TWDB State Flood Plan BCA Input Tool

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 input into FEMA's BCA Toolkit 6.0 to calculate project 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 the Project is expected to be functional.
- 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.

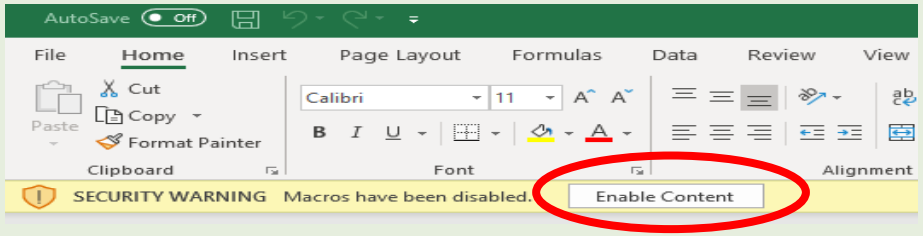
SELECTED MODEL ASSUMPTIONS AND DEFAULT DATA

- 7% Discount Rate
- Annual inflation is ~2%
- Each residence houses 3 people (including 2 workers)
- Per diem for displaced residents is $240/day per household (1 hotel room and meals for 3 people)
- Residential square footage:
  - Small – 1,000
  - Average – 2,500
  - Large – 5,000
- Each commercial building employs 10 people
- Commercial property value is $100/square foot

USING THE BCA INPUT SPREADSHEET & FEMA BCA TOOLKIT

DOWNLOADS

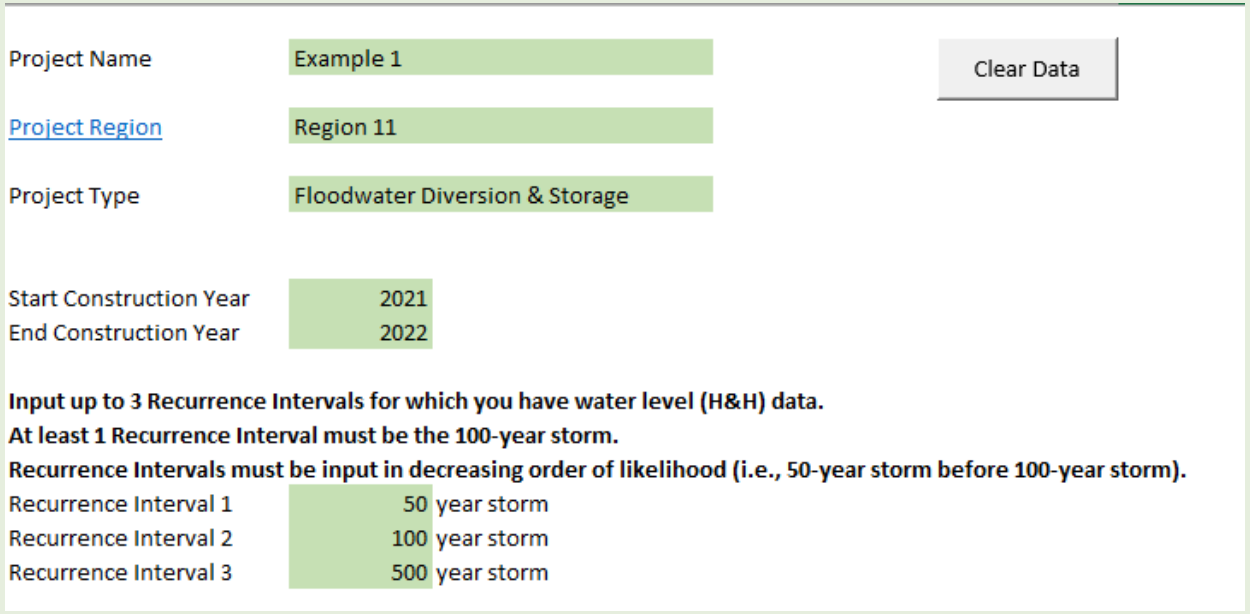
- The TWDB BCA Input Spreadsheet can be found here.
  - The Input Spreadsheet is a Microsoft Excel file that was created in Microsoft Excel for Office 365.
  - It is important to enable macros for the spreadsheet to function correctly.



- 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).

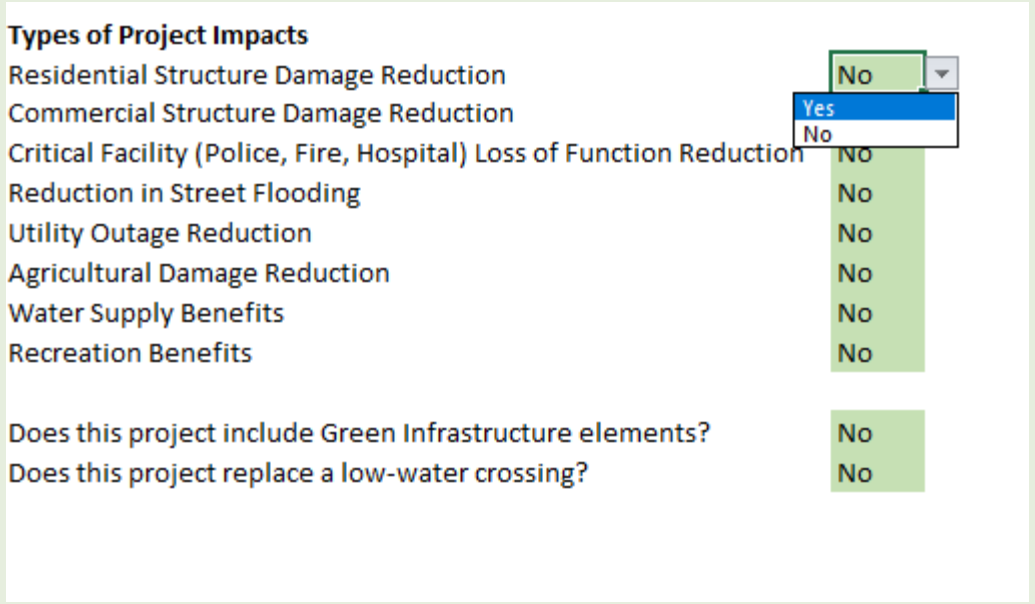


Project Name	Example 1	Clear Data
Project Region	Region 11	
Project Type	Floodwater Diversion & Storage	
Start Construction Year	2021	
End Construction Year	2022	

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).

