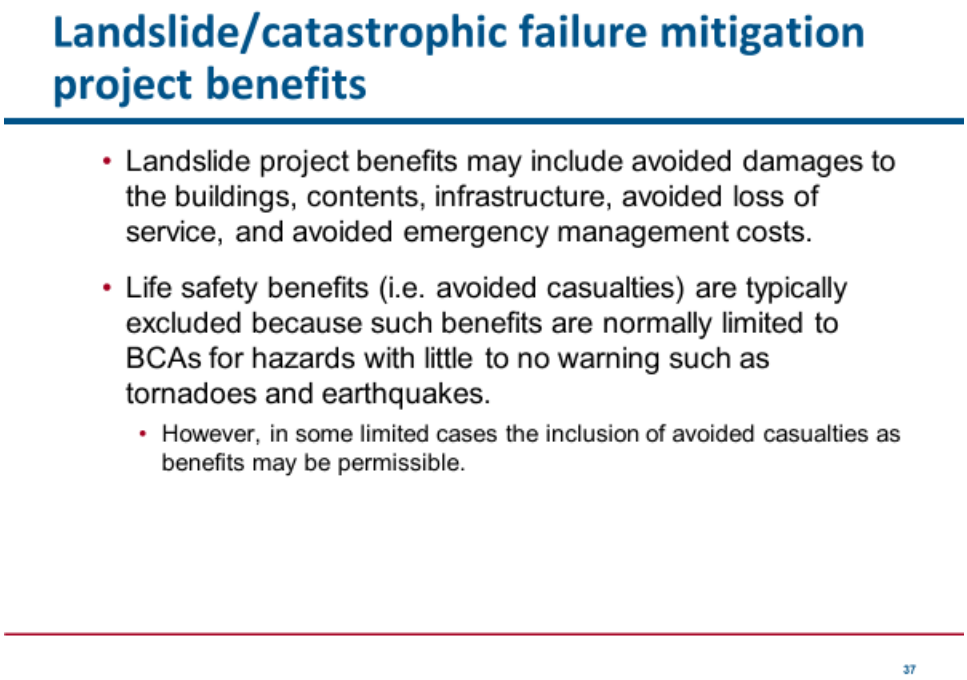


Visual 30: Landslide/catastrophic failure events

Landslides (and other catastrophic failure events such as dam breaches) are different from other hazards because there is seldom data on recurrence.

They are treated as nonrecurring hazards, meaning that the building is not subject to repeated incidents. Most of the time a landslide will impact a building only once, resulting in complete destruction.

Landslide/catastrophic failure mitigation project benefits



Visual 31: Landslide/catastrophic failure mitigation project benefits

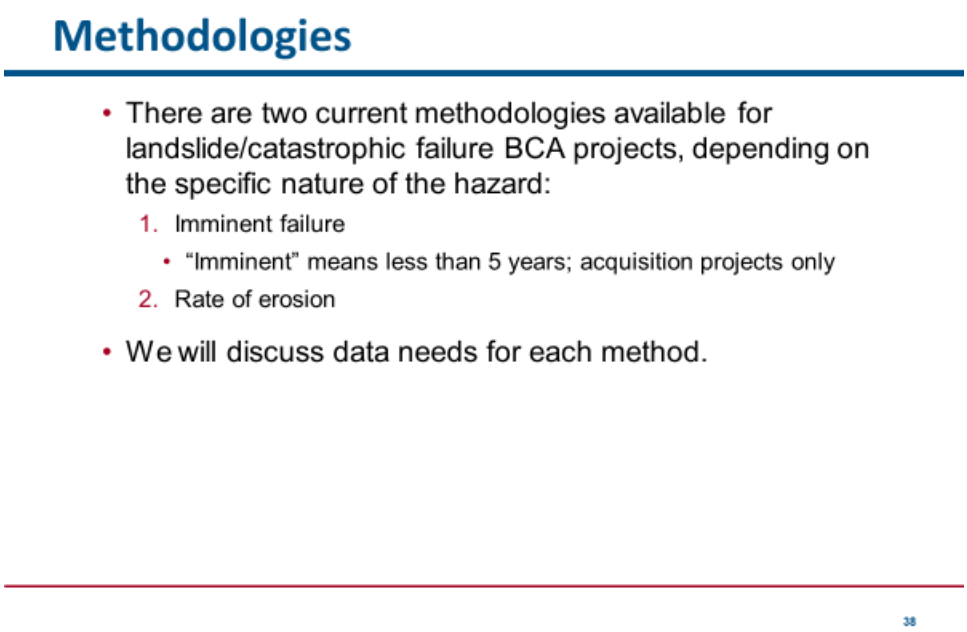
Landslide project benefits may include avoided damages to the buildings, contents, infrastructure, avoided loss of service, and avoided emergency management costs.

An example of an avoided emergency management cost is contamination clean up.

Life safety benefits (i.e. avoided casualties) are typically excluded because such benefits are normally limited to BCAs for hazards with little to no warning such as tornadoes and earthquakes.

However, in some limited cases the inclusion of avoided casualties as benefits may be permissible.

Methodologies



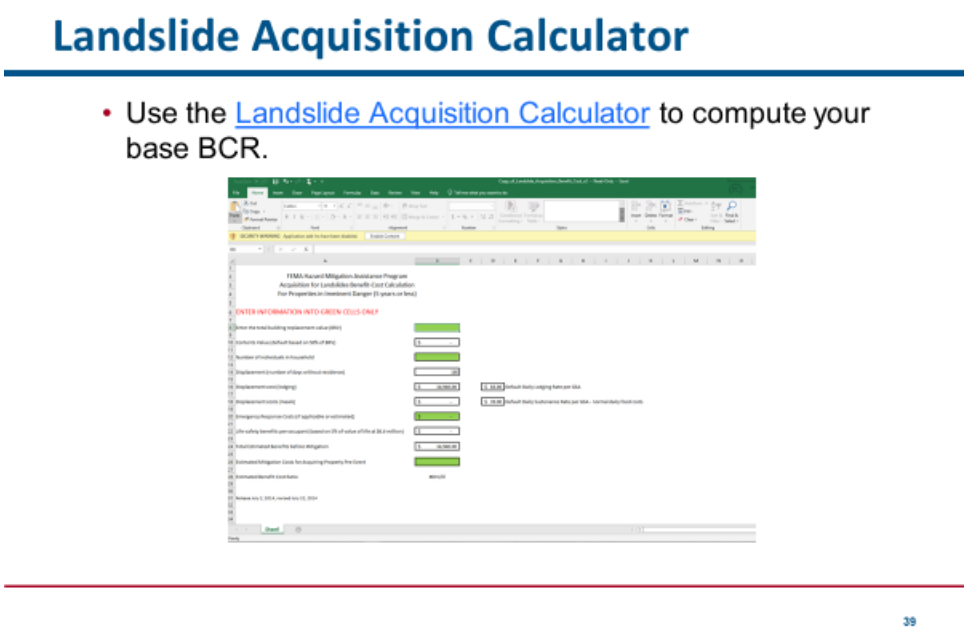
Visual 32: Methodologies

There are two current methodologies available for landslide/catastrophic failure BCA projects, depending on the specific nature of the hazard:

1. Imminent failure: "Imminent" means less than 5 years; acquisition projects only
2. Rate of erosion

We will discuss data needs for each method.

