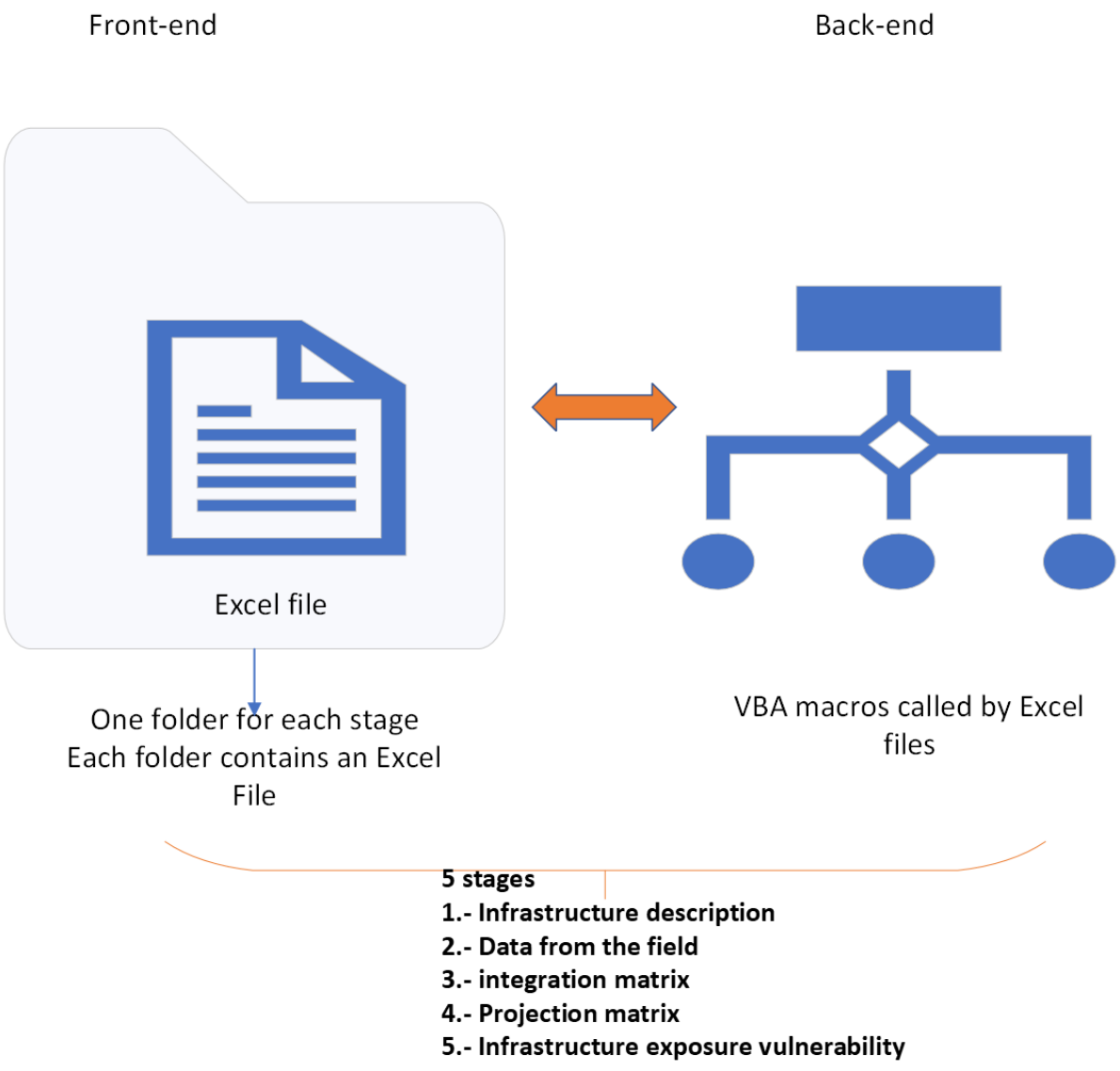
INSTRUCTIONS FOR IT DEVELOPER
Rapid Climate Impact Assessment Calculator

General Framework for Developing a Climate Impact Assessment Calculator Tool

This document explains the CT's architecture, and the macros executed step by step according to the user manual (GitHub, inside Documents: RCIA-CT July.2025.pdf file) and the security of the Excel Workbooks.

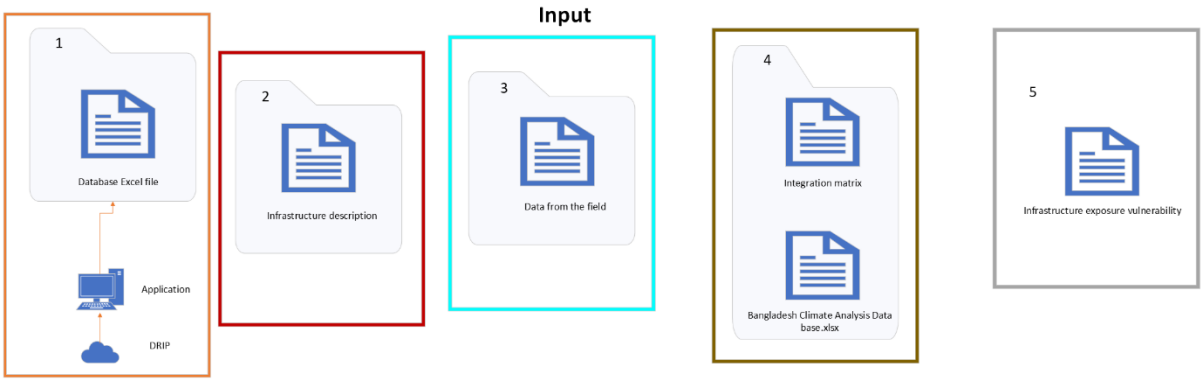
The architecture of the **"Climate Impact Assessment Calculator Tool"** is as follows, where the front-end is the Excel Workbooks and its Worksheets and the back-end is the VBA macros executed by the worksheets' events triggered by pressing a button, changing the state of a combo box, opening the workbook, making available a worksheet, etc.

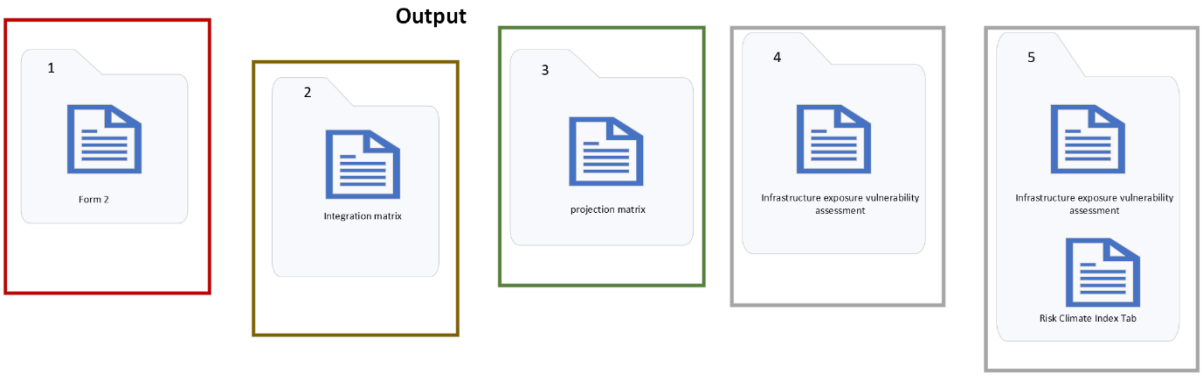
There are five stages, and each stage is made of a folder whose content is an Excel workbook.



The stages have inputs and outputs. A flow of inputs and outputs can be seen as follows, where:

1. An application builds the 'database.xlsx" workbook, this is the **first input**
2. The user fills the "infrastructure description.xlsm" workbook with data describing the infrastructure to be built. This is the **second input**
3. The user selects in "infrastructure description.xlsm" workbook the upazilas where the infrastructure will be built, and the CT creates a tab for each selected upazila in the "Infrastructure description.xlsm" workbook. This is the **first output** and is known as "Form 2"
4. The user finishes the "infrastructure description.xlsm" workbook and the CT creates the "Data from the field.xlsm" workbook where the user fills with data from the field. This is the **third input.**
5. The user finishes the "Data from the field.xlsm" workbook and the CT creates the "Integration matrix.xlsm" workbook. This is the **second output**.
6. The user reviews the "Integration matrix.xlsm" workbook and finishes it, when doing the CT creates the "Projection matrix.xlsm" workbook with two tabs for each upazila and using as input the calculated values of "integration.xlsm" workbook and two matrixes named "Bangladesh Climate Analysis Data base SSP5.xlsx" and "Bangladesh Climate Analysis Data base SSP2.xlsx" which are the **fourth input**. The "Projection matrix.xlsm" is the **third output**.
7. The user selects the upazila in the "Projection matrix.xlsm" workbook for which he / she wants to make the assessment, and the CT creates a "Infrastructure exposure & vulnerability.xlsm" workbook for each upazila selected. This is the **fourth output**.
8. The "Infrastructure exposure & vulnerability.xlsm" for each upazila is the Assessing Infrastructure Exposure and Vulnerability, when it is filled by the user, values are generated in each cell as is explained in "The infrastructure Exposure and Vulnerability assessment" section of "RCIA-CT Nov.2024" document, and the set of values are the **fifth input** to calculate the "Risk Climate index SSP5" and the "Risk Climate index SSP2" which are generated by upazila and it is the CT's **fifth output** which is in "Risk Climate index" tab.





Set up RCIA Calculator Tool

A. The Calculator Tool of the RCIA is designed to be primarily used by trained engineers at HQ level assigned to the project in combination or in consultation with engineers at local level (district or upazila). The training of the RCIA and CRT will be expanded to cover all engineers assigned in project development.

B. The ***Calculator Tool (CT)*** will be delivered in a compressed file (.zip or .rar) that must be unzipped in a directory on your device. Users can request the compressed file or download the file from the Knowledge Management System.

C. Once unzipped/downloaded, the contents of the CT will be visible in the following directory structure:

- Suggestion to name this is "RCIA Project Tool"
    - Data from the field
    - Database
        - Application
            - Administration
            - Backup
            - Downloads
            - Origin
    - Infrastructure description
    - Infrastructure exposure vulnerability
    - Integration matrix
    - Projection matrix

D. The RCIA tool has been designed to run through a series of consecutive steps that must be followed according to the instructions. To complete each step, you will be asked to open an Excel file located in the indicated directory. The files to work with are:

    - Application. This contains a system for importing the DRIP data into a database held by the CT. The database already contains the upazila historic data of all districts. This document, section "Application and Database" explains how to use the application and how to complete the database with other upazila hazard level data.

- Data from the Field. This file contains the Excel file for recording the field data of the site where the infrastructure is to be built.
- Database. This file contains the data generated by the application, and it is the first data for the CT.
- Infrastructure description. This file contains the Excel file describing the infrastructure to be built.
- Vulnerability and exposure of the infrastructure. This file contains the Excel file used to assess the exposure and the vulnerability of the infrastructure.
- The integration matrix. This file contains the Excel file that integrates the data from the CT database and the data collected in the field.
- Projection matrix. This file contains the Excel file that projects hazards over the years up to 2100.

E. When you finish working on a file that corresponds to any step click the "Finish" button on the "Launch" tab, the system closes the current file and opens the next one to continue working on the next step.