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

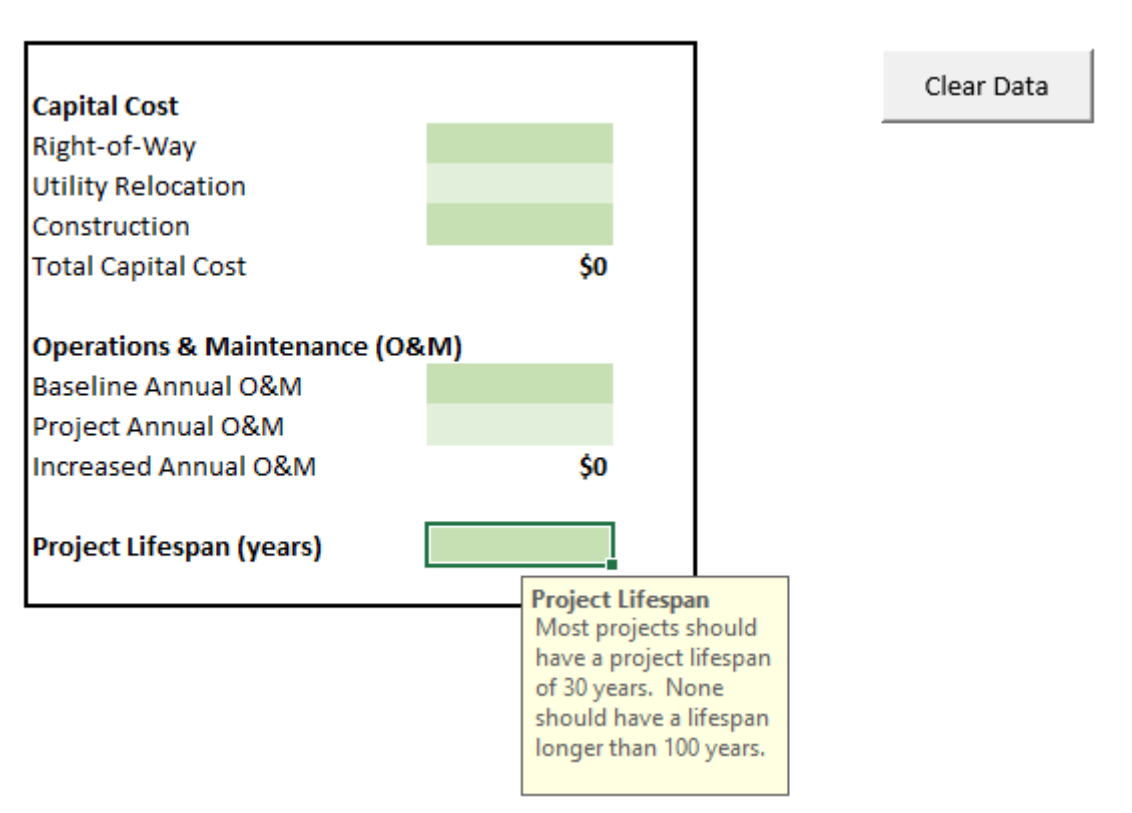
- Select "Yes" for the types of project impacts expected for your Project.



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

PROJECT COSTS

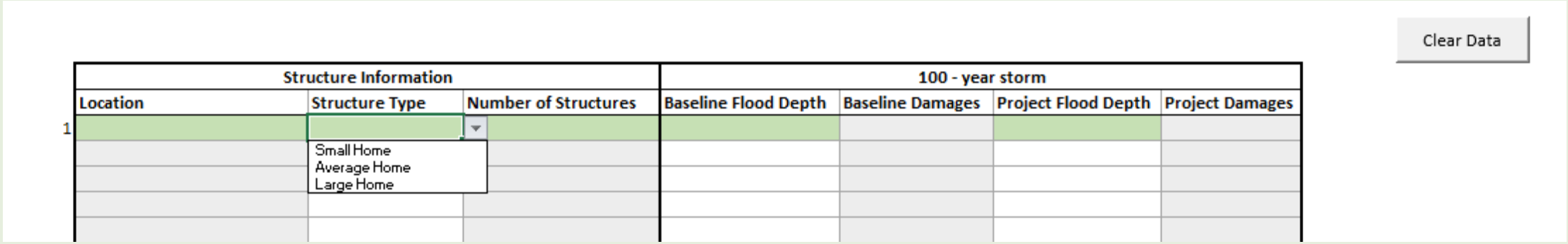
- Input Project costs.



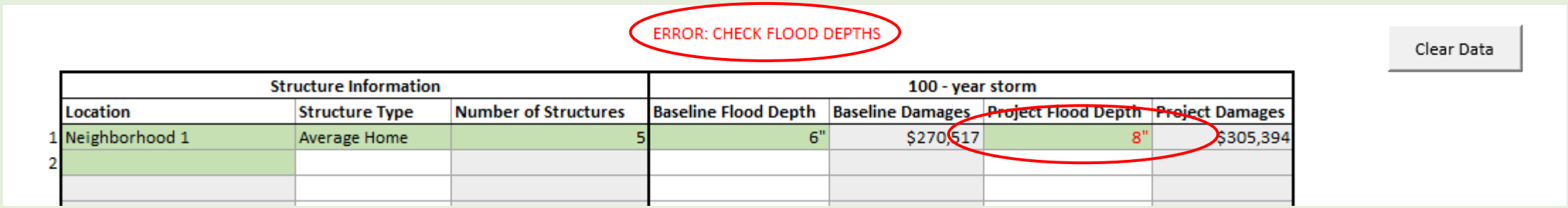
- Construction costs should include all necessary engineering and design costs.
- For projects involving the construction of new infrastructure, total Operations & Maintenance (O&M) costs will generally be positive, reflecting ongoing expenditures needed to maintain the new asset.
- For projects intended 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.

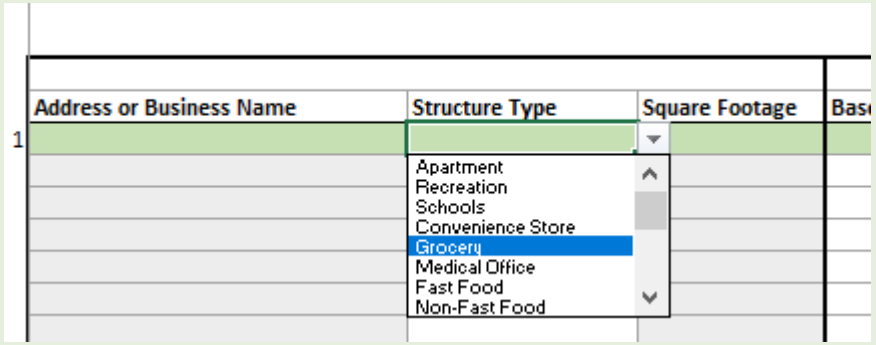


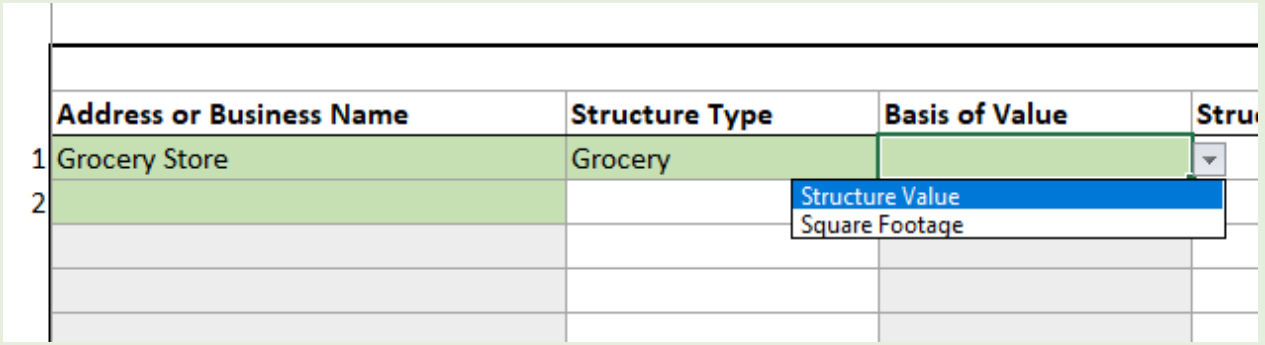
- Repeat for all recurrence intervals. An error message will appear if flood depths are higher for more-frequent storms than less-frequent storms.