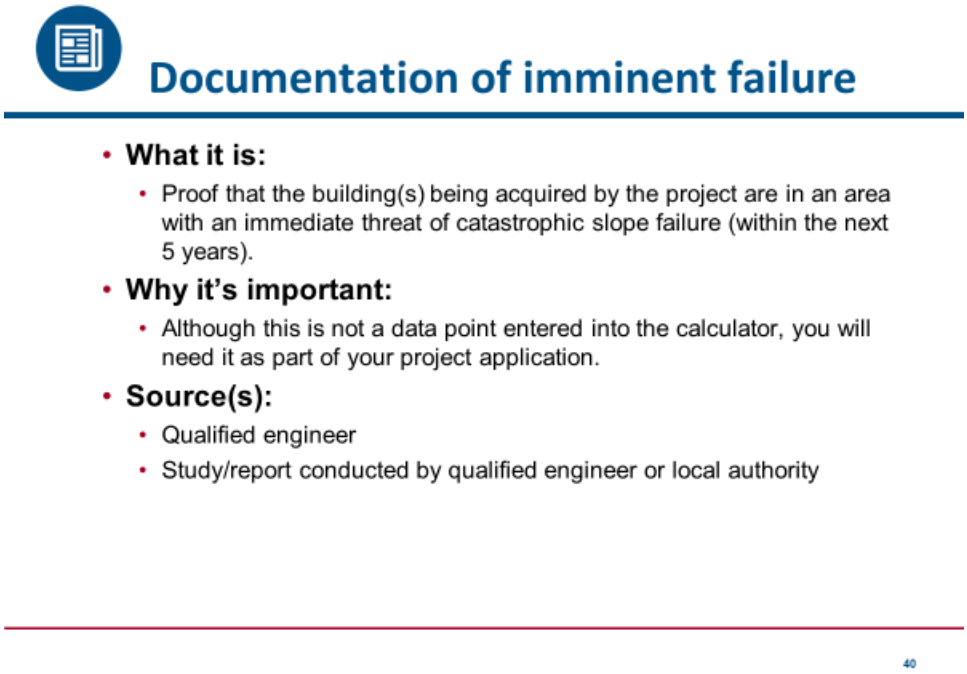
Landslide acquisition calculator



Visual 33: Landslide acquisition calculator

This is for the imminent failure method. Currently you must do this calculation outside the BCA Toolkit, but is planned to be built into future versions of the BCA Toolkit. To assist applicants, FEMA has developed the Landslide Acquisition Calculator.

Documentation of imminent failure



Visual 34: Documentation of imminent failure

What it is:

- Proof that the building(s) being acquired by the project are in an area with an immediate threat of catastrophic slope failure (within the next 5 years).
- This could also be an area with imminent dam failure, etc. It does not have to be landslide.

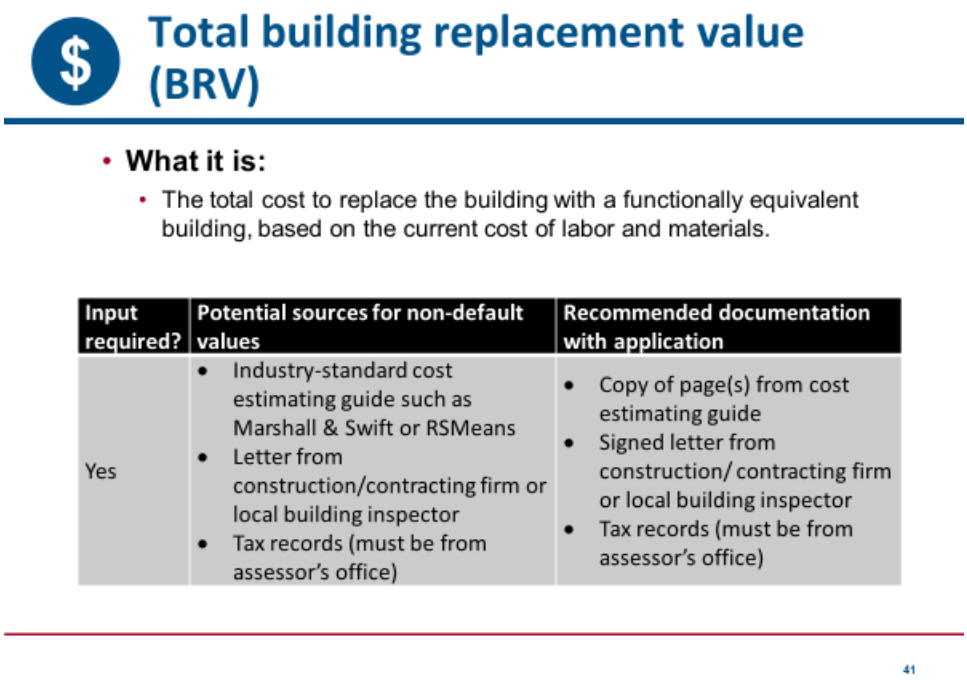
Why it's important:

- Although this is not a data point entered into the calculator, you will need it as part of your project application.

Source(s):

- Qualified engineer
- Study/report conducted by qualified engineer or local authority

Total building replacement value (BRV)



Visual 35: Total BRV

What it is:

- The total cost to replace the building with a functionally equivalent building, based on the current cost of labor and materials.

Why it's important:

- The Landslide Acquisition Calculator uses the total BRV to determine the amount of losses.

