FTA

FEDERAL TRANSIT ADMINISTRATION

How to Use the FTA HMCE Tool

USER GUIDE

January 21, 2014

U.S Department of Transpration
Federal Transit Administration

How to Use the FTA HMCE Tool

USER GUIDE

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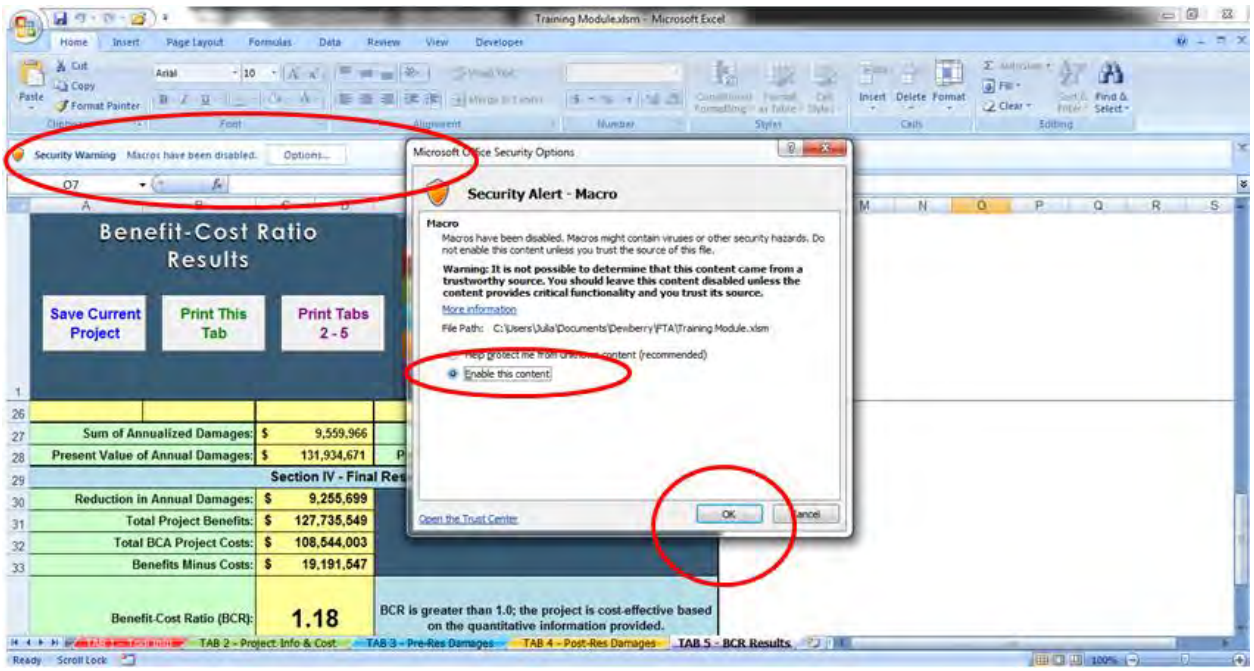
Before You Start



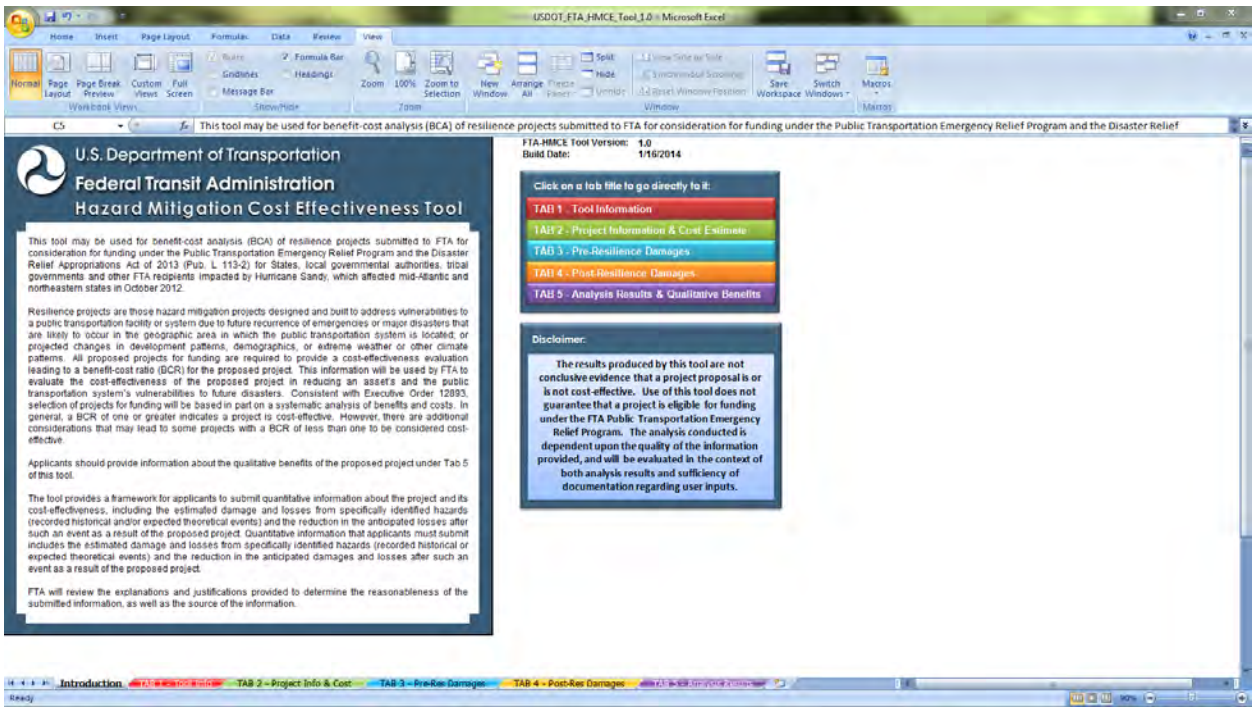
Actions/Inputs

- When you open the tool in Microsoft Excel®, an error bar might appear informing you that **macros have been disabled.**
- Click on **Options.**
- Select the radio button next to **Enable this content.**
- Click **OK.**

Notes and Tips

- Although not needed for calculations, this tool relies on macros to facilitate navigation, saving and printing. Although macros from unknown sources may be dangerous, the macros embedded in the HMCE tool are perfectly safe.
- If you like, you may choose to turn off the feature in Excel that automatically disables macros. You can find instructions on how to do so at microsoft.com.
- Using the XCell Complier version of the tool should also avoid issues with enabling macros.

General Information



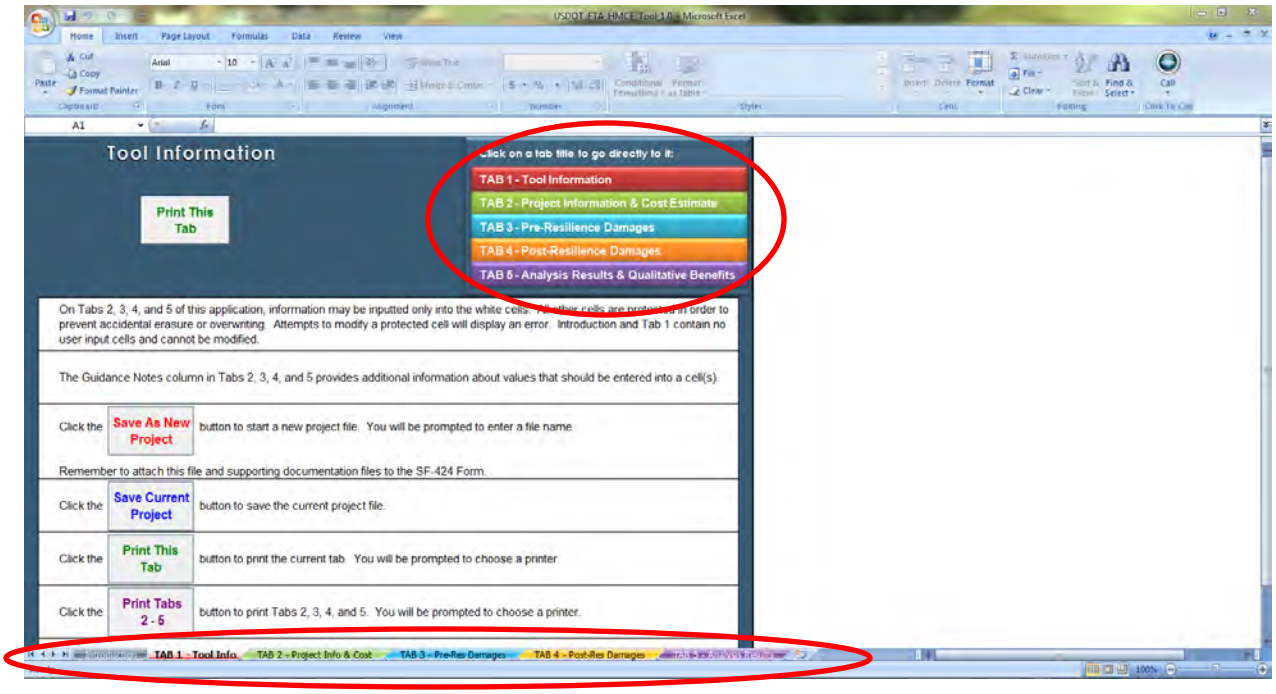
Actions/Inputs

- This first tab includes general information about the software including the tool version, build date and disclaimer.
- Read this information before using the software for the first time.
- Click on any tab button to proceed directly to that tab.

Notes and Tips

- It's worthwhile to read this information and the disclaimer - and you only have to do it once!

Tool Navigation - Tab Titles



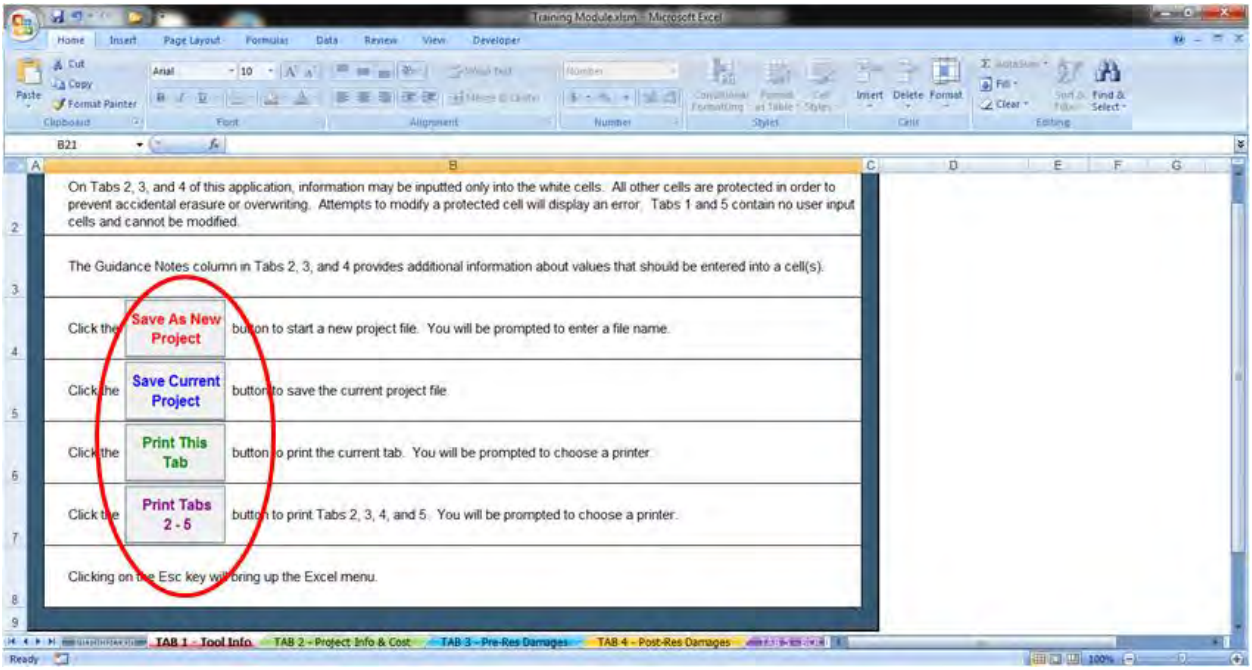
Actions/Inputs

- Click on a tab name to proceed directly to that tab. The required input in Tabs 2 to 4 must be provided by the user before the tool calculates a Benefit-Cost ratio.

Notes and Tips

- You can also navigate through the tool using the tabs at the bottom of the screen.
- These buttons appear on every tab.

Printing and Saving



Actions/Inputs

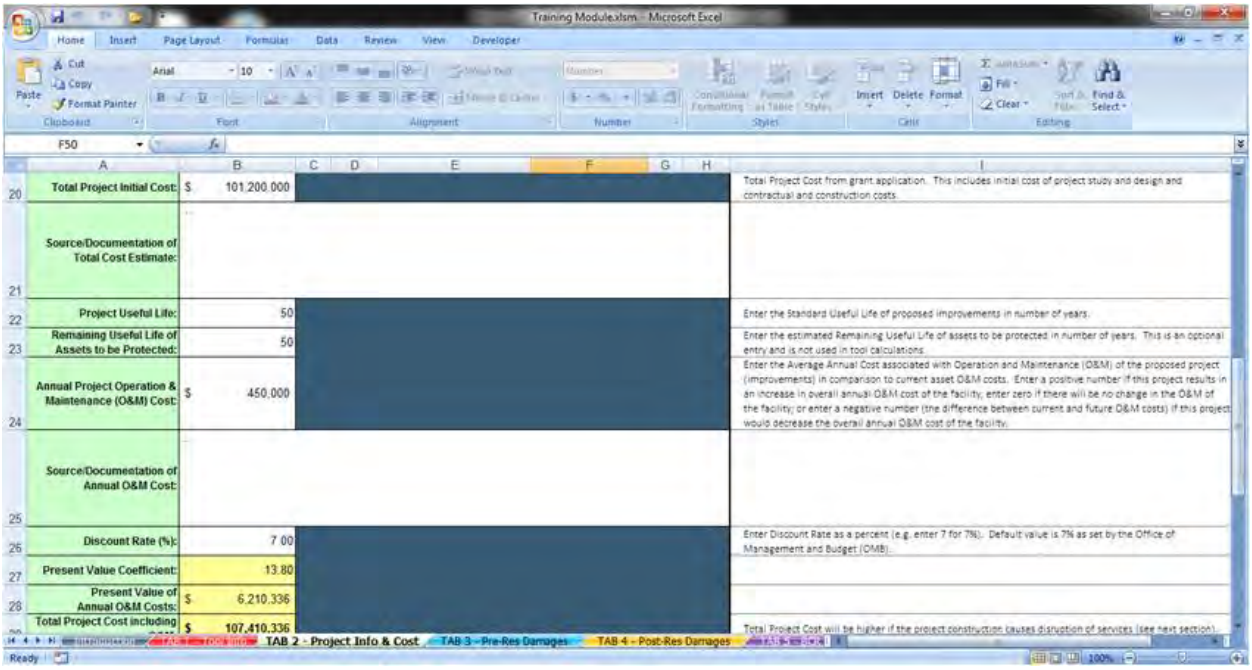
- Click the **Save as New Project** button to create a new project.
- Click the **Save Current Project** button to save your work.
- Click the **Print this Tab** button to print all inputs on the current tab.
- Click the **Print Tabs 2-5** button to print all inputs and outputs.

Note: The information shown above in Tab 1 is for display purposes only. Except for the "Print This Tab" button on top of this page the Tabs actually work only in Tabs 2 to 5.

Notes and Tips

- The **Save as New Project** button appears only on Tab 2.
  - Clicking this button should be your first action when you start a new analysis to ensure that you have an electronic copy of your work.
- The **Print Tabs 2-5** button appears only on Tab 5.
  - It is a good idea to click this button when you complete an analysis to ensure that you have a hard copy record of your work.

General Information and Notes



Actions/Inputs

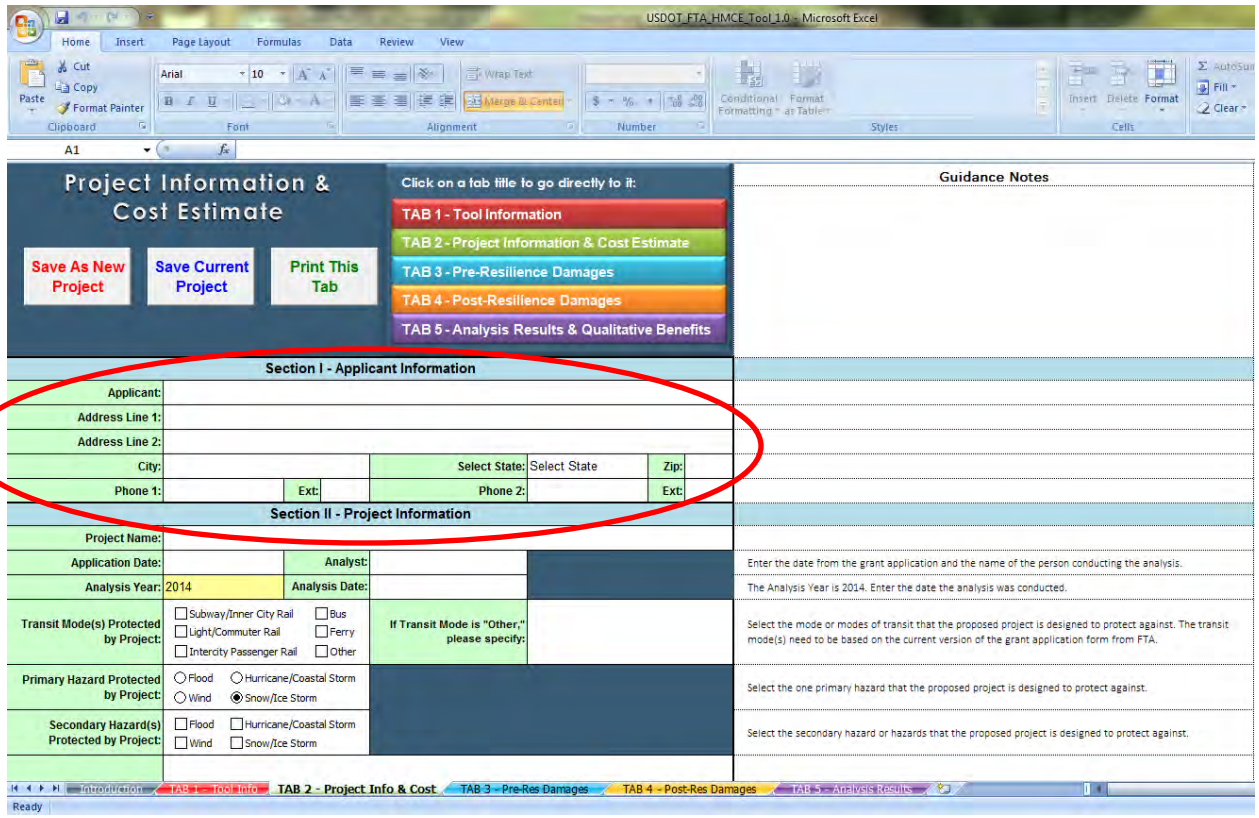
- White cells along the left-hand side of the screen are typically input cells.
- Green cells point to white input cells
- Yellow cells contain values that are calculated based on user inputs or are values carried over from previous tabs or previous sections in the same tab.
- Guidance notes can be found along the right-hand side of the screen.
- Source/Documentation cells are intended as a place where users can provide a brief description of the information used to support a selected cell input.

Notes and Tips

- In most cases, some if not all of the input cells must be populated in order for the tool to calculate results.
- This User Guide contains additional information about inputs, including guidance on recurrence intervals, analysis duration, project useful lives, and more.
- Source/Documentation cells are intended to point to a supporting file attachment(s) in the grant application.

TAB 2
Project Information & Cost Estimate

Section I - Applicant Information



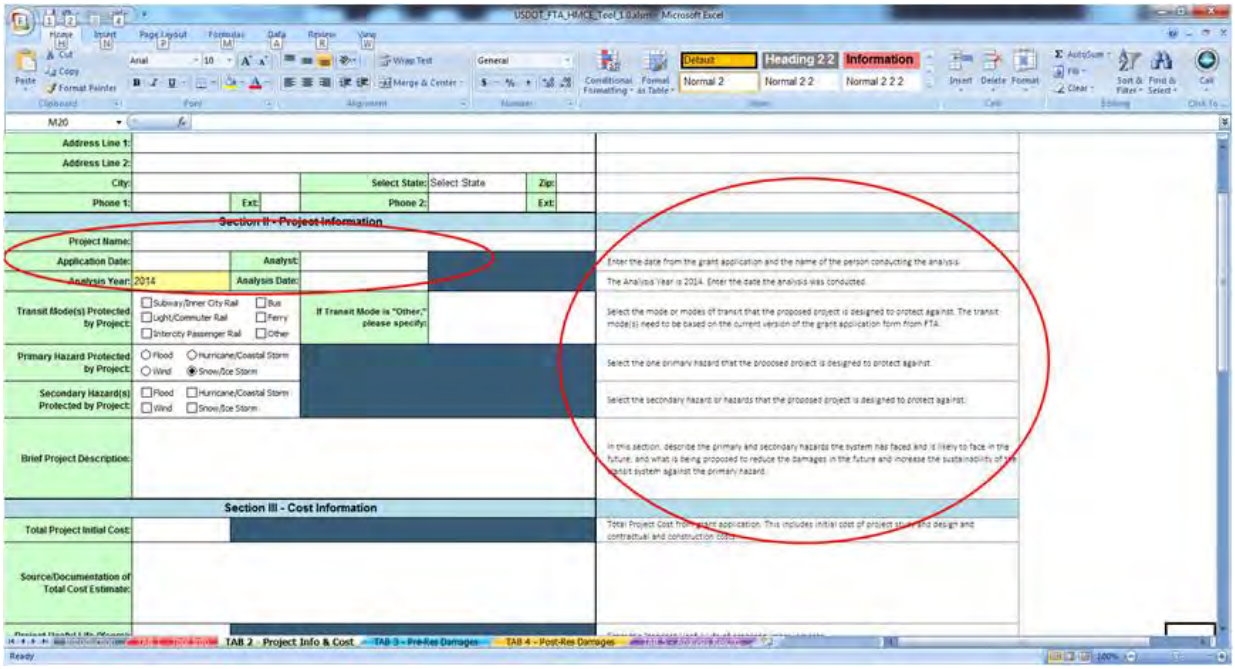
Actions/Inputs

- This section must be completed in its entirety. It will tie the HMCE analysis to the grant proposal.
- Enter the name of the entity applying for an FTA grant in the Applicant box.
- Enter the address and contact information, including contact person's name, email and phone number, in the appropriate boxes.

Notes and Tips

- Be sure to provide the best available contact information for the project point of contact.
- The primary information entered on this tab will auto-populate to subsequent tabs in the HMCE tool.

