TWDB State Flood Plan BCA Input Tool v1.3

Texas Water Development Board

INSTRUCTIONS FOR USE

Prepared by AECOM

INTRODUCTION

PURPOSE

- All projects in the Texas State Flood Plan must have a benefit-cost analysis (BCA) completed.
- Depending on the type and scope of the project, a BCA can be data-intensive and complex.
- In an effort to reduce the burden on small communities, TWDB has developed an Input Spreadsheet to work in conjunction with FEMA's BCA Toolkit 6.0.
- The Input Spreadsheet helps the community gather and organize the necessary data and calculate flood damages by recurrence interval.
- The flood damages by recurrence interval are annualized and discounted to the current year to calculate benefits.
- The purpose of this document is to guide the user through the Input Spreadsheet and the FEMA BCA Toolkit to produce a BCA for their project.

BASICS OF BENEFIT-COST ANALYSIS

- Benefits of Flood Risk Management Projects are derived from reduced flood damages.
- Flood damages are estimated under the Baseline (without-project/before mitigation) condition and the Project condition (with-project/after mitigation) for one or more recurrence intervals.
- Flood damages can include direct structural and content damages as well as increased costs of detours around flooded streets, delays to emergency services, costs of utility outages, and other impacts.
- Once the flood damages under each scenario are summed, they are multiplied by the probability that a storm would occur in each year of the analysis period and discounted to the present day.
- The discounted benefits are compared to the discounted costs to determine the Benefit-Cost Ratio (BCR). A BCR > 1.0 indicates that the project is cost-effective.

IMPORTANT TERMINOLOGY

- Recurrence Interval
  The average time between events, based on the probability that a given event with be equaled or exceeded in a given year.
- Baseline
  The condition that will exist if the Project is not constructed; in many (most) cases, this is the Existing Condition.
- Analysis Period
  The period of time over which Project benefits and costs are calculated. This is usually less than or equal to the Project lifespan.
- Discounting
  An adjustment made to account for the time value of money, which allows for benefits, which accrue over many years into the future, to be compared to costs, which are incurred in the present.
- Hydrology & Hydraulics (H&H)
  An H&H Study is conducted to determine the volume and rate of flow of water as it moves through a watershed, basin, channel, or structure.
- Capital Costs
  The costs necessary to make the project function and produce benefits, including construction, design, right-of-way, utility relocations, permitting, and other support costs that are necessary for project completion.
- O&M Costs
  Ongoing costs required to maintain the project and keep it functioning over its lifecycle.

DATA NEEDS

- Project information such as Capital and O&M costs.
- Types of Project impacts, such as reduction in structure flooding, reduction in street flooding, etc.
- Knowledge of the Project area, such as number of residential and commercial structures, daily traffic levels, etc.
- Flood level (H&H) data that reflects the Baseline and Project conditions for up to three recurrence intervals; one recurrence interval must be the 100-year storm event.

SELECTED MODEL ASSUMPTIONS AND DEFAULT DATA

Editable by User

- Residential square footage:
  - Small – 1,000
  - Average – 2,500
  - Large – 5,000
- Each residence houses 3 people (including 2 workers)
- Each commercial building employs 10 people
- Property value is $119/square foot[1]

Not Editable by User

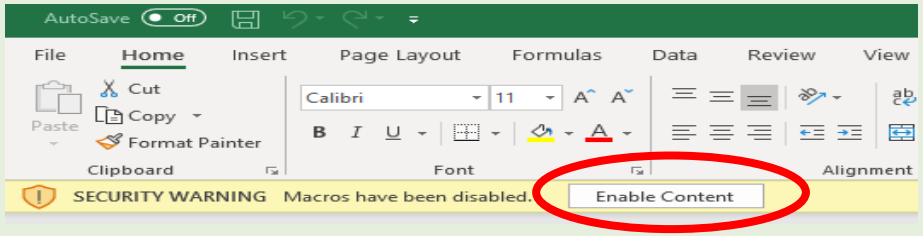
- 3% Discount Rate
- Future annual inflation is ~2%
- Displacement costs include 1 hotel room per affected household and meals for each household member

[1]FEMA Default value of $100/square foot updated to 2024 price level

USING THE BCA INPUT SPREADSHEET & FEMA BCA TOOLKIT

DOWNLOADS

- The TWDB BCA Input Spreadsheet can be found here.
  - The Input Spreadsheet is a Microsoft Excel file that was created in Microsoft Excel for Office 365.
  - It is important to enable macros for the spreadsheet to function correctly.



- FEMA's BCA Toolkit 6.0 and installation instructions can be found here.
  - BCA Toolkit 6.0 may be used in the desktop version of Excel (Excel 2013 or later) or in Excel Online. If your organization does not permit individual acquisition of add-ins, you may use the BCA Toolkit in Excel Online.
- It is recommended that you save a blank version of each spreadsheet. Copy and paste a new version for each Project to ensure the appropriate data is included with the corresponding Project.

PROJECT INFORMATION

- Input Project information in the green cells. Add recurrence intervals in decreasing order of frequency (i.e., more frequent events first).

Project Name	Example 1	Clear Data
Project Region	Region 11	
Project Type	Drainage improvements	
Start Construction Year	2025	
End Construction Year	2026	

Input up to 3 Recurrence Intervals for which you have water level (H&H) data.
At least 1 Recurrence Interval must be the 100-year storm.
Recurrence Intervals must be input in decreasing order of likelihood (i.e., 50-year storm before 100-year storm).
Do not include Recurrence Intervals higher than (less frequent) than a 500-year storm.

Recurrence Interval 1	50	year storm
Recurrence Interval 2	100	year storm
Recurrence Interval 3	500	year storm

- Select "Yes" for the types of project impacts expected for your Project.

Types of Project Impacts	
Residential Structure Damage Reduction	No
Commercial Structure Damage Reduction	Yes / No
Critical Facility (Police, Fire, Hospital) Loss of Function Reduction	No
Reduction in Street Flooding	No
Utility Outage Reduction	No
Agricultural Damage Reduction	No
Water Supply Benefits	No
Recreation Benefits	No
Does this project include Green Infrastructure elements?	No
Does this project replace a low-water crossing?	No