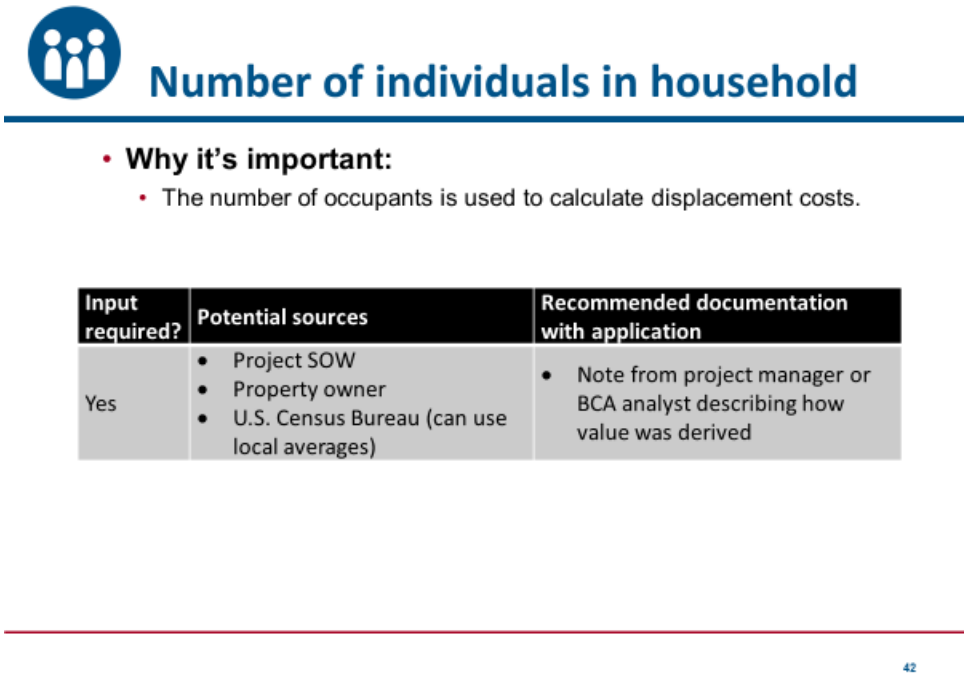
Source(s):

- FEMA standard value = $100/sf (multiply the square feet of the building by 100 to get the total BRV)
- Industry-standard cost estimating guide such as Marshall & Swift or RSMeans
- Letter from construction/contracting firm or local building inspector
- Tax records (must be from assessor's office)

Recommended BCA documentation with application:

- Copy of page(s) from cost estimating guide
- Signed letter from construction/ contracting firm or local building inspector
- Tax records (must be from assessor's office)

Number of individuals in household



Visual 36: Number of individuals in household

Why it's important:

- The number of occupants is used to calculate displacement costs.

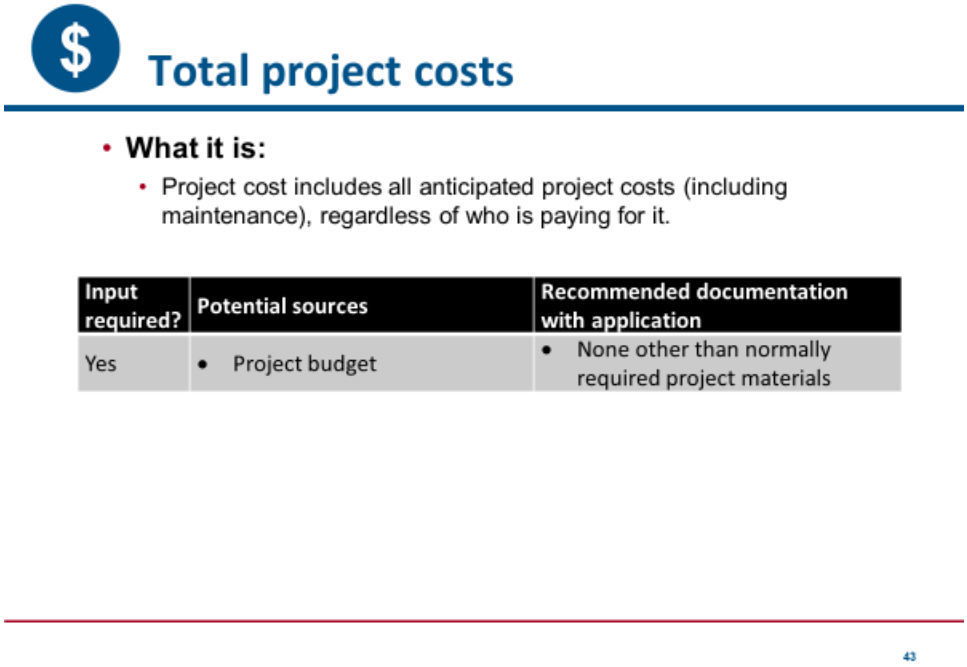
Source(s):

- Project SOW
- Property owner
- U.S. Census Bureau (can use local averages)

Recommended BCA documentation with application:

- Note from project manager or BCA analyst describing how value was derived

Total project costs



Visual 37: Total project costs

What it is:

- Project cost includes all anticipated project costs (including maintenance), regardless of who is paying for it.

Why it's important:

- The project cost is the denominator in the BCR equation. Assuming the benefits remain constant, the higher the project cost, the lower the BCR.

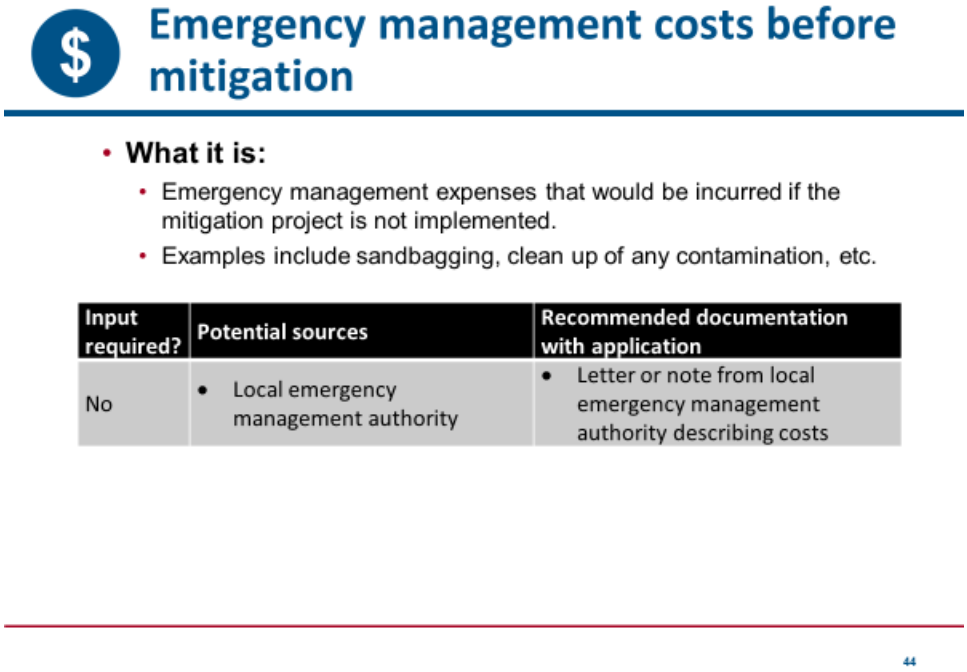
Source(s):

- Project budget

Recommended BCA documentation with application:

- None other than normally required project materials

Emergency management costs before mitigation



Visual 38: Emergency management costs before mitigation

What it is:

- Emergency management expenses that would be incurred if the mitigation project is not implemented.
- Examples include sandbagging, clean up of any contamination, etc.