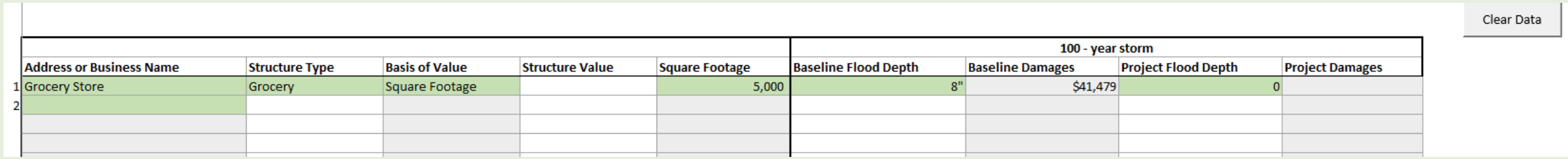
[1]Source: https://www.floodsmart.gov/sites/default/files/flood-loss-potential_jul19.pdf

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.







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

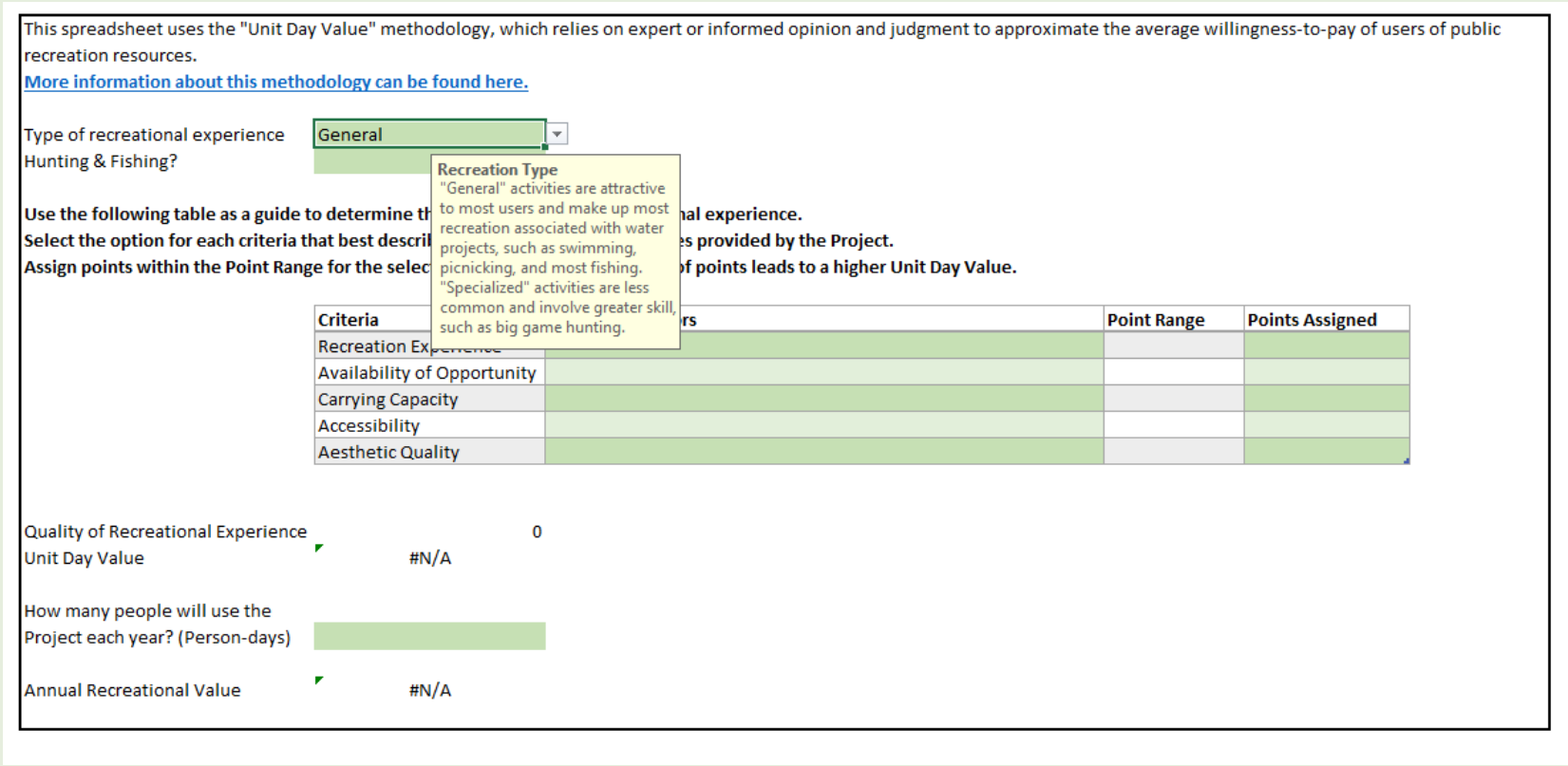
- Input data into the green cells if the Project includes replacing a Low Water Crossing.
- The model estimates potential injuries, loss of life, and emergency response costs from motorists attempting to cross a flooded street.
- As the depth of flooding increases, the likelihood that a motorist would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

	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

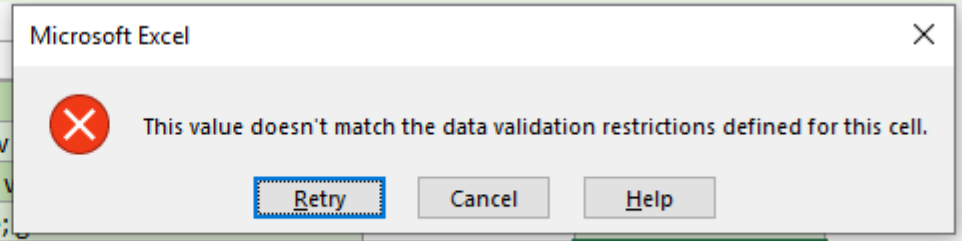
RECREATION

- 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

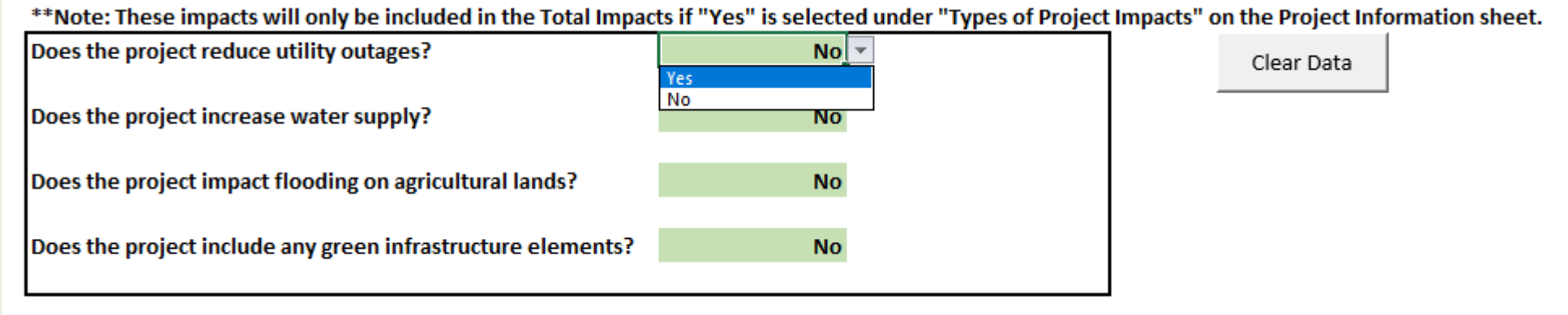
- The spreadsheet will not allow the user to input more than the total number of points allowed for a specific Criteria.