F. There are some macros that are invocated to protect the worksheet's data that must not be changed.

G. There are hidden columns and cells in some worksheets that maintains. data as:

   a. The type of infrastructure ("Launch" tab – Z2), in all workbooks except "Exposure & vulnerability"

   b. The project name, ("Launch" tab – AA2) in all workbooks except "Exposure & vulnerability"

   c. The password ("Launch" tab – Z3) in all workbooks except the sheets of "Exposure & vulnerability" ("Commitment" tab – Z2)

   d. The list of upazilas ("Launch" tab – Y column) only in "Infrastructure description" workbook. This list is always updated with the upazila names of "Database".

H. There are hidden worksheets to implement the functionality of the stages.

Step 1. Infrastructure Hazard Assessment.

The Objective of step 1 is to assess hydrometeorological and climatic hazards that may affect infrastructure.

The Workbook "Infrastructure description.xlsm" is the implementation of step 1. Its properties are:

i. When opening the Workbook the macro named "Workbook_Open()" is executed. It fills three invisible combo boxes to select division, district and upazila with the names of divisions, districts and upazila that comes from the database file ("database.xlsx"), All the data is filled without be filtered.
   a. "Workbook_Open()" is a "ThisWorkbook" macro
   b. The three invisible combo boxes are "diviEx", "districtEx" and "upaEx"
   c. To do its job, "Workbook_Open()" uses other macros:
      - "GetParentFolder" to get the name of parent folder
      - "CheckOS" to get the operating system
      - "FindValueInArray" to properly fill the combo boxes
      - "SortArrayAtoZ" to alphabetically order the combo boxes's values

ii. When "Workbook_Open()" finishes of filling the three invisible combo boxes, it fills one of the visible combo boxes (div) with the divisions

Starting the Evaluation Project

The first visible worksheet is named "Launch" and allows its functionality though the macros specified in each step:

i. A "New ***Assessment Project***" button to initiate the creation of a project.
   - Macro: "'Infrastructure description.xlsm'!Button24_Click" in "Module 3", which gets a random number plus the today date to build the project ID

ii. The system should automatically generate and assign an ID to each new assessment project inside cell F2 and today date in cell H2 .
   - When the system generates the ID project.
   - ID and date can be modified by the user.
   - The button "New Assessment project" is hidden
   - The button "Clear contents" is unhidden

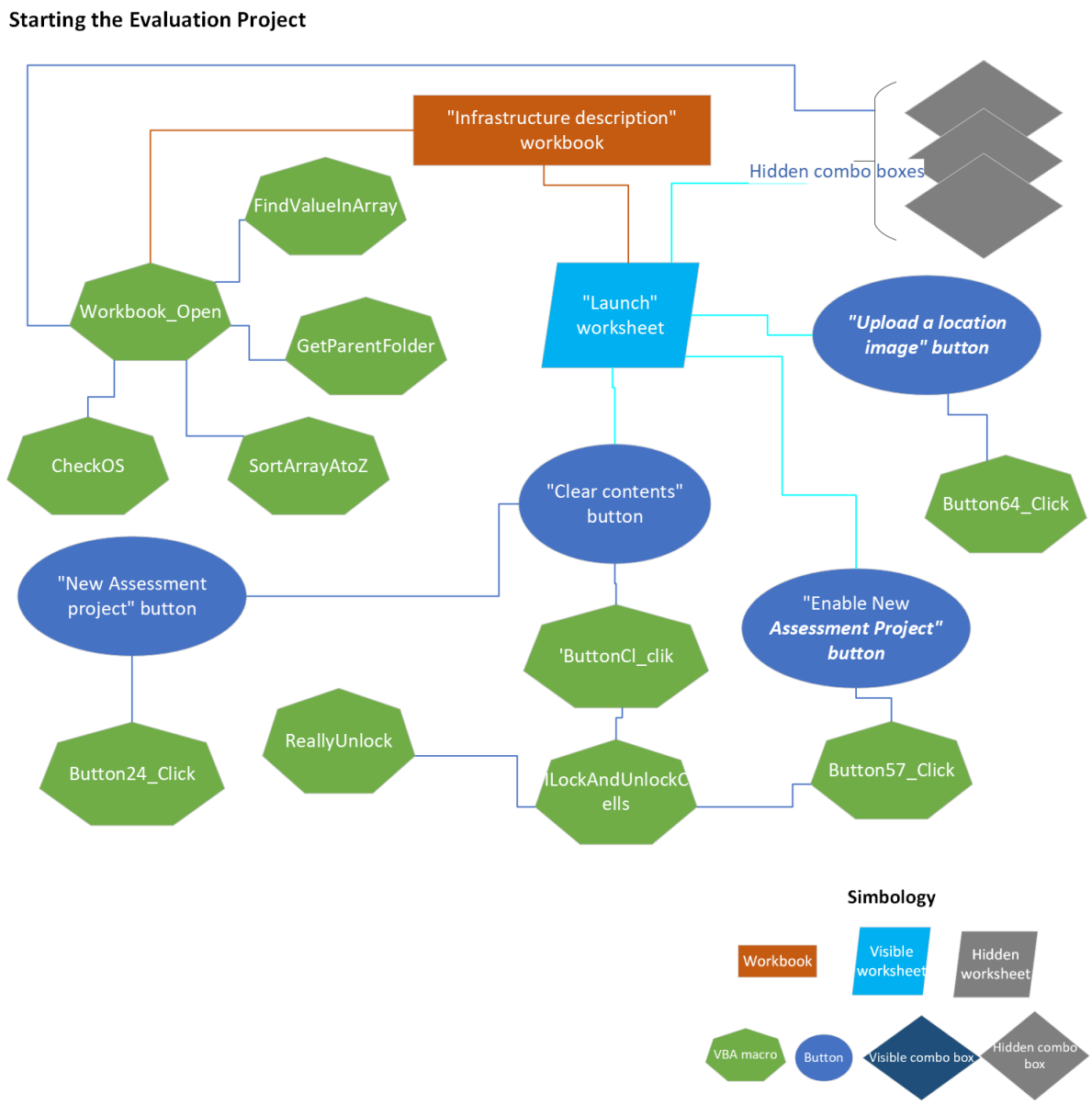
iii. The 'Clear content' button to clear the content and start again.
   - The macro used is "'Infrastructure description.xlsm'!ButtonCl_clik" in "Module 4"

iv. There is a button named "Enable 'Assessment project'" to show the hidden button "New Assessment project".

- The macro called is “Infrastructure description.xlsm'!Button57_Click” in “Module 3”

The following diagram shows stage "Starting the Evaluation Project" with its structure and macros

Diagram 1



Entering Basic Information in the “Infrastructure Description Form”

The example in fig. 1

Figure 1. Example **Form 1. Planned infrastructure**		
	Project Assessment ID	Date

Project name					
Sub-project name					
Planned dates	**Works Starting date:**		**Works Completion Date:**		
Responsible office of LGED					
Select the type of infrastructure for this Assessment Project.	**Drainage**	**Water system**	**Bridges**	**Roads**	**Buildings**
	☐	☐	☐	☐	☐
What kind of planned works is?	Maintenance ☐				
	New Planned infrastructure ☐				
	Rehabilitation Planned infrastructure ☐				
	Reconstruction Planned infrastructure ☐				
What is the expected lifespan of Planned infrastructure?	≤10 years	≤20 years	≤40 years	≤60 years	>60 years
	☐	☐	☐	☐	☐

Elevation and topography	Describe elevation, surrounding topography, drainage characteristics, and distance to water body or river
Structural Characteristics	
Materials used	Describe proposed materials
Age and Condition	For an existing infrastructure system, describe the age and condition. Older infrastructure may be more vulnerable due to wear and tear, outdated design standards, or degradation of materials
Design Specifications	It is important to describe the details of the design standards that will be used, such as load capacity, wind resistance, and flood resistance. This information will provide data on the likelihood that the infrastructure will be able to withstand extreme events
Functional and operational data	
Type and function of the infrastructure system	It is important to describe the details of the design standards that will be used, such as load capacity, wind resistance, and flood resistance. This information will provide data on the likelihood that the infrastructure will be able to withstand extreme events
Use patterns	Describe data on the frequency and volume of use, such as the daily traffic on a bridge or the treatment capacity of a water treatment plant)
Maintenance and rehabilitation history of existing infrastructure	
Maintenance records	Describe whether it has been regularly maintained, irregularly maintained, or not properly maintained. Remember that regular maintenance can increase resilience, so knowing the maintenance and repair history will help in assessing vulnerability)
Adaptation Measures	Describe for infrastructure, information on existing adaptation measures (e.g. flood barriers, heat resistant coatings) will allow to know the current level of resilience and possible areas for improvement

v. To get the map where the infrastructure will be built, press the button "Open Create Google Maps". A Google Map page will be displayed where you can create a map or edit a map. The url is

https://support.google.com/mymaps/answer/3024454?hl=en&amp%3Bref_topic=3188329

- You have to save this map as an image.
- The "'Infrastructure "OpenGoogleMapsWithCoordinates" macro in "Módulo1" is called for this button.

vi. Next, go to the "Upload a location map image" button and upload an image in a format (.jpg, .jpeg, .gif, .png) that shows the location points and/or layout lines of the infrastructure to be constructed, covering all the upazilas involved, into the "Image" worksheet.

- Though the "Upload map location image" button the macro "'Infrastructure description.xlsm'!Button64_Click" in "Module 5" is called to upload the image.
- The uploaded image could be the image obtained from Google maps.

vii. Then select the division, district and upazila where the specific type of infrastructure you are assessing will be constructed.

- When a division is selected, the system fills the "district" combo box with the districts of the selected division using the macro "'Infrastructure description.xlsm'!DropDown65Real_Change" in "Module 5" which uses the "distriEx" invisible combo box to select the districts of the selected division and fill the combo box.
- When a district is selected, the system fills the "upa" combo box with the upazila of the selected district using the macro "'I 'Infrastructure description.xlsm'!DistriReal_Change" in "Module 5" which uses the "upaEx" invisible combo box to select the upazilas of the selected district and fill the combo box.

viii. Once you have selected an upazila, the CT will create a tab with the name of the selected upazila, and the content is the data extracted from the "database.xls" file constructed with the Application from the Disaster Risk Information Platform (DRIP)[1]. In the Form 2 (Fig. 2) can be seen an example of a certain upazila with data from the "database.xls" workbook.

- The macro "Upa_Change" in Module 5, creates a new tab with the name of the selected upazila and with the hazard level data from the upazila tab from the database file.
- For do this job the application uses the macro "CopyDataToNewSheet" in Module 1 which uses the hide tab "Model" to duplicate it and fill it with data from database. You must proceed to select the upazilas that will form your *assessment project* one by one, and the CT will automatically create as many Form 2 as the number of upazilas you have selected for your assessment project.