Section II - Project Information and Guidance



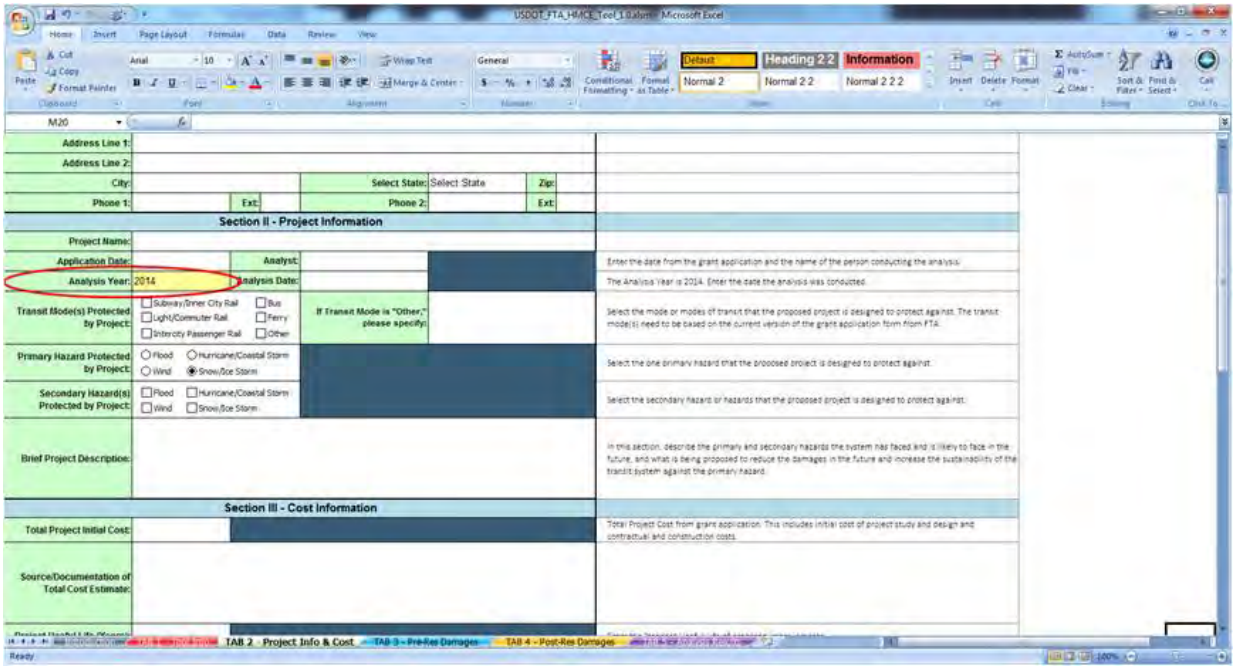
Actions/Inputs

- Enter the **Project Name.**
- Enter the date on which you're submitting the application in the **Application Date** box.

Notes and Tips

- The project name should be somewhat descriptive of the project.
  - For example, "Main Street Bridge Improvements" is more informative than "DOT Project".

Section II (continued) **- Analysis Details**



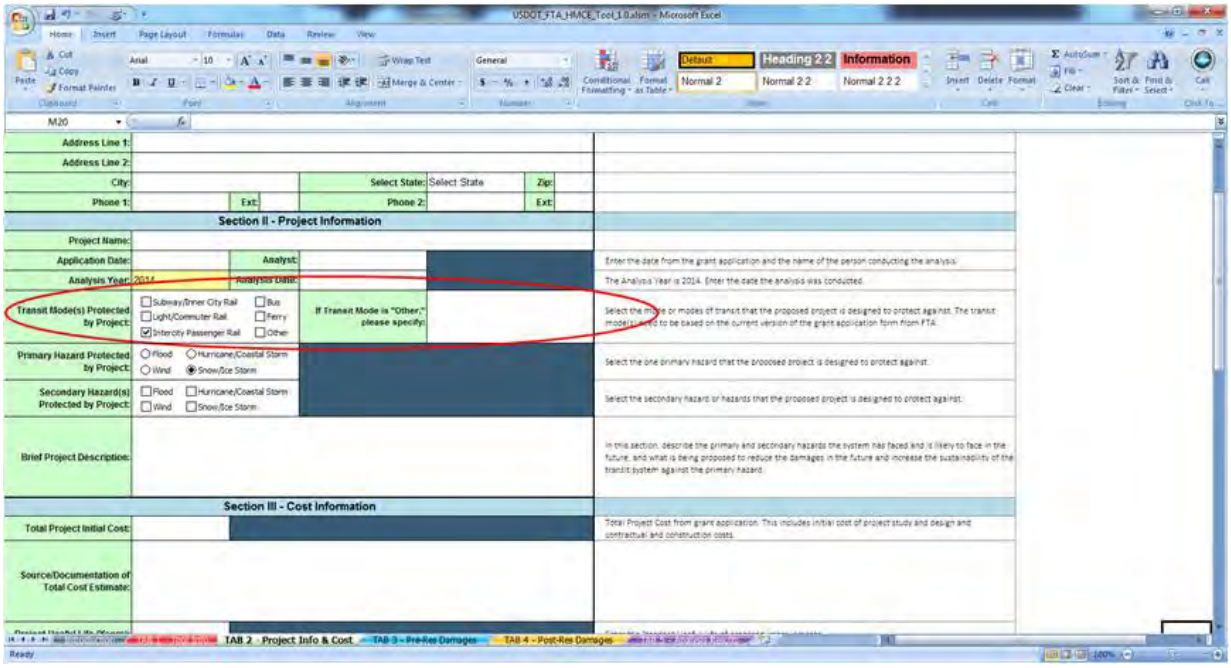
Actions/Inputs

- No input is required for Analysis Year. For this FTA funding cycle, all analysis will be done based on a 2014 proposal submittal date.
- Enter the name of the person conducting the analysis and the date the analysis was conducted in the appropriate boxes.

Notes and Tips

- The tool converts all dollar-value inputs to the equivalent dollar-value in the analysis year. This allows an “apples-to-apples” comparison of benefits and costs.

Section II (continued) **- Transit Mode(s) Protected by Project**



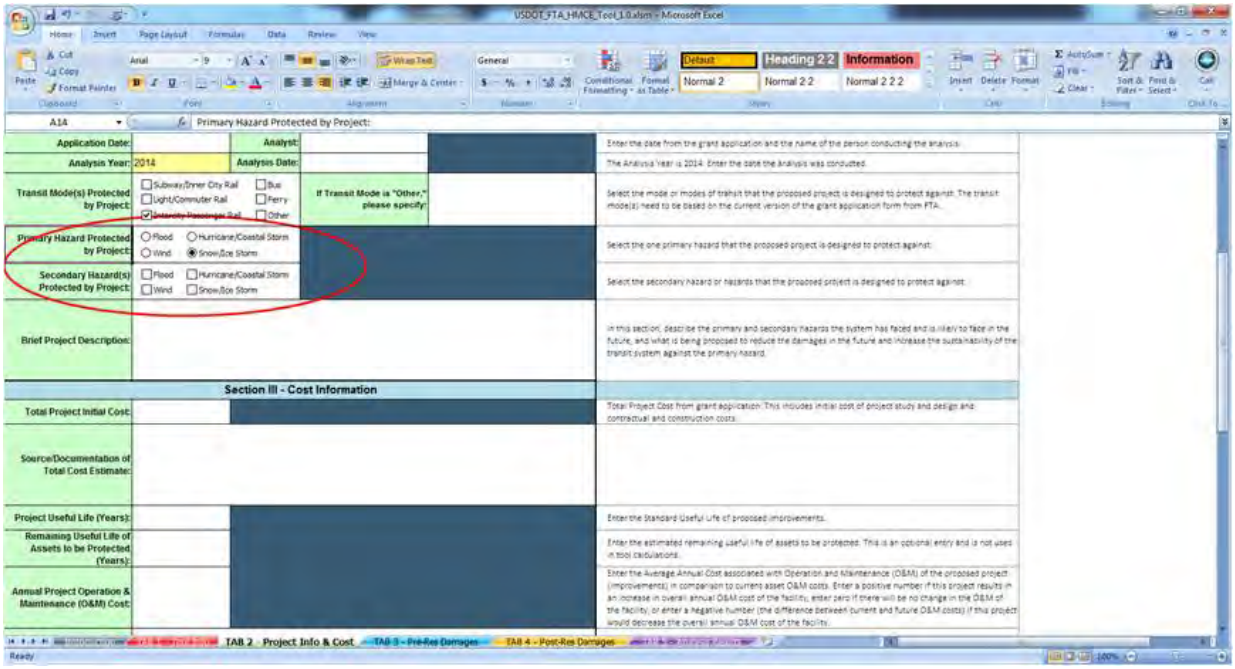
Actions/Inputs

- Select all of the transit modes that will be protected by the proposed project.
  - If the transit type is not listed, select “Other” and describe the mode in the given box.

Notes and Tips

- You can select as many transit modes as apply to your project.

Section II (continued) **- Primary and Secondary Hazards**



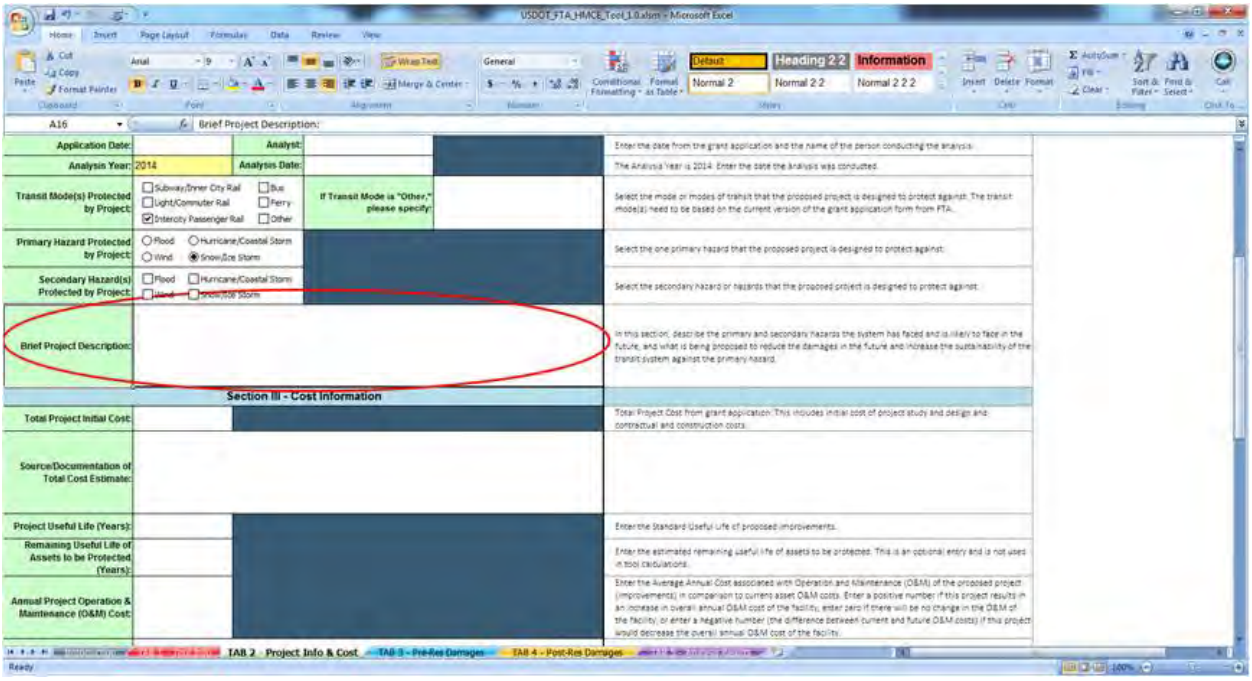
Actions/Inputs

- Select the **Primary Hazard** your project is designed to protect.
- If your project protects against more than one type of hazard, you may select secondary hazards in the **Secondary Hazard(s)** box.

Notes and Tips

- The HMCE tool is designed to analyze benefits for one of the following four types of primary hazards: flood, wind, hurricane/coastal storm, and snow/ice storm.
- You can select only one primary hazard, but you can select as many secondary hazards as apply.
- You do not have to select a secondary hazard.

Section II (continued) - **Brief Project Description**



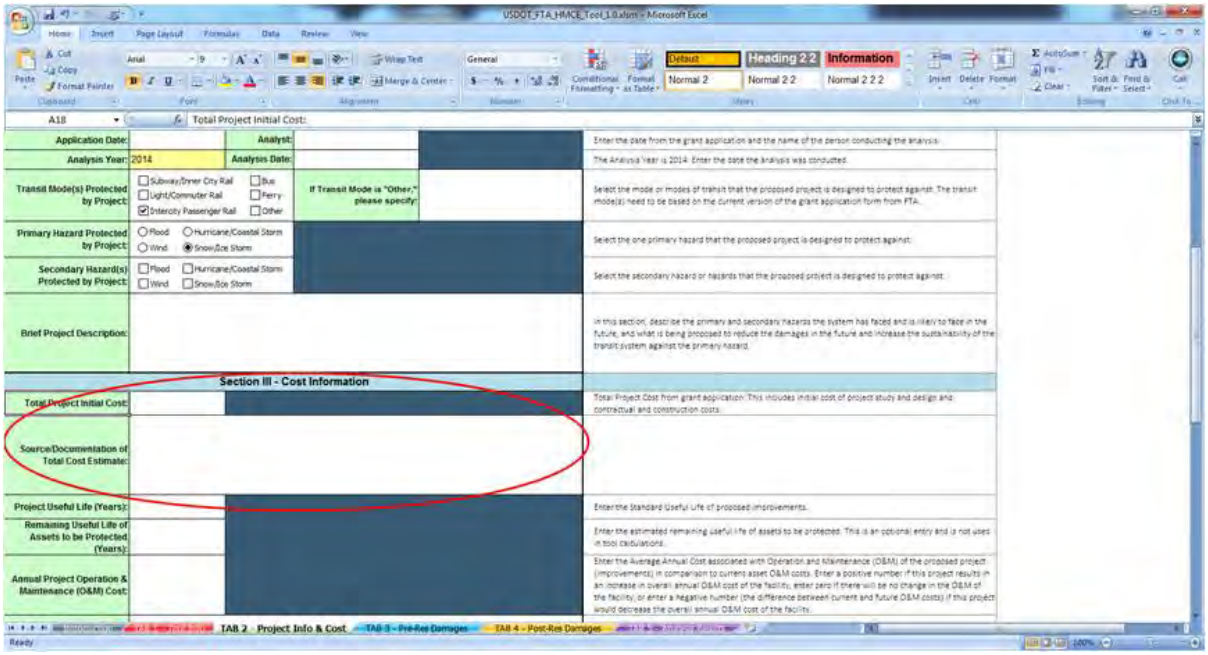
Actions/Inputs

- In **Brief Project Description**, describe the proposed project. This is an opportunity to describe your project qualitatively before you start entering numbers.
- If you like, you can copy and paste the description from the grant proposal form.

Notes and Tips

- When you briefly describe your project, try to answer the following questions:
  - **What** does the project entail?
  - **Why** is it important to complete this project?
  - **Where** will the project take place?
  - **How** will the project be implemented?

Section III - Project Cost Information



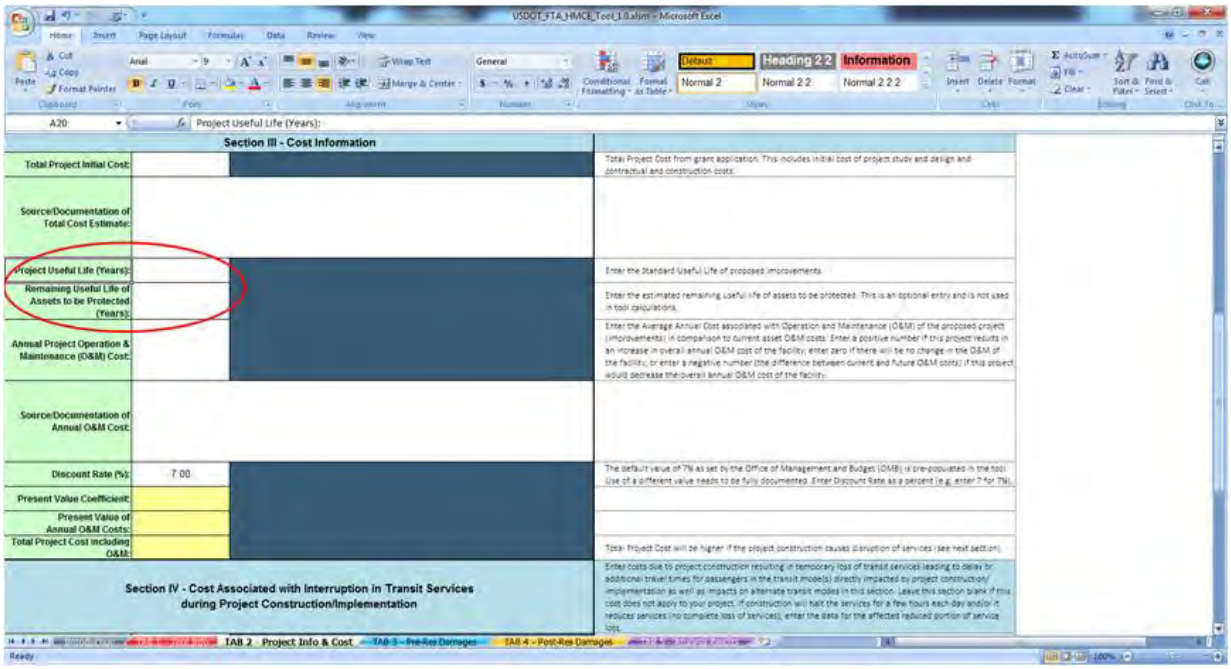
Actions/Inputs

- Enter the total project cost from your grant application in **Total Project Initial Cost.**
- In **Source/Documentation,** briefly describe where your estimate came from, such as a contractor's estimate.
  - If possible, reference the file or location where the cost estimate can be found.

Notes and Tips

- Your total initial project cost should include:
  - Pre-Construction Costs of study and design;
  - Construction Costs; and
  - Ancillary Costs of contractual costs and associated mark-ups.
- Total initial project cost entered should match the total cost on the grant proposal form.

Section III (continued) **- Project Useful Life and Remaining Useful Life of Assets to be Protected**



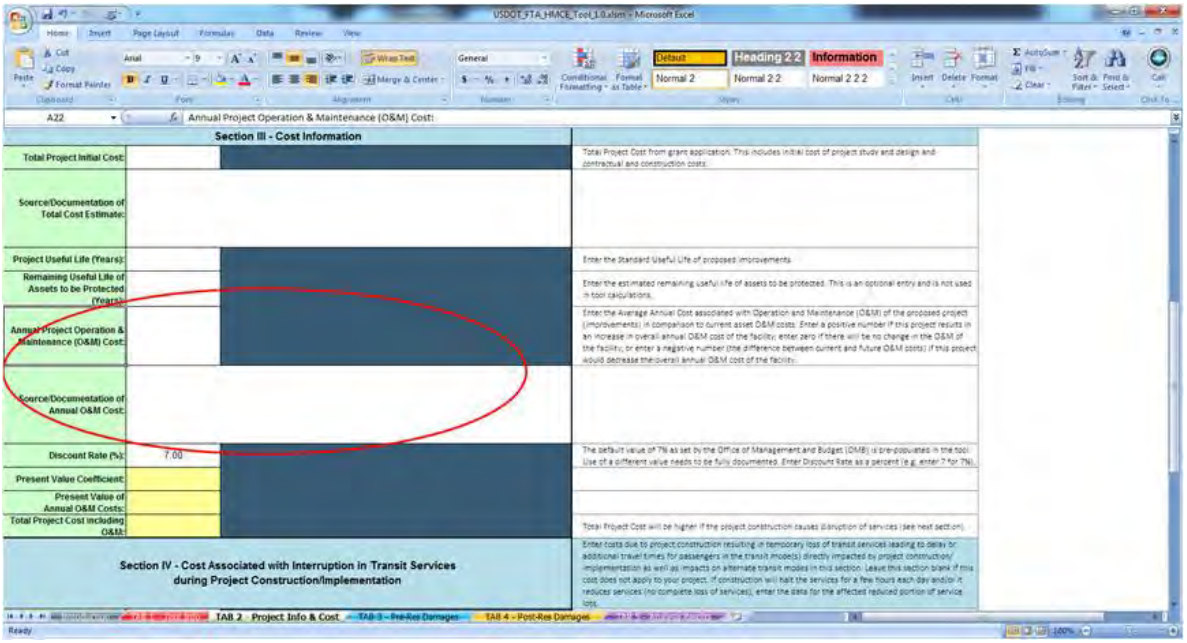
Actions/Inputs

- Enter the duration, in years, over which the project will protect the asset(s) in **Project Useful Life.**
- Enter the duration, in years, over which the asset(s) is expected to remain serviceable in **Remaining Useful Life.** If unknown, leave this cell blank.

Notes and Tips

- **Standard Project Useful Life (PUL) summary guidance is given in Appendix A of this User Guide.**
- **Summary guidance on the useful life of assets is given in Appendix B of this User Guide.**
- HMCE Tool analysis conducted based on Project Useful Life.
- Although the remaining useful life is not used in calculations, it can help to provide qualitative context for the proposed project to grant reviewers.

Section III (continued) **– Operation & Maintenance Costs**



Actions/Inputs

- Enter the difference between the average annual operation and maintenance (O&M) costs associated with the proposed project and the current average annual O&M costs for the asset to be protected by the project.

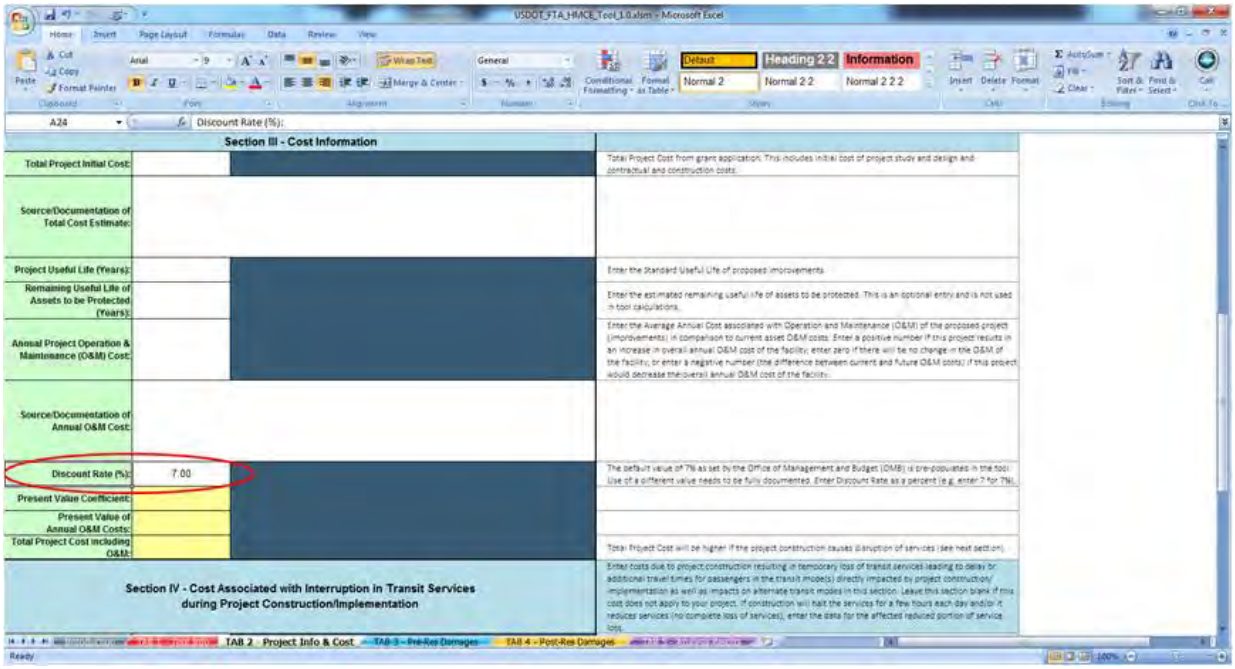
Annual Project O&M Cost **=** (Average Annual O&M Costs for Proposed Project) **–** (Current Average Annual O&M Costs for Asset)

- Briefly describe the source of this value. If possible, reference a file or location containing these calculations.

Notes and Tips

- You may enter any numerical value here:
  - A **positive** value indicates that O&M costs will be higher after the proposed project is complete.
  - **Zero** indicates that O&M costs will not change.
  - A **negative** value indicates that the proposed project will actually reduce annual O&M costs.