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 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

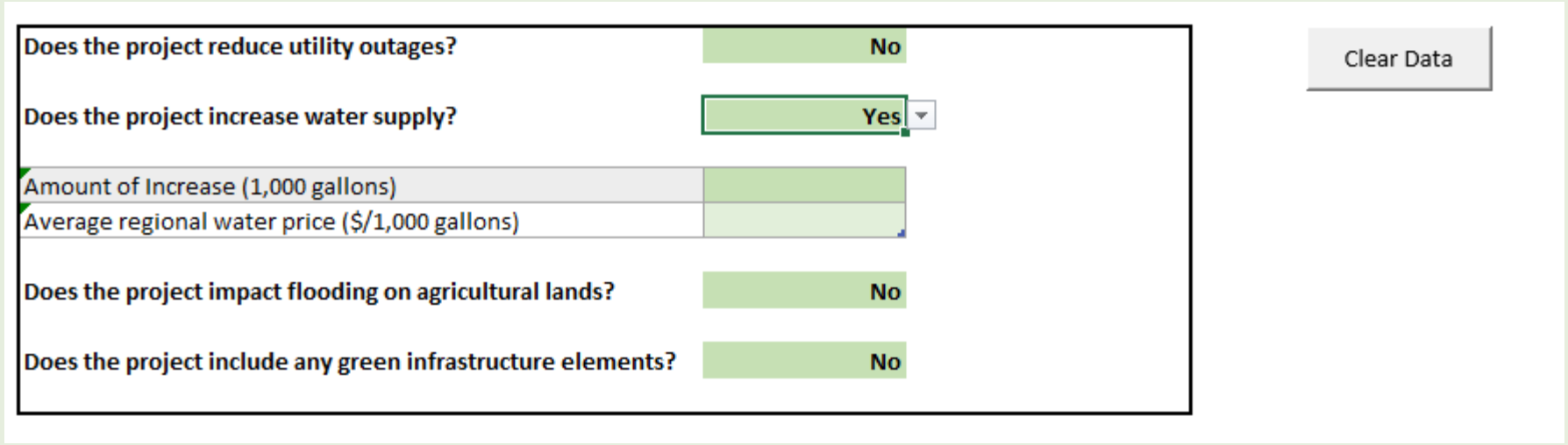
Utility Type	No. of Customers
Electrical	
Potable Water	
Wastewater	

Number of Days Outage	100 - year storm	
Utility Type	Baseline	Project
Electrical		
Potable Water		
Wastewater		

Does the project increase water supply?	No
Does the project impact flooding on agricultural lands?	No
Does the project include any green infrastructure elements?	No

WATER SUPPLY

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



Does the project reduce utility outages?	**No**
Does the project increase water supply?	**Yes**
Amount of Increase (1,000 gallons)	
Average regional water price ($/1,000 gallons)	
Does the project impact flooding on agricultural lands?	**No**
Does the project include any green infrastructure elements?	**No**

Clear Data

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 elements?	**Yes**

Type of habitat	**Acres**
Green open space	
Riparian	
Wetlands	
Forests	
Marine & Estuary	

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 Structure Damage	$551,838	$284,281
Residential Loss of Function	$389,964	$344,065
Commercial Structure Damage	$50,045	$0
Commercial Loss of Function	$8,423	$0
Flooded Streets	-	-
Utility Impacts	$781,371	$0
Agricultural Losses	-	-
Low Water Crossing Damages	-	-

	100 - year storm	
Flooded Structures by Recurrence Interval	**Baseline**	**Project**
Flooded residential structures	**10**	**10**
Impacted Residents	30	30
Flooded commercial structures	**1**	**0**
Impacted Employees	10	0

Other Project Impacts	**Benefits**
Water Supply Benefits	$0
Environmental Benefits	$108,564
Residual Value of Investment	$0
Recreational Benefits	$130,827

INPUTS INTO BCA TOOLKIT

- Total Baseline (Before Mitigation) and Project (After Mitigation) damages are collated by Recurrence Interval on the Results tab.
- These are the required inputs for the BCA Toolkit.