Why it's important:

- Costs that would be avoided if the project is implemented are benefits of the project.

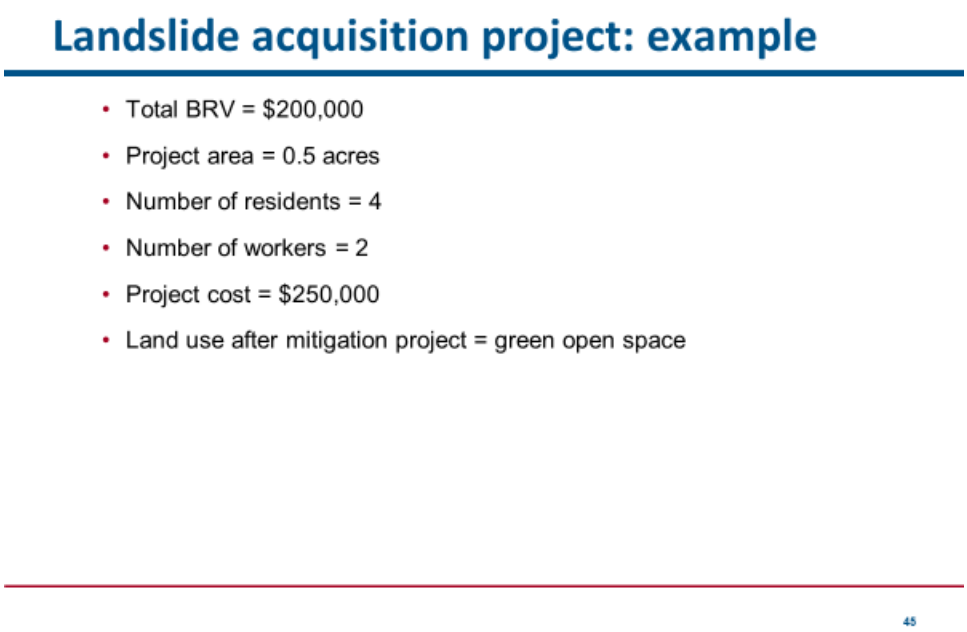
Source(s):

- Local emergency management authority

Recommended BCA documentation with application:

- Letter or note from local emergency management authority describing costs

Landslide acquisition project: example

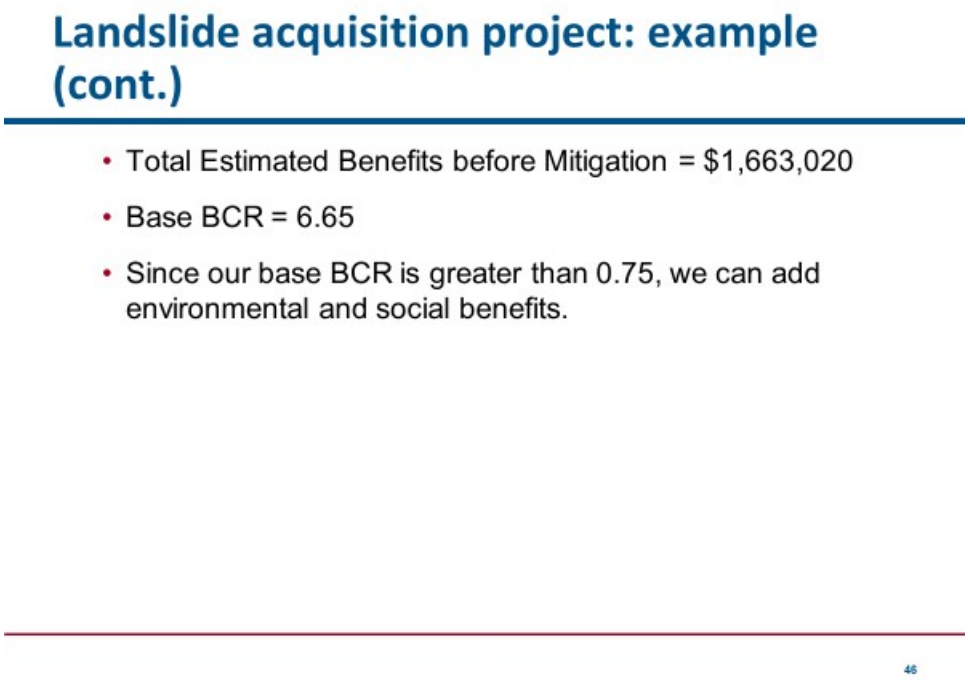


Visual 39: Landslide acquisition project (example)

- Total BRV = $200,000
- Project area = 0.5 acres
- Number of residents = 4
- Number of workers = 2
- Project cost = $250,000
- Land use after mitigation project = green open space

We have shown how to compute the base BCR for a landslide acquisition project using the Landslide Acquisition Calculator spreadsheet. Now we'll show how to add environmental and social benefits, if applicable.