Section III (continued) **- Discount Rate**



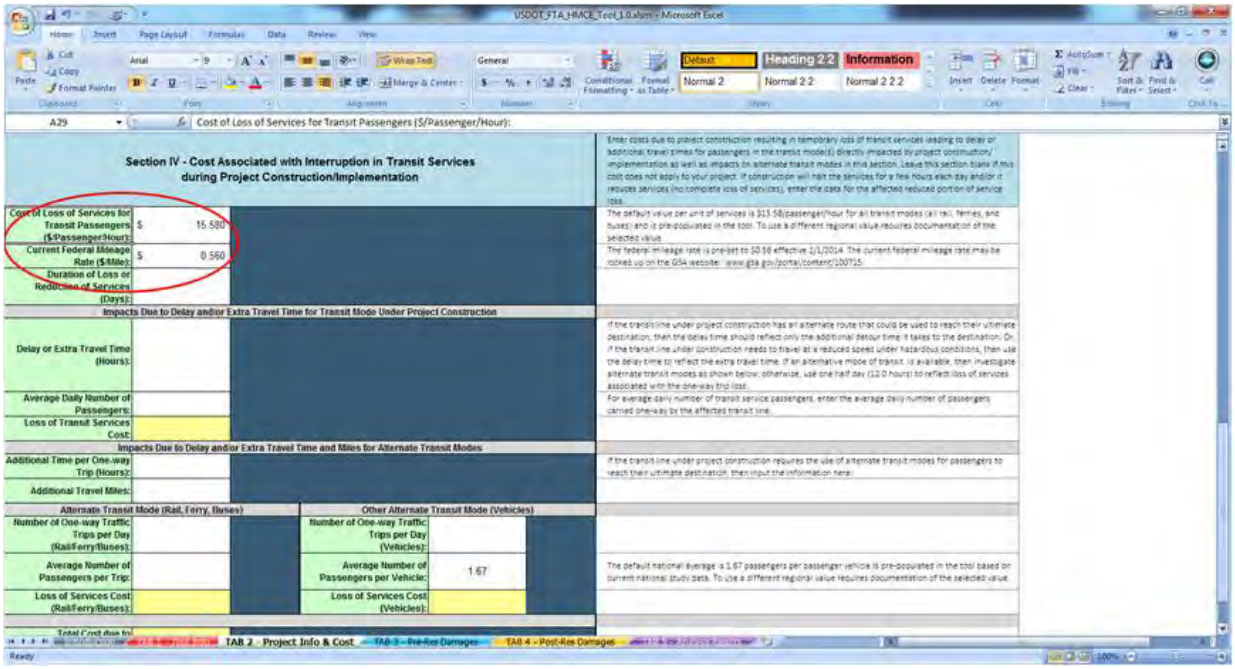
Actions/Inputs

- No input is required for the Discount Rate. For this FTA funding cycle, the discount rate is pre-populated at 7 percent (7.00%).

Notes and Tips

- Office of Management and Budget (OMB) Circular A-94 has established the standard discount rate of 7 percent for project benefit-cost analysis.
- The discount rate accounts for the time value of money.

Section IV – Interruption of Service Costs



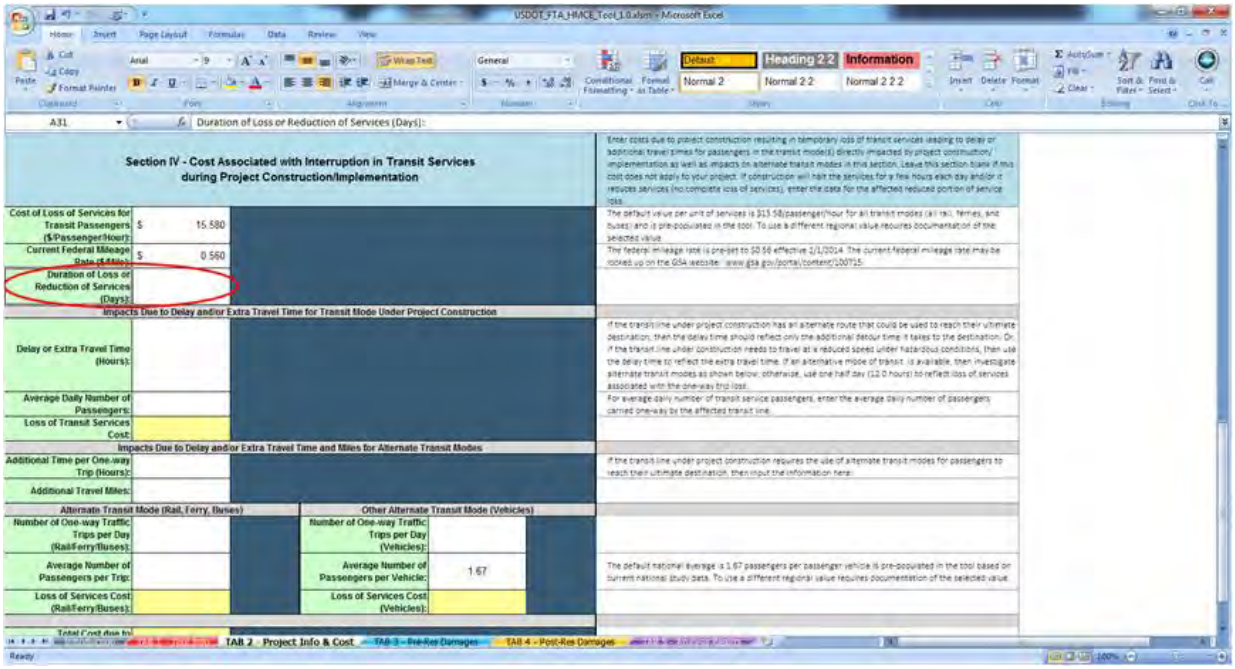
Actions/Inputs

- This section allows input of costs for interruption of transit service associated with construction or implementation of the proposed resilience project.
- Enter the cost per passenger per hour associated with loss of service in **Cost of Loss of Services for passengers** if different from the default value.
- Enter the **Current Federal Mileage Rate** for passenger vehicles if different from the default value.

Notes and Tips

- You only need to provide the value(s) that apply to your project. For example, you do not need a mileage rate for a project that does not impact bus or passenger vehicle traffic.
- The default cost of loss of service per passenger for all rail, bus, and ferry transit projects is $15.58/passenger/hour based on the current national average hourly wage rate and DOT guidance.
- The current Federal mileage rate of $0.56/mile for passenger vehicles is determined by the GSA for 2014.

Section IV (continued) **- Duration of Service Loss or Reduction**



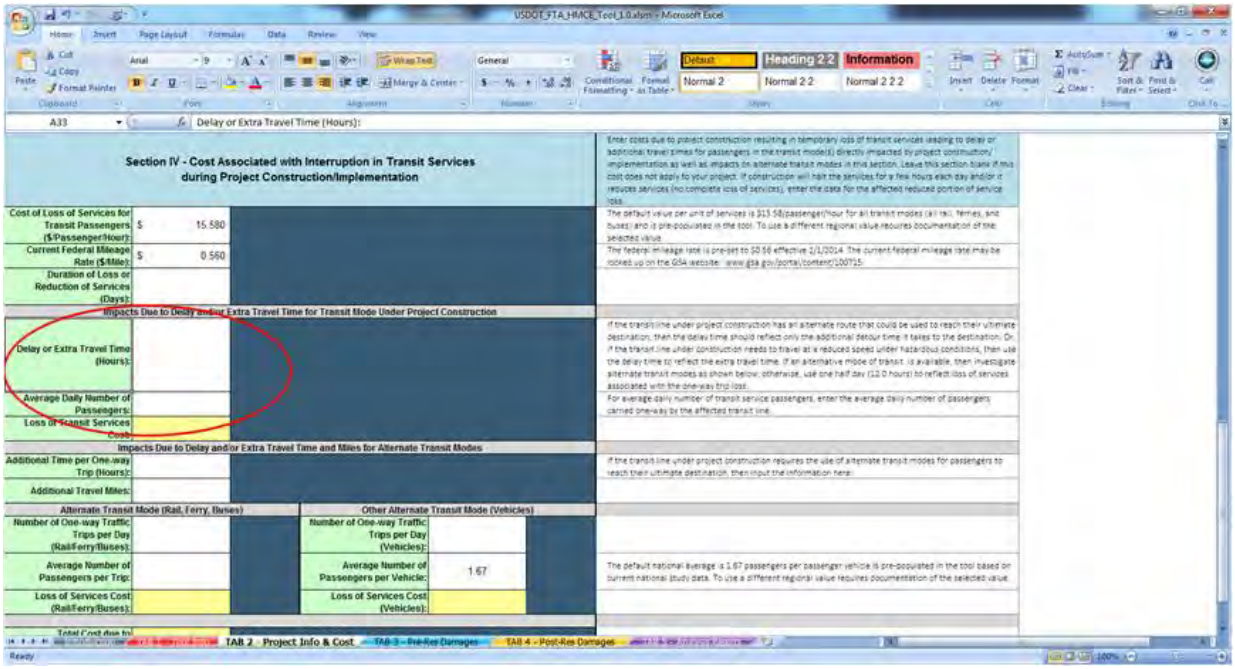
Actions/Inputs

- Enter the **Duration of Loss or Reduction of Services** in days associated with construction or implementation of the proposed project.
- Enter “0” if there will not be a reduction in services for the associated transit mode during project construction.

Notes and Tips

- The duration of loss/reduction is the **length of time (in days) during project construction or implementation that passenger travel will be impacted.**

Section IV (continued) **- Interruption of Transit Services**



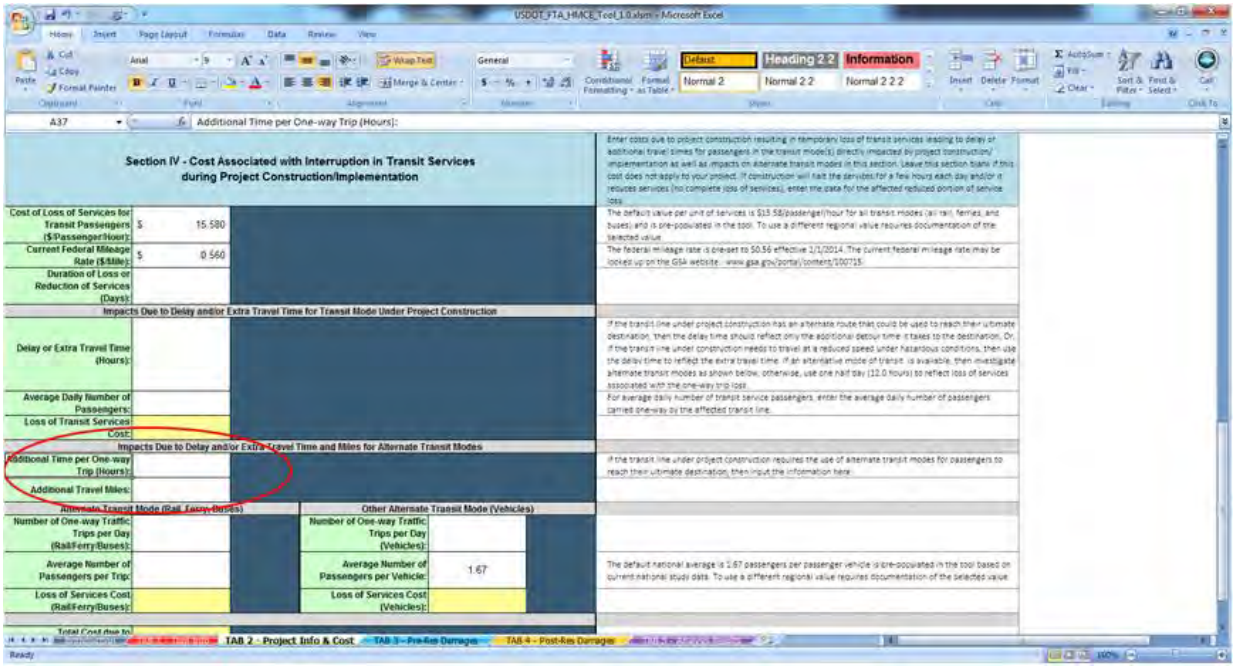
Actions/Inputs

- Enter the indicated values if your project has service interruptions involving an alternate route on the same transit mode or reduced transit speeds during construction.
- Enter the estimated **Delay or Extra Travel Time** in hours.
- Enter the **Average Daily Number of Passengers** using the transit line during the construction period(s)**.**
- If no service interruptions will occur, enter 0.

Notes and Tips

- The estimated delay is how much longer it will take passengers to get to their destination due to construction.
- If no service is available to take passengers to their destination, then Delay Time should be one-half day (12 hours) to reflect loss of one-way trip.
- The **Loss of Transit Services Cost** will populate automatically.
- You should maintain documentation to support the number of passengers impacted by the delays.

Section IV (continued) **- Impacts on Alternative Transit Modes**



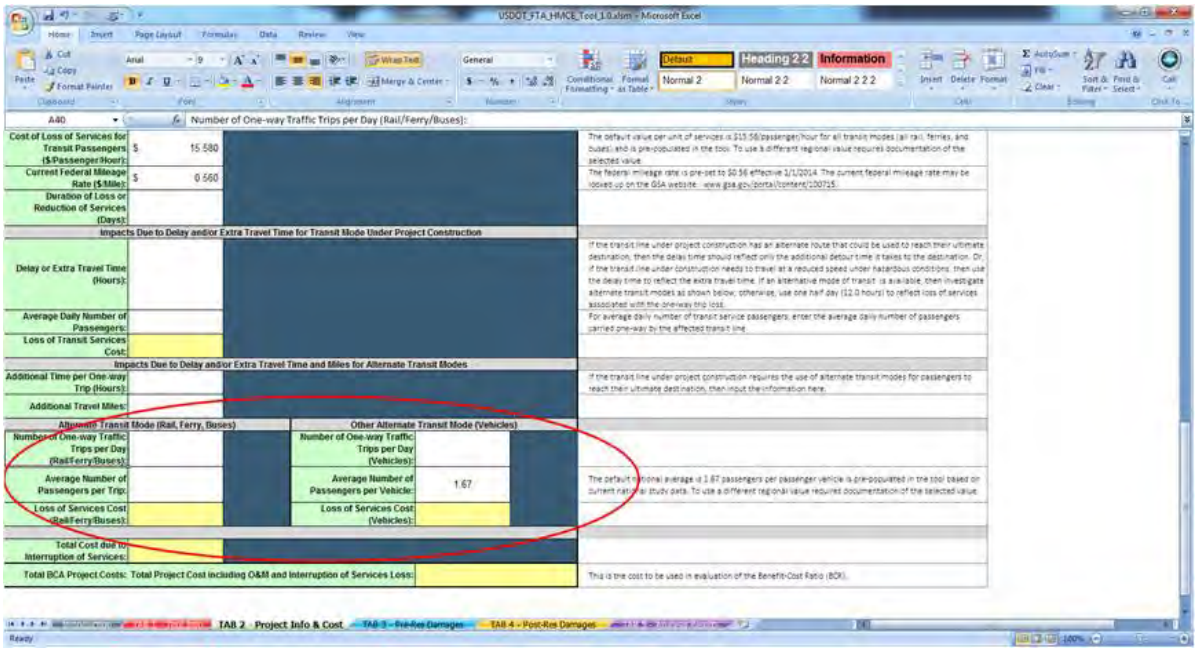
Actions/Inputs

- Enter the indicated values if your project will impact an alternative mode of transit including passenger vehicle traffic.
- Enter the **Additional Time per One-Way Trip** in hours for the alternative transit mode.
- Enter the **Additional Travel Miles** per one way trip in miles for passenger vehicles.

Notes and Tips

- The additional time per one-way trip is how much longer one trip will take during construction.
- The additional travel miles accounts for delays or detours on alternative transit modes caused by project construction. If there are no delays or detours, enter 0 or leave this field blank.

Section IV (continued) **- Interruption of Alternative Transit Modes**



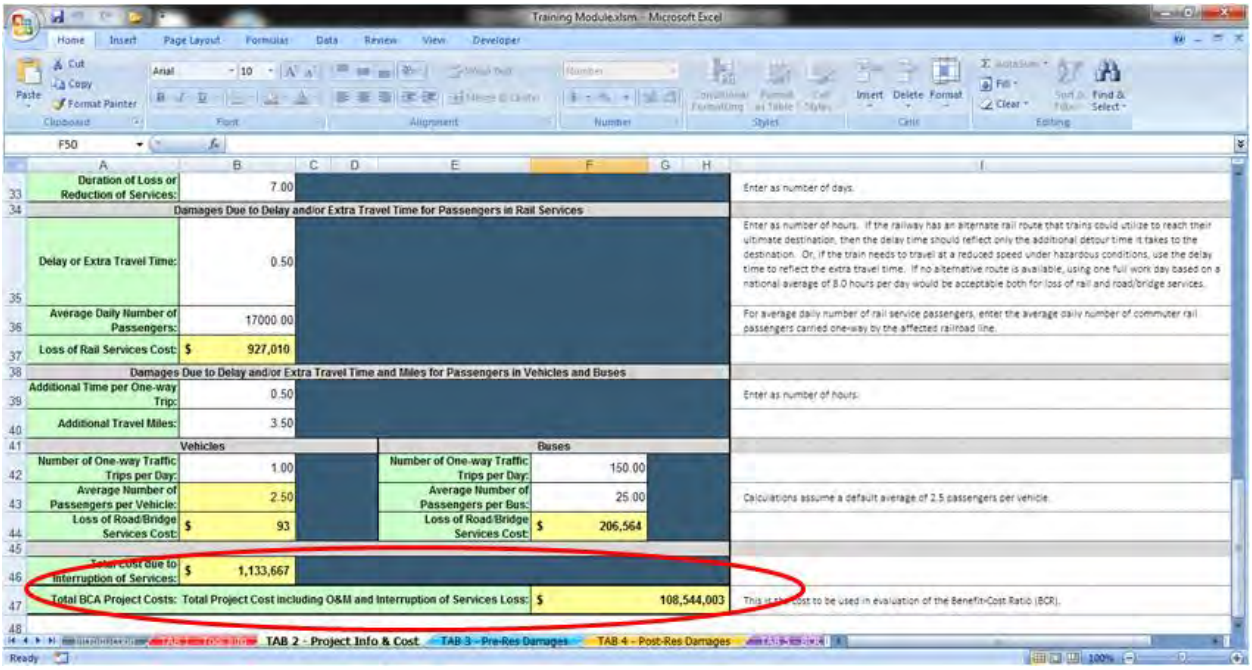
Actions/Inputs

- If alternative transit modes (rail, ferry, bus) will be impacted, enter the **Number of One-way Traffic Trips per Day (Rail/Ferry/Buses)** and the **Average Number of Passengers per Trip**.
- If passenger vehicles will be impacted, enter the **Number of one-way Traffic Trips per Day** made by passenger vehicles.
- If there will not be impacts on rail, ferry, bus, or vehicle travel, enter 0.

Notes and Tips

- You can enter trip information for rail, ferries, buses and passenger vehicles.
- The default value for Average Number of Passenger per Vehicle (1.67) is based on the latest available DOT traffic studies and should not be changed without supporting documentation.
- You should maintain documentation to support your estimates of the number of trips and average number of bus passengers.

Section IV (continued) **- Project Cost Summary**



Actions/Inputs

- The Total BCA Project Costs will be displayed at the bottom of Tab 2. This number will be used in the evaluation of the benefit-cost ratio (BCR).
- No additional inputs are required for Tab 2.
- Remember to **Save As New Project** if you have not done so already or **Save Current Project** (on top of page) if you have saved as a new project already.
- Please proceed to Tab 3.

Notes and Tips

- The total interruption costs and total project costs will populate in the Total BCA Project Costs based on your inputs to this point.

General Notes - Expected vs. Historic Damages

TAB 3 – Pre-Resilience Damage: the current (as-is) situation

- Two basic options for inputting damage:

1) Historic Damages, based on records from actual past disaster events
    - Need a minimum of one known RI event or three unknown RI events occurring in different years

2) Expected Damages, based on damages predicted from a theoretical model or engineering analysis.
    - Need a minimum of one or more events with known RIs

TAB 4 – Post-Resilience Damage: residual damage (project effectiveness)

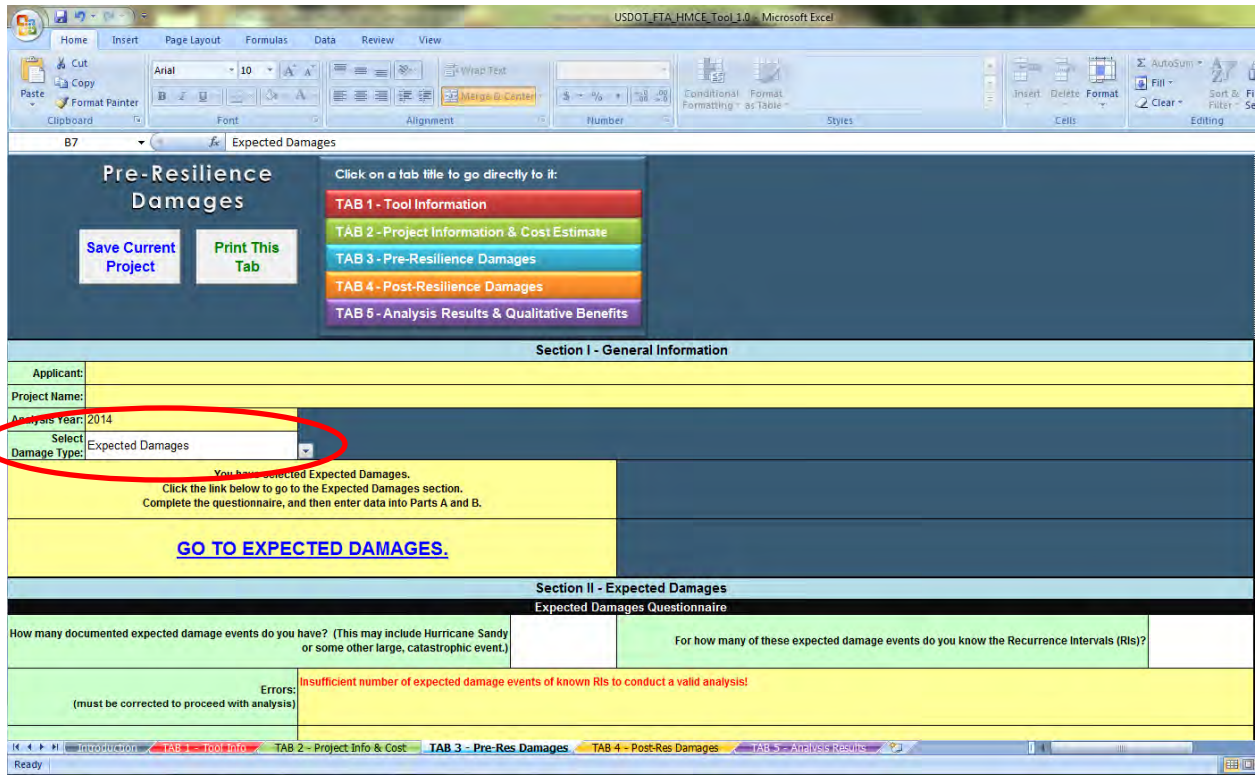
- Input damages based Expected Damages only

TAB 3 and TAB 4 Both Allow Input of the Following Damages:

- Physical Damages Costs – permanent repair/replacement
    - Fixed Structures - transit stations, tracks, maintenance facilities, substations
    - Rolling Stock – rail cars, buses, ferries
- Response and Recovery Costs – emergency repairs and other temporary measures
- Other Damage Costs – miscellaneous costs (debris, cleanup)

  Economic Impacts of Lost Transit Service (Non-Physical Damages) – service losses/delays, alternate transit, additional mileage

General Notes - Expected vs. Historic Damages



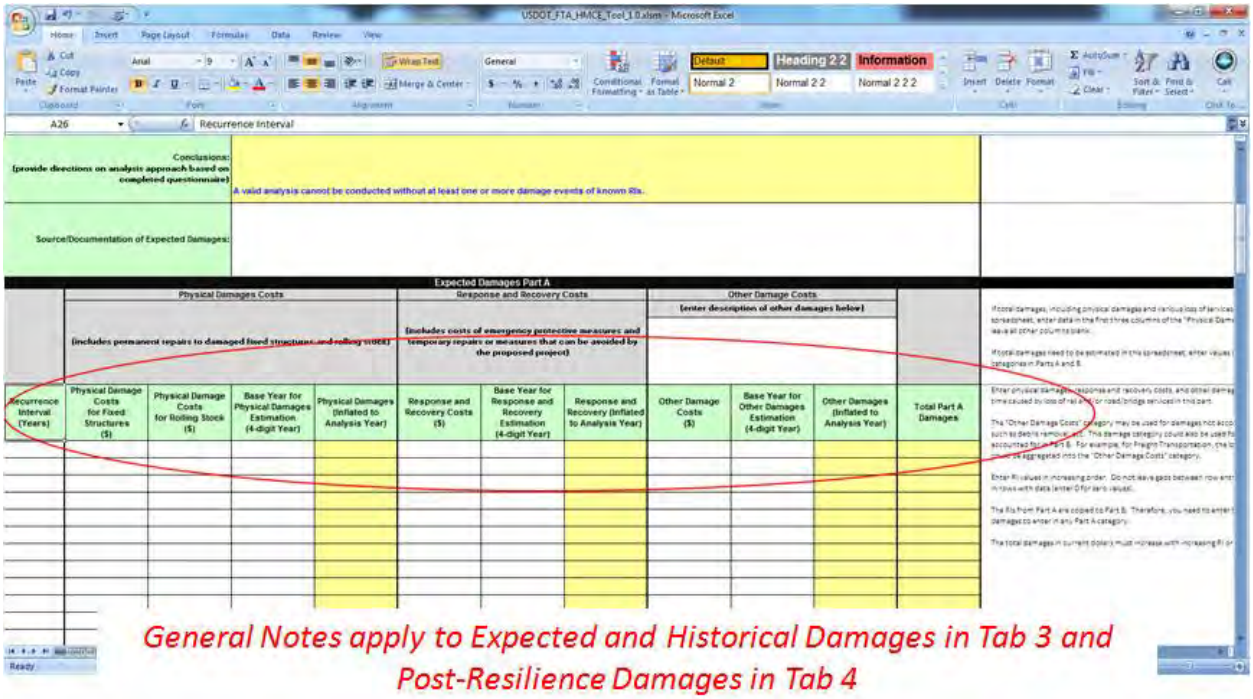
Actions/Inputs

- In **Tab 3, Section I,** Select Expected Damages or Historic Damages from the drop-down menu.
- If you select "Historic Damages", click the button to skip to the appropriate section. Otherwise, proceed with the Expected Damages questionnaire.