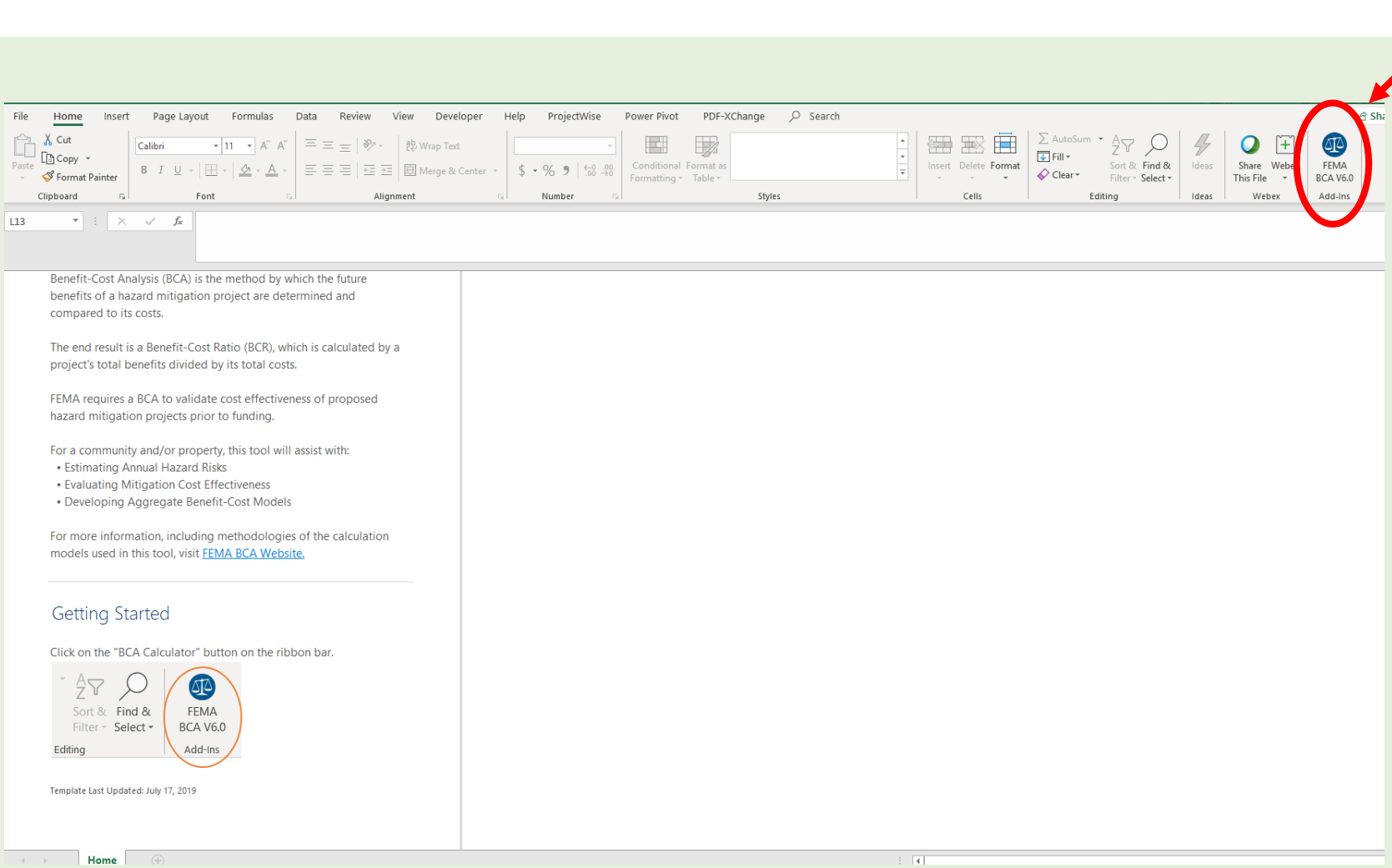
Input Into BCA Toolkit

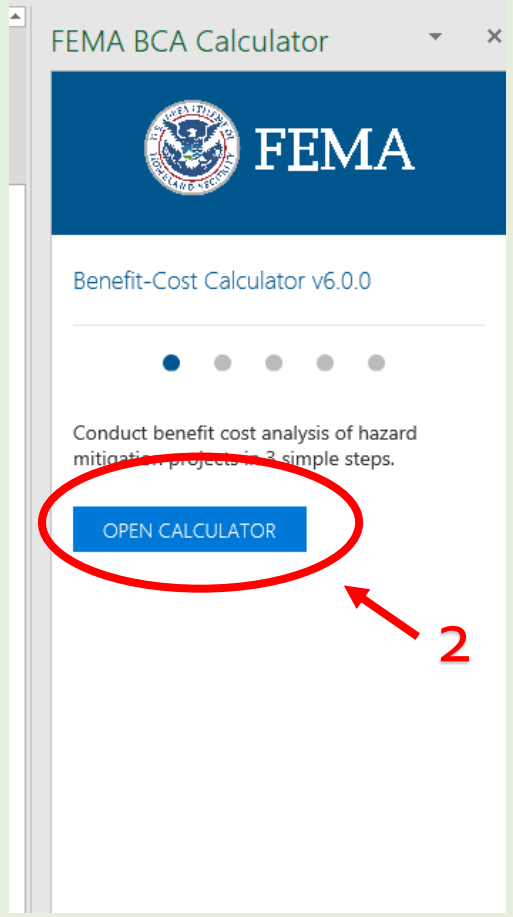
Project Useful Life 30

Event Damages	Baseline	Project
100 - year storm	$1,781,640	$628,346

- At this point in the analysis, open the BCA Toolkit 6.0. Installation instructions can be found here.