Landslide acquisition project: example



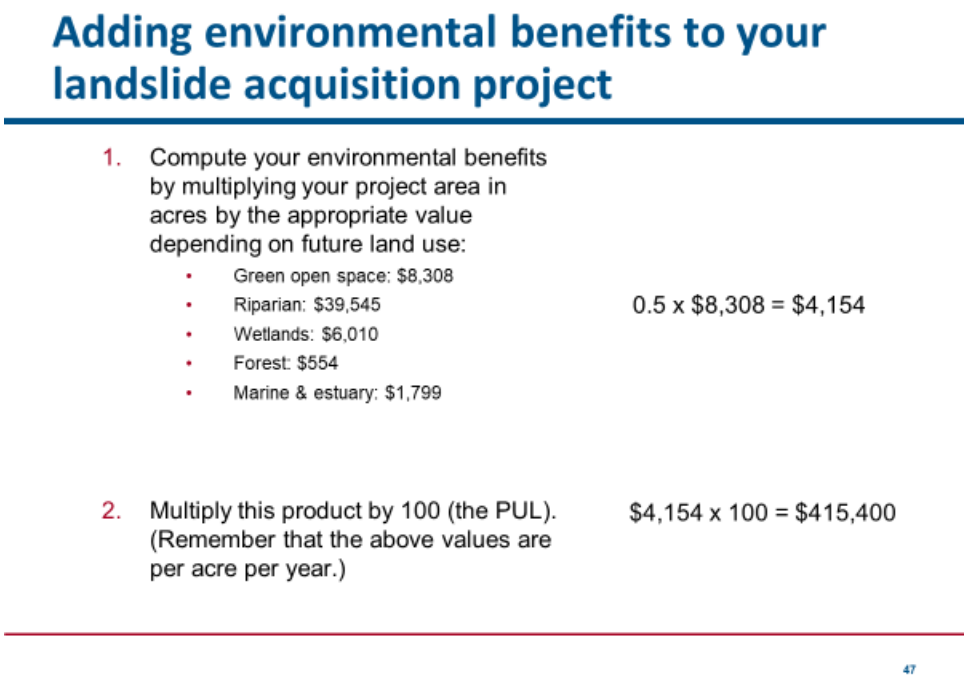
Visual 40: Landslide acquisition project: example (cont.)

Total Estimated Benefits before Mitigation = $1,663,020

Base BCR = 6.65

Since our base BCR is greater than 0.75, we can add environmental and social benefits.

Adding environmental benefits to your landslide acquisition project



Visual 41: Adding environmental benefits to your landslide acquisition project

First, compute your environmental benefits by multiplying your project area in acres by the appropriate value depending on future land use:

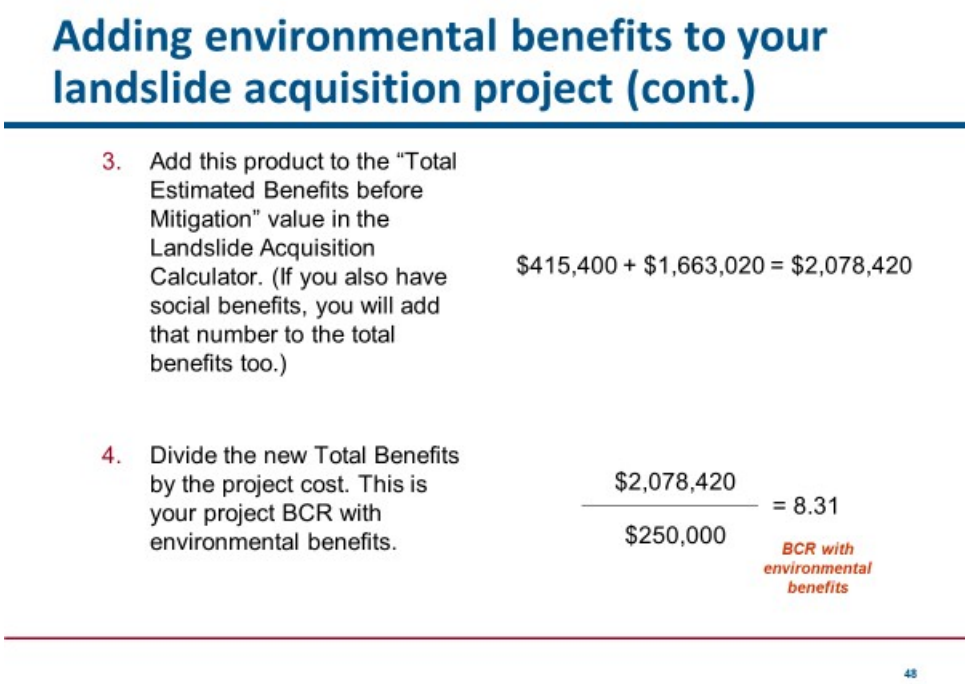
- Green open space: $8,308
- Riparian: $39,545
- Wetlands: $6,010
- Forest: $554
- Marine & estuary: $1,799

$$0.5 * \$8{,}308 = \$4{,}154$$

Then, multiply this product by 100 (the PUL). (Remember that the above values are per acre per year.)

$$\$4{,}154 * 100 = \$415{,}400$$

Adding environmental benefits to your landslide acquisition project



Visual 42: Adding environmental benefits to your landslide acquisition project (cont.)

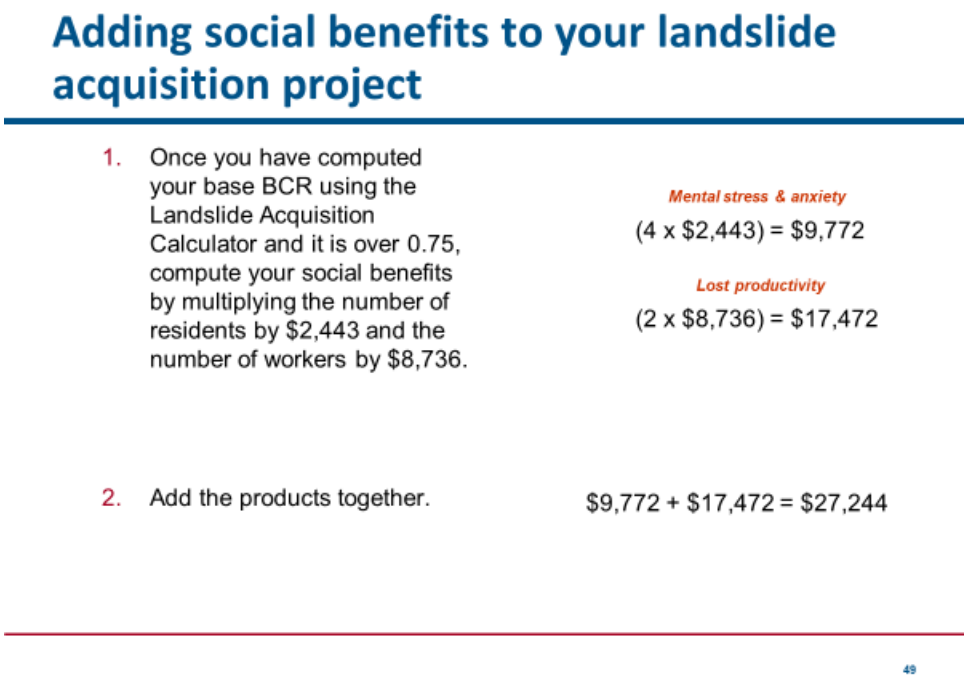
Third, add this product to the "Total Estimated Benefits before Mitigation" value in the Landslide Acquisition Calculator. (If you also have social benefits, you will add that number to the total benefits too.)