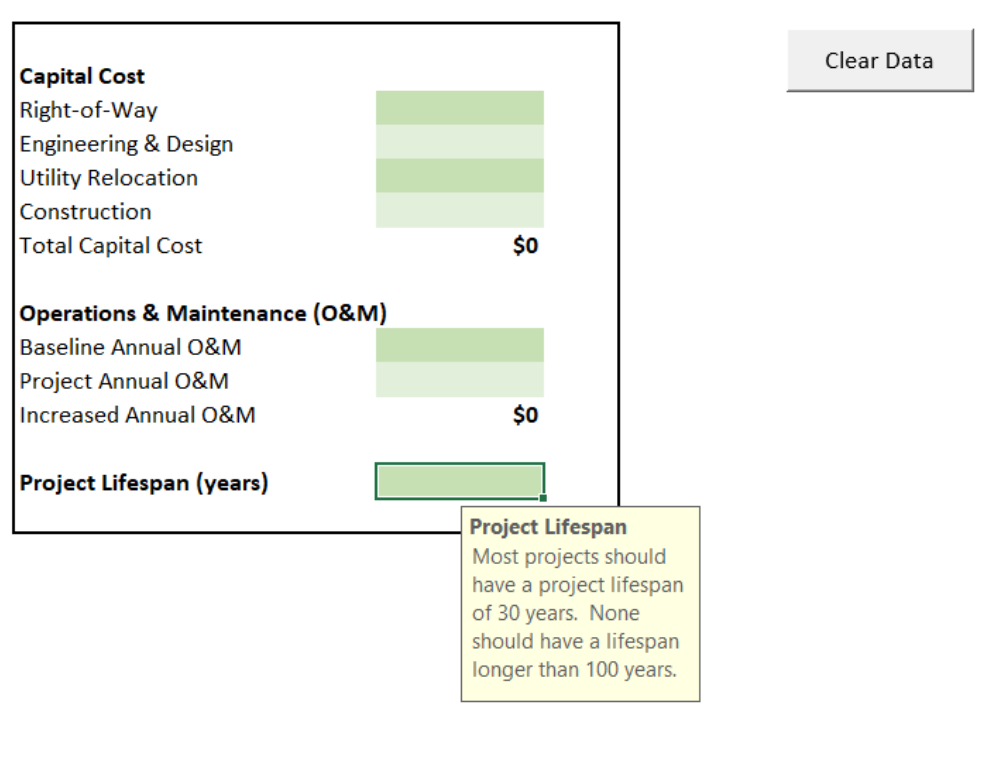
DEFAULT VALUES

Input	Default Value	User Value	Justification
Analysis period (years)	30	30	
Federal mileage rate	$0.68	$0.68	
Number of people per vehicle	1.67	1.67	
Average vehicle value	$29,052	$29,052	
Number of people per household	3	3	
Number of workers per household	2	2	
Number of employees per non-residential structure	10	10	
Autos per household	2	2	
Property value per square foot	$119	$119	
Small home (sq ft)	1,000	1,000	
Average home (sq ft)	2,500	2,500	
Large home (sq ft)	5,000	5,000	
Contents value (as percent of residential home value)	100%	1	

- Update default values in the green cells as necessary. The white cells will continue to show the default data for reference.
- When submitting the BCA to TWDB, include references to support any values that have been updated.

PROJECT COSTS

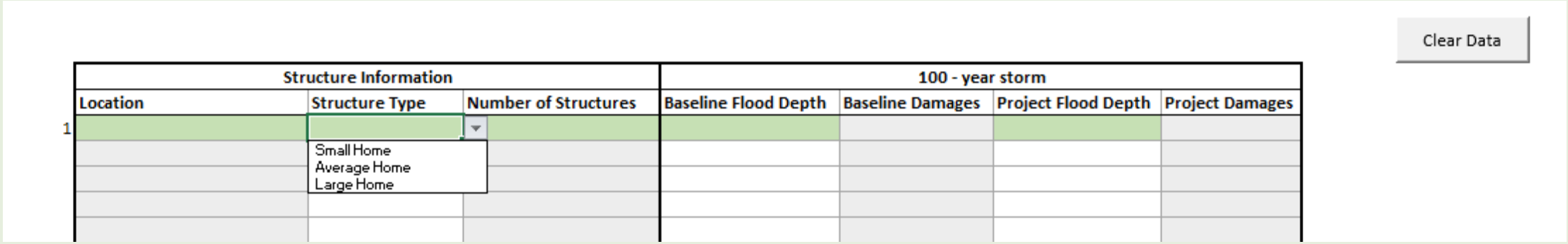
- Input Project costs.



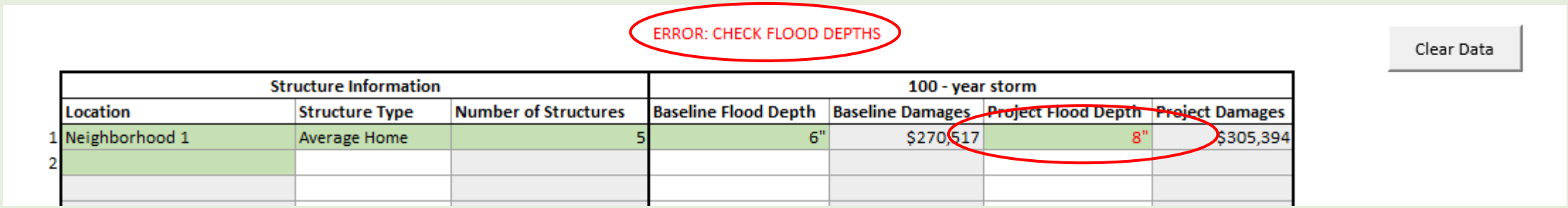
- For projects involving the construction of new infrastructure, total Operations & Maintenance (O&M) costs will generally be positive, reflecting ongoing expenditures needed to maintain the new asset.
- For projects intended to replace, reconstruct, or rehabilitate existing infrastructure, the net change in O&M costs under the proposed project may be negative, as newer infrastructure may require less frequent and less costly maintenance compared to an aging, deteriorating asset.

RESIDENTIAL STRUCTURES

- Input cells are highlighted Green.
- Residential structures can be classified as "Small Home," "Average Home," or "Large Home."[1]



- An error message will appear if the Project Flood Depth is greater than the Baseline Flood Depth.