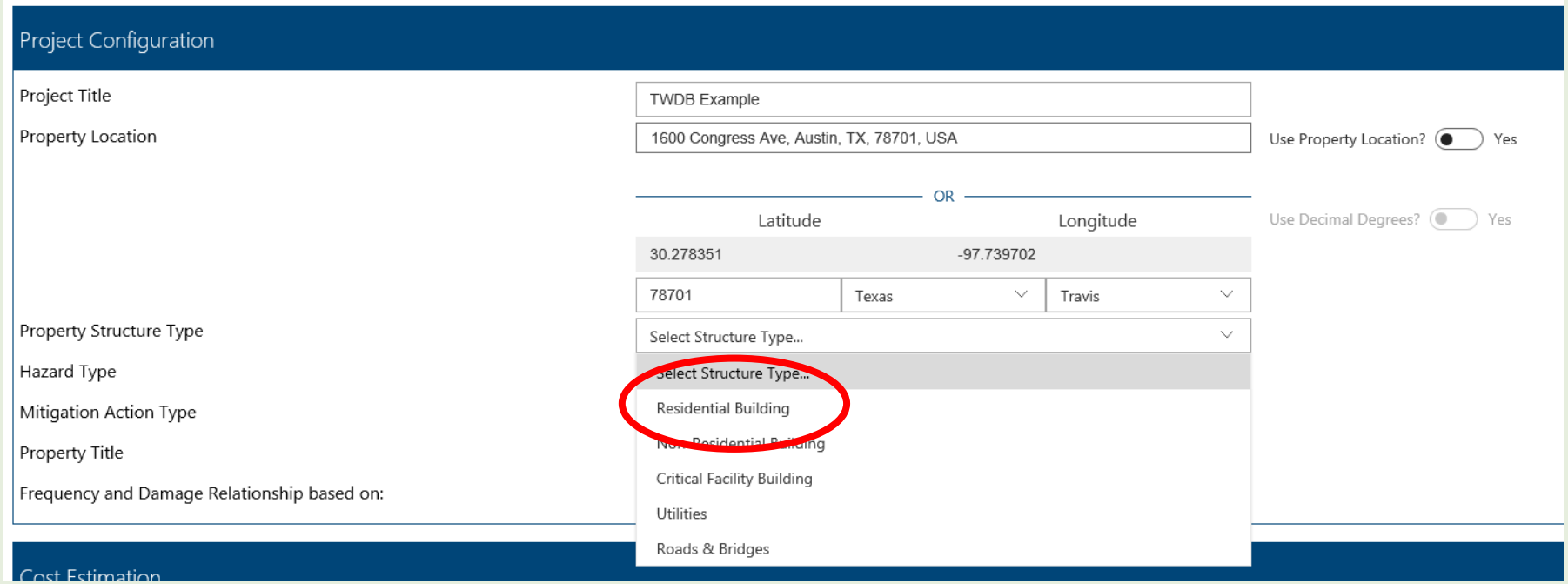
OPEN BCA TOOLKIT 6.0





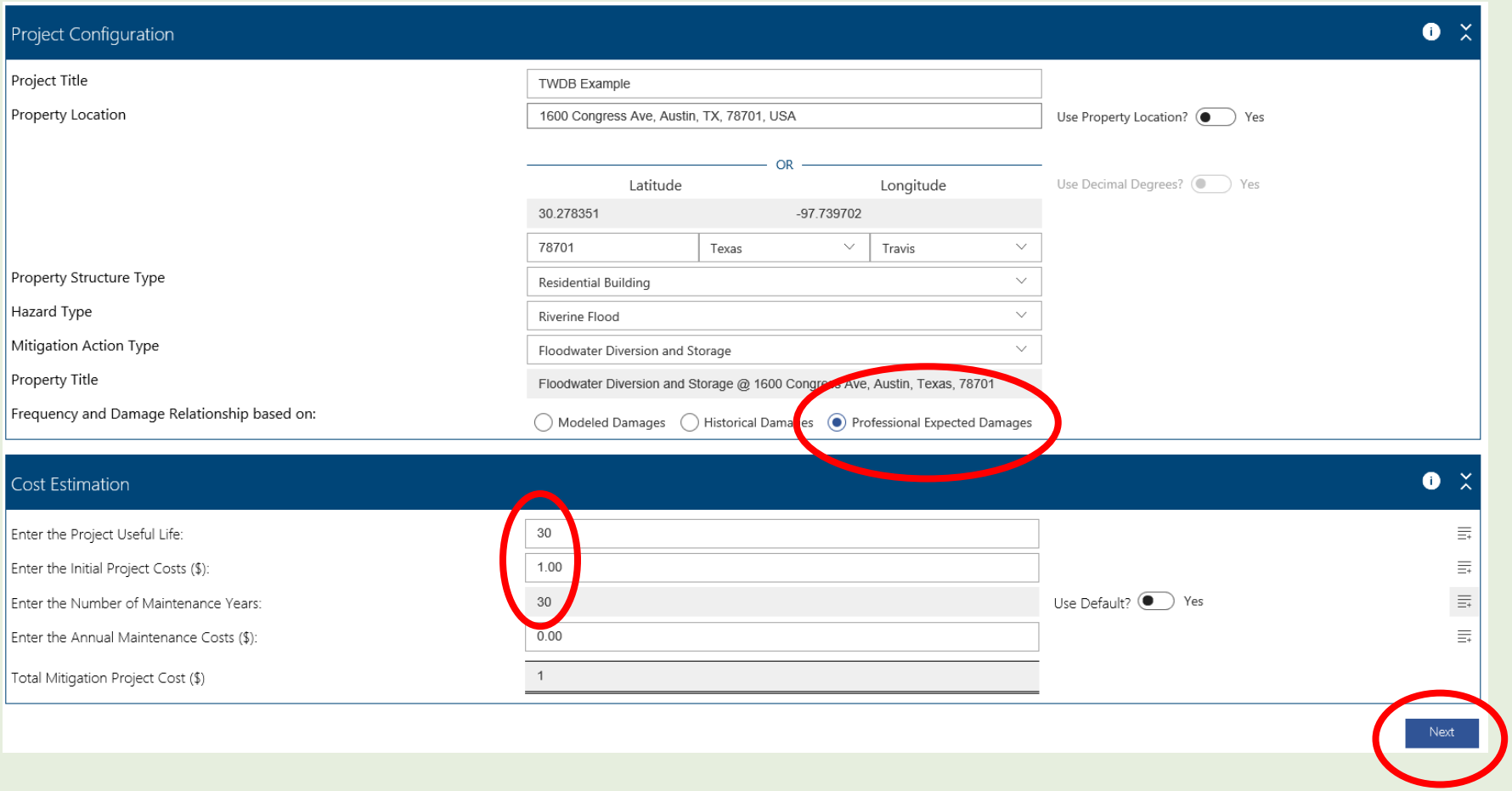
ADD PROJECT

- 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.
- Unless the benefiting structure is a Critical Facility Building (Fire, Hospital, Police), select "Residential Building."



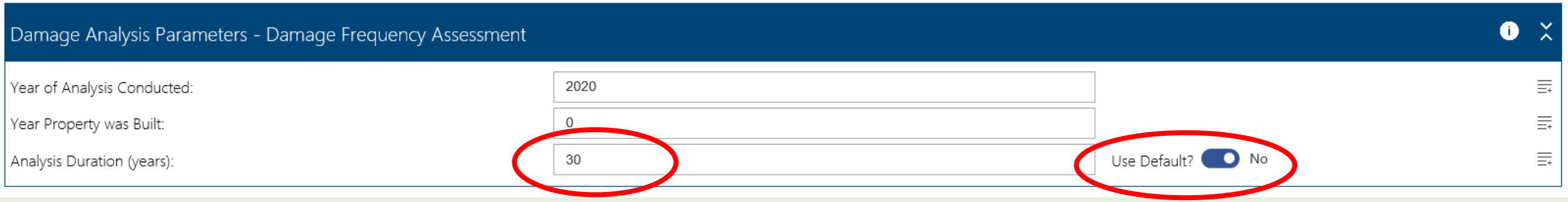
PROJECT CONFIGURATION AND COSTS

- Select "Professional Expected Damages."
- Input the Project Useful Life shown in the "Results" sheet of the BCA Input Spreadsheet. This will not be more than 30 years.
- Input Project Costs of $1
- Click "Next."



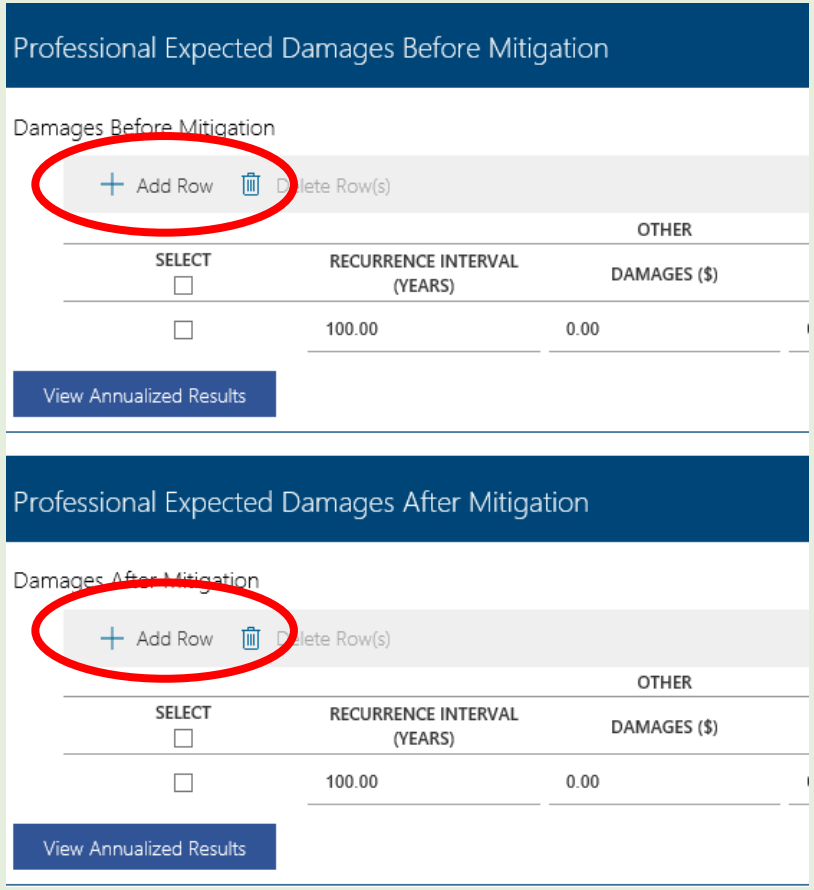
DAMAGE ANALYSIS PARAMETERS

- Click the "Use Default?" button to select "No."
- Input the Project Useful Life into the Analysis Duration (years) field.



PROFESSIONAL EXPECTED DAMAGES

- You will input the damages calculated in the BCA Input Spreadsheet for Before Mitigation (Baseline) and After Mitigation (Project).
- Input the Recurrence Interval(s) used in the analysis. If there is more than 1 Recurrence Interval, use the "Add Row" button to add them.