$$\$415{,}400 + \$1{,}663{,}020 = \$2{,}078{,}420$$

Fourth, divide the new Total Benefits by the project cost. This is your project BCR with environmental benefits.

$$\frac{\$2{,}078{,}420}{\$250{,}000} = 8.31$$

Adding social benefits to your landslide acquisition project



Visual 43: Adding social benefits to your landslide acquisition project

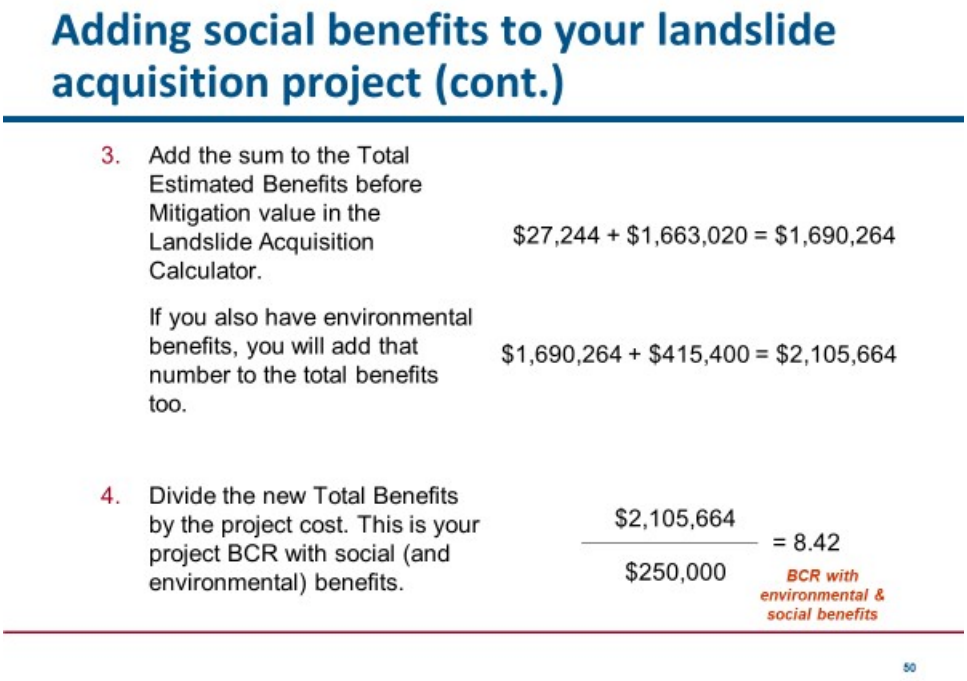
First, once you have computed your base BCR using the Landslide Acquisition Calculator and it is over 0.75, compute your social benefits by multiplying the number of residents by $2,443 and the number of workers by $8,736.

$$4 * \$2{,}443 = \$9{,}772$$
$$2 * \$8{,}736 = \$17{,}472$$

Then, add the products together.

$$\$9{,}772 + \$17{,}472 = \$27{,}244$$

Adding social benefits to your landslide acquisition project



Visual 44: Adding social benefits to your landslide acquisition project (cont.)

Third, add the sum to the Total Estimated Benefits before Mitigation value in the Landslide Acquisition Calculator.

$$\$27{,}244 + \$1{,}663{,}020 = \$1{,}690{,}264$$

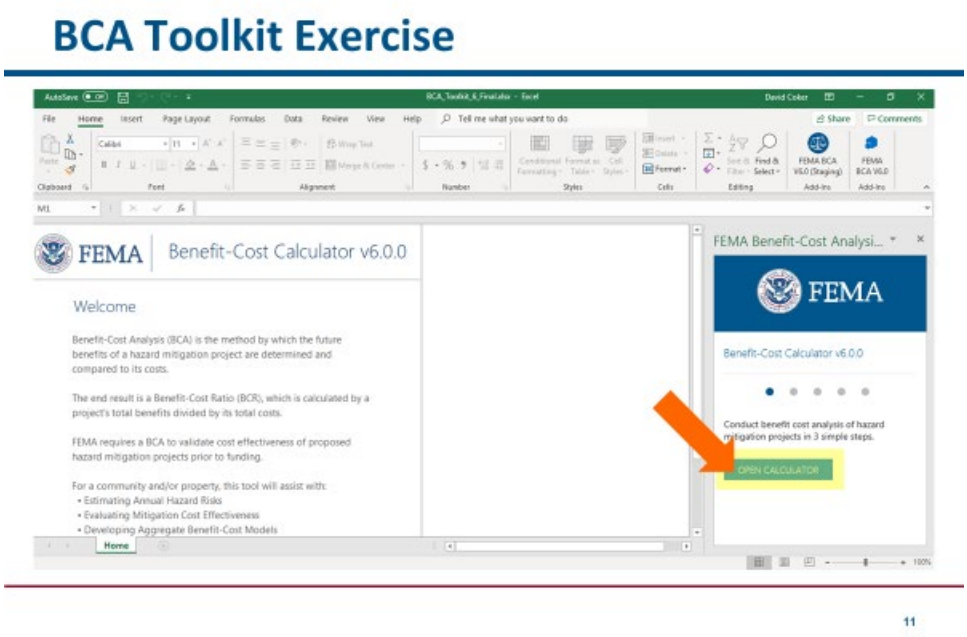
If you also have environmental benefits, you will add that number to the total benefits too.

$$\$1{,}690{,}264 + \$415{,}400 = \$2{,}105{,}664$$

Fourth, divide the new Total Benefits by the project cost. This is your project BCR with environmental and social benefits.