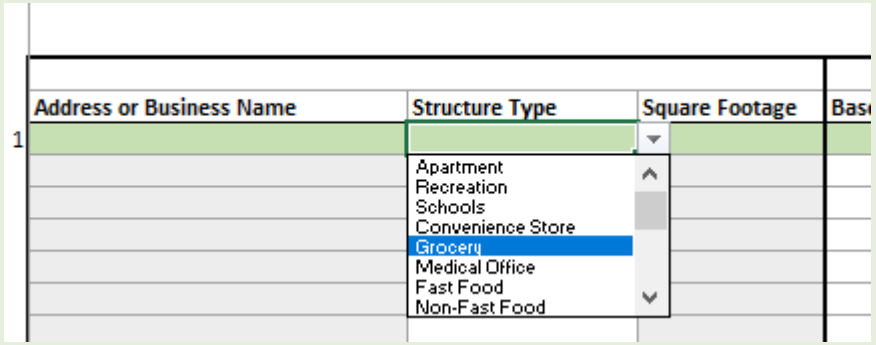


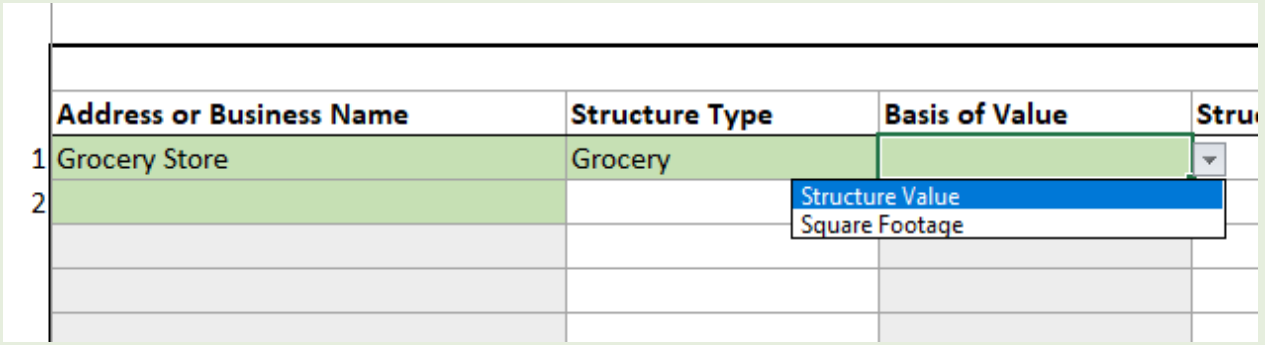
- Repeat for all recurrence intervals. An error message will appear if flood depths are higher for more-frequent storms than less-frequent storms.

[1]Source: https://www.floodsmart.gov/sites/default/files/flood-loss-potential_jul19.pdf

COMMERCIAL STRUCTURES

- Input structure information for any commercial structures that are expected to benefit from the Project.
- Use the drop-down list to select the type of commercial structure.
- Select whether you want to calculate damages based on square footage or structure value.
- An error message will appear if the Project Flood Depth is greater than the Baseline Flood Depth.
- Repeat for all recurrence intervals. An error message will appear if flood depths are higher for more-frequent storms than less-frequent storms.





Clear Data

	Address or Business Name	Structure Type	Basis of Value	Structure Value	Square Footage	100 - year storm Baseline Flood Depth	Baseline Damages	Project Flood Depth	Project Damages
1	Grocery Store	Grocery	Square Footage		5,000	8"	$41,479	0	
2									

FLOODED STREETS

- Input information into the green cells if the Project will reduce the length (mileage) and/or duration of street flooding.
- Streets are considered impassable if flooding is >6 inches.
- Note that EMS response time during a storm event should be ≥ normal EMS response time.

	100 - year storm	
	Baseline	Project
How many miles of roadway is flooded >6"?		
How long are the roadways impassable (hours)?		
What is the daily traffic (vehicle count) on the affected roadways?		
How much mileage does the detour add to the route? (Difference between direct route and detour)		
How much time (minutes) does the detour add to the route? (Difference between direct route and detour)		
Normal Emergency Medical Services (EMS) response time (minutes)		
EMS response time during storm event		
Number of households impacted by EMS delay due to flooded streets		
Number of commercial buildings impacted by EMS delay due to flooded streets		

Clear Data

LOW WATER CROSSING

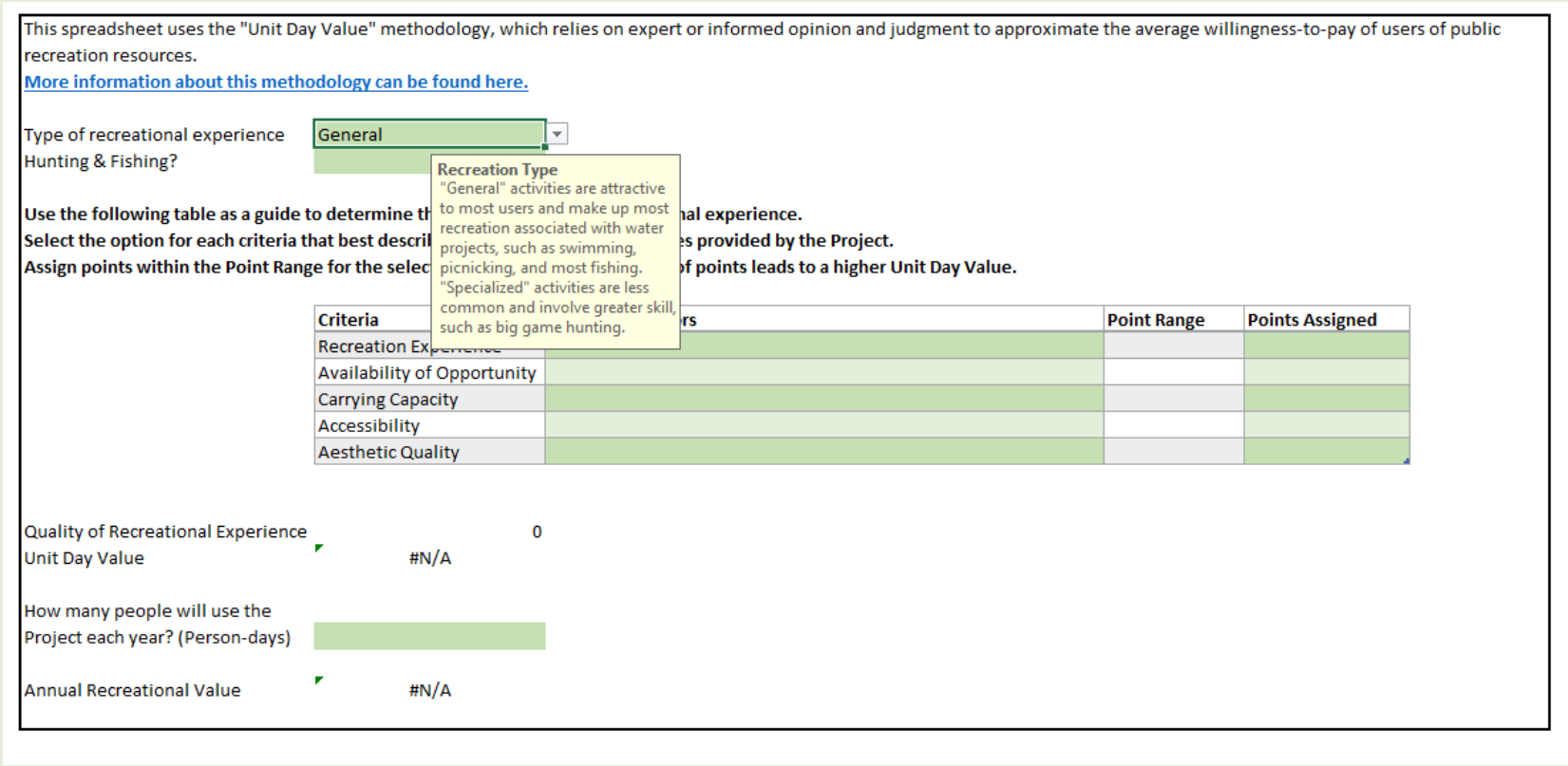
- Input data into the green cells if the Project includes replacing a Low Water Crossing.
- The model estimates potential injuries, loss of life, and emergency response costs from motorists attempting to cross a flooded street.
- As the depth of flooding increases, the likelihood that a motorist would attempt to cross decreases, but the probability of a successful crossing also decreases.
- Detour avoidance benefits should be calculated using the Flooded Streets tab.