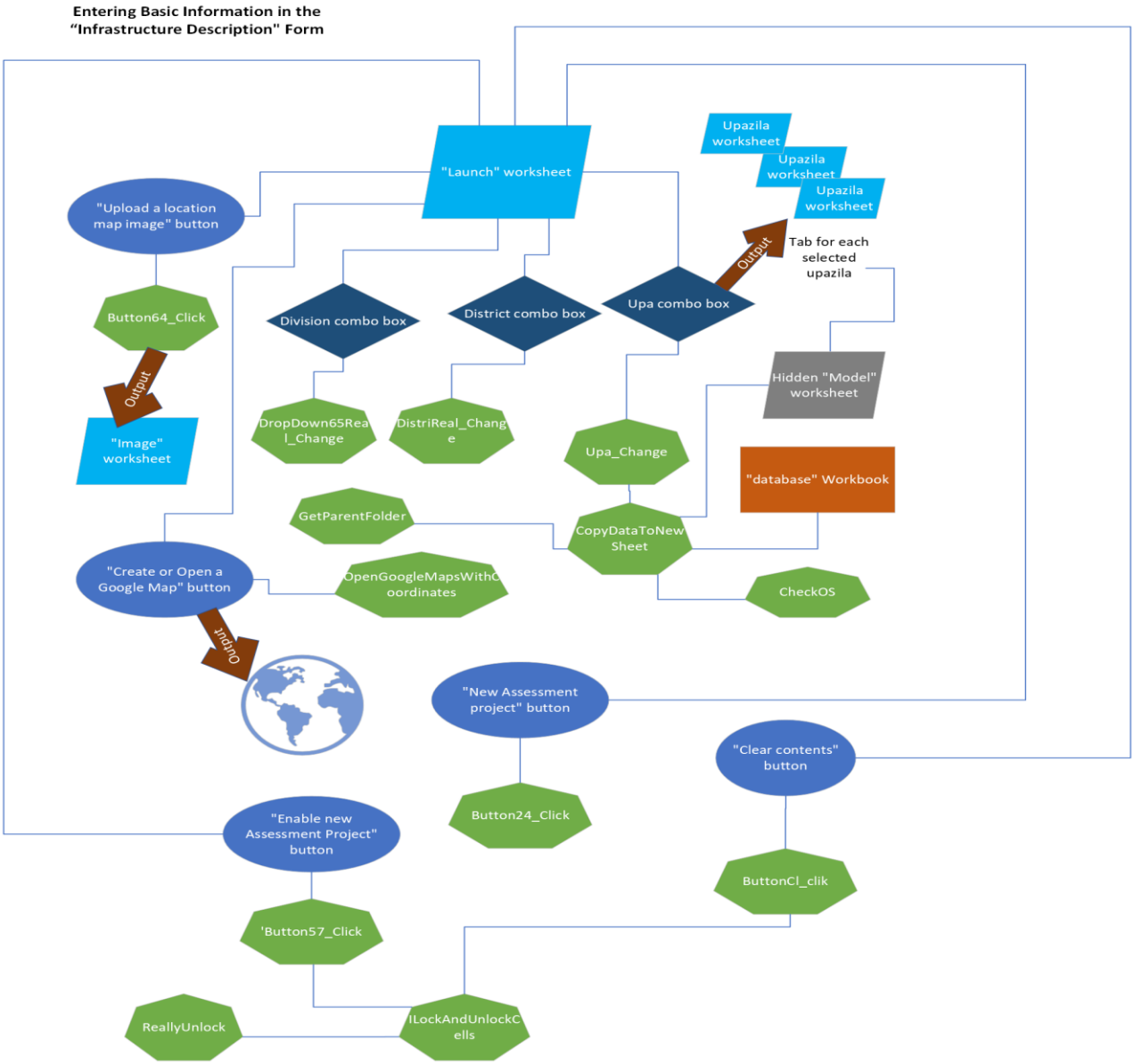
[1] At present, the database contains all the upazilas, specially the three pilot districts of the CRIM project. The user can add new upazilas by using the developed tool and following the steps described in the "Application and Database" of this document.

Note: The divisions, districts and upazila available for selecting in combo boxes, come from de "Database" file.

Form 2. For UPAZILA LEVEL USES Hydrometeorological events observed by the local stakeholders						
Division: Barishal						
District: Bhola **Upazila:** **Bhola Sadar**						
Hazardous events at Upazila level	**Hazard level classification from the field**					
	Very high	High	Medium	Low	Very low	N/A
Data from the DRIP						
1. Cyclone						
2. Drought: Kharif						
3. Drought: Pre Kharif						
4. Earthquake						
5. Erosion						
6. Flash flood						
7. Flood						
8. Landslides						
9. Salinity						
10. Sea Level Rise						
11. Storm surges						

The following diagram shows stage "Entering Basic Information in the "Infrastructure Description Form" with its structure and macros.

Diagram 2



Ending the "Infrastructure Description Form"

i. Check that the selected upazilas are as they should be. If you confirm, you can complete the process by clicking the 'Finish' button on the 'Launch' tab.

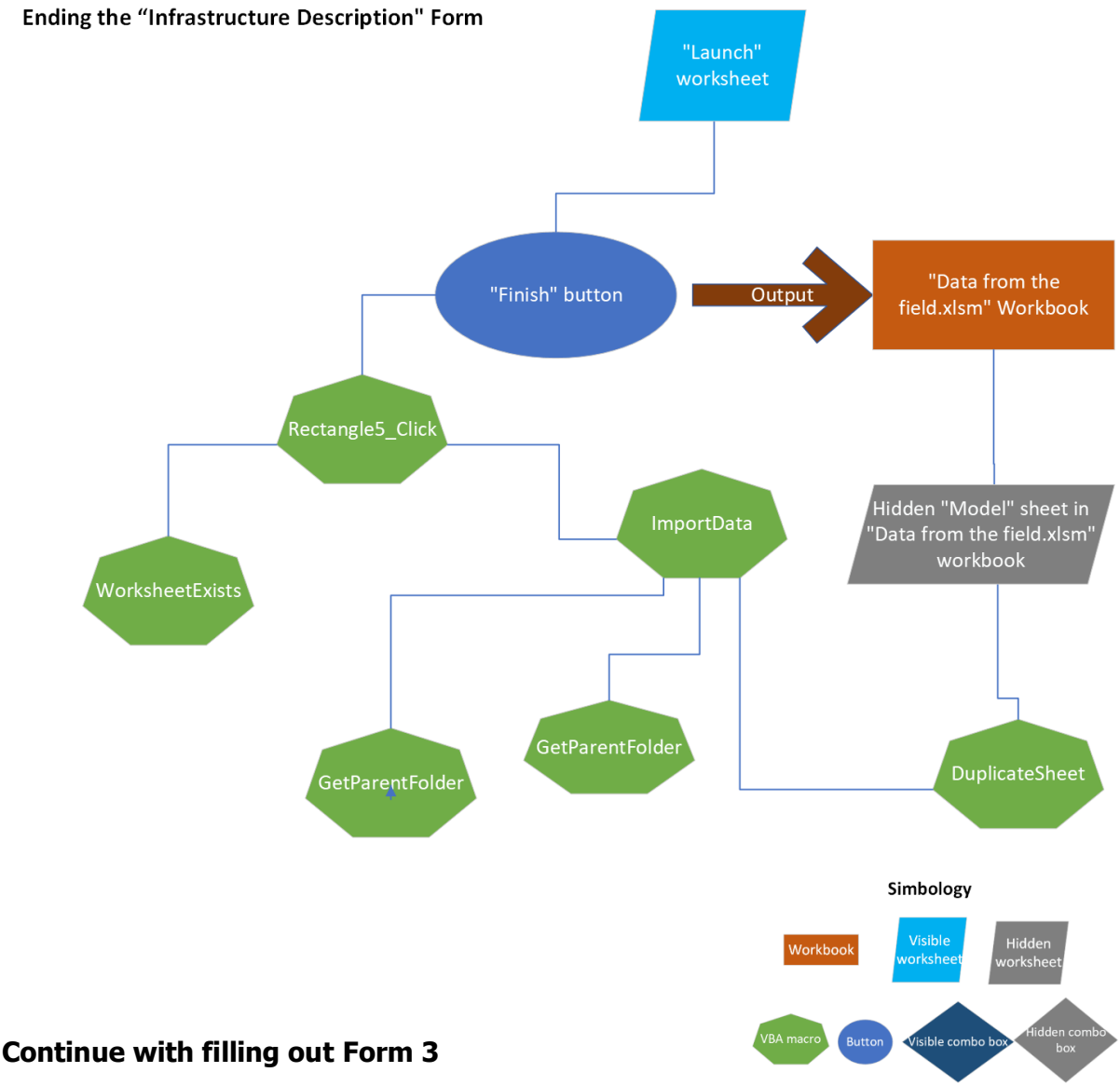
→ The Calculator Tool will check the entered data that and, if everything is validated, the CT will ask to create a form named *"data from the field"*.

- The macro called when "Finish" button is clecked is "'Infrastructure description.xlsm'!Rectangle5_Click" in "Module 6"
- This macro checks the validation of the form, verifying all the fields have values and that at least one upazila have been selected

- Once the validation of form is ok, the macro "ImportData" in "Module 2" is called to import data of form 1 to form 3, named "Data from the field.xlsm" explained in the following process "Continue with filling out Form 3". The macros used are
  - "GetParentFolder" in "Module 1"
  - "Duplicate Sheet" in "Module 5" to duplicate the "Model" sheet in "Data from the field.xlsm" workbook

The following diagram shows stage "Ending the 'Infrastructure Description Form" with its structure and macros.

Diagram 3



Continue with filling out Form 3

This requires field inspections to validate or complement the findings extracted from the DRIP platform. The form 3 also allows to assess some variables that are not captured by the DRIP. These detailed observations require the input from engineers at district and/or upazila level.

The Form 3 has as many tabs as upazila were selected in previous stages. For each upazila the form must be filled by marking an 'X' in the appropriate cell.

i. When an "X" is marked, the macro "Workbook_SheetChange" is called
   - This macro uses a sheet named "Data" which has the same structure as the upazila form, and inside each cell a number exists, and the macro shows the corresponding number in the same position and is filled with the column color.

ii. In previous stage each upazila tab was generated making a duplicate of the worksheet "Model" in this workbook.
   - The "Model" worksheet uses Excel conditional formatting for filling each not empty cell with a colour according to its numeric value. The explanation of the colours can be seen in section "Normalization and classification" of "RCIA-CT Nov.2024" document.
   - The text (numeric value) colour format follows the same colour pattern.

Fig. 3 shows a filled form for a certain upazila.