Notes and Tips

- You must have damage data from at least one event regardless of your selection.
- Use Expected Damages if you are using damages predicted by a model.
  - You must know the recurrence interval associated with each expected damage event.
  - Post-Resilience Damages = Expected Damages
- Use Historic Damages if you are using records of damages from past disasters.
  - You do not need to know any recurrence intervals for historic damages, but you can enter up to 2 recurrence intervals.
- More detailed information about expected and historical damages can be found in the HMCE training materials.
- Recurrence interval is the expected return period of an event based on the annual probability of occurrence. (For example, a 100-year recurrence interval has a 1 in 100 probability or 1% chance of occurrence or exceedance in any given year.)

General Notes - Entering Damages



Actions/Inputs

- Use one row for each damage event. If there are more rows in the table than you have damage events, leave the extra rows blank.

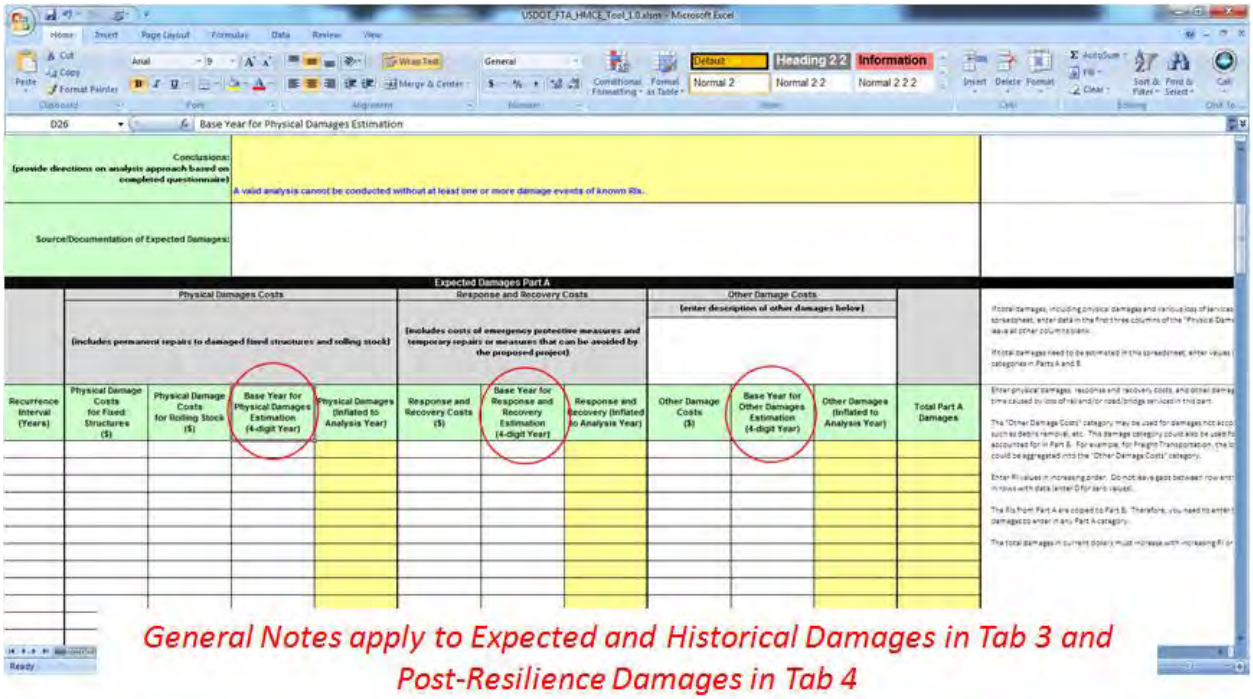
Notes and Tips

- If you enter a value in the first cell of a row (recurrence interval or year), you must enter a value in every other green cell in that row, even if the value is “0”.

Additional Guidance on Recurrence Intervals

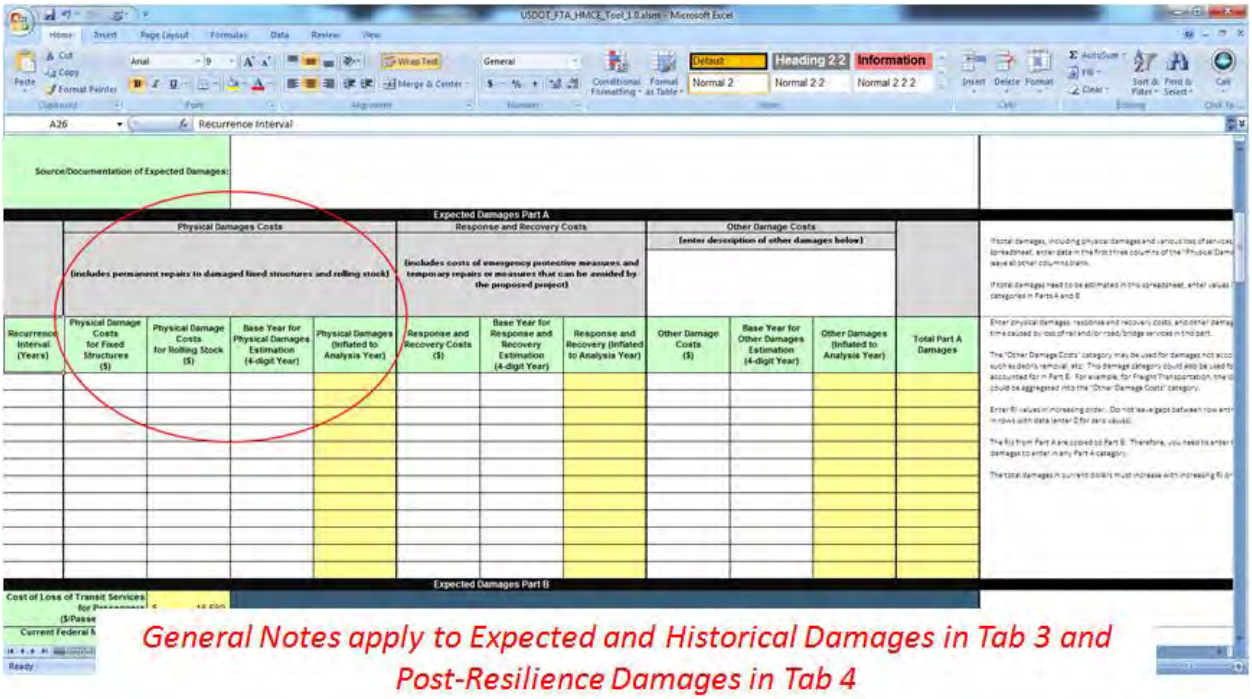
- You cannot repeat a recurrence interval, for instance you cannot enter two 25-year events.
  - If you have two 25-year events, enter “25” as the RI for the lower dollar-value event and “26” as the RI for the higher dollar-value event.
- Be sure that your damages increase with increasing RIs; for example, you cannot have a 500-year event with lower damages than a 100-year event.
- **Summary guidance on estimating Hurricane Sandy Flood RIs in New York and New Jersey is given in Appendix C.**

General Notes - Base Year for Damage Estimates



- The Base Year is the year the damages were estimated for, and is used as the basis to inflate old estimates to analysis year (2014) dollars.
  - If damage values are adjusted to a certain year's dollars prior to entry in the tool, the base year should be that year. For example, if a model was run in 2008 such that all estimates are in 2008 dollars, the base year should be 2008.
  - For expected damages, the base year will be the year for which the estimate was made.
  - For historic damages, the base year will be the year for which the damage was estimated, not necessarily the year in which the damage occurred.
- Dollar values are inflated to the analysis year based on the latest available Engineering News Record (ENR) Construction Cost Index data.

General Notes - Physical Damages



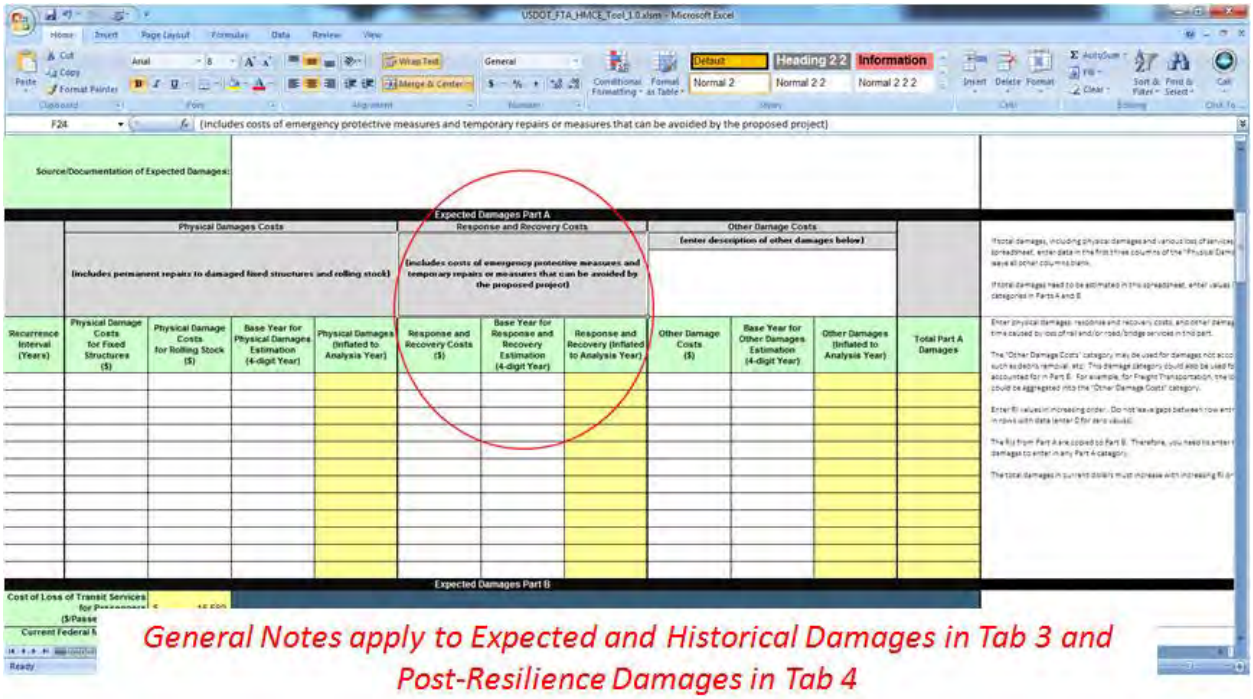
Actions/Inputs

- Enter the **Physical Damage Costs for Fixed Structures** for each event.
- Enter the **Physical Damage Costs for Rolling Stock** for each event.
- Enter the four-digit year in which damages were calculated in **Base Year for Physical Damages Estimation.**

Notes and Tips

- Physical damage costs can be approximated as the cost to repair the element to pre-disaster condition.
  - This may be shown on a FEMA *Project Worksheet*(s) as permanent work (Categories C-G).

General Notes - Response and Recovery Costs



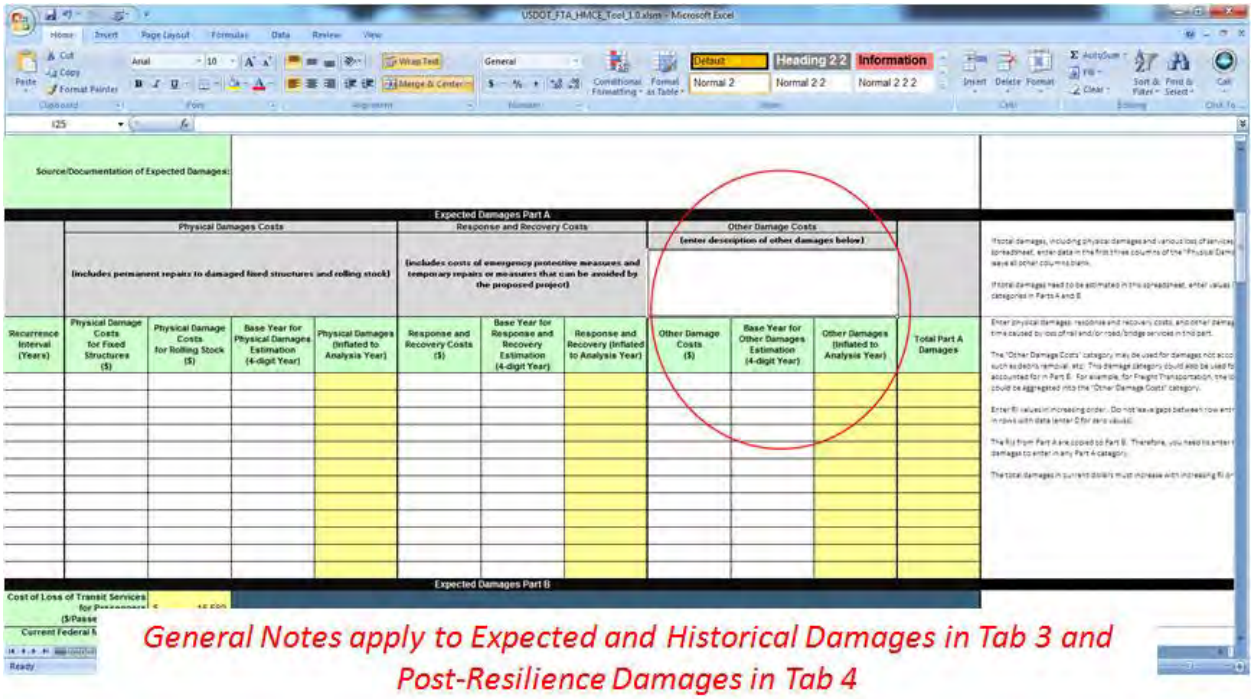
Actions/Inputs

- Enter the **Response and Recovery Costs** for each event.
- Enter the four-digit year in which damages were calculated in **Base Year for Response and Recovery Estimation.**

Notes and Tips

- Response and recovery (R&R) costs can include the costs of emergency protective measures (such as sandbags) and temporary repairs or measures that can be avoided by the proposed project.
  - This may be shown on a FEMA *Project Worksheet*(s) as emergency work (Categories A and B).

General Notes - Other Damage Costs



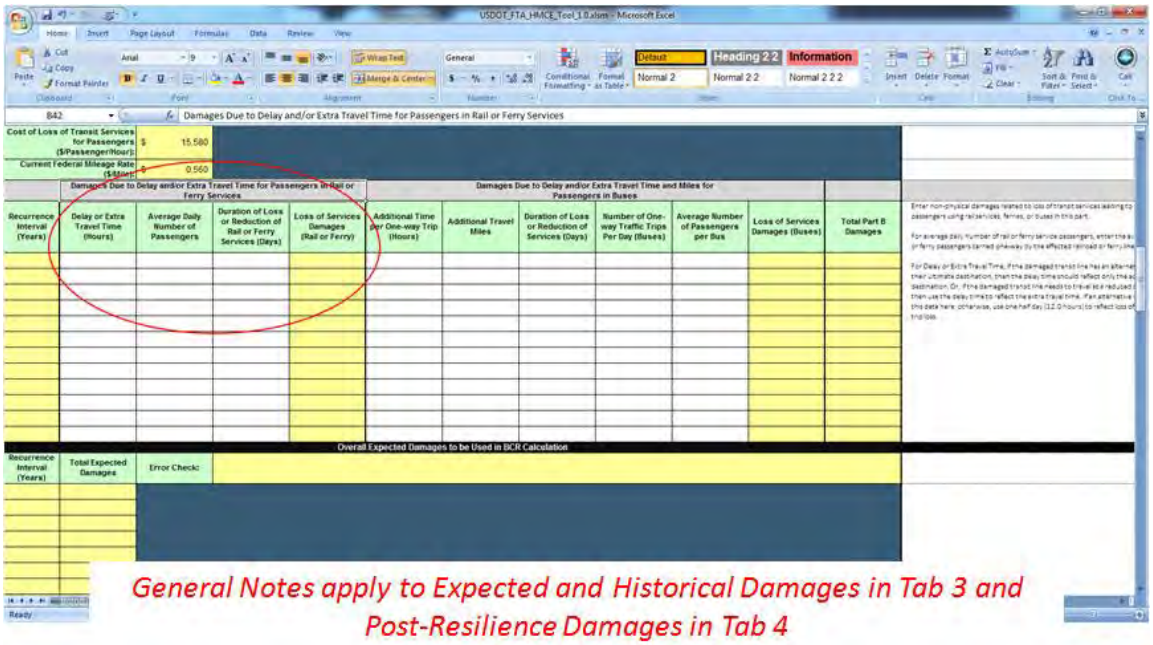
Actions/Inputs

- Enter a brief **Description of Other Damages** you are claiming.
- Enter the **Other Damage Costs** for each event (i.e., damage costs not captured by Physical Damage Costs and/or Response and Recovery Costs.)
- Enter the four-digit year in which damages were calculated in **Base Year for Response and Recovery Estimation.**

Notes and Tips

- If you don't have other damage categories, be sure to enter 0 in the green cells for all rows in which you have damage data.
- Examples of other damage costs include:
  - Debris removal and disposal
  - Emergency management
  - Environmental cleanup
  - Equipment cleaning

General Notes - Damages Due to Delay for Rail/Ferry Passengers



General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

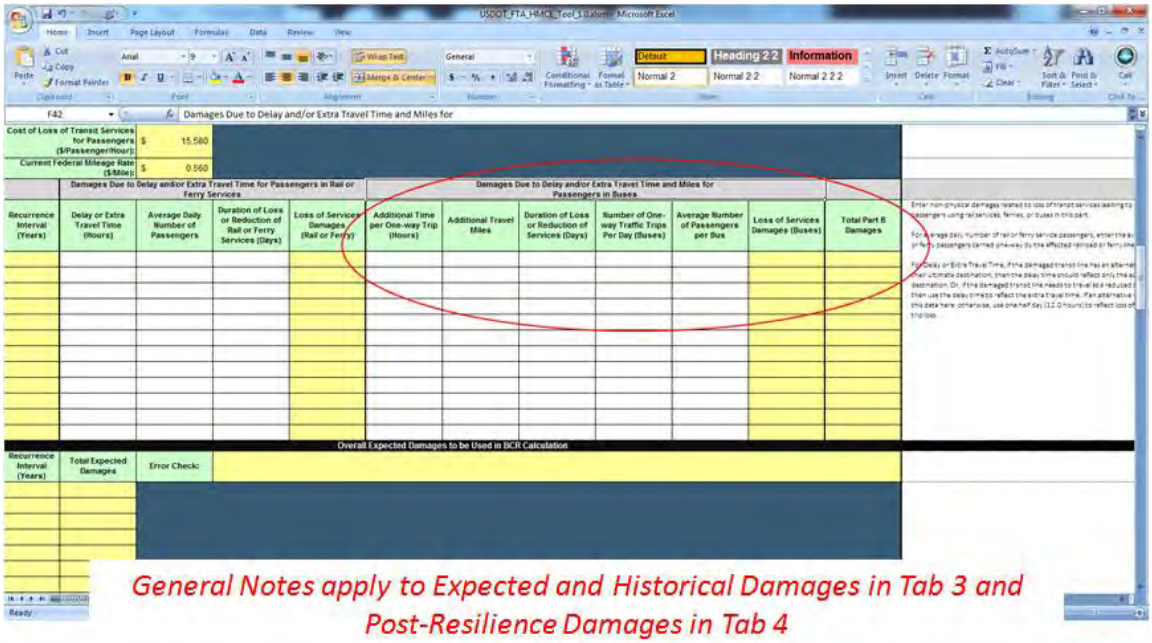
Actions/Inputs

- Enter the **Delay or Extra Travel Time** in hours caused by each event.
- Enter the **Average Daily Number of Passengers** for each event.
- Enter the **Duration of Loss or Reduction of Rail or Ferry Services** in days for each event.

Notes and Tips

- **Be sure to enter the average daily passengers for the year in which the damage occurred (for Historic Damages) or was estimated (for Expected Damages)**.
- As stated previously in Tab 2 guidance, if no service is available to take passengers to their destination, then Delay Time should be one-half day (12 hours) to reflect loss of one-way trip.

General Notes - Damages Due to Delay for Bus Passengers



Actions/Inputs

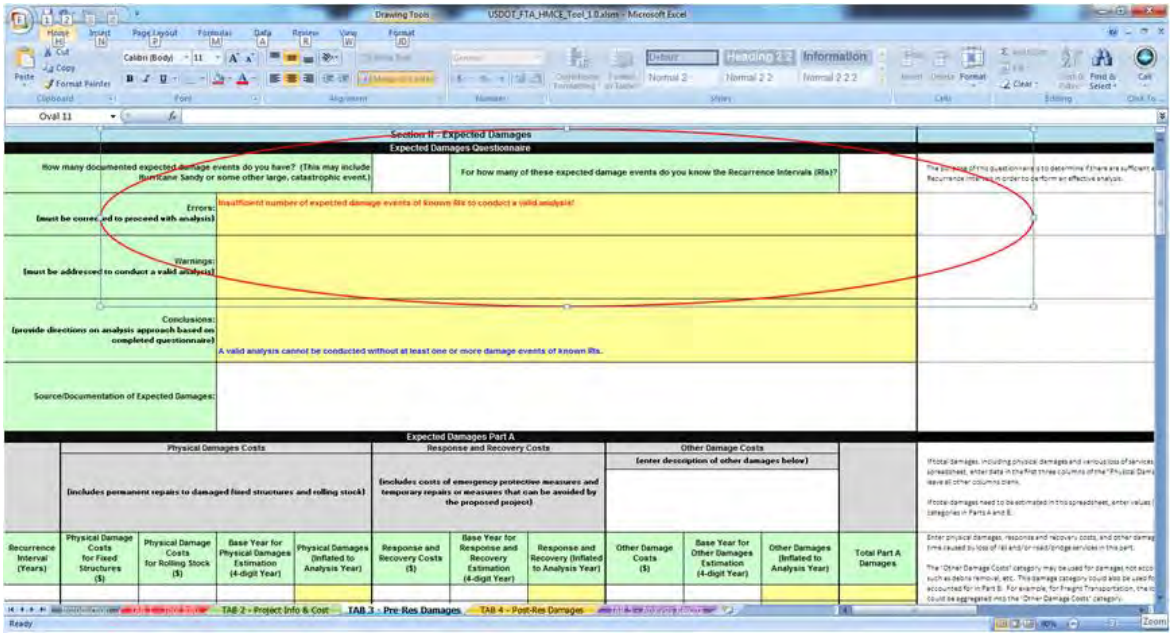
- Enter the **Additional Time per One-Way Trip** in hours.
- Enter the **Additional Travel Miles** in miles.
- Enter the **Duration of Loss or Reduction of Services** in days for each event.
- Enter the **Number of One-way Traffic Trips per Day (Buses)** made by buses.
- Enter the **Average Number of Passengers in each Bus** for each event.