	100 - year storm	
Input	**Baseline**	**Project**
Depth of flooding over roadway		
Duration of flooding (hours)		
Daily Traffic		
What is the length of the detour (minutes)?		

Clear Data

RECREATION

- Recreation benefits are calculated using the "Unit Day Value" methodology.
- Follow the instructions in the workbook closely. This worksheet includes multiple drop-down selections and informational popups. Input cells are highlighted green.
- The number of points assigned for each Criteria determine the overall quality of recreational experience and the "Unit Day Value" of the recreational aspect of the Project.
- Person-days are calculated by multiplying the number of people who will use the recreational aspect of the Project by the number of days they will use it.
- If 30 people are expected to use the Project every weekend, then the person-days is 30x52 = 1,560.


This spreadsheet uses the "Unit Day Value" methodology, which relies on expert or informed opinion and judgment to approximate the average willingness-to-pay of users of public recreation resources.

More information about this methodology can be found here.

Type of recreational experience: General

Hunting & Fishing?

Recreation Type
"General" activities are attractive to most users and make up most recreation associated with water projects, such as swimming, picnicking, and most fishing. "Specialized" activities are less common and involve greater skill, such as big game hunting.

Use the following table as a guide to determine th **nal experience.**
Select the option for each criteria that best descri **s provided by the Project.**
Assign points within the Point Range for the selec **f points leads to a higher Unit Day Value.**

Criteria	rs	Point Range	Points Assigned
Recreation Ex			
Availability of Opportunity			
Carrying Capacity			
Accessibility			
Aesthetic Quality			

Quality of Recreational Experience: 0

Unit Day Value: #N/A

How many people will use the Project each year? (Person-days)

Annual Recreational Value: #N/A

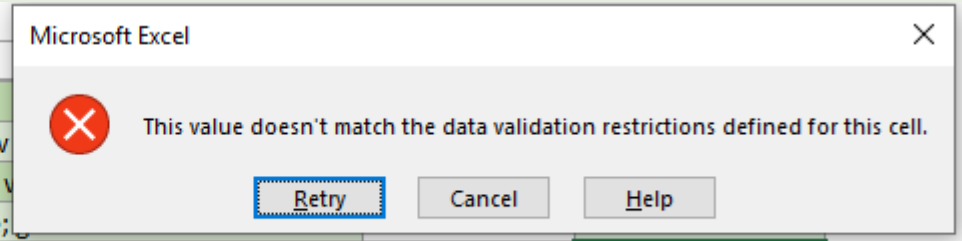
RECREATION

- Select the Evaluation Factor that best describes the Project recreation features.
- The Point Range is determined by the Evaluation Factor that is selected.
- Assign points within the Point Range – if the Point Range is 5-10, then the Points Assigned should be between 5 and 10.
- If the Points Assigned is higher than the Point Range, a "Check Value" error message will appear.

Criteria	Evaluation Factors	Point Range	Points Assigned
Recreation Experience	Several general activities	5-10	8
Availability of Opportunity	Several within 1 hour travel time; a few within 30 min. travel time	0-3	2
Carrying Capacity	Adequate facilitiies to conduct activity without deterioration of the	6-8	6
Accessibility	Good access, high standard road to site; good access within site	15-18	16
Aesthetic Quality	Above average aesthetic quality; and limiting factors can be reasona	7-10	12 CHECK VALUE

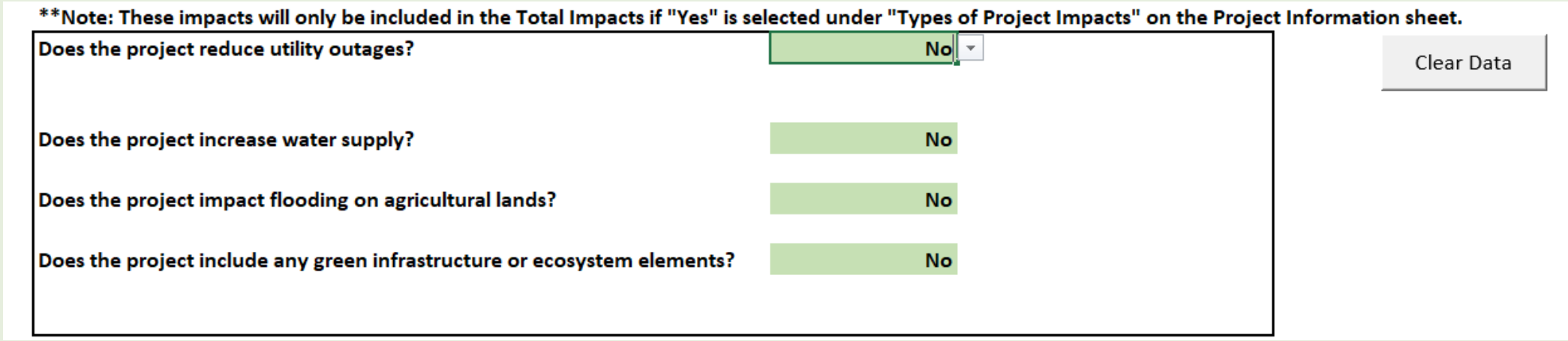
- The spreadsheet will not allow the user to input more than the total number of points allowed for a specific Criteria.

Criteria	Evaluation Factors		
Recreation Experience	Several general activities		
Availability of Opportunity	Several within 1 hour travel time; a few		
Carrying Capacity	Adequate facilitiies to conduct activity		
Accessibility	Good access, high standard road to site;		
Aesthetic Quality	Above average aesthetic quality; and limiting factors can be reasona	7-10	30



OTHER IMPACTS

- Other Impacts include Utility Outages, Water Supply, Agricultural Damages, and Green Infrastructure/Ecosystem benefits.
- Select "Yes" for the types of impacts appropriate for your project.



UTILITY OUTAGES

- Input the number of customers served by the affected utility and the number of days outages under the Baseline and Project conditions.

**Note: These impacts will only be included in the Total Impacts if "Yes" is selected under "Types of Project Impacts" on the Project Information sheet.