Form 3. Hazard assessment of the planed site-location of planed infrastructure

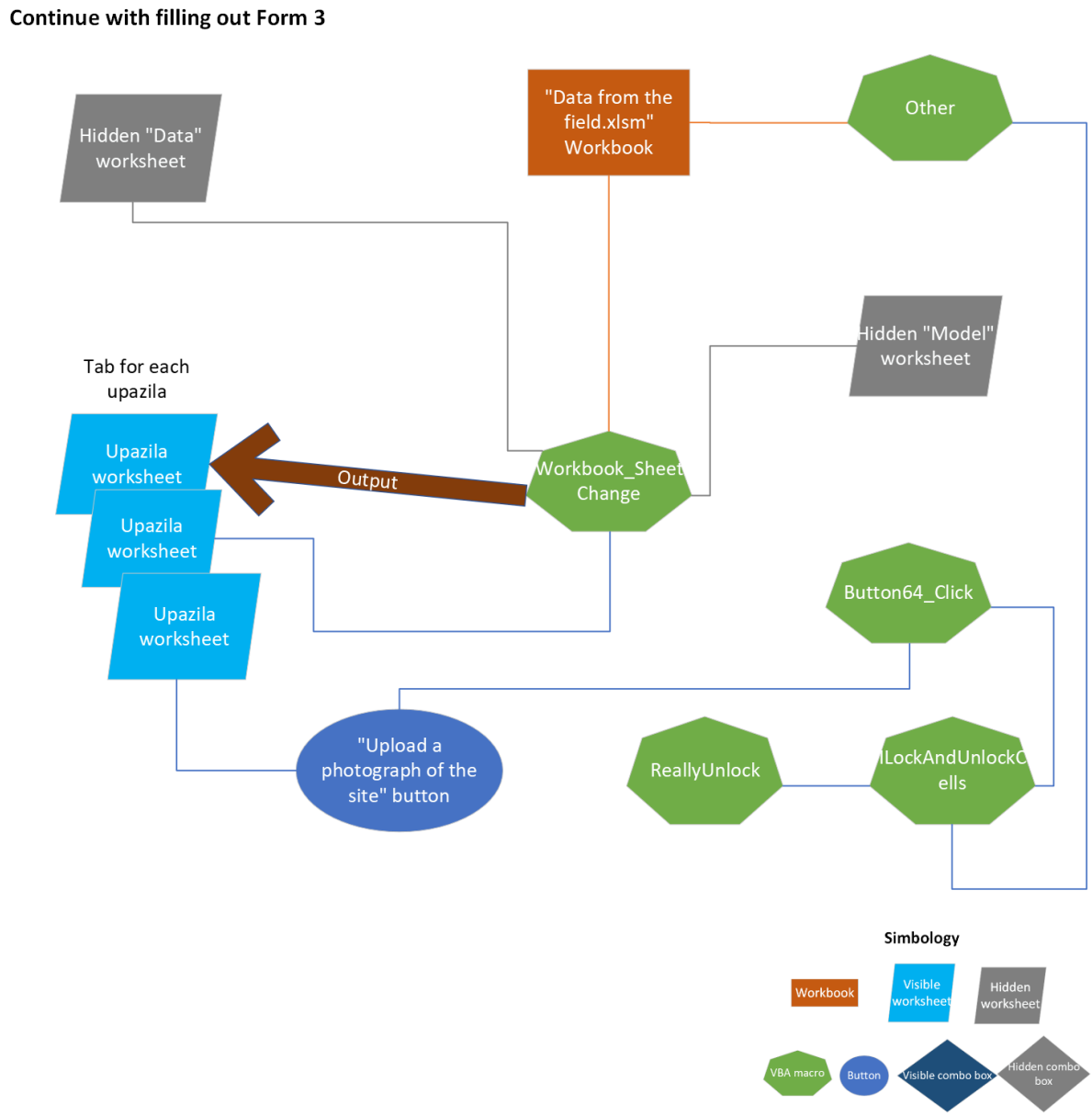
Division: Barishal
District: Bhola
Upazila: Bhola Sadar

Hazard Variable	Hazard classification based on field observations.					
	Very high	High	Medium	Low	Very low	N/A
Data from the field level: This hazard classification is related to the specific location of the proposed infrastructure.						
Cyclone	X					
Drought: Pre Kharif	X					
Erosion		X				
Flash flood		X				
Flood		X				
Landslides						
Salinity						
Sea Level Rise			X			
Storm surges				X		
Heat wave				X		
Heavy Rain				X		
Hailstorms				X		
Canal or stream overflow	X					
Erosion of coastal slopes and/or shorelines	X					
River-bank erosion						
Strong sedimentation					X	
Fresh water scarcity					X	
Lightning					X	

The "Upload a photography of the site" button is present in each upazila tab and uploads an image in a format (.jpg, .jpeg, .gif, .png). The button calls the macro "Data from the field.xlsm'!Button64_Click"

The following diagram shows stage "Continue with filling out Form 3" with its structure and macros.

Diagram 4



Ending Form 3

When Form 3 for each upazila is completed, the 'Finish' button in the 'Launch' tab must be pressed.

iii. The "Finish" button will call the "Rectangle1_Click" macro in "Module 4".

- The macro will validate that all upazila have one marked X (a filled colour with its number) for each hazard. Its job will be done through the following macros in "Module 1":
  - CheckAll
  - CheckNotEmpty

- CheckCellForNonNumericValue

iv. If validation is ok, the "CreateMatrixField", "CreateMatrixField2", "CreateMatrixHistoric" and "CreateFieldHistoric" macros are called to create the "Integration Matrix" that will continue to integrate Form 2 and Form 3 (field data) into the "Integration Matrix.xlsm" workbook, which will be explained after.

v. "CreateMatrixField" fills the "Integration Matrix" with data from the field from "Heat Wave" to "Lightning" hazards. The macro invoked by "CreateMatrixField" is "DuplicateSheet" in "Module 2" to duplicate the "Model" worksheet of "Integration Matrix.xlsm" workbook.

   - When a worksheet has been created (one for each upazila) inside "Integration Matrix.xlsm" workbook, the current workbook ("Data from the field.xlsm") is closed.

vi. "CreateMatrixField2" fills the "Integration Matrix" with data from the field from "Cyclone" to "Storm Surges" hazards.

   - These values are filled in hidden rows in the corresponding upazila sheet in "Integration Matrix".

vii. "CreateMatrixHistoric" fills the "Integration Matrix" with data from the DRIP (Form 2) from "Cyclone" to "Storm Surges" hazards.

   - These values are filled in hidden rows in the corresponding upazila sheet in "Integration Matrix"

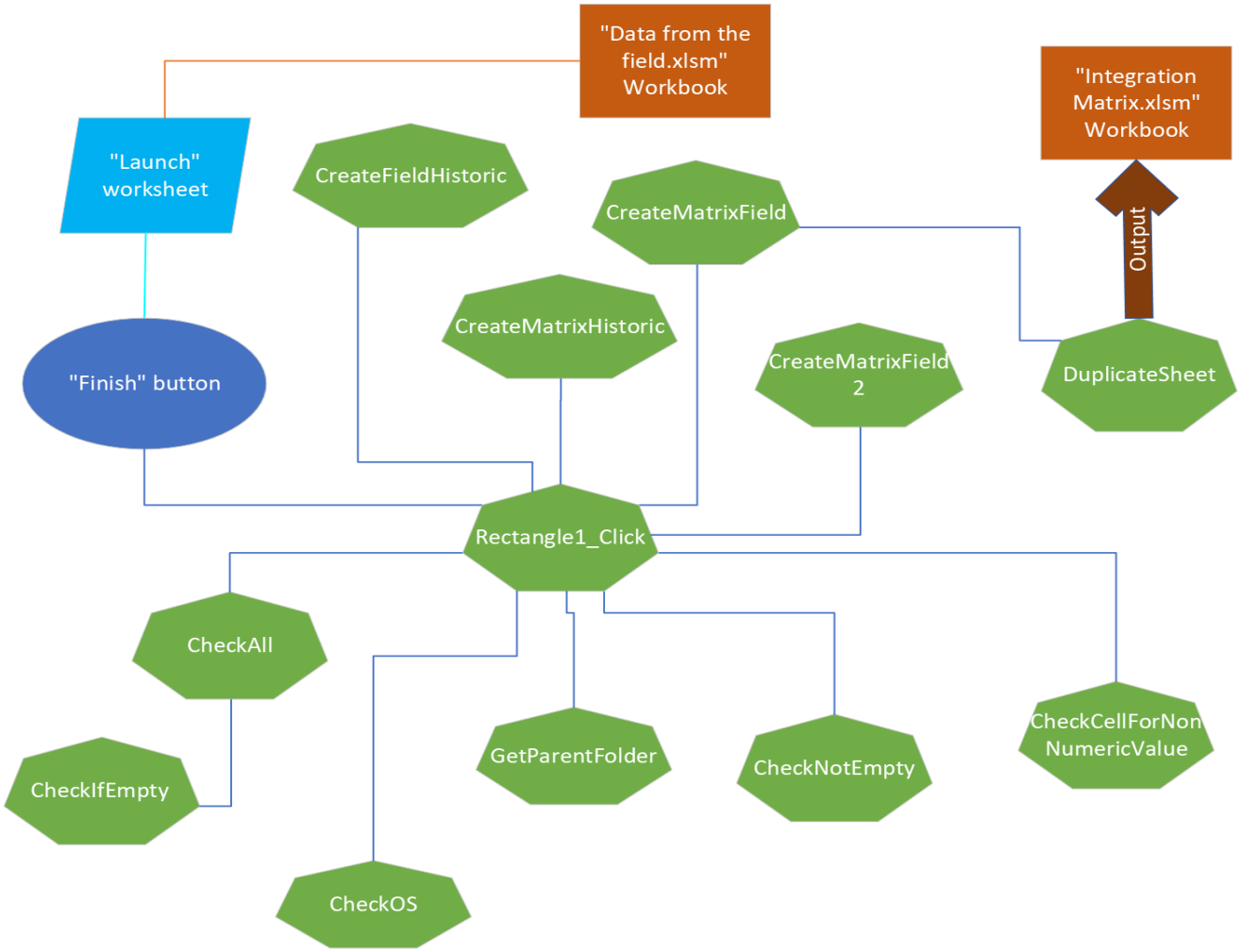
viii. "CreateFieldHistoric" fills the "Integration Matrix" averaging the values from DRIP (Form 2) "Data from the Field (Form 3) from "Cyclone" to "Storm Surges" hazards.

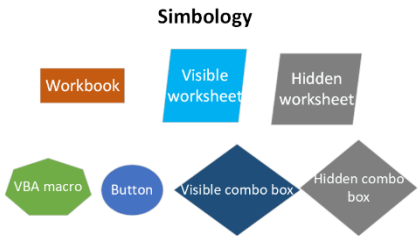
   - The average is taken from the hidden rows and is filled in not hidden rows of the "Integration Matrix".

The following diagram shows stage "Ending Form 3" with its structure and macros.

Diagram 5

Ending Form 3





Continue with Integration Matrix

Figure 4 shows how is this matrix.

INTEGRATION MATRIX (active cell from Form 2 + Form 3)					
Division: Barishal					
District: Bhola					
Upazila: Bhola Sadar					
Hazard Variable (VH)	**Hazard Level (HL)**				
	Very high	High	Medium	Low	Very low
Cyclone					
Drought: Pre Kharif					
Erosion					
Flash flood					
Flood					
Landslides					
Salinity					
Sea Level Rise					
Storm surges					
Heat wave					
Heavy Rain					
Hailstorms					
Canal or stream overflow					
Erosion of coastal slopes and/or shorelines					
River-bank erosion					
Strong sedimentation					
Fresh water scarcity					
Lightning					
Aggregated Hazard Index (Ahi)	Ahi for Upazila: Bhola Sadar			[37,8895833412806]	

ix. Review the Integration Matrix and then press "Finish" on the "Launch" **tab**. The CT will ask to create a projection matrix.