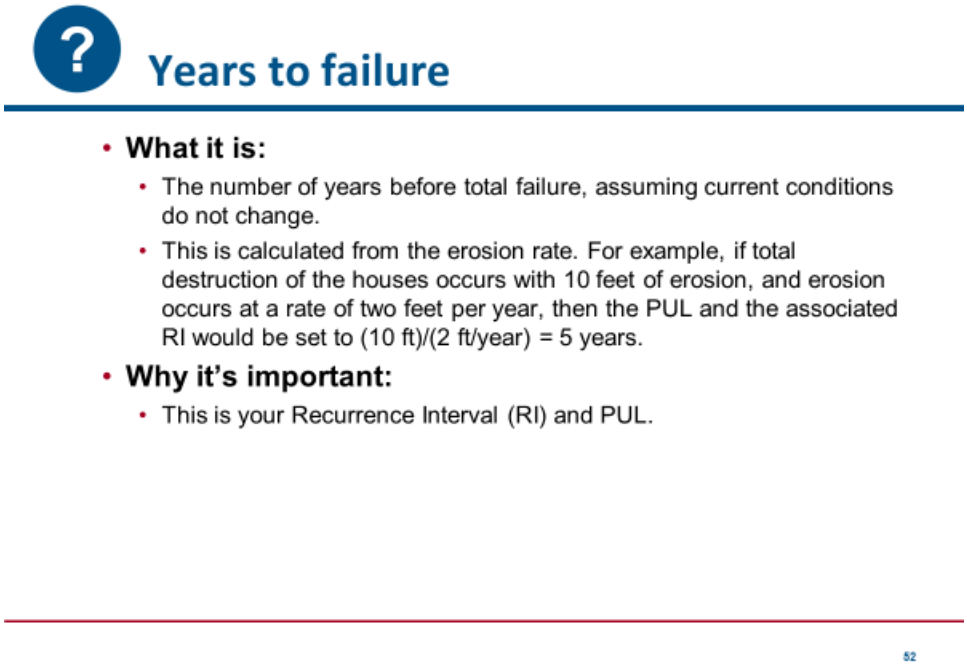
$$\frac{\$2{,}105{,}664}{\$250{,}000} = 8.42$$

BCA Toolkit Exercise



Now we will show how to use the rate of erosion to perform a BCA for a landslide or other catastrophic failure project. Since the damage to the property has not occurred yet, we'll be using the Professional Expected Damages option.

Years to failure



Visual 45: Years to failure

The main piece of data you'll need is the years to failure, which is calculated from the erosion rate.

What it is:

- The number of years before total failure of the building(s), assuming current conditions do not change. This is calculated from the erosion rate. For example, if total destruction of the houses occurs with 10 feet of erosion, and erosion occurs at a rate of two feet per year, then the PUL and the associated RI would be set to (10 ft)/(2 ft/year) = 5 years.

Why it's important:

- This is your Recurrence Interval (RI) and PUL.

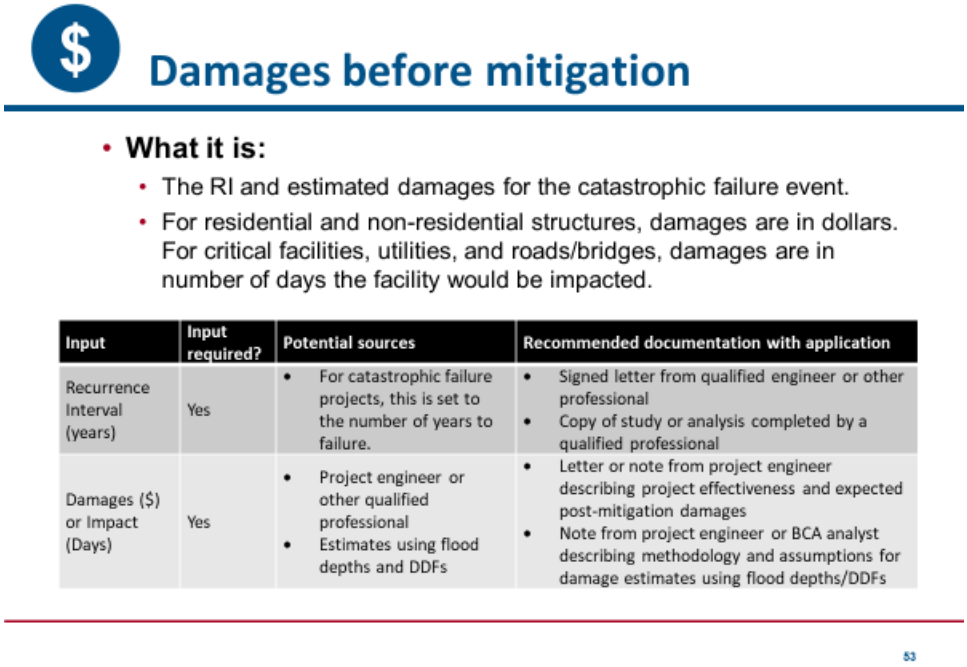
Source(s):

- Qualified engineer or other professional

Recommended BCA documentation with application:

- Signed letter from qualified engineer or other professional
- Copy of study or analysis completed by a qualified professional

Damages before mitigation



Visual 46: Damages before mitigation

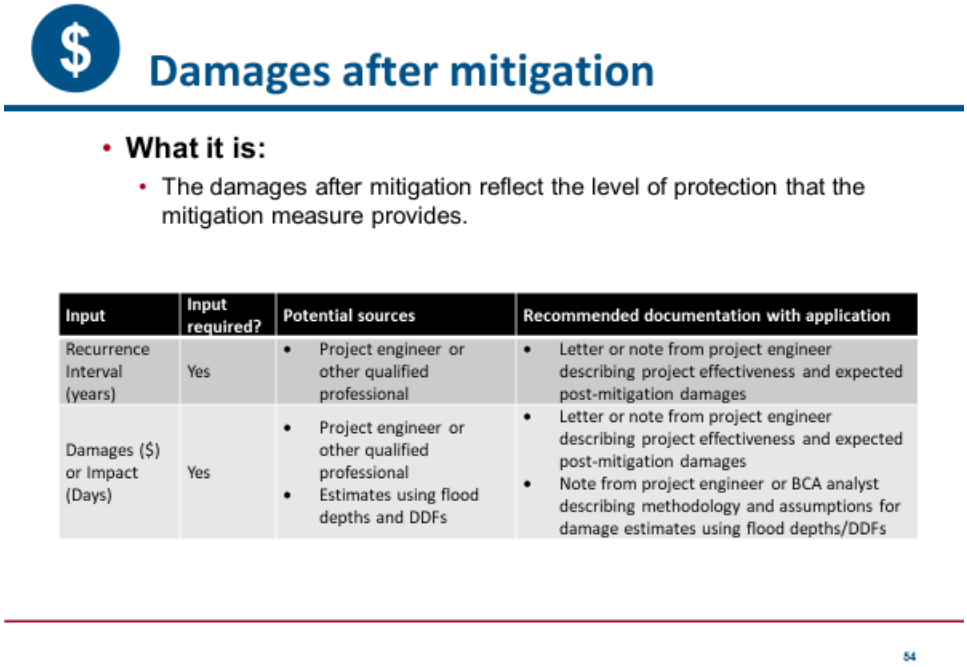
What it is:

- The RI and estimated damages for the catastrophic failure event. For catastrophic failure projects, the RI is set to the number of years to failure.
- For residential and non-residential structures, damages are in dollars. For critical facilities, utilities, and roads/bridges, damages are in number of days the facility would be impacted.