Does the project reduce utility outages?	Yes

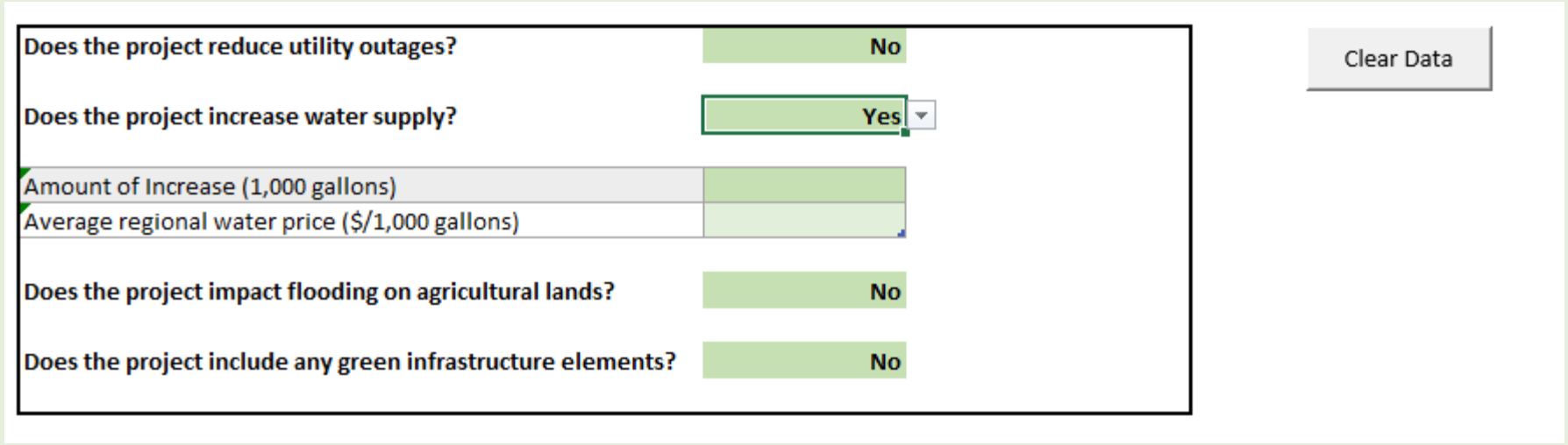
Clear Data

Utility Type	No. of Customers
Electrical	
Potable Water	
Communications/IT	
Wastewater	

Number of Days Outage	50 - year storm	
Utility Type	Baseline	Project
Electrical		
Potable Water		
Communications/IT		
Wastewater		

WATER SUPPLY

- Input the increase in water supply provided by the Project and the price of water in your region.



AGRICULTURAL DAMAGES

- Input the damages per acre and the number of acres damaged under the Baseline and Project conditions.
- The model can calculate decreased damages for three types of agricultural land – pasture, low-value crops, and high-value crops.

Does the project impact flooding on agricultural lands?	Yes

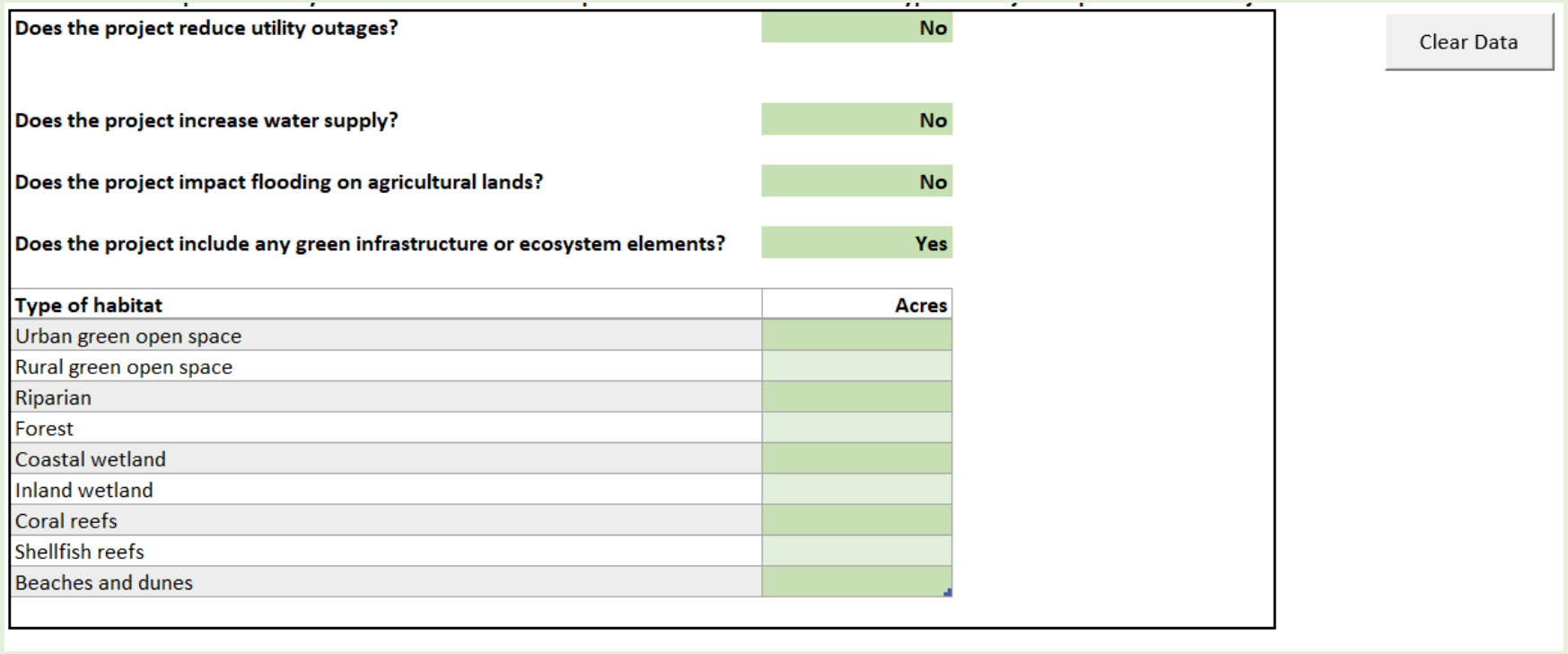
	100 - year storm	
Acreage	**Baseline**	**Project**
Acres of pasture damaged		
Acres of high-value crops damaged		
Acres of low-value crops damaged		

Crop Type	**Damage/Acre**
Pasture	
High-Value Crops	
Low-Value Crops	

Does the project include any green infrastructure elements?	No

GREEN INFRASTRUCTURE

- Input the number of acres of habitat that will be created by the Project.



Does the project reduce utility outages?	**No**
Does the project increase water supply?	**No**
Does the project impact flooding on agricultural lands?	**No**
Does the project include any green infrastructure or ecosystem elements?	**Yes**

Type of habitat	**Acres**
Urban green open space	
Rural green open space	
Riparian	
Forest	
Coastal wetland	
Inland wetland	
Coral reefs	
Shellfish reefs	
Beaches and dunes	

Clear Data

TOTAL IMPACTS

- Review the damages and benefits on the Total Impacts tab.
- There are no inputs on this tab.