- When pressing "Finish" button, "Integration Matrix.xlsm'!Rectangle4_Click" is called for creating "Projection Matrix" which calls the "CreateProjectionMatrix" macro and "WorksheetExists" to indeed create the "Projection Matrix". For doing its job, "CreateProjectionMatrix" uses the Workbook "Bangladesh Climate Analysis Data base" and also calls other macros:
  - "GetParentFolder"
  - "DuplicateSheet"
  - "PorRangoHazard" to fill data coming from Form3 from Cyclone to Storm Surges data
  - "PorRangoField" to fill data coming from Form3 from Heat Wave to Lightning hazards

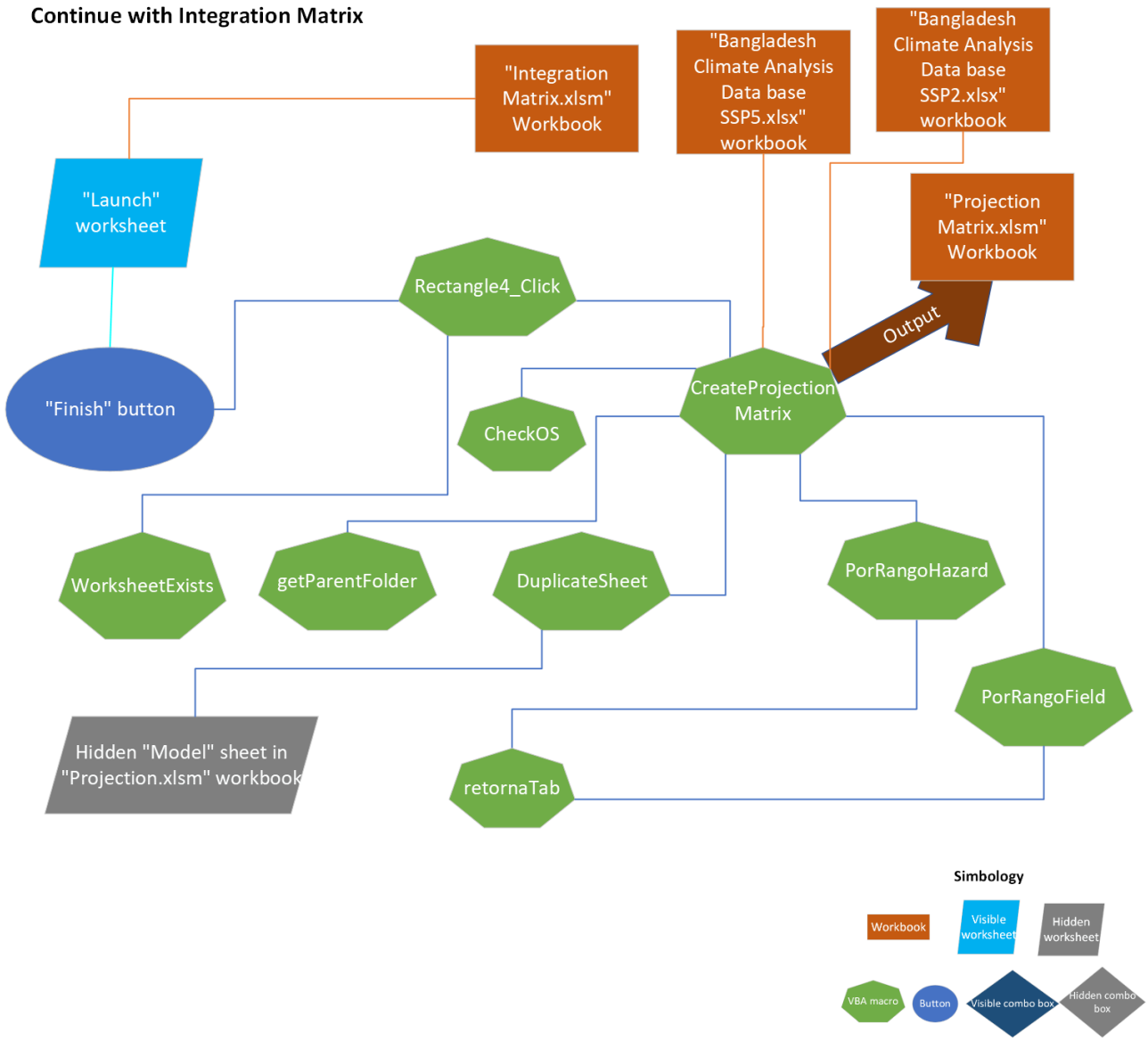
x. Both procedures "PorRangoHazard" and "PorRangoField" in order to generate values in "Projection Matrix", take values of "Integrated Matrix" and the values of these

Workbooks "Bangladesh Climate Analysis Data base SSP2.xlsx" and 'Bangladesh Climate Analysis Data base SSP5.xlsx"

- Both procedures call “RetornaTab” to find the tab in "Bangladesh Climate Analysis Data base SSP2.xlsx" and 'Bangladesh Climate Analysis Data base SSP5.xlsx" where to search the values. The tabs are the divisio names.

The following diagram shows stage "Continue with Integration Matrix” with its structure and macros.

Diagram 6



Projection Matrix

For creating the "Projection Matrix", the macro duplicates the worksheets "Model SSP5" and "Model SPP2" inside the projection matrix. "Model" worksheets are the pattern of the projection matrix for each period of time.

i. Press Ok and the CT will produce two hazard projections for each upazila from the current period to 2100 (Fig. 5), using the SPP5 and the SPP2 climate change scenario.

Projection Matrix Period **2020-2039** *(SSP5 Scenario)*

Division: Barishal | District: Bhola | Project: a

	Very High	High	Medium	Low	Very Low
Upazila: Bhola Sadar					
Cyclone	82,95				
Drought: Pre Kharif				22,95	
Erosion			42,95		
Flash flood				22,95	
Flood	82,95				
Landslides					2,95
Salinity					2,95
Sea Level Rise			42,95		
Storm surges			42,95		
Heat wave				22,95	
Heavy Rain				22,95	
Hailstorms				22,95	
Canal or stream overflow	82,95				
Erosion of coastal slopes and/or shorelines	82,95				
River-bank erosion					
Strong sedimentation					2,95
Fresh water scarcity					2,95
Lightning					2,95
Aggregated Hazard Index (Ahi)	37,95				

Projection Matrix Period **2040-2059** *(SSP5 Scenario)*

Division: Barishal | District: Bhola | Project: a

	Very High	High	Medium	Low	Very Low
Upazila: Bhola Sadar					
Cyclone	85,95				
Drought: Pre Kharif				25,95	
Erosion			45,95		
Flash flood				25,95	
Flood	85,95				
Landslides					5,95
Salinity					5,95
Drought: Pre Kharif			45,95		
Storm surges			45,95		
Heat wave				25,95	
Heavy Rain				25,95	
Hailstorms				25,95	
Canal or stream overflow	85,95				
Erosion of coastal slopes and/or shorelines	85,95				
River-bank erosion					
Strong sedimentation					5,95
Fresh water scarcity					5,95
Lightning					5,95
Aggregated Hazard Index (Ahi)	40,95				

Print this upazila

Note: now the CT is ready to start the next step.

Step 2. Assessing Infrastructure Exposure and Vulnerability

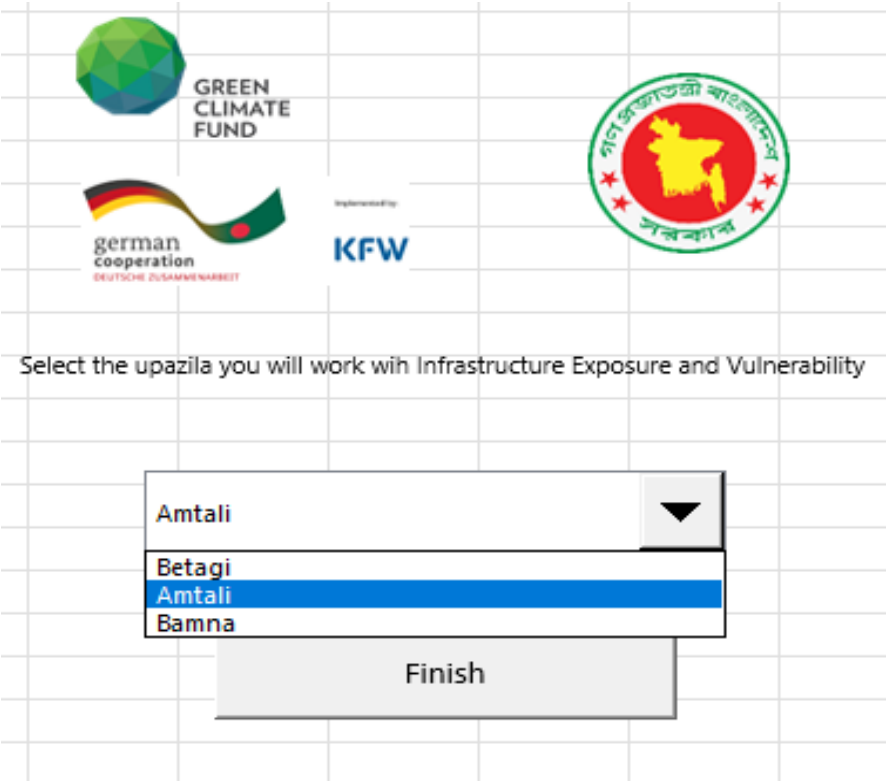
This step serves one objective:

- Assess Infrastructure Probabilistic **Exposure**. This refers to the potential level of damage or loss that the infrastructure could suffer if exposed to the effects of a hazardous hydrometeorological event at its location; and

Selecting the upazila in "Projection Matrix"

2.1 The following step is to select the upazila for which the exposure and vulnerability of the proposed infrastructure will be assessed. To do this, go to the 'Launch' tab and select one of the upazilas from the list of your assessment project (Figure 6). Note: The exposure and vulnerability assessment process should be carried out separately for each upazila.

(Fig.6. Example)



2.2 Once you have selected the upazila, click on the 'Finish' button and the CT will create an Excel file for the upazila you have selected in the 'Infrastructure Exposure and Vulnerability' directory.

i. When "Finish" button is pressed, "Button2_Click" macro is invoked which creates a workbook for each selected upazila. This workbook is a infrastructure exposure & vulnerability assessment workbook. It's based in "Infrastructure exposure & vulnerability.xlsm" workbook. Macros invoked by "Button2_Click" are:

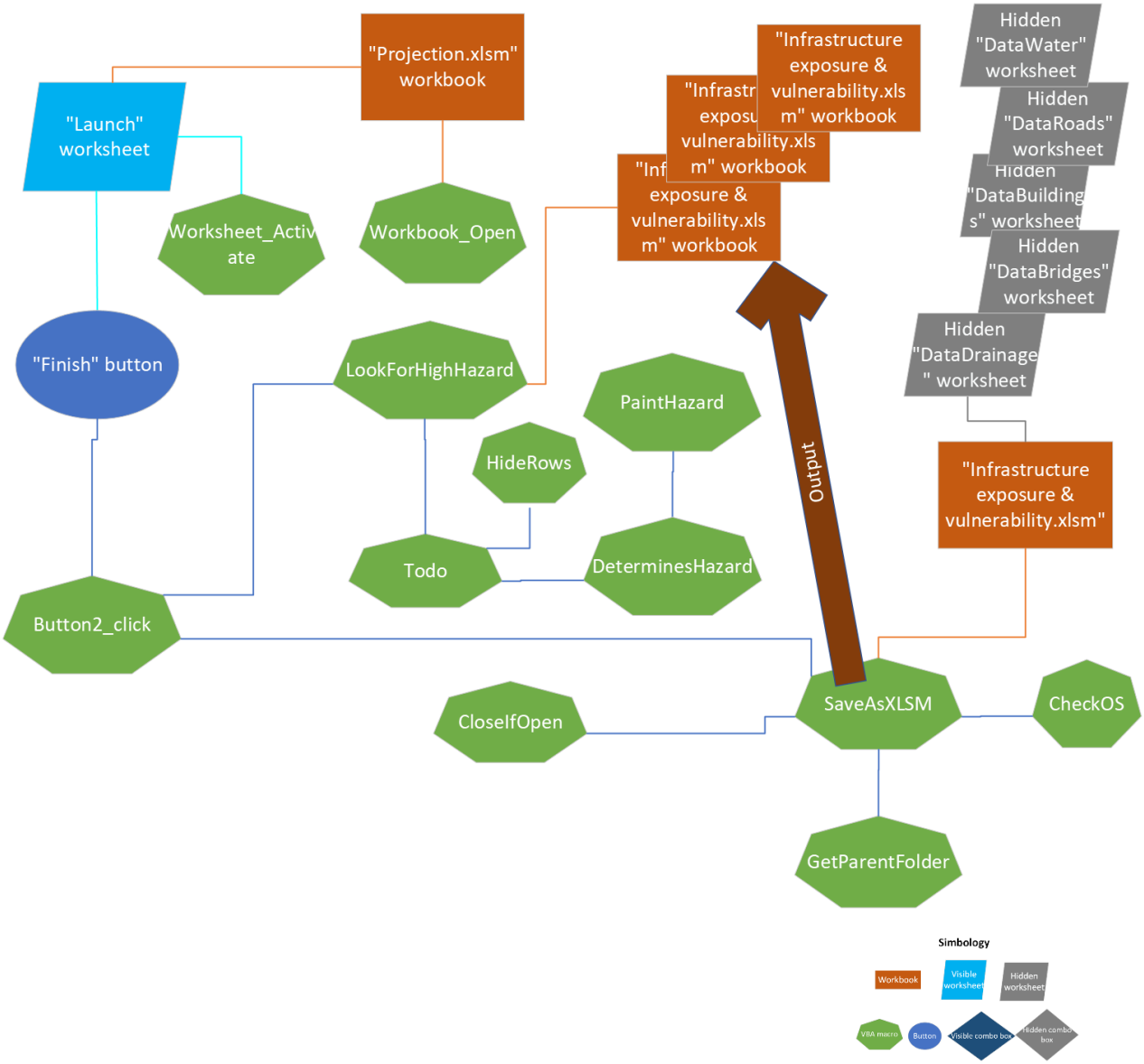
- "SaveAsXLSM" for duplicating origin workbooks
- "LookforHighHazard" for selecting only high and very high level hazards from "Projection Matrix". Which calls to:
  - "Todo" which calls "DeterminesHazard" and "HideRows" macros. This last macro, hides hazard rows which do not have the very high, or high level.
  - "DeterminesHazard" calls to "PaintHazard" to colour the hazard row with the corresponding level hazard colour.

ii. The way all mentioned macros work is hiding all the hazard rows that does not have the required level and showing row by row.

The following diagram shows stage "Selecting the upazila in "Projection Matrix" with its structure and macros.

Diagram 7

Selecting the upazila in "Projection Matrix"



Working with Exposure and Vulnerability Excel file with the name of the corresponding upazila

2.3 Go to the directory and open the created Exposure and Vulnerability Excel file with the name of the corresponding upazila.

2.4 When you open the file, you will be presented with a compromise text on the standard criteria to be considered when classifying the level of exposure and vulnerability.

2.5 Based on this, you should carefully review each classification criteria 1 to 5. The classification criteria to be used in the Exposure and Vulnerability assessment, are:

1. ***Very low.*** This refers to minor damage that does not require major repair of the infrastructure. Although such damage does not affect the functionality of the infrastructure services, it is important to address it to avoid further deterioration of the infrastructure that could affect the

services if it were to occur again. In an infrastructure management system, such damage would require strict adherence to routine maintenance.

2. ***Minor.*** This refers to minor losses that does not require major repair or rehabilitation of the infrastructure. Although such losses is "minor", it is important to address it to avoid further deterioration of the infrastructure and consequent problems with quality and continuity of service. In an infrastructure management system, such damage would require specific, more attentive, or targeted maintenance than regular maintenance, including some additional strengthening or protection measures.
3. ***Moderate.*** This refers to more significant losses or damage that requires more intensive repair and may affect the functionality of the infrastructure in the short to medium term. These losses or damage may require a rehabilitation effort to restore the infrastructure to its original condition and are likely to require more significant financial and engineering resources to resolve.
4. ***Major.*** This is serious losses or damage that compromises the structural integrity of the infrastructure, renders the assets unsafe or unusable, and requires extensive repair or even complete reconstruction. The cost of repairing such losses or damage is significant, both in terms of money and time, and the impact on local communities and the economy can be long-lasting.
5. ***Very high.*** Refers to total damage and the need to completely replace the infrastructure.

2.6 You must confirm that you have understood those criteria clicking the button '**Confirm**' which calls the "'Button1_Click" macro. Following the confirmation, the tool will display **four tabs**:

i. ***Infrastructure Exposure & Vulnerability Assessment*** matrix.
ii. Produce a **Report**.
iii. Climate Risk **Index SSP5**.
iv. Climate Risk **Index SSP2**

When you open the Workbook, the macro named "Workbook_Open()" is executed. It configures the "Infrastructure Exposure & Vulnerability Assessment" worksheet to show the appropriated buttons and only the first line of the first selected hazard. To make its job, "ShowHide" macro is invocated.

2.7 **Open** the Infrastructure Exposure and Vulnerability Assessment tab and review its structure:

i. The first row describes the type of infrastructure you are assessing.
ii. The second and third rows describe the district and upazila where the infrastructure exposure and vulnerability assessment is being conducted.
iii. The fourth and fifth rows describe the heading of the exposure assessment.
iv. The sixth and seventh row describes the infrastructure component to be assessed:
    - physical structure,
    - construction materials and
    - site conditions.

    In addition, the 5 levels of exposure can be observed.

v. The eighth row shows the type of hydro-meteorological hazard, and the colour refers to the degree of hazard as assessed in the previous steps.

Form 5. Bridges

District: Bhola

Upazila: Bhola Sadar

Continue to next line

Infrastructure exposure assesment matrix **Project: Test**

Physical Structures	Extent of Damage					Constructions Materials	Extent of Damage					Site-location Conditions	Extent of Damage				
	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
Cyclonic storm																	
High winds and heavy rains causing stress and potential weakening of bridge structures.						Accelerated rusting and corrosion of metal elements in the bridge due to increased moisture and saltwater intrusion.						Damage to roads leading to and from the bridge, affecting accessibility and functionality.					

2.8 Once you have reviewed the structure of the matrix, you will begin the analysis by following the procedure below:

i. Start by finding the Infrastructure Exposure Assessment section (rows 4 and 5, columns A, B, C, D, E, F), subsection "Physical Structures" (rows 6 and 7, column A), and then focus on row 8, which describes the hazard type and level.

ii. Once you have read and understood the scenario, proceed to classify the extent or level of damage that would occur if the hydrometeorological event were to occur at that level of severity. To do this, use the criteria described in para 2.5 above and apply your best engineering knowledge and experience.

iii. Apply an "**X**" in the appropriate box in the "Extent of Damage" section (rows 6 and 7, columns B, C, D, E or F).

- When an "X" is marked, the macro "Workbook_SheetChange" is called.

- This macro uses a sheet named "DataBuildings" or "DataBridges" or "DataRoads" or "DataWater" or "DataDrainage" according to the infrastructure type, which (any of them) has the same structure as the "Infrastructure Exposure & Vulnerability Assessment ″worksheet (which, in turn, also depends on the type of infrastructure), and inside each cell a number exists, and the macro shows the corresponding number and color in the same position.

iv. Continue this process of analysis and ranking until you have completed the 'Infrastructure Exposure and Vulnerability Assessment Matrix' for the upazila.

v. To facilitate interaction, when the tab corresponding to the type of infrastructure (buildings, bridges, roads, drainage or water system) is displayed, only the first line of the first hazard to be evaluated will be displayed. To proceed with the next line you must click the "**Continue to next line**" button. When all the lines of the hazard in question have been evaluated, the system informs you and a button appears "**Continue to next hazard**"; clicking the button executes the first line of the next hazard. Continue with the "**Continue to next line**" and "**Continue to next hazard**" until the evaluation is completed.

- When "Continue to next line" is pressed, "'Line_Click" macro is called to show the next line of the current hazard
- When "Continue to next hazard" is pressed Hazard_Button1_Click() is called to show the next hazard. This macro calls "Show" macro to make its work.

2.9 When you have completed the E&V assessment or even as the evaluation is completed for the selected upazila, you will now be able to generate a report of the E&V assessment. This option is available on 'Report' tab. In this report you will find:

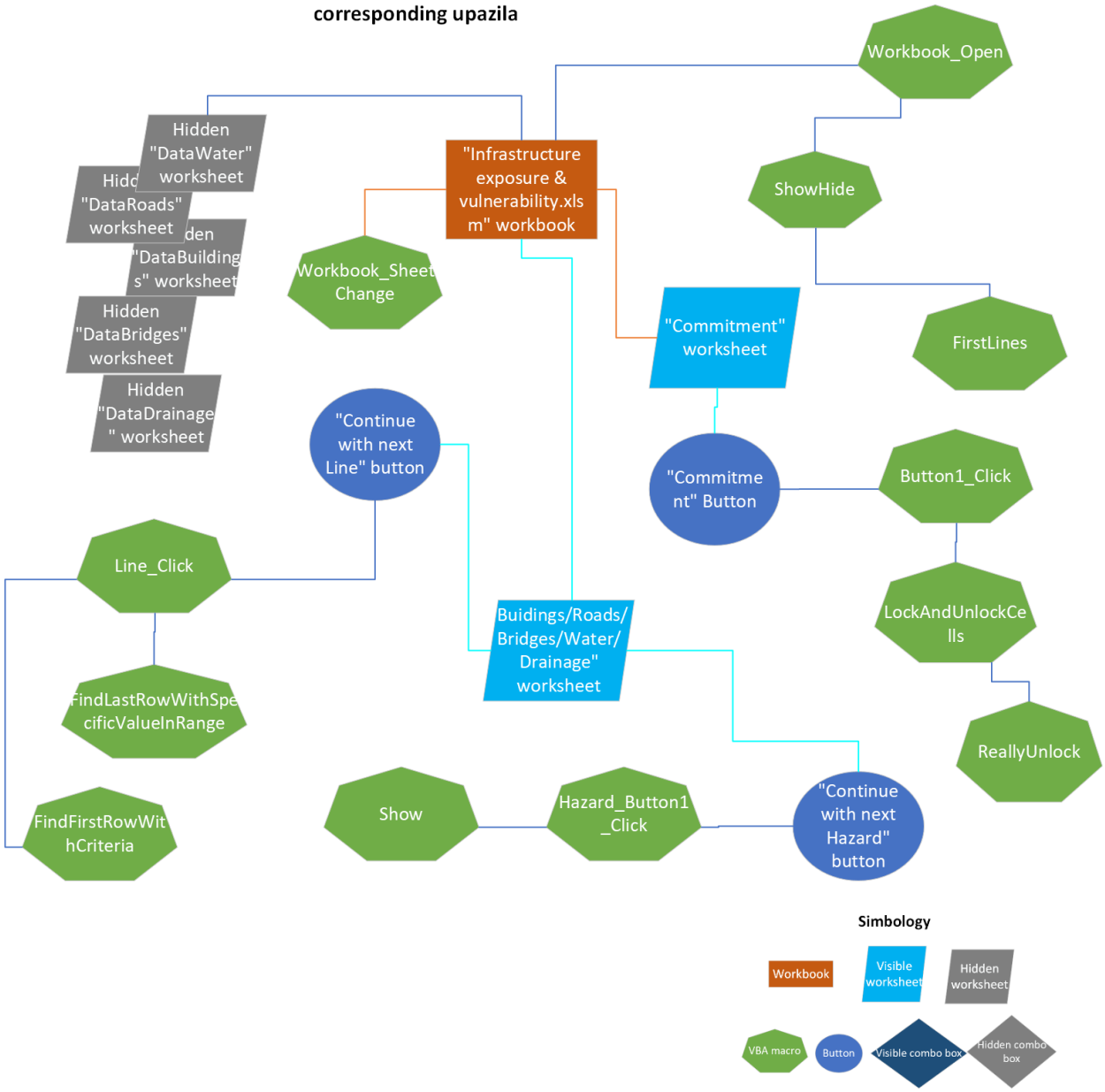
i. An estimate of the exposure index for the assessed infrastructure.