Notes and Tips

- **Be sure to enter the average daily passengers for the year in which the damage occurred (for Historic Damages) or was estimated (for Expected Damages)**.
- As stated previously in Tab 2 guidance, if no service is available to take passengers to their destination, then Delay Time should be one-half day (12 hours) to reflect loss of one-way trip.

TAB 3
Pre-Resilience Damages, Part 1 - Expected Damages (Section II)

Expected Damages Questionnaire - Number of Events



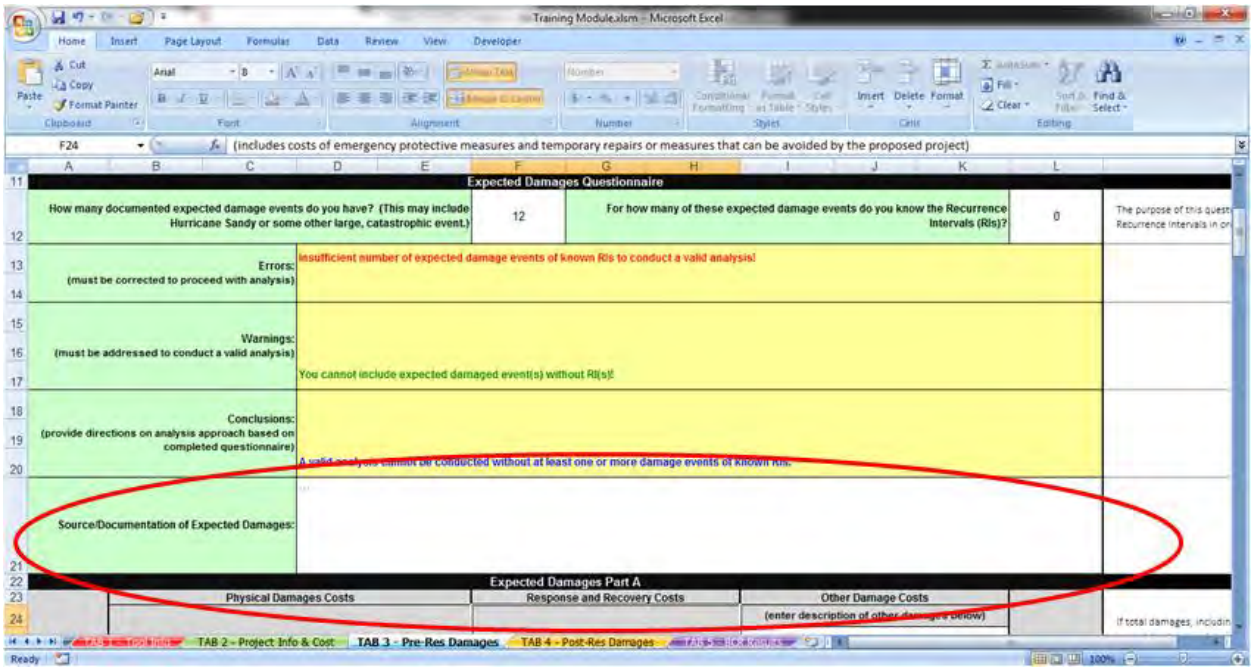
Actions/Inputs

- Enter the **Number of expected damage events** you have. (This may include one or more catastrophic events of known recurrence intervals.)
- Enter the **Number of known recurrence intervals** for your damage events.
- Analyses based on one event of known RI are of limited accuracy and not recommended.
- Analyses based on two or more events of known RIs are preferred, especially if one or more are based on Hurricane Sandy or some other large, catastrophic event

Notes and Tips

- You must have between 1 and 12 expected damage events, and you must know the recurrence intervals for each event to be included in your analysis.
- If your entries do not meet the criteria, then Errors, Warnings and/or Conclusion (such as those shown above) will appear.
  - **Errors** must be corrected to proceed with analysis
  - **Warnings** must be address to conduct a valid analysis
  - **Conclusions** provide directions on analysis approach

Expected Damages Questionnaire (continued) **- Source of Expected Damages**



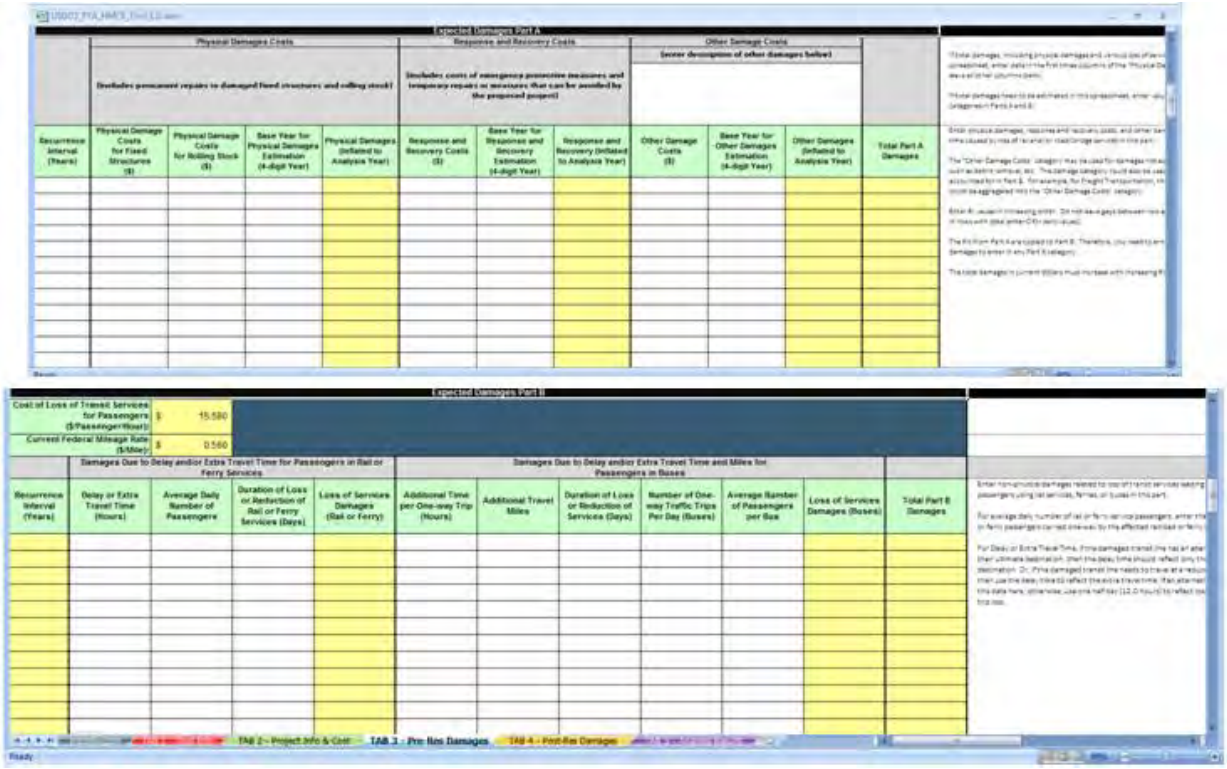
Actions/Inputs

- Describe or list the **Source/Documentation of Expected Damages.**

Notes and Tips

- Include a link or a reference to the document with the source of expected damages.
- Attach copy of the engineering report or similar document with the source and methodology used to determine the expected damages separately.

Expected Damages Part A and Part B - Entering Expected Damages and Losses



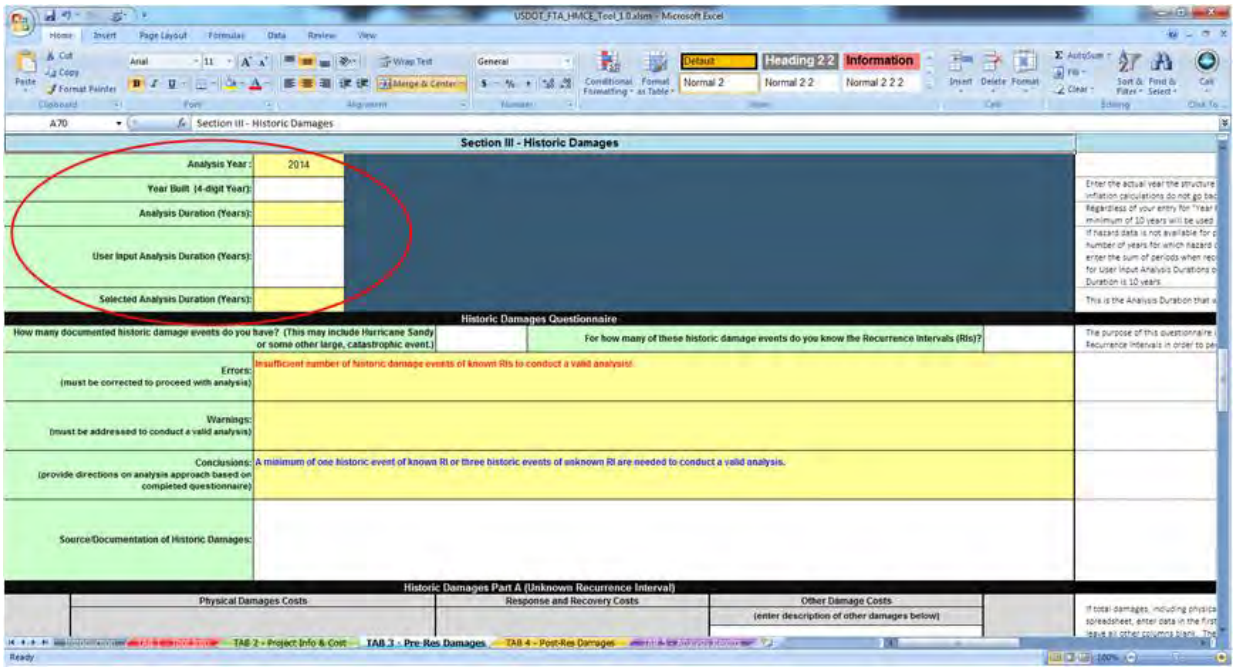
Actions/Inputs

- Follow the General Notes on Entering Damages to complete Expected Damages Part A (damages) and Part B (service losses).

Notes and Tips

- Remember that if you start a row, you must enter a value in every white cell in that row in Parts A and B, even if the value is 0.

Historic Damages - Analysis Year and Analysis Duration



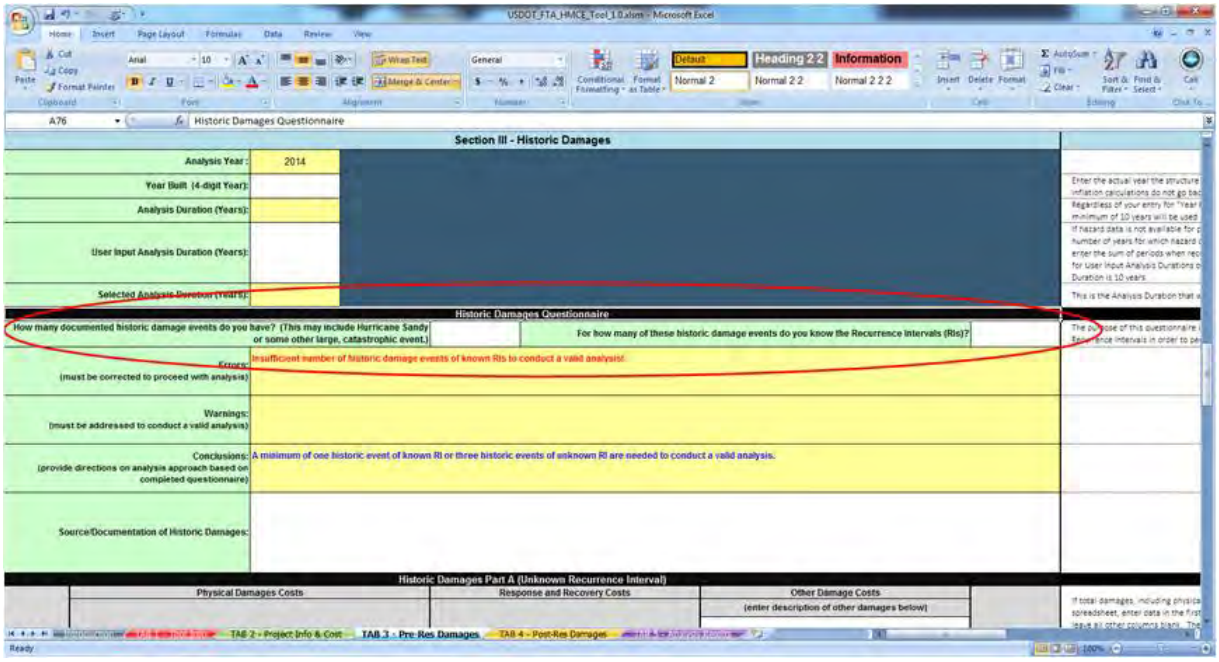
Actions/Inputs

- Enter the **Year Built** of the system or asset being protected.
- If you choose to use an alternative analysis period, enter a **User Input Analysis Duration.** The minimum allowable User Input Analysis Duration is 10 years.
- User Input Analysis Duration may be used with supporting documentation for the following situations: 1) Discontinuities in damage records, 2) Replacement of facility, 3) Change in local flow conditions, 4) Structure age is old or hard to determine (use 50 years)

Notes and Tips

- Enter the earliest year built of the largest component of the system being protected.
- If hazard data is not available or there are discontinuities in records for part of the Analysis Duration since the Year Built, you may input a user Input Analysis Duration based on the total number of years for which hazard data is available.
- Significant documentation requirements apply for User Input Analysis Durations of less than 30 years.

Historic Damages Questionnaire – Number of Events



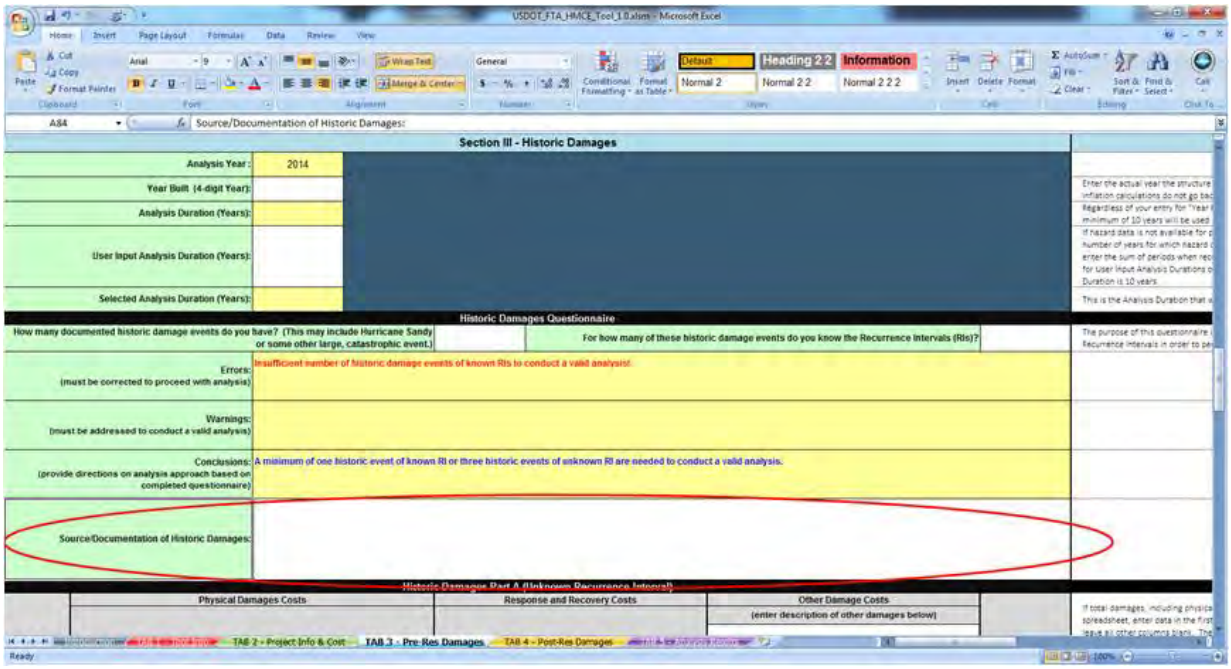
Actions/Inputs

- Enter the **Number of historic damage events** you have.
- Enter the **Number of known recurrence intervals** for your damage events.
- If your entries do not meet the criteria shown in the Notes and Tips, then Errors, Warnings and/or Conclusion (such as those shown above) will appear.
  - **Errors** must be corrected to proceed with analysis
  - **Warnings** must be address to conduct a valid analysis
  - **Conclusions** provide directions on analysis approach

Notes and Tips

- You must have between 1 and 12 historic damage events that meet one of the following situations.
  1) At least 3 historic events with unknown RIs occurring in different years
  2) At least 1 (no more than 2) historic events with known RIs
  3) A combination of historic events with known and unknown RIs as described in situations 1) and 2), where the total values of the known RI events exceed the values of all unknown RI events

Historic Damages Questionnaire (continued) - **Source of Historic Damages**



Actions/Inputs

- Describe or list the **Source/Documentation of Historic Damages**.

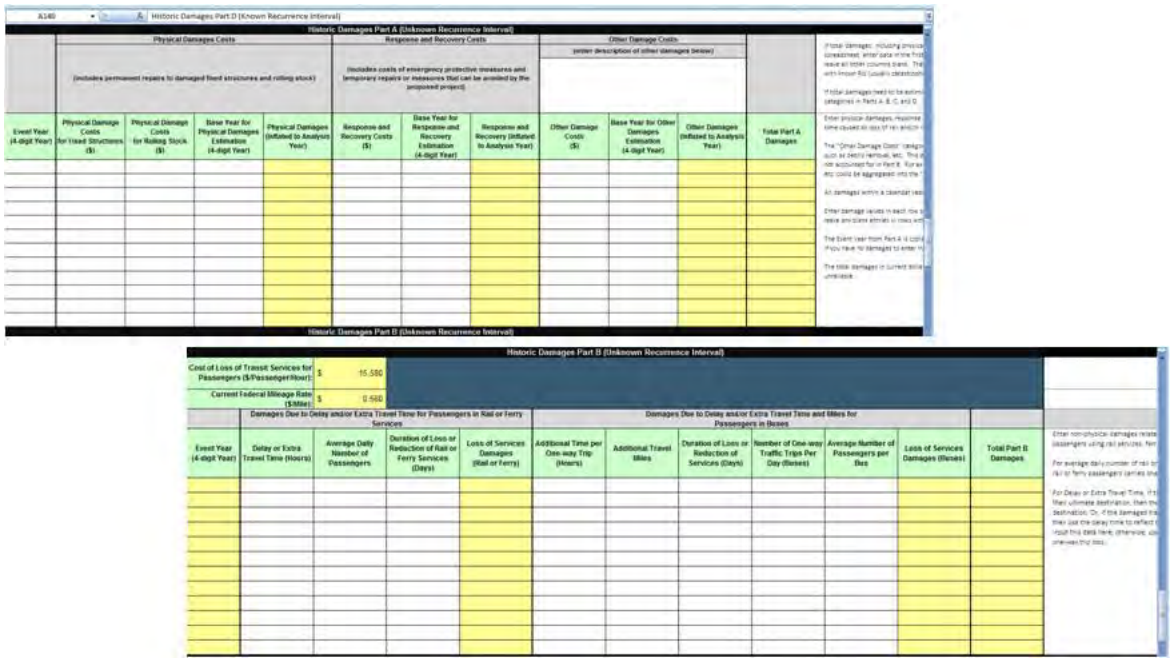
Notes and Tips

- If possible, include a link or a reference to a document with the source of historic damages.
- Attach copy of reference document(s) – such as damage worksheets, transit agency records, newspaper articles or transit agency newsletters - separately.

Additional Notes on Historic Damage Questionnaire – Preferred Approaches

- As with expected damages, analyses based on one historic damage event of known RI are of limited accuracy and are not recommended.
- Analyses based on two historic events of known RIs are better, especially if one of the known historic event RIs is for Hurricane Sandy (or some other large event) and the other known historic event RI is based on a more frequently occurring event.
- Analyses based on three or more historic events with a combination of up to two known RIs are preferred, especially if one or more of the known historic event RIs is for Hurricane Sandy or some other large, catastrophic event and the other historic event RIs are based on more frequently occurring events.

Historic Damages Parts A and B - Entering Events with Unknown Recurrence Intervals



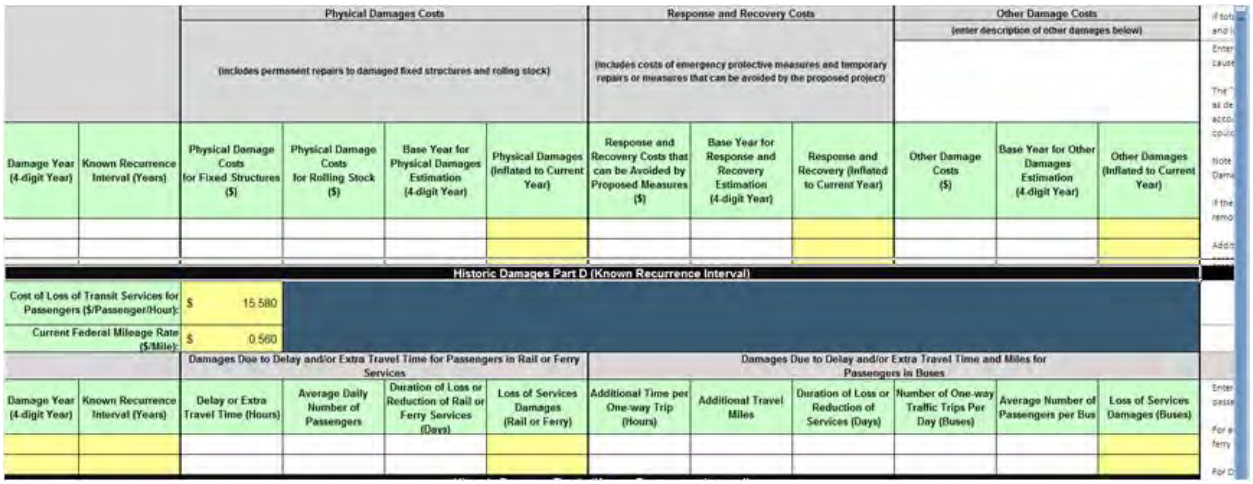
Actions/Inputs

- Follow the General Notes on Entering Damages for Historic Damages Part A (damages) and Part B (service losses) with one exception: instead of entering recurrence intervals, enter the year in which the damage occurred.
- When using only historic damage events with unknown recurrence intervals, you may input a minimum of 3 (no more than 12) events occurring in different years.

Notes and Tips

- If you have multiple events in the same year, combine the damages from each event and enter them as a single event.
- If you know the recurrence intervals of more than 2 events, then input the two largest events as known RI events and enter the additional events as unknown recurrence intervals, or you can input as expected damages if all RIs are unknown.
- Remember if you start a row in Part A, you must enter values in every white cell in that row in Part A and Part B, even if the value is 0.