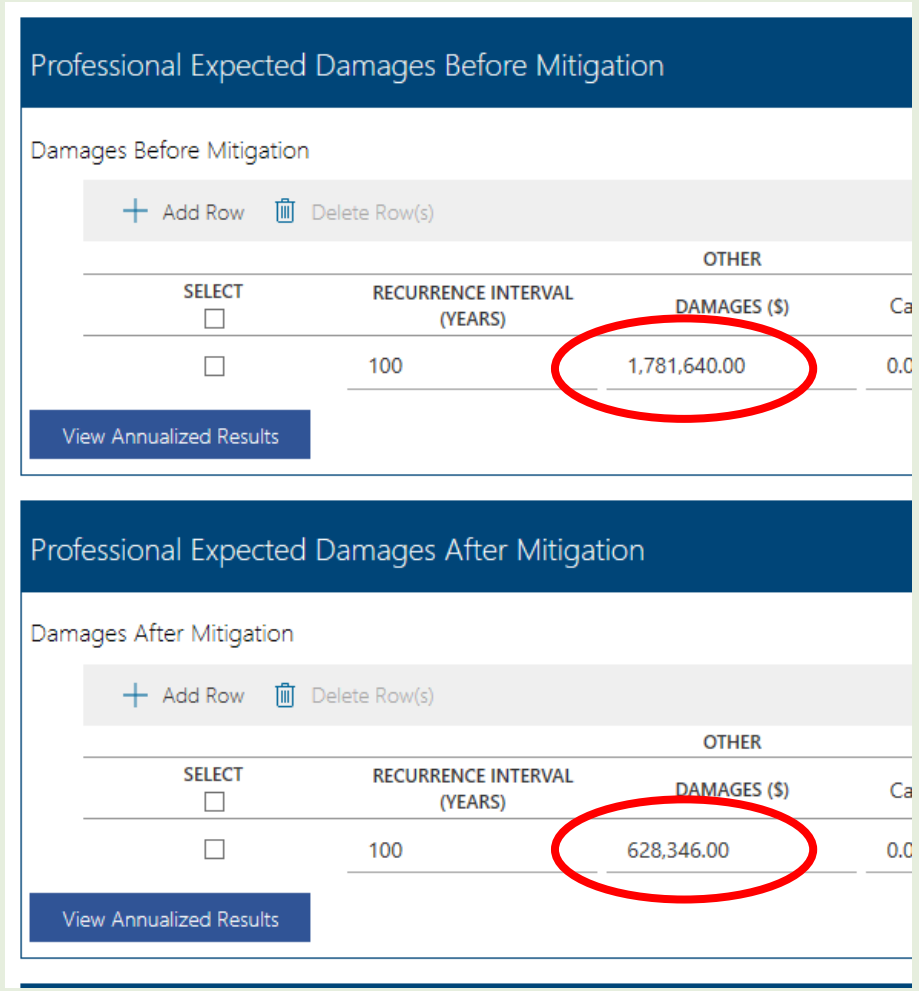
PROFESSIONAL EXPECTED DAMAGES

- Input the Baseline damages into the Damages Before Mitigation field and the Project damages into the Damages After Mitigation field.

Input Into BCA Toolkit

Project Useful Life 30

Event Damages	Baseline	Project
100 - year storm	$1,781,640	$628,346

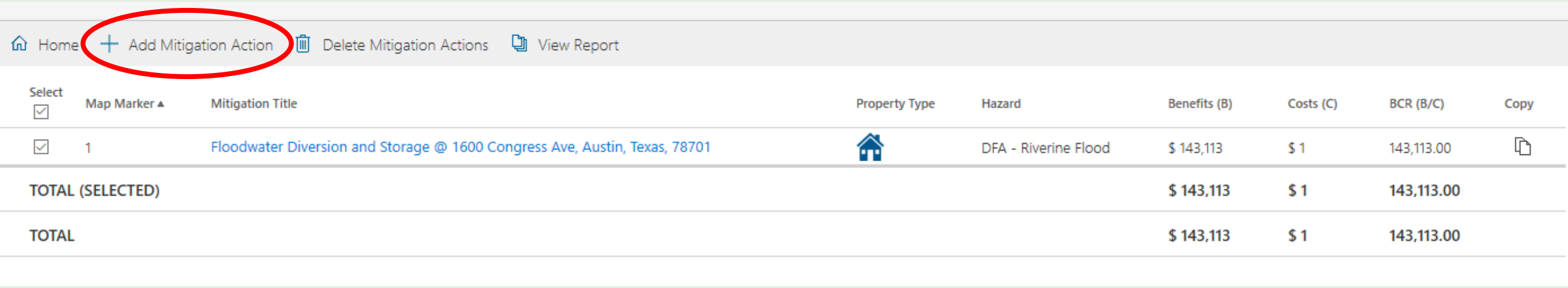


BENEFIT-COST SUMMARY

- Do NOT input any Additional Benefits into the BCA Toolkit.
- Select "Finish."

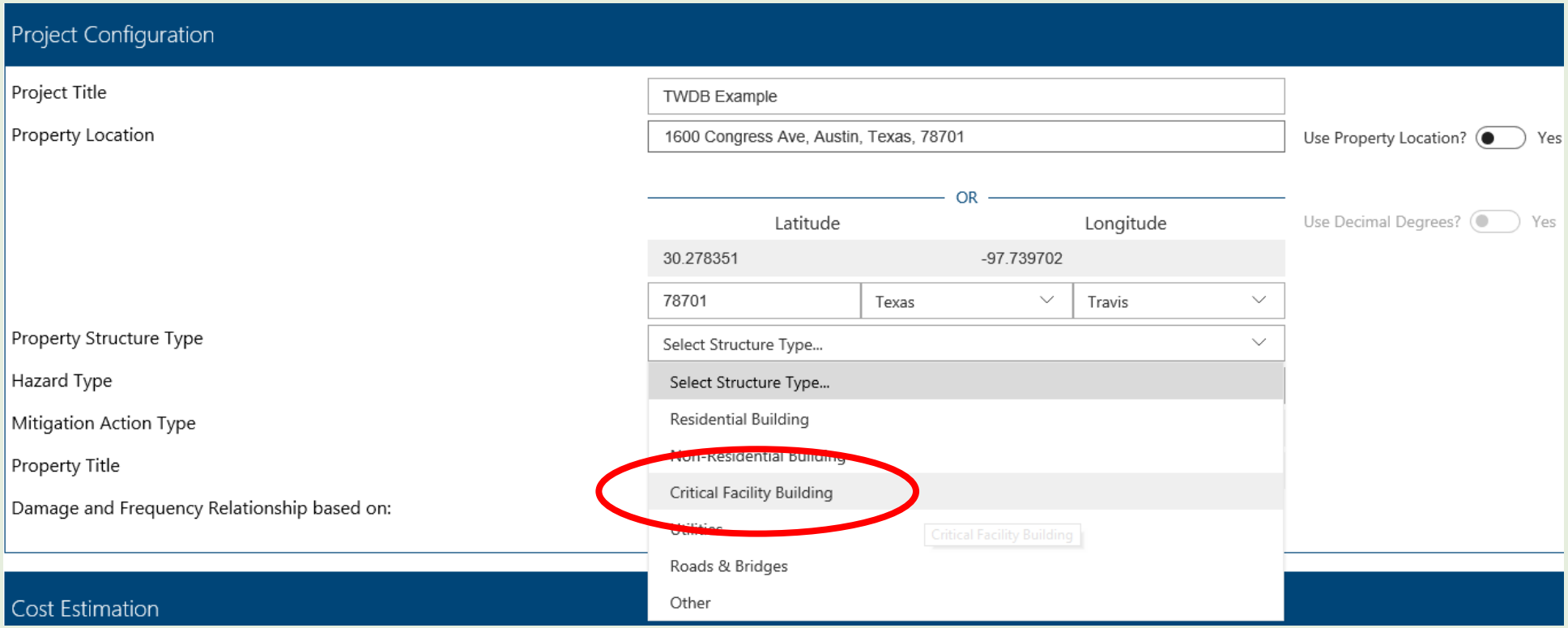
CRITICAL FACILITIES

- If the Project will decrease damages to Critical Facilities (Fire, Police, Hospital), these damages are input into the BCA Toolkit separately.
- Select "Add Mitigation Action."