2.10 To carry out the E&V analysis and assessment for a new upazila, you should repeat steps 2.1 to 2.9. These steps should be repeated as many times as the number of upazilas included in this assessment project.

The following diagram shows stage "Working with Exposure and Vulnerability Excel file with the name of the corresponding upazila" with its structure and macros.

Diagram 8

Working with Exposure and Vulnerability Excel file with the name of the corresponding upazila



Step 3. Probabilistic Infrastructure Risk Index.

3.1 This step measures the probability of experiencing a specified level of infrastructure damage or loss due to hydrometeorological events.

3.2 The risk index is derived by averaging various infrastructure risk indices calculated for each upazila. If this averaged index falls within the medium risk category or higher, a Comprehensive Climate Change Impact Assessment (CCIA) is recommended for all infrastructures across the upazilas included in this assessment.

3.3 If the overall averaged climate risk index is classified as low or very low, it is not mandatory to conduct assessments for all upazilas. However, it is crucial to check if any individual upazila's risk index reaches the medium or higher risk categories. Upazilas meeting these criteria should undergo the CCIA process.

Go directly to CCIA			**No need to go to CCIA**	
Very high	High	Medium	Low	Very low
Range: from 52% to 100%			**Range: from 1% to 51.99%**	

To generate the report.

3.4 Go to the Climate Risk Index tab of the calculation tool. This tab displays the 'Climate Risk Index', which is calculated dynamically and in real time as the assessment is carried out.

3.5 Select the 'Report' tab. The calculator will display the results for the selected upazila.

i. When pressing "As*sessing Infrastructure Exposure Report*", "ExposurePrint" macro is called

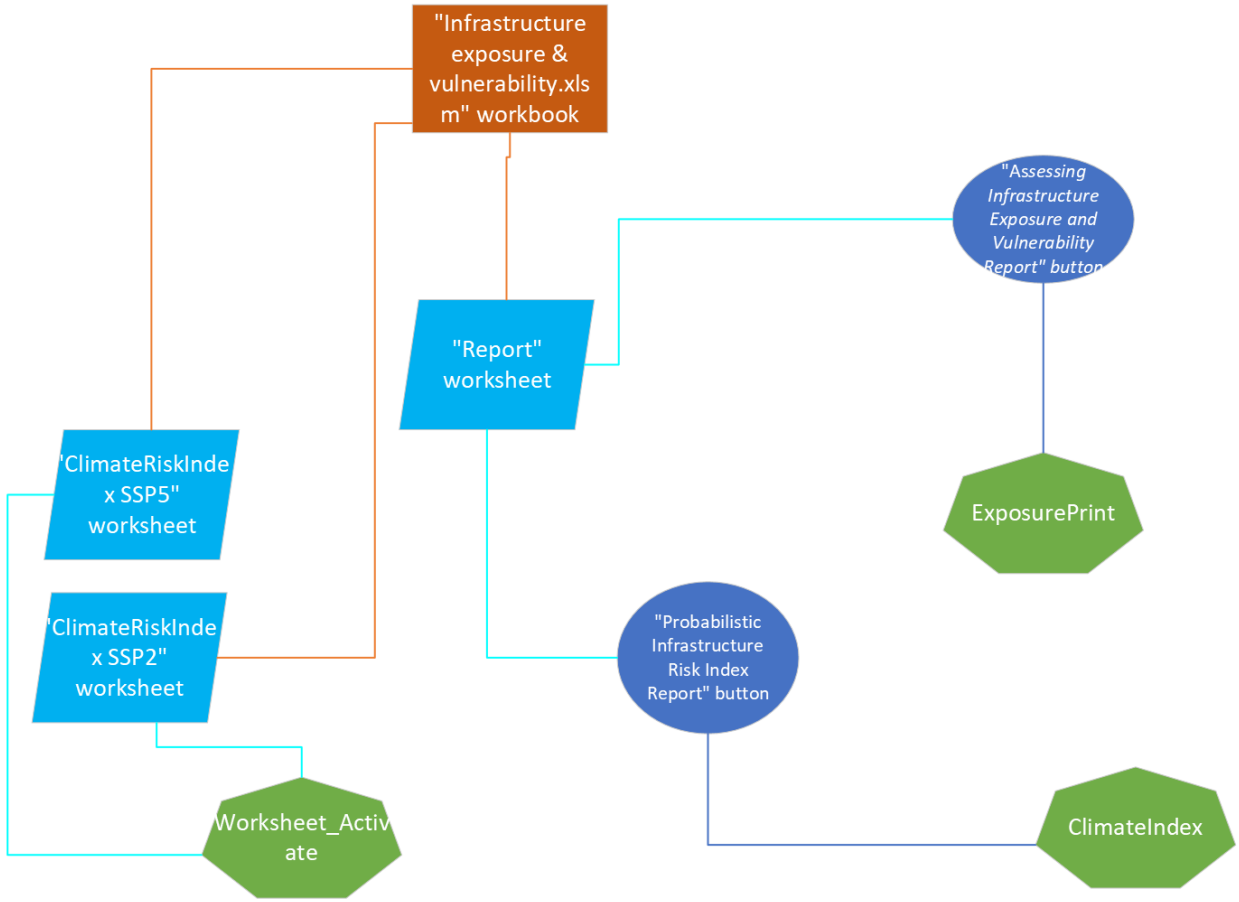
ii. When pressing "Probabilistic Infrastructure Risk Index Report", "ClimateIndex" macro is called

3.6 You can save the report in a designated folder or print this report.

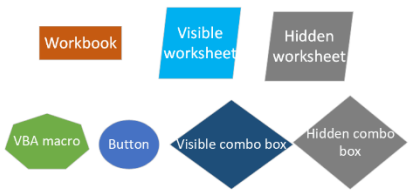
The following diagram shows stage "Reporting" with its structure and macros.

Diagram 9

Reporting



Simbology



Utility macros

These are functions thar are called transversally

Macro	Objective
LockAndUnlockCells	Lock and Unlock cells
ReallyUnlock	Unlock cells
CheckOS	Find if the Operating System where CT is executing is Windows or MAC
GetParentFolder	Get the parent folder where CT is located
DuplicateSheet	Duplicates "Model" sheet
HideTransaction	Hide all the background processing
ShowTransaction	Reset configurations with respect to showing alerts
WorkSheetExist	Find if a sheet exists in a certain workbook

SECURITY

The CT is structured as Excel workbooks, each with several sheets. To implement security, all these sheets have been protected with a password. This password can be changed. It's strongly suggested that only the IT team change it.

The actual password is CreliC*01

The password change must be made by running a routine that first unprotects the sheets with the current password and then protects the sheets with the new password.

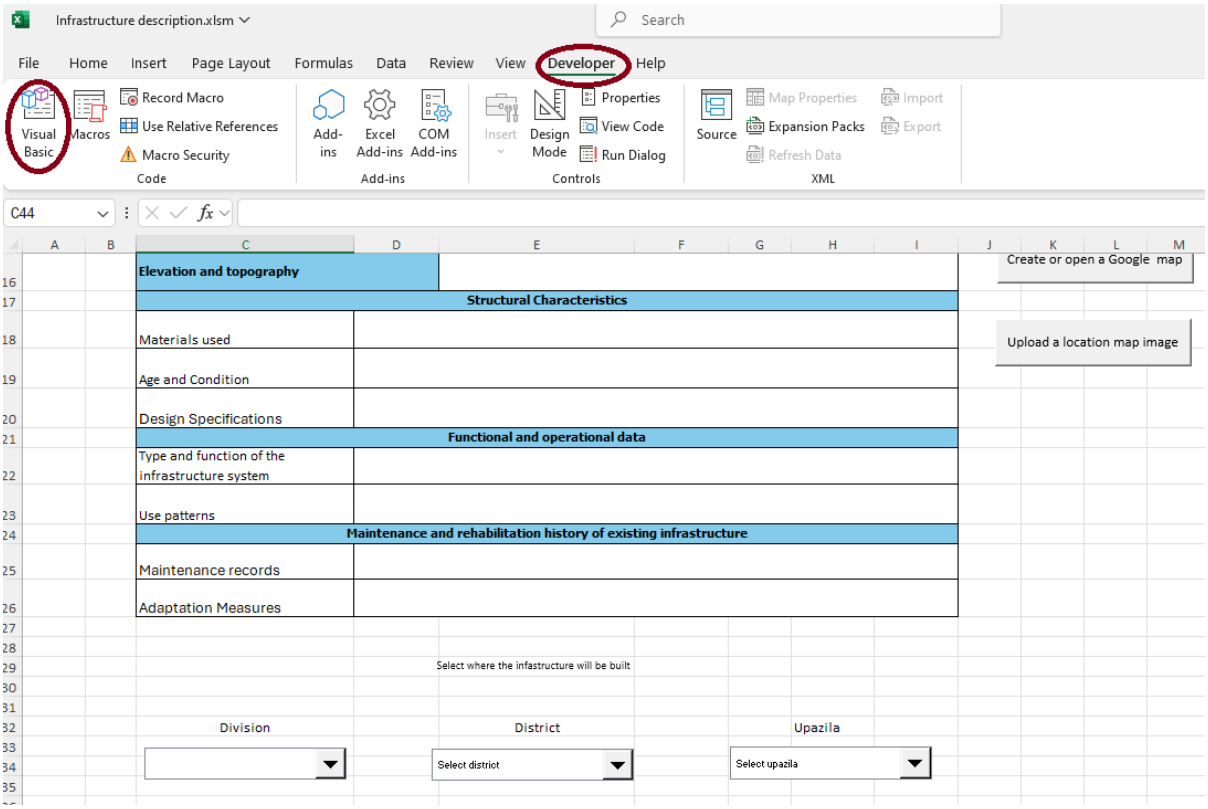
The steps to change the password in all Workbooks and all sheets is as follows:

i. Open the workbook "Infrastructure description.xlsm"