Historic Damages Parts C and D - Entering Events with Known Recurrence Intervals



		Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Response and Recovery Costs (includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			Other Damage Costs (enter description of other damages below)		
Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Current Year)	Response and Recovery Costs that can be Avoided by Proposed Measures ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Current Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Current Year)

Historic Damages Part D (Known Recurrence Interval)

Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580
Current Federal Mileage Rate ($/Mile):	$ 0.560

		Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses					
Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)

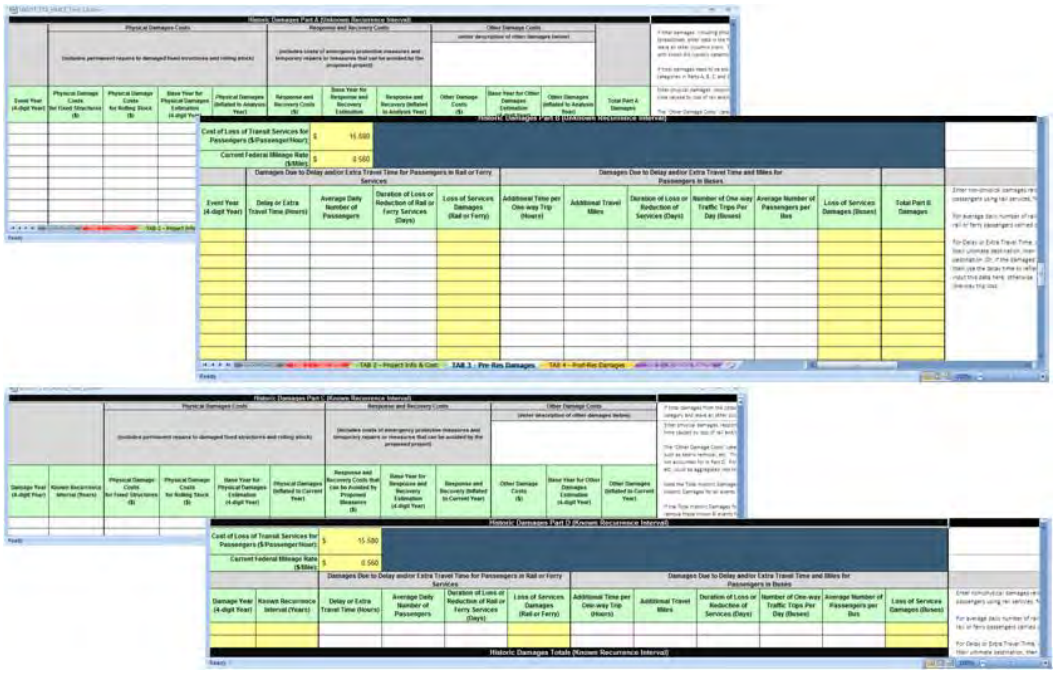
Actions/Inputs

- Follow the General Notes on Entering Damages for Historic Damages Part C (damages) and Part D (service losses).
- Include the year in which the damage occurred for each event with a known recurrence interval.
- When using only historic damage events with known recurrence intervals, you may input a minimum of one and a maximum of two events.
- Analyses based on one damage event of known recurrence interval are of limited accuracy and are not recommended.

Notes and Tips

- You can run multiple versions of the scenario in the tool, using known recurrence intervals in one case and leaving out the recurrence intervals (i.e. running those events as unknown recurrence interval events) in another, to see which yields better results.
- If you know the recurrence intervals of more than 2 events, then input the two largest events as known RI events and enter the additional events as unknown recurrence intervals, or can input as expected damages if all RIs are unknown.
- Remember if you start a row in Part C, you must enter values in every white cell in that row in Part C and Part D, even if the value is 0.

Historic Damages Parts A, B, C and D - Unknown and Known Recurrence Intervals



Actions/Inputs

- Follow the General Notes on Entering Damages for both unknown recurrence intervals (Historic Damages Parts A and B) and known recurrence intervals (Historic Damages Parts C and D).
- In addition, enter the **Year in which the damage occurred** for each event, including those with known and unknown recurrence intervals.

Notes and Tips

- If you are using historic damages, you can enter damages for events:
  - With known recurrence intervals only (1 minimum, 2 maximum);
  - With unknown recurrence intervals only (3 minimum, 12 maximum); or
  - With a combination of known and unknown recurrence intervals (3 minimum, 12 maximum).

Be sure to enter each event only once; in other words, if you enter an event as a known RI event, you do not need to enter it in the unknown RI table as well.

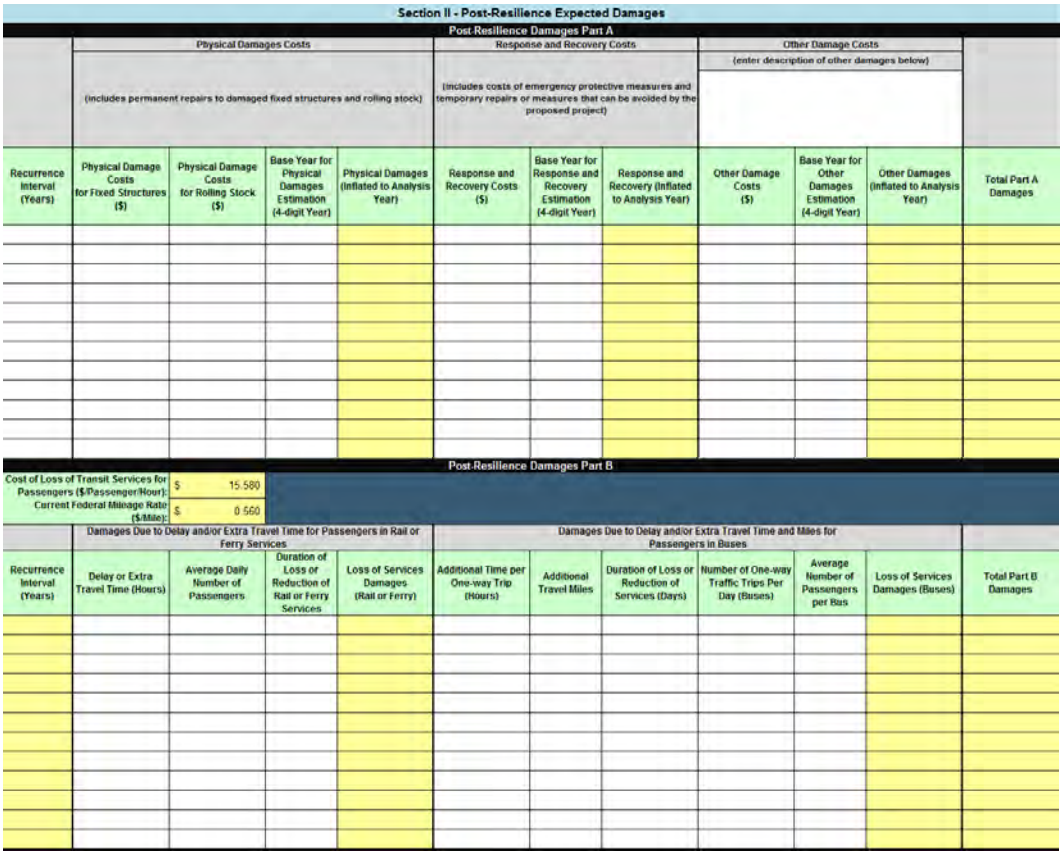
Post-Resilience Damages – Definition and Basic Guidance Assumptions

Post-resilience damages: Damages expected to occur after the resilience project design level event has occurred. For instance, if the project is designed to protect up to the 500-year event, there should be some post-resilience damages beginning at the 500-year event.

The following basic guidance assumptions may be used to estimate post-resilience damages based on the type of project, the engineering design level of effectiveness, and the pre-resilience damages:

- Acquisition/Relocation projects: Zero post-resilience damages.
- Elevation projects: No post-resilience damages until design level of effectiveness is reached, then use minimum pre-resilience damages beginning at the design level of effectiveness.
- Flood barriers/dry floodproofing: No pre-resilience damages until design level of effectiveness is reached, then apply the maximum pre-resilience damages that would occur for that flood level after that.
- Wet floodproofing: Use reduced pre-resilience damages to reflect reduced clean up or down time costs until design level of effectiveness is reached, then apply the maximum pre-resilience damages that would occur for that flood level after that.
- Other projects: Generally use no post-resilience damages until design level of effectiveness if reached, then either conservatively assume the maximum pre-resilience damages once the design level of effectiveness is reached or incrementally increase pre-resilience damages as RIs increase.

Post-Resilience Damages Parts A and B - Entering Damages



Section II - Post-Resilience Expected Damages

Post-Resilience Damages Part A

	Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Response and Recovery Costs (includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			Other Damage Costs (enter description of other damages below)			
Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response and Recovery Costs ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Analysis Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Analysis Year)	Total Part A Damages

Post-Resilience Damages Part B

Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$	15.580
Current Federal Mileage Rate ($/Mile):	$	0.560

	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses						
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)	Total Part B Damages

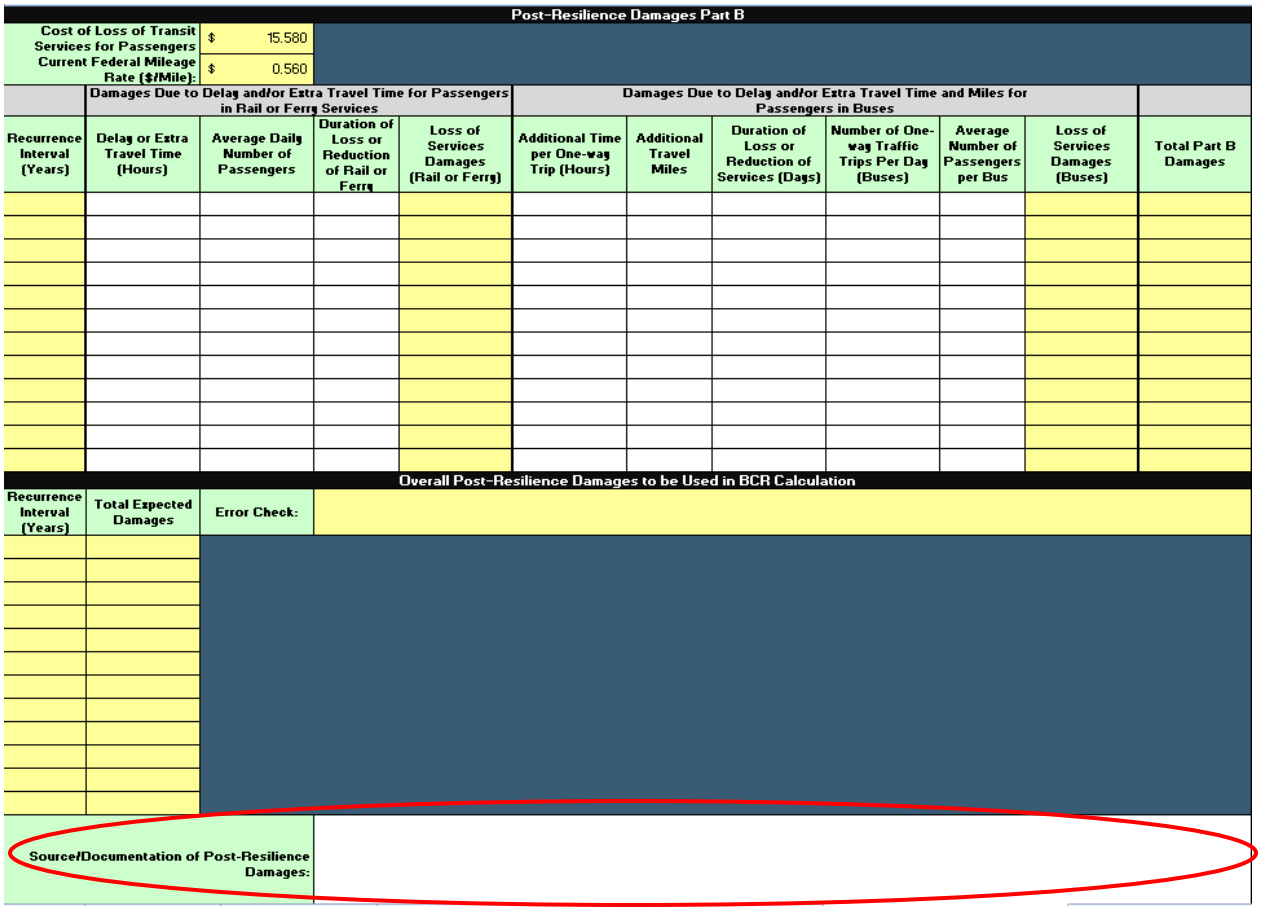
Actions/Inputs

- Follow the General Notes on Entering Damages for Post-Resilience Damages Part A (damages) and Part B (service losses).

Notes and Tips

- If a project results in zero post-resilience damages, then the user must input the maximum pre-resilience event recurrence interval with zero values for the tool to correctly calculate the BCA results.
- Remember if you start a row in Part A, you must enter a value in every white cell in that row in Part A and Part B, even if the value is 0.

Post-Resilience Damages – Source of Post-Resilience Damages



Post-Resilience Damages Part B											
Cost of Loss of Transit Services for Passengers	$ 15.580										
Current Federal Mileage Rate ($/Mile):	$ 0.560										
	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses						
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)	Total Part B Damages
Overall Post-Resilience Damages to be Used in BCR Calculation											
Recurrence Interval (Years)	Total Expected Damages	Error Check:									
Source/Documentation of Post-Resilience Damages:											

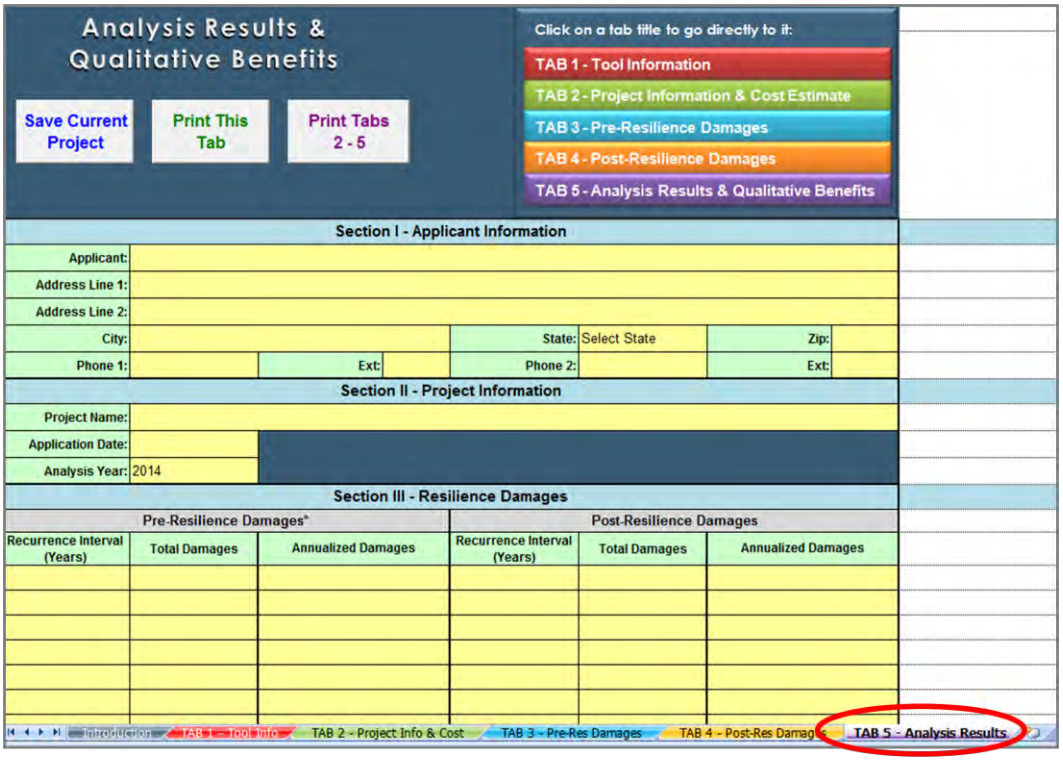
Actions/Inputs

- Describe or list the **Source/Documentation of Post-Resilience Damages**.

Notes and Tips

- If possible, include a link or a reference to a document with the source of post-resilience damages.
- Attach copy of reference document(s) – such as preliminary design drawings or engineering studies - separately.

Sections I thru III - Summary Information



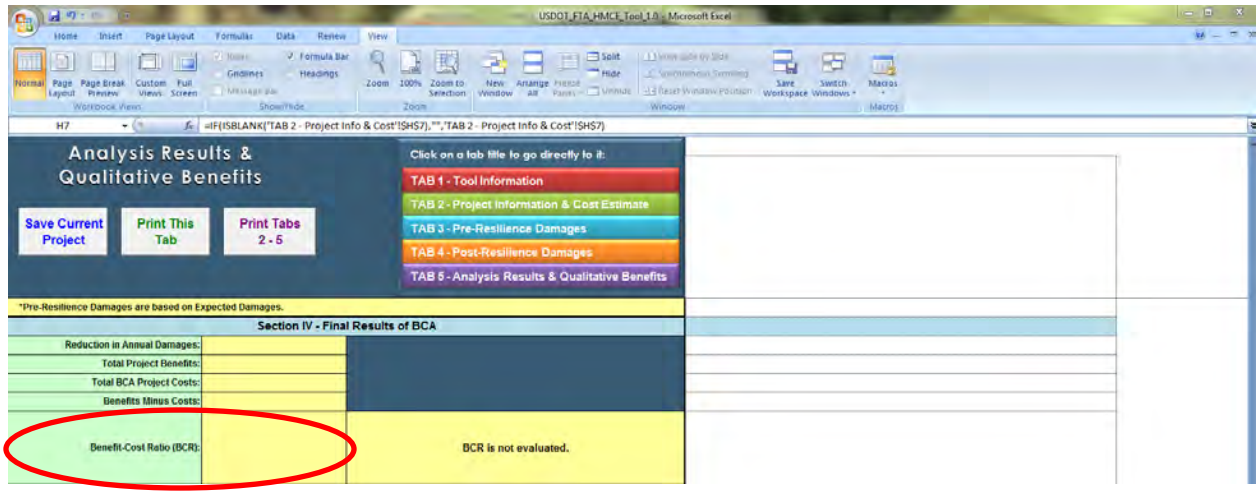
Actions/Inputs

- Tab 5 summarizes all inputs and outputs of the software.
- Tab 5 also allows you to print Tabs 2 through 5 all at once.

Notes and Tips

- If you haven't already, be sure to save your work!

Section IV – Final Results of BCA (Benefit-Cost Ratio)



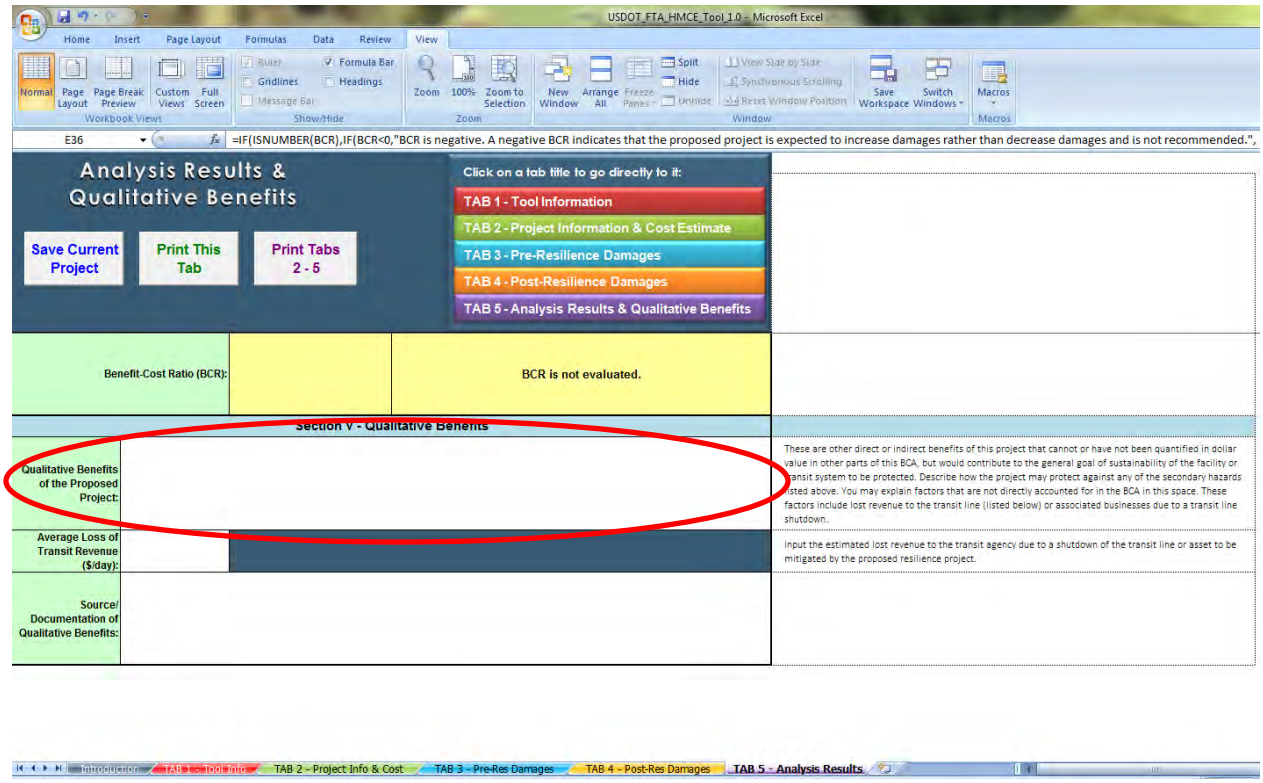
Actions/Inputs

- Review the benefits and costs calculated by the tool.
- The Benefit-Cost Ratio (BCR) is the final output.
- You have now completed the quantitative analysis portion - you're *almost* done with the tool.

Notes and Tips

- Different BCA results have different meanings:
  - A BCR greater than 1.0 indicates a cost-effective project.
  - A BCR less than 1.0 indicates that although the project is not considered cost-effective based on the quantitative information provided, it may be cost-effective based on a review of the qualitative information provided.
  - A negative BCR indicates the project is not effective at reducing damages and losses.
- The BCR is one of seven factors that will be considered in grant proposal reviews; a BCR less than 1.0 will not automatically remove a proposal from consideration.

Section V - Qualitative Benefits



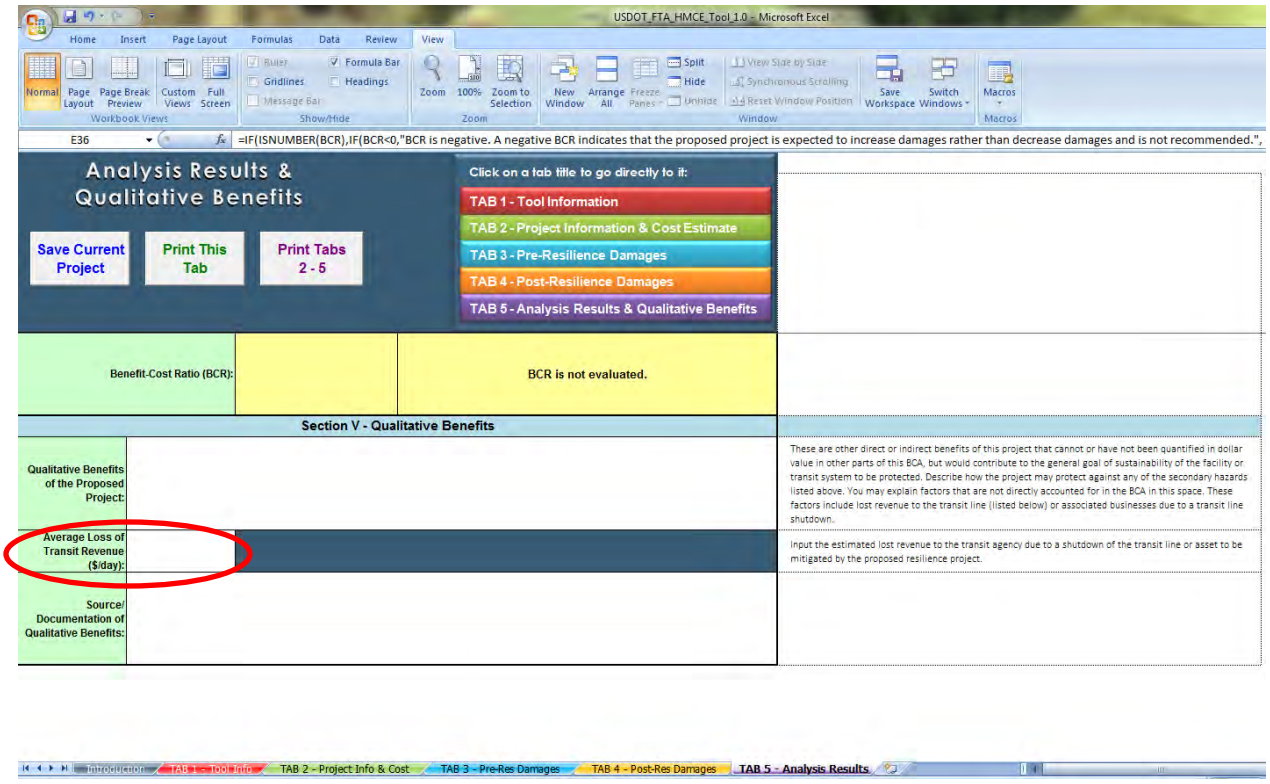
Actions/Inputs

- Input **Qualitative Benefits of the Proposed Project** that are not reflected in the qualitative analysis portions of the tool.