	100 - year storm	
Project Impacts by Recurrence Interval	**Baseline**	**Project**
Residential Flood Damage	$9,759,930	$1,192,081
Commercial Flood Damage	$193,529	$3,300
Flooded Streets	$8,670	$0
Utility Impacts	-	-
Agricultural Losses	-	-
Low Water Crossing Damages	-	-

	100 - year storm	
Impacted Structures by Recurrence Interval	**Baseline**	**Project**
Impacted residential structures	**45**	**15**
Impacted Residents	135	45
Impacted commercial structures	**2**	**1**
Impacted Employees	20	10

Other Project Impacts	**Benefits**
Water Supply Benefits	$0
Environmental Benefits	$0
Residual Value of Investment	$6,000
Recreational Benefits	$0

VIEW RESULTS

- Total Baseline (Before Mitigation) and Project (After Mitigation) damages are collated by Recurrence Interval on the Results tab. These are annualized using a 3% discount rate.
- Damage reduction benefits are added to other benefits.
- Use FEMA BCA Toolkit to calculate Critical Facility Benefits.
- Total benefits are compared to total costs to determine benefit-cost ratio(s).

Project Useful Life	**30**

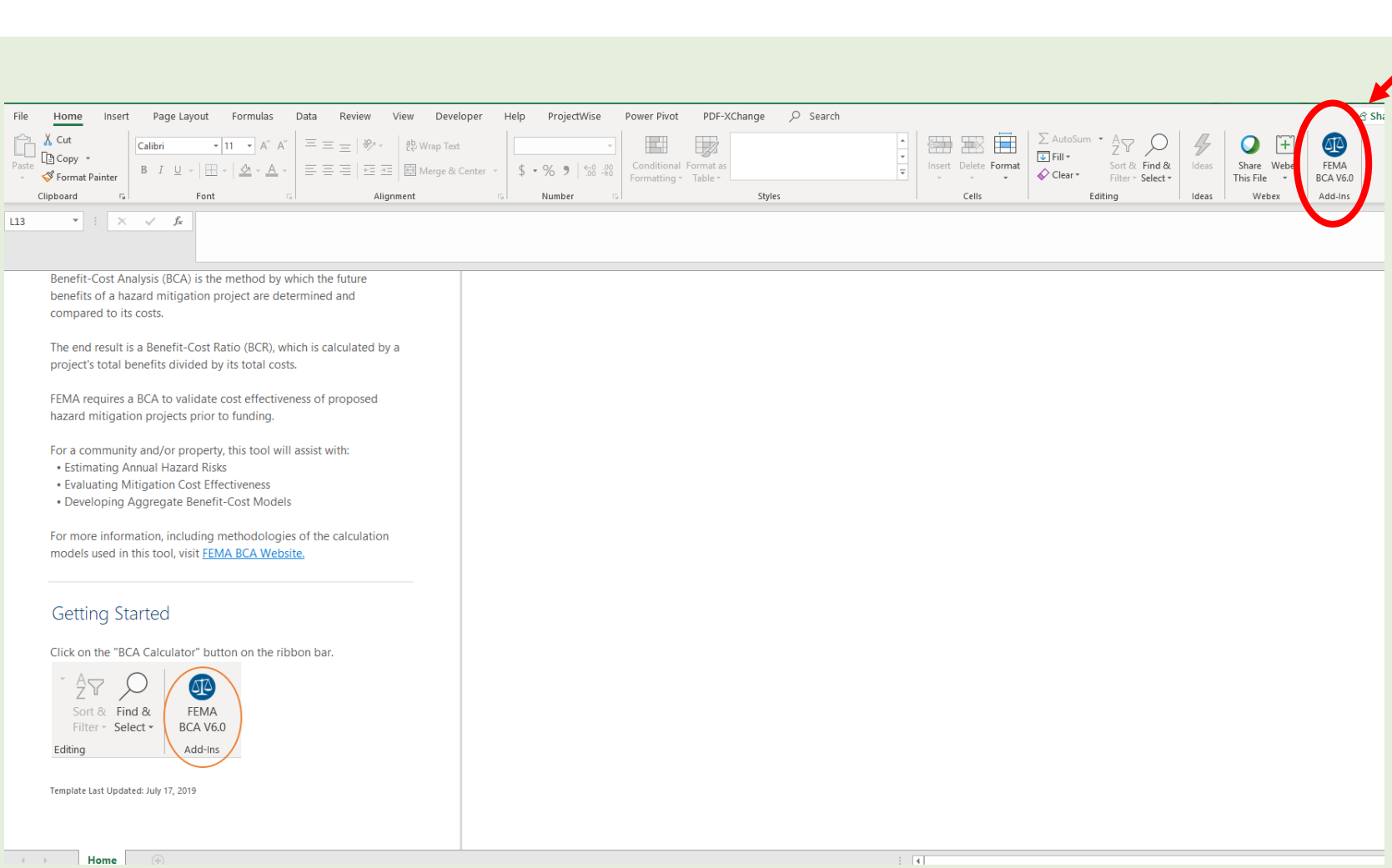
Event Damages	**Baseline**	**Project**
100 - year storm	**$9,962,129**	**$1,195,381**
Annualized Damages	**$99,620**	**$11,954**

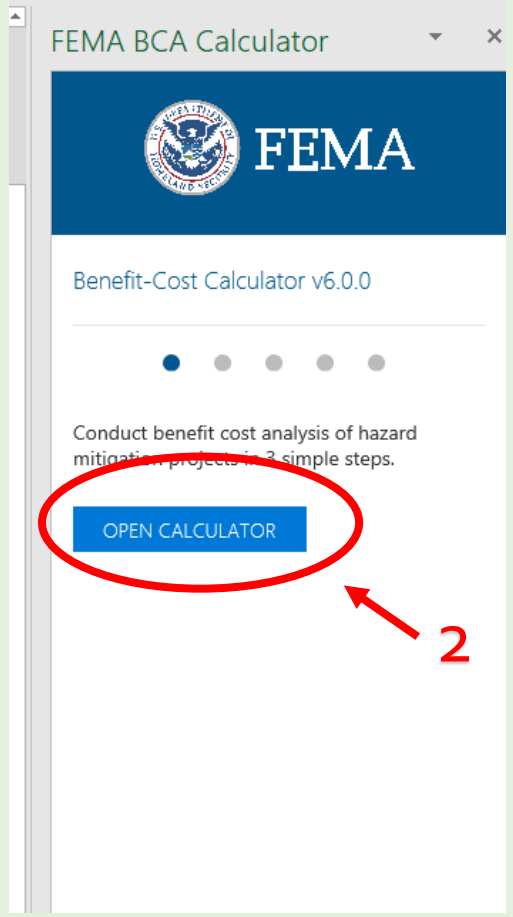
Damage Reduction Benefits	$1,668,245
Critical Facility Benefits	
Other Benefits (Not Recreation)	$6,000
Recreation Benefits	$0
Total Benefits	**$1,674,245**
Total Costs	**$999,788**
Net Benefits	$674,457
Net Benefits with Recreation	$674,457
Final BCR	**1.7**
Final BCR with Recreation	**1.7**

CRITICAL FACILITIES

- If the Project will protect critical facilities (police, hospital, fire station), use the FEMA BCA Toolkit v6.0 to calculate those benefits.
- These benefits will be added to the BCA Input Tool on the Results tab.
- The FEMA BCA Toolkit v6.0 can be downloaded here.