Why it's important:

- The BCA Toolkit uses the before-mitigation damage data to estimate future damages that would be avoided by the mitigation project (i.e., the benefits).

Damages after mitigation



Visual 47: Damages after mitigation

What it is:

- Recall that only acquisition projects are 100% effective. All other project types will have some damages after mitigation.
- A stabilization project, for example, will have after-mitigation damages based on a reduced erosion rate or protection up to a particular recurrence interval.
- For non-residential structures, the after-mitigation damages will be in number of days the service is expected to be down. Likewise, the number of days of lost service should be lower after mitigation, up to the level of protection.

Why it's important:

- The BCA Toolkit uses project effectiveness to estimate damages after mitigation.

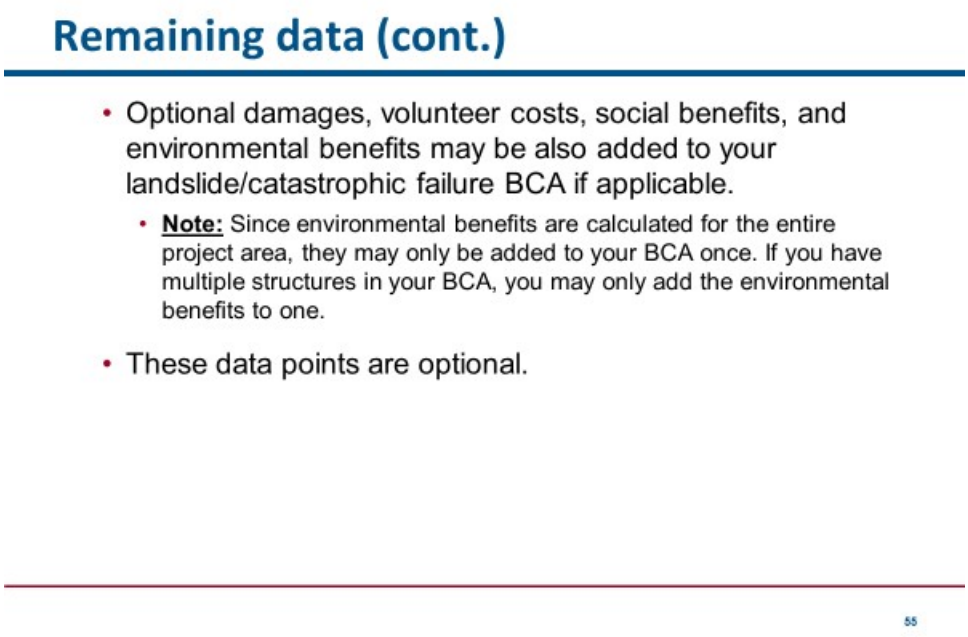
Source(s):

- H&H study
- Project engineer or other qualified professional
- For residential structures, we can use DDFs to estimate these damage amounts, but the difference is that for the after-mitigation damages, we need to know the recurrence interval for the flood depths. For a flood control project, the flood depths for the same recurrence interval should be lower after mitigation, at least up to the level of protection. (Otherwise, the mitigation project is not effective!)

Recommended BCA documentation with application:

- Letter or note from project engineer describing project effectiveness and expected post-mitigation damages
- Relevant page(s) from H&H study
- Note from project engineer or BCA analyst describing methodology and assumptions for damage estimates using flood depths/DDFs

Remaining data



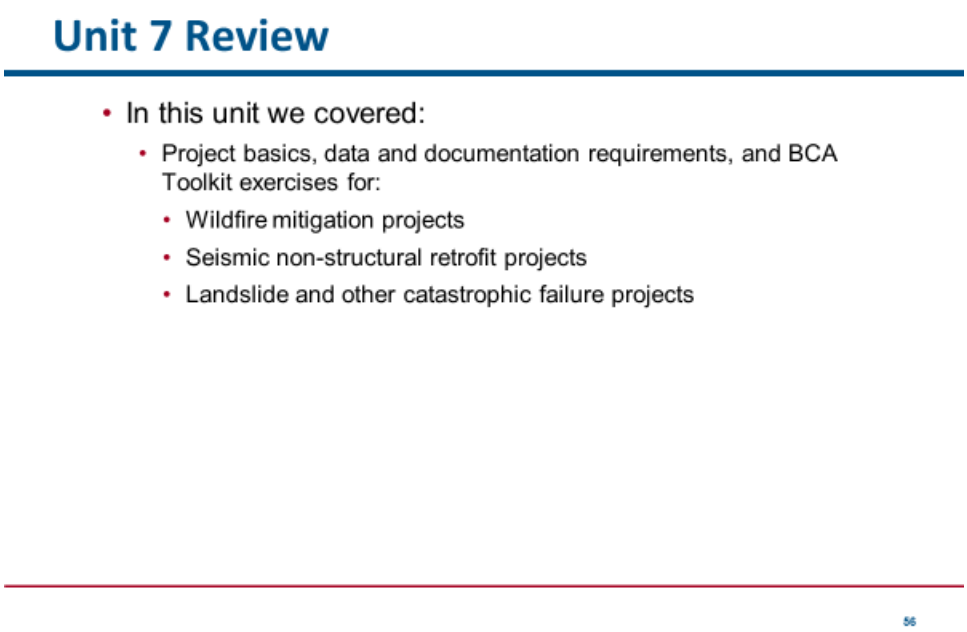
Visual 48: Remaining data (cont.)

Optional damages, volunteer costs, social benefits, and environmental benefits may be also added to your landslide/catastrophic failure BCA if applicable.

Note: Since environmental benefits are calculated for the entire project area, they may only be added to your BCA once. If you have multiple structures in your BCA, you may only add the environmental benefits to one.

These data points are optional.

Unit 7 Review



Visual 49: Unit 7 Review

In this unit we covered:

- Project basics, data and documentation requirements, and BCA Toolkit exercises for:
  - Wildfire mitigation projects
  - Seismic non-structural retrofit projects
  - Landslide and other catastrophic failure projects