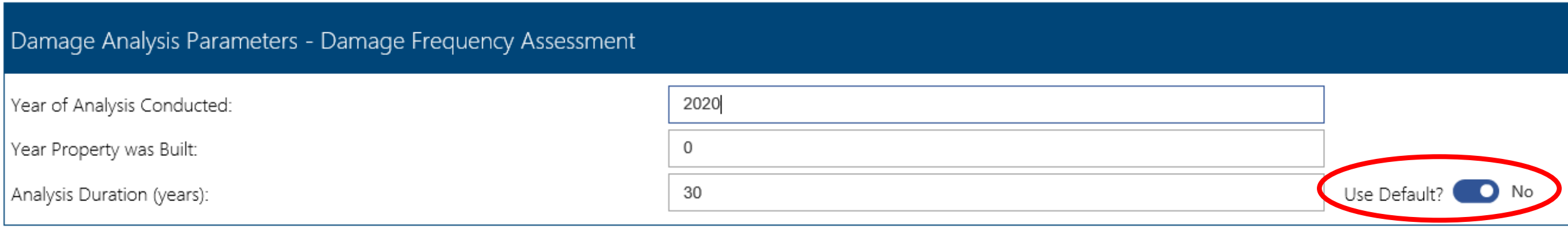
CRITICAL FACILITIES - PROJECT CONFIGURATION

- Select "Critical Facility Building." All other Project Configuration and Cost data remains the same. The Damage and Frequency Relationship is based on Professional Expected Damages.



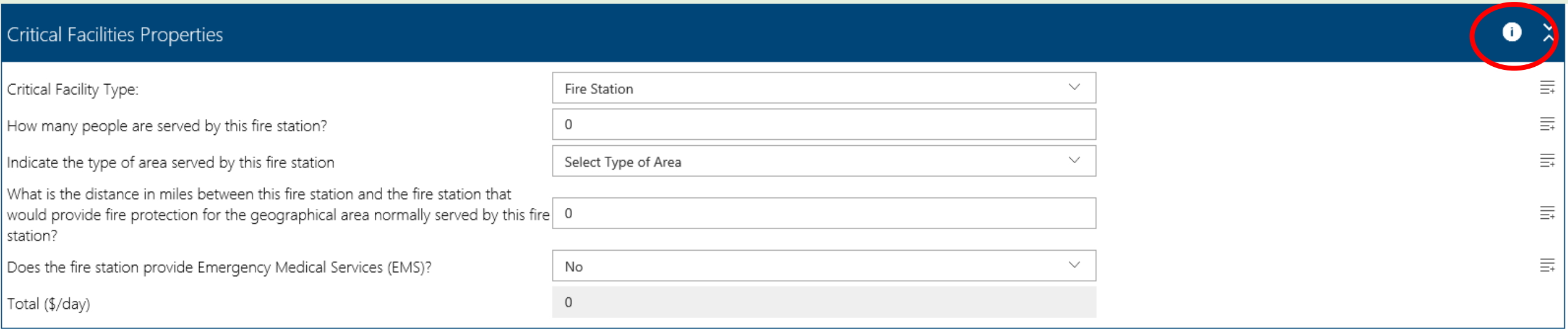
CRITICAL FACILITIES - DAMAGE ANALYSIS PARAMETERS

- Click the "Use Default?" button to select "No."
- Input the Project Life in the Analysis Duration.



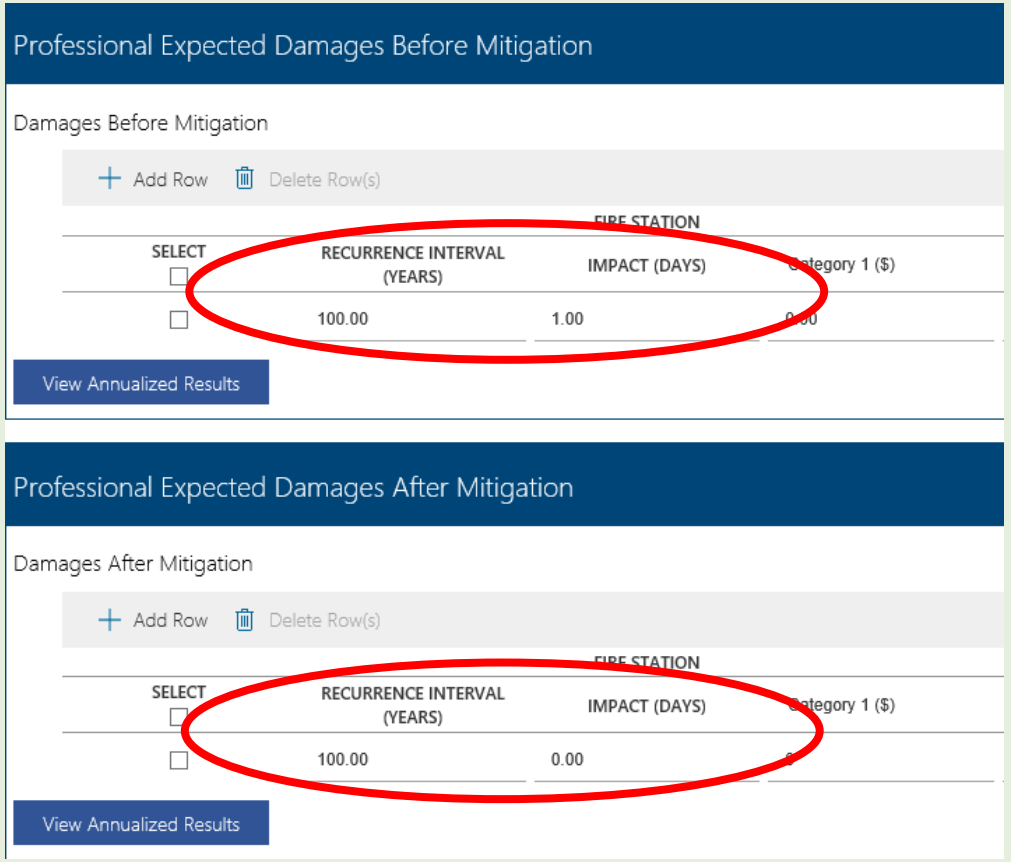
CRITICAL FACILITIES PROPERTIES

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



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 Total Benefits from the BCA Toolkit into the green "Total Benefits from BCA Toolkit" field in the BCA Input Spreadsheet.

Home | Add Mitigation Action | Delete Mitigation Actions | View Report

Select	Map Marker	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)
☑	1	Floodwater Diversion and Storage @ 1600 Congress Ave, Austin, Texas, 78701		DFA - Riverine Flood	$ 143,113	$ 1	143,113.00
☑	2	Drainage Improvement @ 1600 Congress Ave, Austin, Texas, 78701		DFA - Riverine Flood	$ 136	$ 1	136.00
TOTAL (SELECTED)					$ 143,249	$ 2	71,624.50
TOTAL					$ 143,249	$ 2	71,624.50

Input Into BCA Toolkit

Project Useful Life: **30**

Event Damages	Baseline	Project
100 - year storm	**$1,781,640**	**$628,346**

Total Benefits from BCA Toolkit	$143,249
Other Benefits (Not Recreation)	$108,564
Recreation Benefits	$130,827
Total Costs	$96,729

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.

Input Into BCA Toolkit

Project Useful Life	30

Event Damages	Baseline	Project
100 - year storm	$1,781,640	$628,346

Total Benefits from BCA Toolkit	$143,249
Other Benefits (Not Recreation)	$108,564
Recreation Benefits	$130,827
Total Costs	$96,729
Net Benefits	$155,084
Net Benefits with Recreation	$285,911
Final BCR	**2.6**
Final BCR with Recreation	**4.0**

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.