OPEN BCA TOOLKIT 6.0



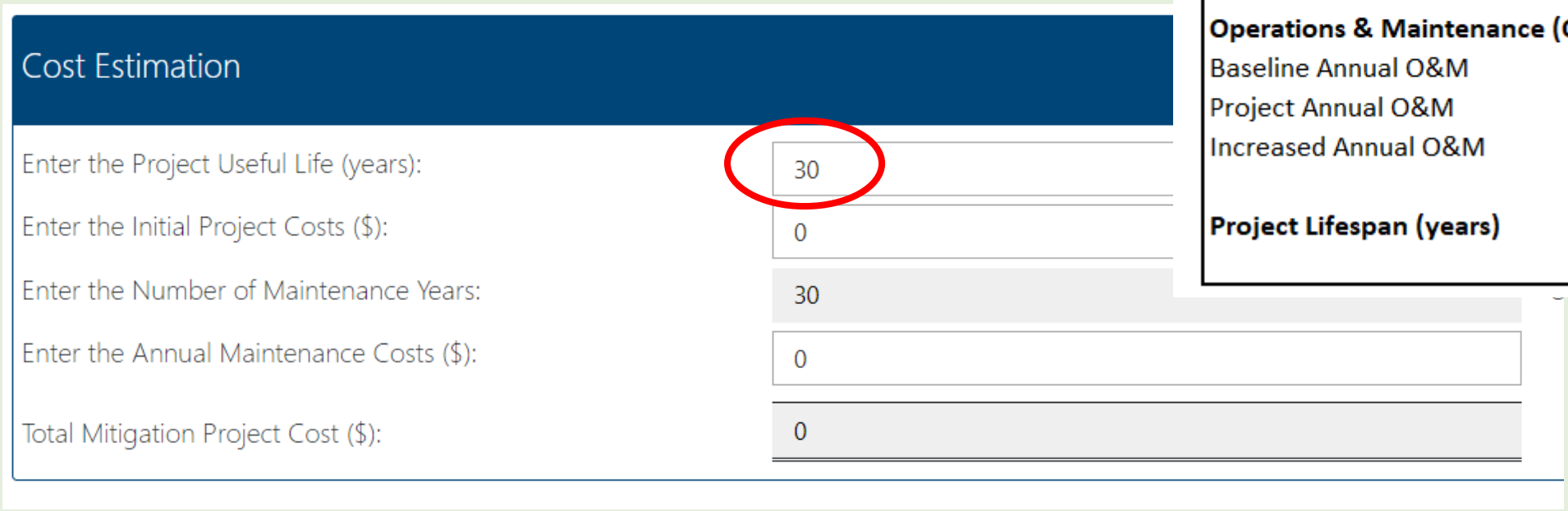


ADD PROJECT

- Click "Add Project."
- Input Project information in the Project. Configuration box.
- The Property Structure Type refers to the benefiting structures – NOT the Project. structure itself.
- Select "Critical Facility Building."
- The Damage and Frequency Relationship is based on Professional Expected Damages.

CRITICAL FACILITIES - PROJECT CONFIGURATION

- Do not input costs.
- Project lifespan should match the one used in the Project Costs tab of the BCA Input Tool.

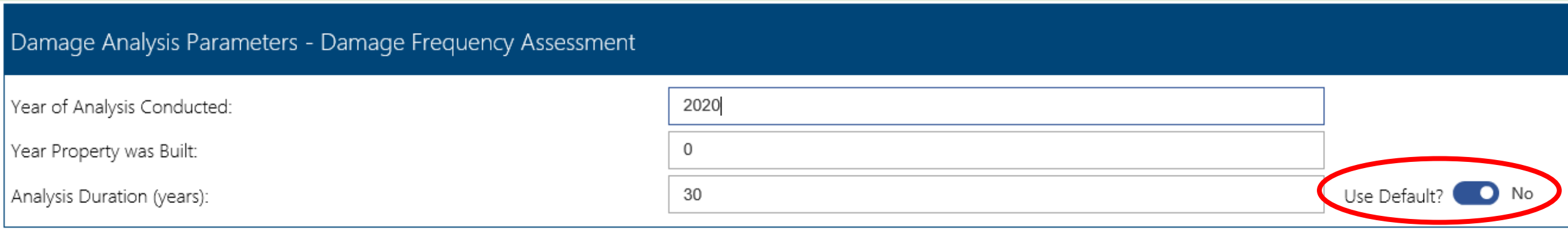


Capital Cost	
Right-of-Way	$15,000
Engineering & Design	$30,000
Utility Relocation	
Construction	$1,000,000
Total Capital Cost	**$1,045,000**
Operations & Maintenance (O&M)	
Baseline Annual O&M	
Project Annual O&M	
Increased Annual O&M	**$0**
Project Lifespan (years)	30

CRITICAL FACILITIES - DAMAGE ANALYSIS PARAMETERS

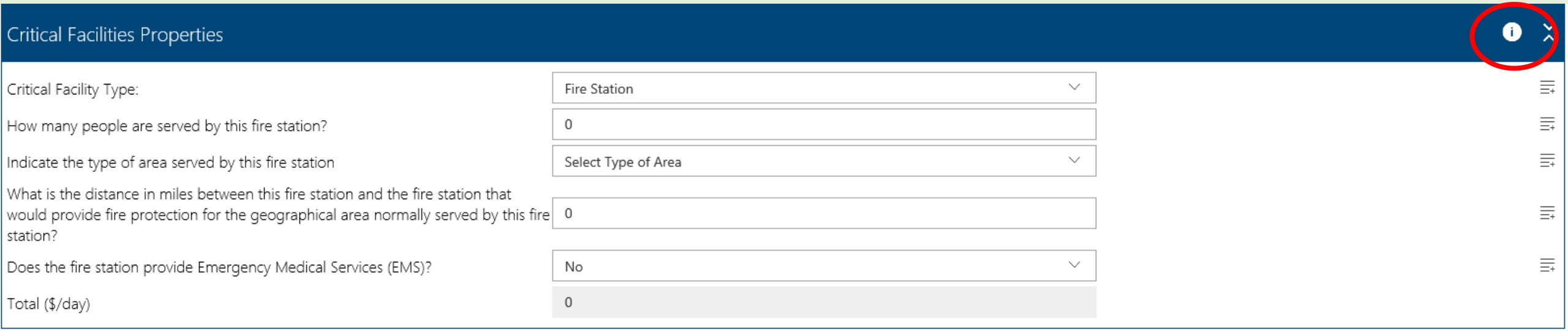
- Click the "Use Default?" button to select "No."
- Input the analysis duration used in the "Default Values" tab of the BCA Input Tool in the Analysis Duration. (Analysis duration should be less than or equal to project lifespan.)