Notes and Tips

- Qualitative Benefits are other direct or indirect benefits of this project that cannot or have not been quantified in dollar value in other parts of this BCA, but would contribute to the general goal of sustainability of the facility or transit system to be protected.
- You can describe how the project may protect against any of the secondary hazards listed in Tab 2, and explain factors that are not directly accounted for in the BCA in this space.

Section V (continued) - **Average Daily Loss of Transit Revenue**



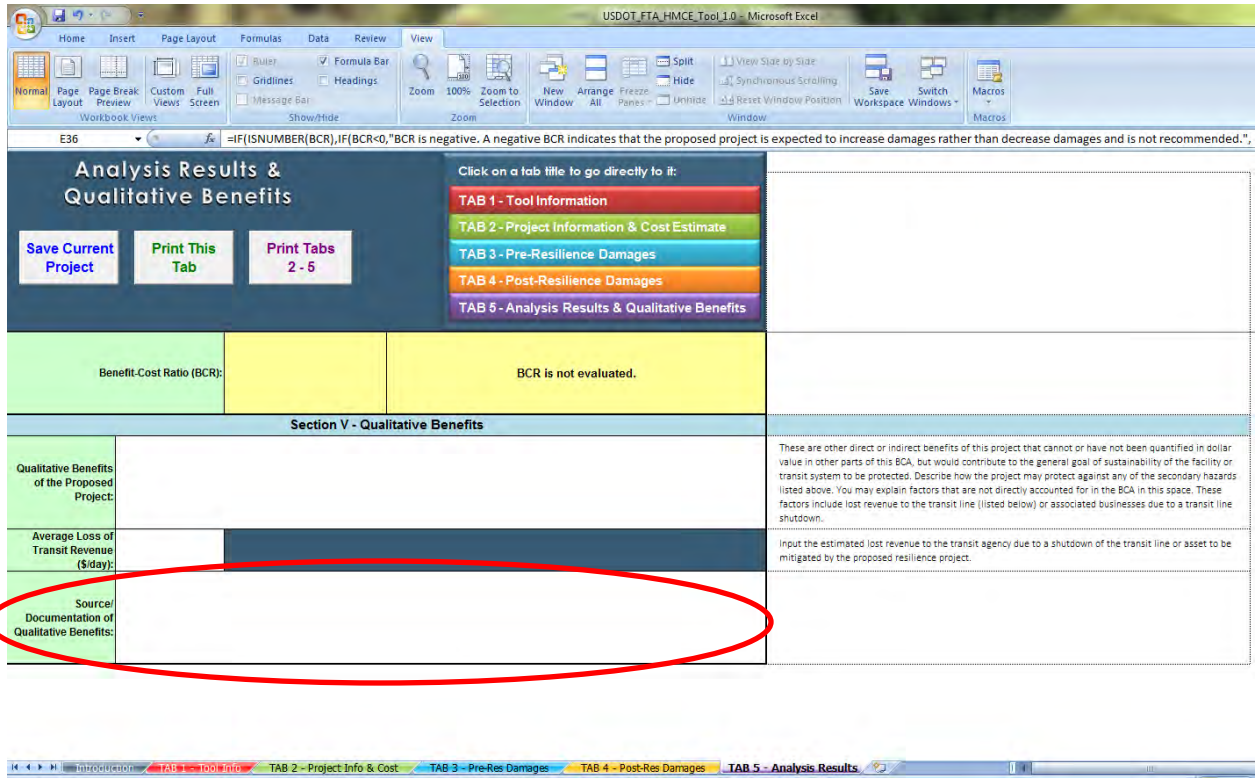
Actions/Inputs

- Input the estimated **Average Loss of Transit Revenue** to the transit agency in dollars per day due to a shutdown of the transit line or asset to be mitigated by the proposed resilience project.

Notes and Tips

- This input allows for accounting of lost revenue to the transit line and associated businesses due to a transit line shutdown.

Section V (continued) **- Documentation of Qualitative Benefits**



Actions/Inputs

- Describe or list the **Source/Documentation of Qualitative Benefits**.
- Congratulations—you're done!

Notes and Tips

- If possible, include a link or a reference to a document with the source of qualitative benefits.
- Attach copy of reference document(s) – such as transit agency records or impact studies - separately.

Appendix A – Project Useful Life Summary Guidance

Standard project useful life values used by other federal agencies such as FEMA are summarized in the following table. Standard project useful life values may be used with minimal documentation. Acceptable Limits may be used in lieu of standard values, but will require additional documentation (such as a manufacturer's warranty or an engineering report) to support values that exceed the standard project useful life.

Project Type	Standard Project Useful Life (years)	Acceptable Limits (years)	Comments
Acquisition	100	100	None
Elevation – Non-Residential, Public, and/or Historic Building or Transit Facility	50	50-100	None
Non-Residential Building Retrofit	25	25-50	None
Public and/or Historic Building/Transit Facility Retrofit	50	50-100	None
Roof Diaphragm Retrofit	30	30	Roof hardening and roof clips
Non-Structural Building/Facility Elements	30	30	Ceilings, electrical cabinets, generators, parapets, chimneys
Non-Structural Major Equipment	15	15-30	Elevators, HVAC, sprinklers
Non-Structural Minor Equipment	5	5-20	Generic contents, racks, shelves
Major Infrastructure (minor localized flood reduction projects)	50	35-100	None
Concrete Infrastructure, Flood Walls, Roads, Bridges, Major Drainage Systems	50	35-50	None
Culverts (concrete, PVC, CMP, HDPE, etc.) with end treatments	30	25-50	End treatment (wing walls, end sections, head walls, etc.)
Culverts (concrete, PVC, CMP, HDPE, etc.) without end treatments	10	5-20	End treatment (wing walls, end sections, head walls, etc.)
Pump Stations, Substations, Wastewater Systems, or Equipment such as Generators	50	50	Structures
Pump Stations, Substations, Wastewater Systems, or Equipment Such as Generators	5	5-30	Equipment
Hurricane Storm Shutters	15	15-30	Depends on type of storm shutter
Utility Mitigation/Resilience Projects	50	50-100	Major (e.g., power lines, cable, hardening gas, water, sewer lines, etc.)
Utility Mitigation/Resilience Projects	5	5-30	Minor (e.g., backflow valves, downspout disconnect, etc.)
Equipment Purchases	2	2-10	Small, portable equipment (e.g., computer)
Equipment Purchases	30	5-30	Heavy equipment

Appendix B – Useful Life of Asset Summary Guidance

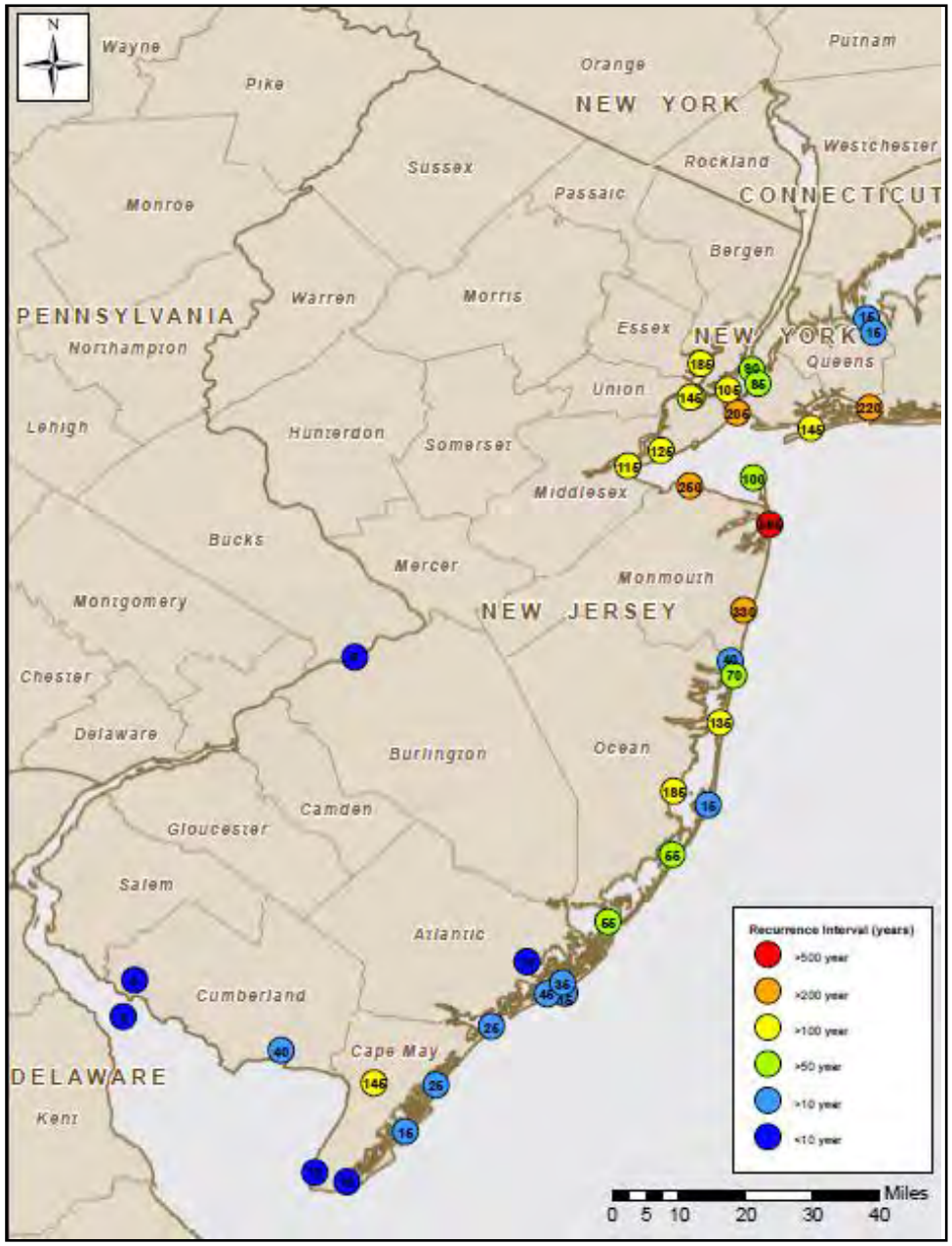
Guidance for estimating the useful life of transit assets based on FTA Grant Management Requirements Circular 5010 (revised August 2012) is summarized in the following table.

Asset Type	Minimum Useful Life (years)	Comments
Buses		
Large, heavy-duty transit buses including over the road buses	12	Approximately 35'–40', and articulated buses
Small size, heavy-duty transit buses	10	Approximately 30'
Medium-size, medium-duty transit buses	7	Approximately 25'–35'
Medium-size, light-duty transit buses	5	Approximately 25'–35'
Light Duty Vehicles		
Other light-duty vehicles	4	Other light-duty vehicles used as equipment and in transport of passengers (revenue service) such as regular and specialized vans, sedans, and light-duty buses including all bus models exempt from testing in the current 49 CFR part 665
Trolleys		
Fixed guideway steel-wheeled "trolley"	25	Streetcar or other light rail vehicle
Fixed guideway electric trolley-bus with rubber tires obtaining power from overhead catenary	15	
Simulated trolleys, with rubber tires and internal combustion engine	Refer to criteria for buses	Often termed "trolley-replica buses"
Rail Vehicles		
All rail vehicles	25	At time of grant application, the grantee may propose alternative useful life to be reviewed by FTA
Ferries		
Passenger Ferries	25	
Other Ferries (without refurbishment)	30	
Other Ferries (with refurbishment)	60	
Other Facilities		
Railroad or highway structure	50	
Other buildings and facilities	40	Concrete, steel, and frame construction

NOTE: Per FTA Circular 5010, grantees should identify the method used to determine the asset useful life. Acceptable methods life include, but are not limited to: 1) Generally accepted accounting principles; 2) Independent evaluation; 3) Manufacturer's estimated useful life; 4) Internal Revenue Service guidelines; 5) Industry standards; 6) Grantee experience; 7) The grantee's independent auditor who needs to concur that the useful life is reasonable for depreciation purposes; or 8) Proven useful life developed at a Federal test facility.

Appendix C – Hurricane Sandy Flood Recurrence Interval Summary Guidance

Guidance for estimating the storm surge flood recurrence interval of Hurricane Sandy is in New York and New Jersey is based on a January 2013 analysis report prepared by a FEMA contractor (CDM PA TAC Recovery Services). The results of this report are summarized in the following chart and tables and chart and shared with permission from FEMA Headquarters



Gage Information		Predicted X-Percent Annual Chance Elevation					Hurricane Sandy		
ID	Gage Name	10%	4%*	2%	1%	0.2%	Estimated Water Level from Table 3 (ft NAVD88)	Estimated X-Percent Annual Chance Elevation	Estimated Recurrence Interval (years)
		10 Year	25 Year	50 Year	100 Year	500 Year			
8516945	Kings Point, NY	9.7	10.9	11.9	12.7	14.5	10.19	7%	15
8517986	Verrazano-Narrows Air Gap, NY	7.1	8.8	10.0	11.3	14.7	12.84	0.5%	205
8518750	Battery, NY	6.9	8.6	9.9	11.3	14.9	11.21	1.1%	90
8519461	Bayonne Bridge Air Gap, NY	7.0	8.5	9.7	10.8	13.5	11.47	0.7%	150
8519483	Bergen Point West Reach, NY	7.0	8.5	9.7	10.8	13.6	11.47	0.7%	145
8530973	Robins Reef, NJ	7.1	8.8	10.1	11.5	15.0	11.69	1%	105
8531680	Sandy Hook, NJ	7.2	8.8	9.9	11.2	14.4	11.32	1%	100
8534720	Atlantic City, NJ	6.0	7.1	8.0	8.9	12.1	6.28	7%	15
8536110	Cape May, NJ	5.7	6.6	7.3	7.9	9.3	5.90	10%	10
8537121	Ship John Shoal, NJ	7.1	7.7	8.1	8.7	10.9	6.19	20%	5
8539094	Burlington, Delaware River, NJ	9.0	9.9	10.6	11.4	14.0	8.35	20%	5
HWM-NY-KIN-900	Fair, debris line on chain link fence in Brooklyn, NY	6.6	8.4	9.7	11.2	14.7	10.99	1.2%	85
HWM-NY-QUE-502	Good, seed line on house garage in Queens, NY	9.7	10.9	11.9	12.7	14.5	10.31	7%	15
01311850	Jamaica Bay at Inwood, NY	6.3	7.5	8.4	9.4	11.8	10.56	0.5%	220
01311875	Rockaway Inlet near Floyd Bennett Field, NY	6.6	8.0	9.0	10.0	12.6	10.65	0.7%	145
01376558	Lemon Creek at Amboy Road at Pleasant Plains, NY	7.8	9.6	11.0	12.4	16.1	13.00	0.8%	125
01392650	Passaic River at PVSC at Newark, NJ	6.9	8.5	9.6	10.9	14.0	12.10	0.5%	185
01406710	Raritan River at South Amboy, NJ	8.4	10.2	11.6	13.1	16.7	13.50	0.9%	115
01407081	Raritan Bay at Keansburg, NJ	7.8	9.5	10.7	12.0	15.1	13.77	0.4%	250

Gage Information		Predicted X-Percent Annual Chance Elevation					Hurricane Sandy		
ID	Gage Name	10%	4%*	2%	1%	0.2%	Estimated Water Level from Table 3 (ft NAVD88)	Estimated X-Percent Annual Chance Elevation	Estimated Recurrence Interval (years)
		10 Year	25 Year	50 Year	100 Year	500 Year			
01407600	Shrewsbury River at Sea Bright, NJ	5.6	6.7	7.6	8.4	10.1	10.37	0.2%	595
01407770	Shark River at Belmar, NJ	6.9	8.0	8.9	9.7	11.3	10.94	0.3%	330
01408043	Point Pleasant Canal at Point Pleasant, NJ	4.9	5.9	6.7	7.3	8.8	6.38	3%	40
01408168	Barnegat Bay at Mantoloking, NJ	4.1	5.5	6.5	7.5	9.7	6.91	1.4%	70
01408750	Barnegat Bay at Seaside Heights, NJ	3.8	5.0	6.0	6.9	9.3	7.41	0.7%	135
01409110	Barnegat Bay at Waretown, NJ	4.0	5.0	5.8	6.6	8.5	7.33	0.5%	185
01409125	Barnegat Bay at Barnegat Light, NJ	4.9	5.7	6.3	6.9	8.2	5.21	7%	15
01409146	East Thorofare at Ship Bottom, NJ	4.6	5.6	6.4	7.1	8.7	6.45	2%	55
01409335	Little Egg Inlet near Tuckerton, NJ	6.2	7.3	8.2	9.0	10.8	8.26	2%	55
01410510	Absecon Creek at US Route 30 at Absecon, NJ	7.5	8.4	8.9	9.8	11.7	7.53	10%	10
01410560	Inside Thorofare at US Rt 40 at Atlantic City, NJ	6.0	7.1	7.9	8.6	10.1	7.62	2%	45
01410600	Absecon Channel at Atlantic City, NJ	6.3	7.4	8.3	9.1	10.9	7.81	3%	35
01411320	Great Egg Harbor Bay at Ocean City, NJ	6.2	7.2	7.9	8.6	10.4	7.25	4%	25
01411350	Ludlam Thorofare at Sea Isle City, NJ	6.5	7.5	8.3	8.9	10.3	7.56	4%	25
01411360	Great Channel at Stone Harbor, NJ	6.4	7.1	7.6	8.2	9.7	6.73	7%	15
01411390	Cape May Harbor at Cape May, NJ	5.8	6.8	7.5	8.2	9.7	5.90	10%	10
01411435	Sluice Creek near South Dennis, NJ	2.1	3.3	3.7	5.7	8.1	6.01	0.7%	145
01412150	Maurice River at Bivalve, NJ	5.5	6.3	6.7	7.8	11.8	7.04	3%	40
01413038	Cohansey River at Greenwich, NJ	7.0	7.6	8.1	8.7	11.6	5.91	20%	5

*The 4% annual chance elevations were calculated using the linear fit equation at each location.

Appendix D – Documentation Requirements for Key Inputs in the HMCE Tool

This appendix contains detailed guidance on documentation for project costs (Section D.1), event damages (Section D.2), event service losses (Section D.3), recurrence intervals (Section D.4), and post-resilience damages (Section D.5).

D.1 Project Costs

D.1.1 Project Cost Elements

The project cost should include the following elements.

Initial Project Cost

The initial project cost should include:

- Pre-construction or non-construction costs: May include right-of-way review, surveying, permitting, site preparation, and engineering design
- Construction costs: The "hard costs"/base cost of the project, developed based on local historic cost data, current bids, or published unit costs
- Ancillary costs: Contractor costs and markups (i.e., mobilization/demobilization, general conditions and requirements, overhead and profit, bid documents, permit fees, project management costs)

Operation and Maintenance (O&M) Costs

O&M costs represent the differential annualized cost of operating and maintaining the proposed resilience project over its useful lifetime vs. the current annualized O&M costs for the existing part of the system that will be impacted by the proposed project. Although not eligible for grant funding, O&M costs must be accounted for in the BCA to ensure the overall investment cost of the project is considered. Remember some "low-cost" projects may have high maintenance costs.

NOTES: In some cases, O&M costs may be negative. As with FEMA mitigation grants, O&M costs for FTA projects are not eligible for grant funding.

Estimated Service Interruption Costs

Costs associated with interruption of transit service during project construction/implementation:

- May still take place even when transit agencies work during off-peak hours or weekends to minimize disruptions from resilience project construction or implementation.
- Although not eligible for grant funding, service interruption costs must be accounted for in the BCA to ensure the overall investment cost of the project is considered.
- In some cases, service interruption costs may exceed the total project initial and/or maintenance costs.

D.1.2 Project Cost Documentation Sources

Project cost documentation sources include:

- Local historic cost data – Cost estimates developed based on experience with similar projects
- Current contractor bids – Bid documents prepared by qualified contractors
- Published unit costs – Published unit cost guidance available from a variety of sources including FTA's Capital Cost database (http://www.fta.dot.gov/12305_11951.html), R.S. Means and/ or Marshall & Swift

D.2 Event Damages

D.2.1 Historic Damages

Historic damages are based on records from actual past disaster events. You need a minimum of one known RI event or three unknown RI events occurring in different years to run the HMCE tool.

Potential sources of documentation include:

1) **Disaster Damage Worksheets**
    - Disaster Damage Worksheets such as FEMA *Project Worksheets* (PWs) are useful for documenting historic damages to public transit facilities from Presidentially-declared disaster events
    - PWs may include Response and Recovery costs (Category A or B) as well as Physical Damage repair and restoration work (Categories C – F)
    - PWs may include emergency protective measures (Category A for debris removal or Category B for sandbagging or emergency services) as well as permanent repair and restoration work (Categories C – F, depending on the type of facility)
    - Make sure PWs apply directly to facility(ies) to be mitigated by the project
    - Always include complete copies of all referenced PWs
    - Spreadsheets may be helpful to organize data when multiple PWs are attached
    - NOTE: FTA and FEMA signed a Memorandum of Understanding (MOA) in March 2013 that outlines the roles and responsibilities of both agencies in providing federal assistance to repair and restore public transportation systems in areas the President has declared a major disaster or emergency. The MOA was required to establish the FTA's newly authorized Public Transportation Emergency Relief Program as part of the Moving Ahead for Progress in the 21st Century Act (MAP-21).
2) **FTA's 28-day and 60-day Damage Assessment Reports**
    - Following Hurricane Sandy, FTA Prepared 28-day and 60-day supplemental reports on public transit projects.
    - Appendix B of the 28-day report includes a cost data table showing an itemized list of damages to various transit agency facilities as a result of Sandy.

3) **Insurance Claims (Flood Events):**
   - Useful for documenting Physical Damages to insured properties (Fixed Structures) from various hazard events
   - For flood events, grantees may obtain flood insurance claim data on all properties insured under the NFIP through BureauNet (http://bsa.nfipstat.com). You can register to obtain information on various properties insured under the NFIP within their community.
   - Additional benefits may be estimated from flood claims data when other event information is available. For example, if the flood claim lists only building damage, but the building type, size and the depth of flooding in the building is known, then the FEMA Depth Damage Functions (DDFs) can be used to extrapolate contents damage and even displacement costs for that event.
   - Be aware of Severe Repetitive Loss (SRL) Program properties.
4) **Insurance Claims (Other Events):**
   - Commercial or public properties may have insurance claims for other (non-flood) events
   - Remember that smaller claims from multiple events typically produce greater benefits that a large claim from a single event
   - Always include complete copies of insurance claims documented on insurance company letterhead.
   - Spreadsheets may be helpful to organize data when multiple claims are attached.
5) **Repair Records:**
   - Useful for documenting historic damages to various facilities (including transit facilities) from hazard events
   - Repair records for public facilities may include records of expenditures in financial databases, receipts for repairs or equipment rental, force account labor records, and may be supported by other documentation such as news articles or community/agency board meeting minutes
   - Repair records must:
     - be related to specific hazard events rather than scheduled maintenance or repairs, and
     - apply directly to asset(s) to be mitigated by the project
   - Always include complete copies of records organized in a spreadsheet when needed
6) **News Articles Citing Credible Sources:**
   - News articles can include nationally or locally published newspapers or newsletters that are printed or posted online
   - Credible sources – sources other than individual (homeowner/customer) accounts
   - Make sure the articles indicate the specific dates and impacts to facilities to be mitigated by the proposed project

D.2.2 Expected Damages

Expected damages are based on damages predicted from a theoretical model or engineering analysis. You need a minimum of one expected damage event with a known RI.