Input	Default Value	User Value	Justification
Analysis period (years)	30	30	



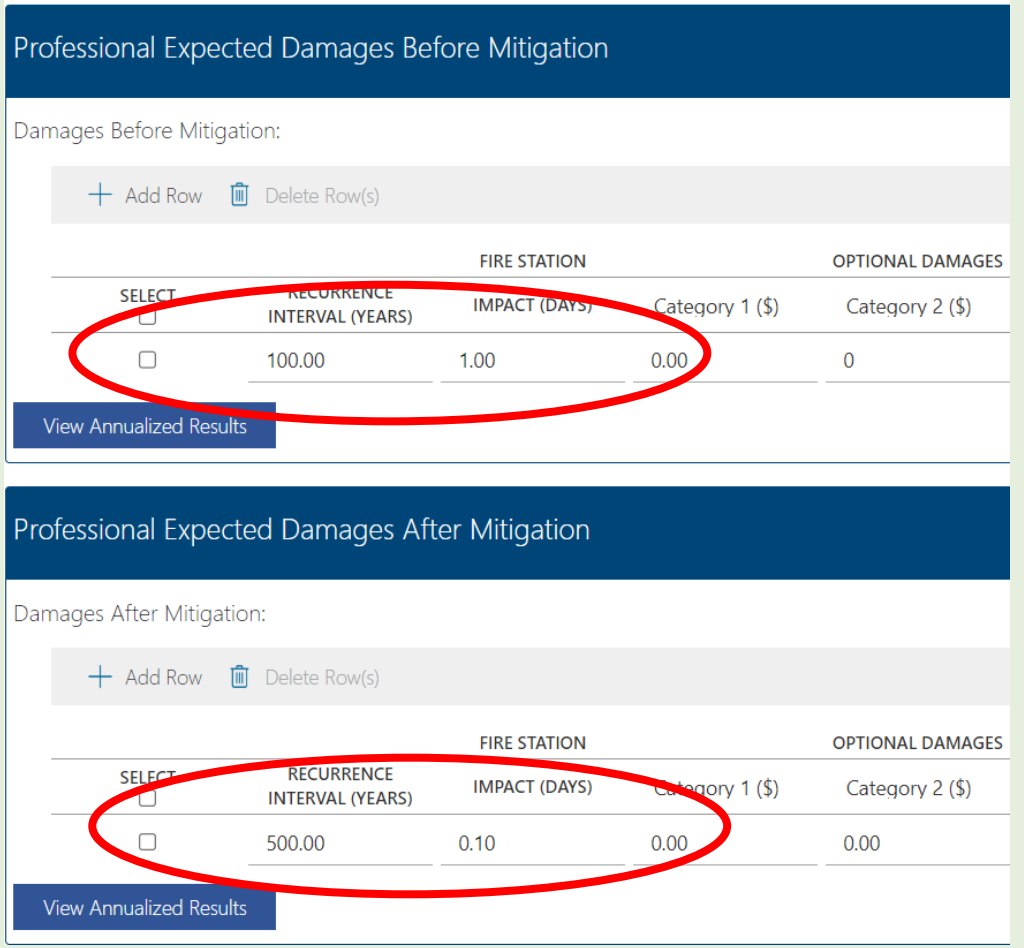
CRITICAL FACILITIES PROPERTIES

- Critical Facilities are Fire Stations, Hospitals, Police Stations, and "Other".
- Input the Properties in the appropriate boxes. Click on the  icon to see more information about the required inputs.



CRITICAL FACILITIES DAMAGES

- Input the Recurrence Interval(s) and the number of days the Critical Facility will be impacted under the Baseline (Before Mitigation) and Project (After Mitigation).
- Select "Finish" at the bottom right of the screen.



TOTAL BENEFITS

- Input the Benefits using a 3% discount rate from the BCA Toolkit into the green "Critical Facility Benefits" field in the BCA Input Spreadsheet.

					Using 7% Discount Rate			Using 3% Discount Rate (For BRIC and FMA only)		
Select	Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
☑	1	Drainage Improvement @ 1600 Congress Ave, Austin, Texas, 78701		DFA - Riverine Flood	$ 4,976	$ 0	0.00	$ 7,860	$ 0	0.00
TOTAL (SELECTED)					$ 4,976	$ 0	0.00	$ 7,860	$ 0	0.00
TOTAL					$ 4,976	$ 0	0.00	$ 7,860	$ 0	0.00

Project Useful Life: **30**

Event Damages	Baseline	Project
100 - year storm	**$9,962,129**	**$1,195,381**
Annualized Damages	**$99,620**	**$11,954**

Damage Reduction Benefits	$1,668,245
Critical Facility Benefits	$7,860
Other Benefits (Not Recreation)	$6,000
Recreation Benefits	$0
Total Benefits	**$1,682,105**
Total Costs	**$999,788**

PROJECT BENEFIT-COST RATIOS

- The BCA Input Spreadsheet will calculate 2 Benefit-Cost Ratios for the Project: a Final BCR and a Final BCR with Recreation.
- Remember to SAVE the Input Spreadsheet and BCA Toolkit workbooks to retain your data.

Project Useful Life	**30**

Event Damages	**Baseline**	**Project**
100 - year storm	**$9,962,129**	**$1,195,381**
Annualized Damages	**$99,620**	**$11,954**

Damage Reduction Benefits	$1,668,245
Critical Facility Benefits	$7,860
Other Benefits (Not Recreation)	$6,000
Recreation Benefits	$0
Total Benefits	**$1,682,105**
Total Costs	**$999,788**
Net Benefits	$682,317
Net Benefits with Recreation	$682,317
Final BCR	**1.7**
Final BCR with Recreation	**1.7**

ITEMS TO CONSIDER

WHAT TO DO IF THE BCR IS <1.0?

- Ensure that all impacts are captured.
- Add more recurrence intervals.
  - A rule of thumb is that the 500-year water elevations are 1.25 times the 100-year water elevations.
- Determine if the default data included in the BCA Input Spreadsheet is appropriate for your project.
  - If the default data is not appropriate for your project, input data directly into the FEMA BCA Toolkit using the Modeled Damages option.