Building Damages

Building damages can be tied to FEMA BCA software or HAZUS-MH.

- **Flood Events:**
  - Flood damages to buildings can be estimated using DDFs based on structure information (building type, number of stories, foundation type, size and BRV) as a function of flood depth above the First Floor Elevation (FFE).
  - DDFs can be documented from the FEMA BCA software, HAZUS-MH output, or transcribed into a separate document or spreadsheet (recommended)
  - Structure information can be documented from various sources, including tax records, structure plans with dimensions, site photographs, engineering reports, and building cost data
  - Be sure to establish the correct reference point for the FFE
- **Wind Events:**
  - Wind damages to buildings can be estimated using WDFs based on structure information (building type, construction materials, details, size, BRV) as a function of hurricane wind speed
  - WDFs can be documented from the BCA software, HAZUS-MH output, or transcribed into a separate document or spreadsheet (recommended)
  - Structure information can be documented from various sources, including engineering reports, tax records, structure plans with dimensions, site photographs, and building cost data
  - Be sure to indicate the applicable expected wind speed in 3-second peak gust (mph) to match wind design standards

Facility Damages

Engineering studies or reports from qualified experts may be used to estimate damages to various [non-building] transit facilities from various hazards. Documentation sources include:

- **Engineering Reports** – Good documentation source to indicate estimated damages to various types of facilities based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professional
- **Transit Agency Studies** – Good documentation source to indicate estimated damages to transit facilities; should include a complete copy of the study prepared by qualified transit agency engineers or contractors

D.3 Event Service Losses

D.3.1 Historic Service Losses

Remember that for each type of service loss, documentation must be provided for:

- cost of lost transit service – based on value of passenger time ($/passenger/hour),
- delay or extra travel time (hours), and
- actual loss of function (LOF) durations for each historic event (days).

Remember that transit service losses can be combined in a variety of ways: For example, a loss of rail transit could use additional temporary bus service or may increase passenger vehicle traffic. The HMCE Tool was designed to balance flexibility of inputting various complex service loss scenarios with efficiency in entering values for the majority of more simple/basic service loss scenarios.

General Notes:

- The HMCE Tool uses a standard value of $15.58/passenger/hour for lost transit service based on:
    - Average hourly wage rate of $31.16 based on latest available data from the Bureau of Labor Statistics (September 2013) report - available online at http://www.bls.gov/news.release/ecec.nr0.htm
    - DOT value of commute time at 50% of wage rate taken from latest FEMA Standard Economic Values Methodology report (December 2011).
- The HMCE Tool also uses a standard value of $15.58/passenger/hour for the Federal mileage rate of personal vehicles based on the latest 2014 rate from the General Services Administration. Available online at - http://www.gsa.gov/portal/content/100715?utm_source=OGP&utm_medium=print-radio&utm_term=mileage&utm_campaign=shortcuts
- NOTE: The standard value is based on national average values reflecting loss of regional economic impacts. Therefore, no adjustments to the number of trips are required to account for residential vs. commercial or emergency vehicles
- As discussed in Unit 2, loss of transit revenue is not considered as a quantitative benefit in the HMCE Tool, but is included as a qualitative benefit.

Loss of Rail or Ferry Service

Rail or Ferry Service Loss values must document Delay or Extra Travel Time (hours) and Average Daily Number of Passengers for lines/systems impacted by the event and addressed by the project. Documentation sources include:

- Transit Agency Statistics – Good for documenting delay or extra travel time and the average daily number of passengers; should be provided from transit agency or included with a signed letter from a transit official.
- Transit Maps – Good for documenting delay times; required for documenting no available alternative route when alternate transit routes included; online sources are acceptable

- Other Sources – Commuter surveys, if available, may be suitable for documenting delay times if developed by a credible source

The Duration of Loss or Reduction of Rail or Ferry Services (days) must be documented for lines/systems impacted by each historic event to be addressed by the proposed project. Documentation sources include:

- Transit Agency Records – Good documentation source to indicate durations of rail/ferry repairs; should be provided from transit agency or included in a signed letter from a transit official
- FEMA *Project Worksheets* (PWs) – Potential documentation source; must include complete/signed copies of PWs
- News Articles Citing Credible Sources – Potential documentation source in locally published newspapers or online newsletters; must include date of article that can be linked to the hazard event and the impacted rail or ferry transit lines/systems.

Loss of Bus Service

Bus Service Loss values must document Additional Time per One-way trip (hours), Additional Travel Miles, Number of One-way Traffic Trips per Day, and Average Number of Passengers per Bus for lines impacted by the event and addressed by the project. Documentation sources include:

- Transit Agency Statistics – Good for documenting additional trip times, additional travel miles, number or trips and average number of passengers; should be provided from transit agency or included with a signed letter from a transit official.
- Bus Route Maps – Good for documenting delay times and additional travel miles; required for documenting no available alternative route when alternate transit routes included; online sources are acceptable
- Other Sources – Commuter surveys, if available, may be suitable for documenting additional time/mileage if from a credible source

The Duration of Loss or Reduction of Bus Services (days) must be documented for lines impacted by each historic event to be addressed by the proposed project. Documentation sources include:

- Transit Agency Records – Good documentation source to indicate durations of bus repairs or bus service interruptions; should be provided from transit agency or included in a signed letter from a transit official
- FEMA *Project Worksheets* (PWs) – Potential documentation source; must include complete/signed copies of PWs
- News Articles Citing Credible Sources – Potential documentation source in locally published newspapers or online newsletters; must include date of article that can be linked to the hazard event and the impacted bus lines.

Passenger Vehicle Delays

Passenger vehicle delay values documentation must include the number of one-way trips (vehicles/day), the delay (detour) time, and any additional mileage associated with the delay. Documentation sources include:

- DOT Traffic Counts – Best for documenting one-way trips; should be provided from DOT or included in a signed letter from a local official
- Maps with Detours and Mileages – Good for documenting delay times and additional mileage; required for documenting no available alternative route; online sources are acceptable
- Other Sources – For smaller subdivision roads where traffic counts are unavailable, can estimate one-way trips using the TRB Highway Capacity Manual or other recognized sources

NOTES:

- Although this is typically applied to project costs (TAB 2), HMCE Tool inputs could be adjusted for this as a benefit (TABS 3 and 4) if a transit line loss leads to increased passenger vehicle traffic and associated delays. This would be done by using the inputs for bus transit service delays.
- The HMCE Tool uses a national average value of 1.67 passengers per passenger vehicle based on the latest available National Household Travel Survey (DOT 2009). This default value can be adjusted if more current or local study data is provided from a credible source.

Passenger vehicle delay duration documentation must include the Duration of Loss or Reduction of Services that triggered the delay. Documentation sources include:

- DOT/Transit Agency Records – Good documentation source to indicate durations of service losses/reductions; should be provided from DOT/transit agency or included in a signed letter from a local official
- FEMA PWs – Potential documentation source; must include complete/signed copies of PWs
- News Articles Citing Credible Sources – Potential documentation source in locally published newspapers or online newsletters; must include date of article that can be linked to the hazard event and loss or reduction of service

NOTE: Although this is typically applied to project costs (TAB 2), HMCE Tool inputs could be adjusted for this as a benefit (TABS 3 and 4) if a transit line loss leads to increased passenger vehicle traffic and associated delays. This would be done by using the inputs for bus transit service delays.

D.3.2 Expected Service Losses

As with historic losses, the following documentation must be provided for each type of service loss:

- cost of lost transit service – based on value of passenger time ($/passenger/hour),
- delay or extra travel time (hours), and

- actual loss of function (LOF) durations for each historic event (days).

Remember that transit service losses can be combined in a variety of ways: For example, a loss of rail transit could use additional temporary bus service or may increase passenger vehicle traffic. The HMCE Tool was designed to balance flexibility of inputting various complex service loss scenarios with efficiency in entering values for the majority of more simple/basic service loss scenarios.

Loss of Rail or Ferry Services

Rail or Ferry Service Loss values and durations must document Delay or Extra Travel Time (hours) and Average Daily Number of Passengers for lines/systems impacted by the event and addressed by the project. Documentation sources include:

- Transit Agency Studies – Good documentation source to indicate estimated durations of service losses to rail/ferry transit facilities, lines and/or systems; should include a complete copy of the study prepared by qualified transit agency engineers or contractors
- Engineering Reports – Good documentation source to indicate estimated durations o service losses to various types of transit facilities based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professional

Loss of Bus Service

Bus Service Loss values and durations must document Additional Time per One-way trip (hours), Additional Travel Miles, Number of One-way Traffic Trips per Day, and Average Number of Passengers per Bus for lines impacted by the event and addressed by the project. Documentation sources include:

- Transit Agency Studies – Good documentation source to indicate estimated durations of service losses to bus facilities, lines and/or systems; should include a complete copy of the study prepared by qualified transit agency engineers or contractors
- Engineering Reports – Good documentation source to indicate estimated durations o service losses to various types of transit facilities based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professional

Loss of Passenger Vehicle Service

Passenger vehicle delay values and durations documentation must include the number of one-way trips (vehicles/day), the delay (detour) time, and any additional mileage associated with the delay. Documentation sources include:

- DOT/Transit Agency Traffic Studies – Good documentation source to indicate estimated durations of passenger vehicle delays; should include a complete copy of the study prepared by DOT/transit agency officials
- Engineering Reports – Good documentation source to indicate estimated durations of passenger vehicle delays based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professionals

Alternative Approach for Historic or Expected Service Losses

For damaged buildings or facilities that experience a loss of function but do not impact transit service, an alternative approach to estimate historic or expected service losses is to look at service losses based on the annual operating budget and loss of function duration for the damaged building or facility:

$$Service\ Loss = \frac{Annual\ Operating\ Budget, \$}{365\ days} \times Service\ Loss\ Duration, days$$

Input alternate approach results as "Other Damages" in the HMCE Tool, and include calculations and supporting documentation as attachments.

NOTE: Since buildings or facilities using the alternative approach do not impact overall transit service, experience with similar projects has shown that they yield benefits are significantly lower than facilities that directly impact transit service.

If you use the alternative approach, you must document the annual operating budget value. Annual reports are best for documenting annual operating budgets for public facilities or net income for commercial buildings; they must indicate breakdown for the individual structure(s) to be addressed by the proposed resilience project; copies of reports from online sources are acceptable.

Service loss duration documentation must include the duration of the building service loss for each historic or expected hazard event. Documentation sources include:

- **Historic Events**:
  - Facility Records – Good documentation source to indicate durations of building service losses and repairs; should be provided from public/transit agency representative or included in a signed letter from a transit agency official
  - Other Potential Sources: FEMA PWs (complete/signed copies); Insurance Claims (complete copies on insurance company letterhead); News Articles Citing Credible Sources
- **Expected Events**:
  - FEMA/HAZUS-MH Damage Functions for Flood or Hurricane Wind – Good documentation source to estimate service loss durations; should include a copy of the Damage Function for applicable the building type
  - Engineering Reports – Good documentation source to indicate estimated service loss durations based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professionals

D.4 Event Recurrence Intervals

D.4.1 Historic Events with Known Recurrence Intervals (RIs)

The HMCE Tool requires:

1. Minimum of three hazard events occurring in different years where either:
    a. The RIs of all events are unknown, **or**
    b. The RIs of up to two events are known **and** have total damage values that exceed the total damage values of all the other unknown RI events
2. Analysis Duration based on the age of the structure or a minimum of 10 years; whichever is greater

NOTE: If you have one historic event of known RI that has damages less than events of unknown RIs, then you can still use the event of known RI but treat it like an unknown RI.

The following approaches may be used to estimate known recurrent intervals of historic events.

Flood Elevations or Discharges Tied to Identified Flood RIs

Documentation must include flood elevations and/or discharges from historic events as well as identified flood RIs that are used to determine the historic event RIs.

- Both stream and tide gauge data can be obtained from the **U.S. Geological Survey (USGS)** website (http://waterdata.usgs.gov/nwis/sw).
    - Make sure to use the gauge data closest to the project site.
- **The USGS PeakFQ Program**, which can be downloaded from the USGS website (http://water.usgs.gov/software/PeakFQ), provides identified flood RI data.
    - Refer to Section 2.1.2 of FEMA's *Supplement to the Benefit-Cost Analysis Reference Guide* for step-by-step instructions and a detailed example of estimating RIs using the USGS PeakFQ approach: the guide is available from the FEMA website (http://www.fema.gov/media-library-data/20130726-1807-25045-6430/bca_guide_supplement__508_final.pdf)
- **FEMA Flood Insurance Study (FIS) Profiles and Discharge Tables or Transects** provide flood elevations and discharges for the 10-, 50-, 100-, and 500-year flood events. FIS data is available from the FEMA Map Service Center website (http://msc.fema.gov), then select Product Catalog from the top menu bar and search for the Effective FIS.
    - As indicated in the NOFA, FTA will consider best available flood hazard information released by FEMA as of February 1, 2014.
    - Following Hurricane Sandy, FEMA produced Advisory Base Flood Elevation (ABFE) and Preliminary Flood Insurance Date Maps (FIRMs) for coastal counties in New Jersey and New York. These advisory maps can be found online at http://184.72.33.183/best.
    - In other cases, Hydraulics and Hydrology (H&H) Studies may be used where FIS data may be incomplete or out-of-date; must include complete copies of studies

Hydrologic Analysis

RI determinations made by a hydrologist or other qualified expert may be limited for use in a specific geographic location, especially for large events such as Hurricane Katrina (2005) or Hurricane Sandy (2012). Documentation sources include:

- Post-event studies prepared by the U.S. Army Corps of Engineers (USACE) or the U.S. Geological Survey (USGS); must include complete copies of studies
- Estimates prepared by a hydrologist; must include background data and/or calculations used to estimate RIs.

Appendix C includes guidance on estimating storm surge flood recurrence intervals for Hurricane Sandy in New York and New Jersey.

Climatological or Rain Gauge Data

Since a 100-year rainfall event does not usually equate to a 100-year flood, rain gauge data for historic damage events must be tied to flood RIs by a hydrologist or other qualified professional. Sources include:

- The National Climactic Data Center (NCDC) records daily rainfall and other climactic data recorded by thousands of weather stations nationwide and is available online (http://www7.ncdc.noaa.gov/IPS/coop/coop.html); must include copies of all applicable data
- NCDC also has U.S. Hourly Precipitation Data (HPS) data records available online (http://www.climate.gov/hourly-precipitation-data)
- Analysis of rain gauge data prepared by a hydrologist; must include background data and/or calculations used to estimate flood RIs

Other Approaches

Other approaches are available to calculate recurrence intervals for hurricane and other wind events. These include:

- **Interpolated wind RIs from FEMA BCA Software Modules:**
    - **Hurricane** event RIs tied to wind speed data by zip code in BCA Hurricane Wind Module
    - **Tornado** event RIs tied to tornado frequency data by county in Tornado Safe Room Module.
    - Documentation sources include:
        - Hurricane wind speeds from NCDC records or copies of published weather data; must indicate wind speed in 3-second peak gust (mph) to match BCA data
        - Tornado event types from NCDC records or copies of published weather data; must indicate wind speed in 3-second peak gust (mph) using Enhanced Fujuta (EF) scale to match BCA data
        - Location by zip code or county can be documented using maps available online

- **Interpolated Wind RIs from ASCE 7 Data:**
    - Wind event RIs tied to ASCE 7 wind speed data by latitude/longitude
    - Documentation sources include:
        - NCDC records wind speed and other climactic data recorded by thousands of weather stations nationwide and is available online (http://www7.ncdc.noaa.gov/IPS/coop/coop.html); must indicate wind speed in 3-second peak gust (mph) to match ASCE 7 data
        - Latitude/longitude data available from various map sites online (e.g., Microsoft's terra server, mapquest.com)
        - ASCE 7 wind speed data can be obtained directly from the following ATC website (http://www.atcouncil.org/windspeed/); listed in 3-second peak gust wind speeds (mph)

D.4.2 Historic Events With Unknown Recurrence Intervals (RIs)

Documentation of historic events with unknown RIs must include the historic event damages and the year built for the facility to be mitigated. Sources include:

- Historic hazard event damages/losses can be documented using approaches and sources listed previously for other historic damage events
- Year Built can be documented using tax records or facility records provided from public/transit agency representative or included in a signed letter from a transit agency official

NOTE: For facilities with multiple structures of different construction dates, the construction date of the oldest structure in the group must be used for the Year Built.

Important Reminders:

- The HMCE Tool uses a minimum Analysis Duration of 10 years
- Significant documentation requirements apply for User Input Analysis Durations less than 30 years
- No historic events that occur before the start of the adjusted Analysis Duration may be included in the analysis
- Inflation calculations do not go back before a Year Built of 1908.

The analysis duration is a key component to determine RIs for unknown RI events, and can present difficulties for facility(ies) that are older or where the Year Built is unknown. A user-input analysis duration may be used when one of the following situations apply:

1) Discontinuities in Damage Records
2) Replacement of Facility
3) Change in Local Flow Conditions
4) Use 50-year Project Useful Life

Discontinuities in Damage Records

If hazard data is not available for part of the Analysis Duration since the Year Built, you may input the total number of years for which hazard data is available. Where there are

discontinuities in damage records, enter the sum of periods when records were kept in the User Input Analysis Duration.

Documentation sources include transit agency damage records, which are the best documentation source to indicate available hazard data; they should include complete copy of records and indicate reasons why records were not kept over selected periods.

Replacement of a Facility

When a facility or facilities to be mitigated are replaced or completely rebuilt, it may be appropriate to adjust the Analysis Duration. Documentation sources include:

- Letter from a city engineer or transit official on appropriate letterhead that includes dates, site photographs, and all details of the facility(ies) replacement/rebuild
- An engineering report with photographs that addresses the date and all details of the facility(ies) replacement/rebuild
- Current and old tax records with photographs that indicate the replacement of the facility(ies)

NOTE: Partial rebuilding/replacement of a facility(ies) is not acceptable documentation to adjust the Analysis Duration

Change in Local Flow Conditions

When local flow conditions have changed significantly over the life of a structure, it may be appropriate to adjust Analysis Duration. Documentation sources include:

- Current and old FIS showing the before and after changes
- Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR)
- Hydraulics and hydrology (H&H) study that accounts for the change
- Letter from city engineer or floodplain manager on community letterhead that addresses the changes in local flow conditions
- Aerial photographs of the project area before and after the change in the watershed, or other photographs with dates showing increased development

Refer to Section 2.1.3 of the *Supplement to the Benefit-Cost Analysis Reference Guide* for step-by-step instructions and a detailed example of adjusting the Analysis Duration using this approach.

Use a 50-Year Project Useful Life

For public infrastructure such as roads or rail lines where the date of construction (Year Built) is old or cannot be accurately determined, it may be permissible to adjust the Analysis Duration to 50 years based on the standard Project Useful Life for such assets. Documentation sources include a letter from a city engineer, DPW official, or transit agency representative on appropriate letterhead that explains why the date of construction cannot be accurately determined.

NOTE: That fact that infrastructure is greater than 50 years old alone is not acceptable documentation to adjust the Analysis Duration.

D.4.3 Expected Damage Events

Only expected damage events with known recurrence intervals may be used in the HMCE tool. Approaches for estimating recurrence intervals are discussed below.

Estimated Event RIs from Engineering Studies

Engineering studies or reports from qualified experts may be used to estimate RIs of various hazard events. Documentation sources include:

- Engineering Reports – Good documentation source to indicate estimated various event RIs to various facilities based on similar historic events or detailed engineering analysis; should include a complete copy of the report prepared by qualified professional
- Transit Agency Studies – Good documentation source to indicate estimated event RIs impacting transit facilities; should include a complete copy of the study prepared by qualified transit agency officials or contractors

Estimated Flood Event RIs based on FEMA BCA Flood Module

Flood event RIs are estimated in the Flood Module as a function of flood depth based on the FEMA Flood Insurance Study (FIS) or equivalent Hydraulics and Hydrology (H&H) data. Documentation sources include:

- FIS Profiles and Discharge Tables or Transect data is available from the FEMA Map Service Center website (http://msc.fema.gov), then select Product Catalog from the top menu bar and search for the Effective FIS
- When available, Preliminary FIS or H&H Studies may be used where Effective FIS data may be incomplete or out-of-date; must include complete copies of studies

Other Approaches for Estimated Wind Event RIs

Hurricane Wind Event RIs are estimated in the Hurricane Wind Module as a function of wind speed based on zip code location. Documentation sources include hurricane wind speeds that indicate 3-second peak gust (mph) to match BCA data; location by zip code can be documented using maps available online.

Wind event RIs can be tied to ASCE 7 wind speed data by latitude/longitude location. ASCE 7 wind speed data can be obtained directly from the following ATC website (http://www.atcouncil.org/windspeed/); listed in 3-second peak gust wind speeds (mph). Latitude/longitude location data available from various map sites online.

D.4.4 Impact of Sea Level Rise (SLR) on Event Recurrence Intervals

The NOFA indicates that grant applicants may consider transit resilience projects that address the impacts of sea level rise (SLR). FTA has gone on to clarify that SLR data may come from government- produced or academic/peer-reviewed sources.

In December 2013, FEMA released information on incorporating SLR into BCA on the FEMA website (http://www.fema.gov/media-library/assets/documents/89659) which can be applied to

HMCE analysis of FTA transit resilience projects and provides several reference to SLR data that meets FTA requirements

SLR impacts reduce coastal flood/surge RIs for Historic or Expected Damage Events, thereby increasing pre-resilience damages and losses for the same event(s); For example, the coastal flood/storm surge RI for Hurricane Sandy may be estimated based on a comparison of the recorded tide gauge levels with the 10-, 50-, 100- and 50-year RI flood events found in the FEMA flood map and flood study data (FIRM and FIS). So if the 10-, 50-, 100- and 500-year RI events are increased to account for sea level rise, then the estimated coastal flood RI for Hurricane Sandy will be reduced and the corresponding damages and losses would be increased.

FTA has indicated that SLR data may come from government- produced or academic/peer-reviewed sources. The FEMA SLR FAQ memo provides the following acceptable sources of SLR data:

- NOAA Center for Operational Oceanographic Products and Services' Mean Annual SLR Trend Data (http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml);
- USACE Climate Change Adaptation Sea Level Change Curves (http://corpsclimate.us/ccaceslcurves.cfm); and
- Globalchange.gov provides more information specific to New Jersey and New York (http://www.globalchange.gov/what-we-do/assessment/coastal-resilience-resources)

D.5 Post-Resilience Damage and Losses

Remember that very few resilience projects are 100% effective at reducing all future damages and losses - nearly all projects have some residual risk/damages. Post-Resilience damages and losses will depend on the project type and the design level of effectiveness. General rules of thumb for post-resilience damages include:

- Acquisition/Relocation: Zero post-resilience damages
- Elevation: No post-resilience damages until design level of effectiveness is reached, then use minimum pre-resilience damages beginning at design level of effectiveness
- Flood barriers/Dry floodproofing: No pre-resilience damages until design level of effectiveness is reached, then apply pre-resilience damages that would occur at the design flood level
- Wet floodproofing: Reduce pre-resilience damages to reflect reduced cleanup or downtime costs until design level of effectiveness is reached, then apply maximum pre-resilience damages that would occur for that flood level
- Other projects: Generally use no post-resilience damages until design level of effectiveness if reached, then either conservatively assume the maximum pre-resiliency damages once the design level of effectiveness is reached or incrementally increase pre-resiliency damages as RIs increase.

Project effectiveness documentation sources can include engineering or technical reports that indicate design level or effectiveness, or a detailed project scope with plans and specifications.