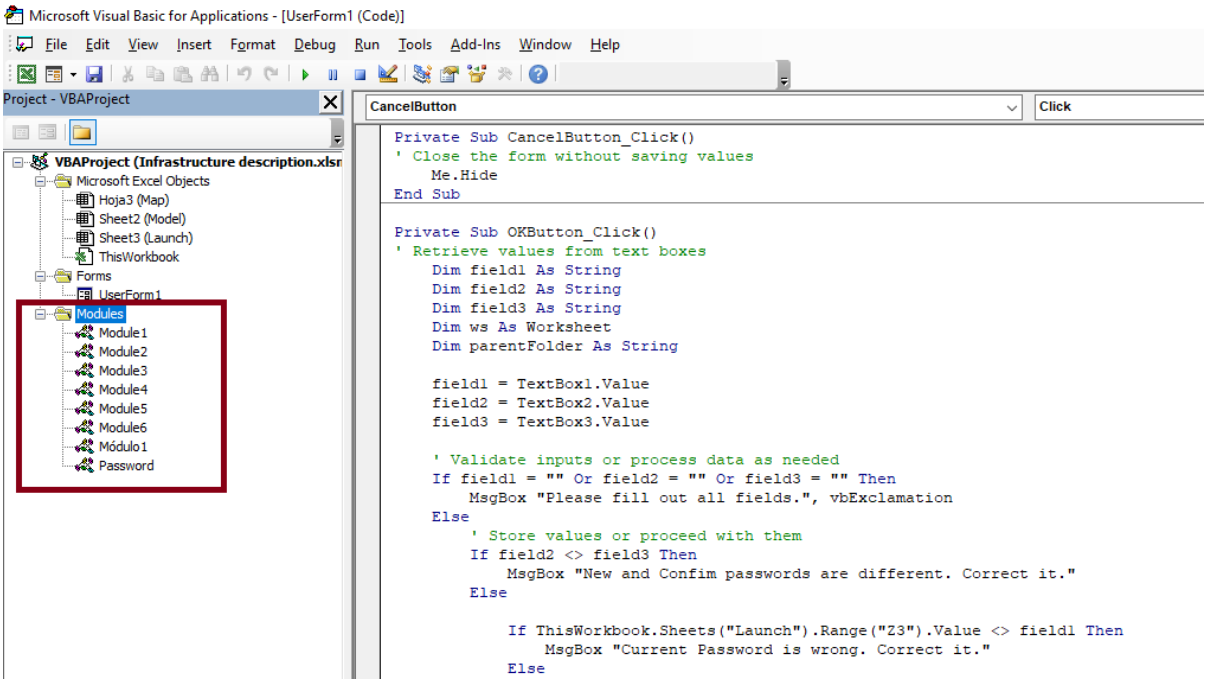
ii. Enable the Developer tab in Excel, follow these steps:
   a. **In Excel** "Infrastructure description.xlsm" go to the **File** menu.
   b. Select **Options** from the menu on the left side.
   c. In the **Excel Options** window, click on **Customize Ribbon**.
   d. On the right side, under the **Main Tabs** section, find and check the box next to **Developer**.
   e. Click **OK**.

iii. Click on "Developer"

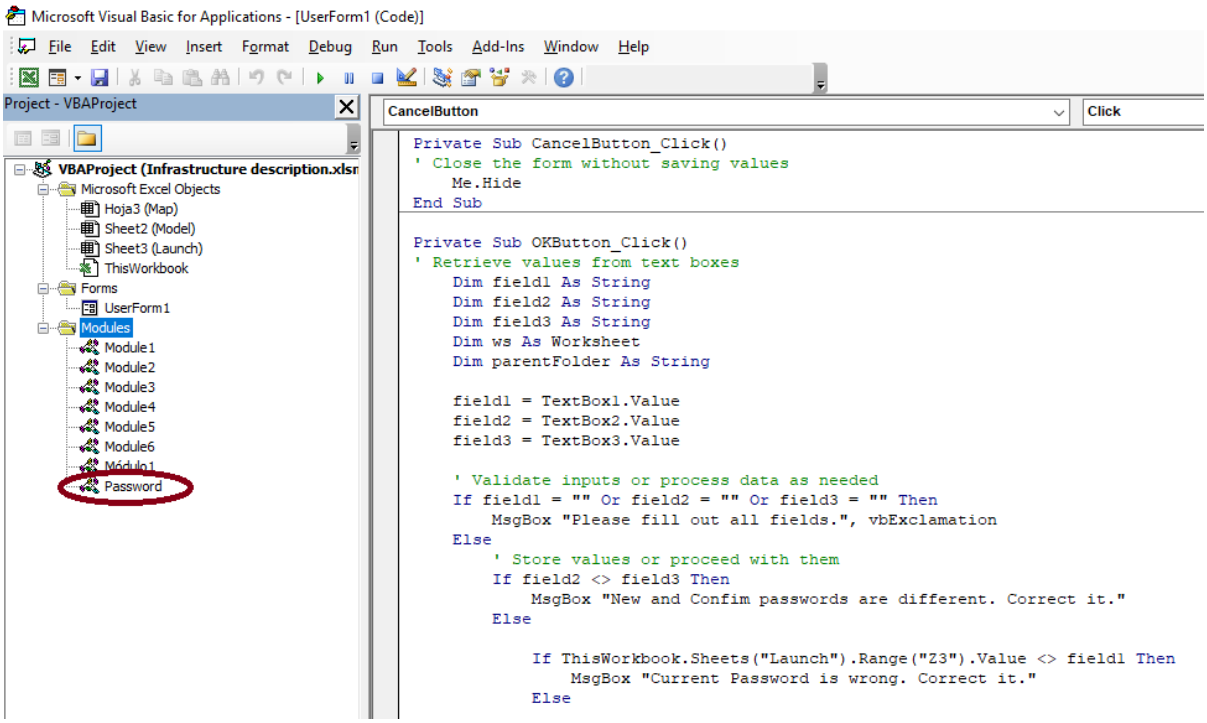
iv. Click on "Visual Basic"



v. The VBA structure will be displayed on the left side panel. See the "Modules" group.

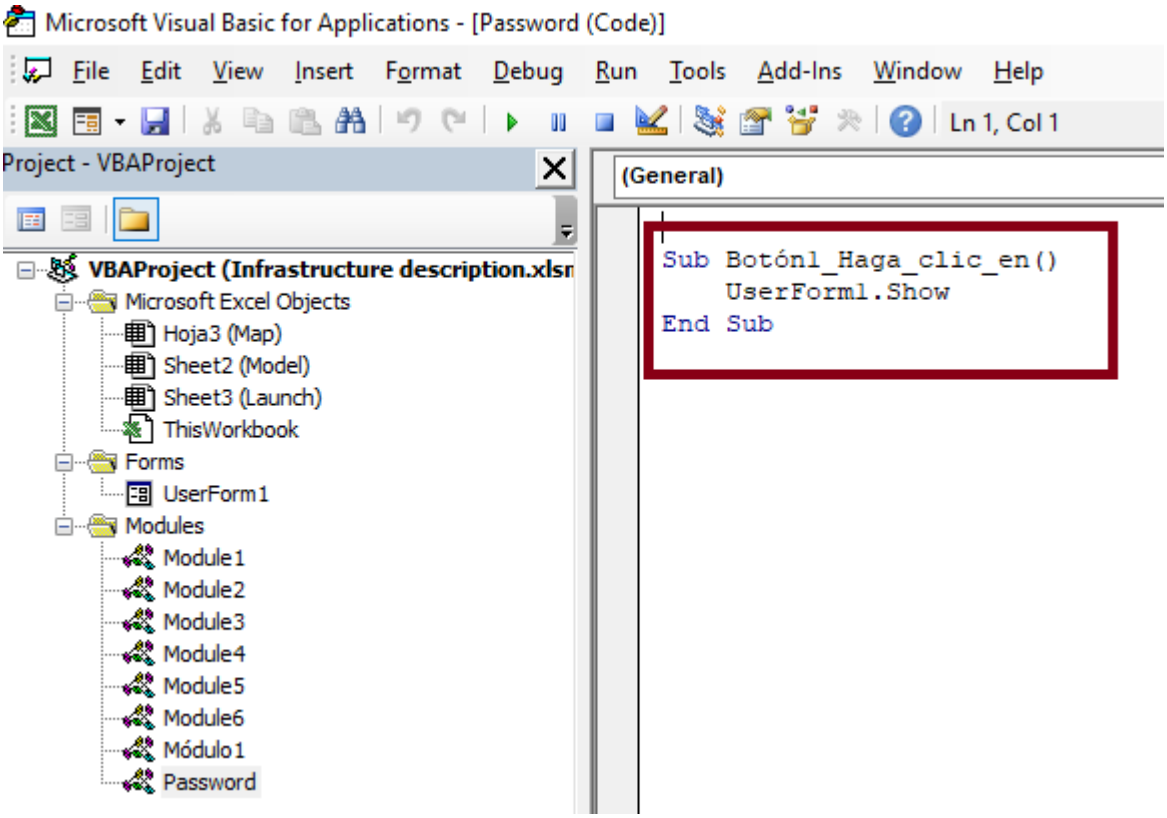


vi. Inside "Modules", you will see the "Password" Module. Double Click on it.

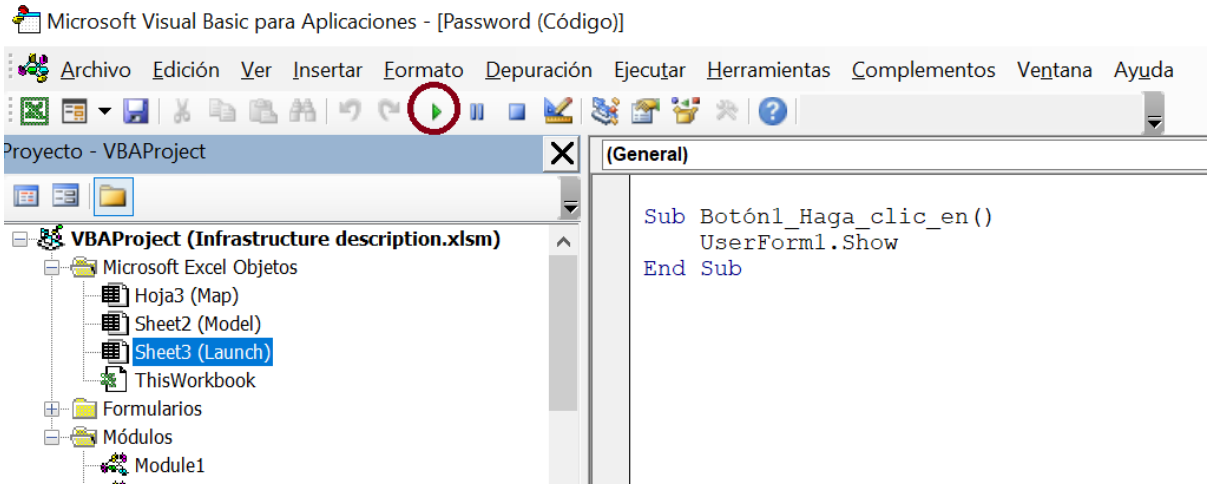


vii. When you double click on "Password", the code will be shown at the right panel. You can see the routine "Boton1_Haga_clic_en()" to change the password.

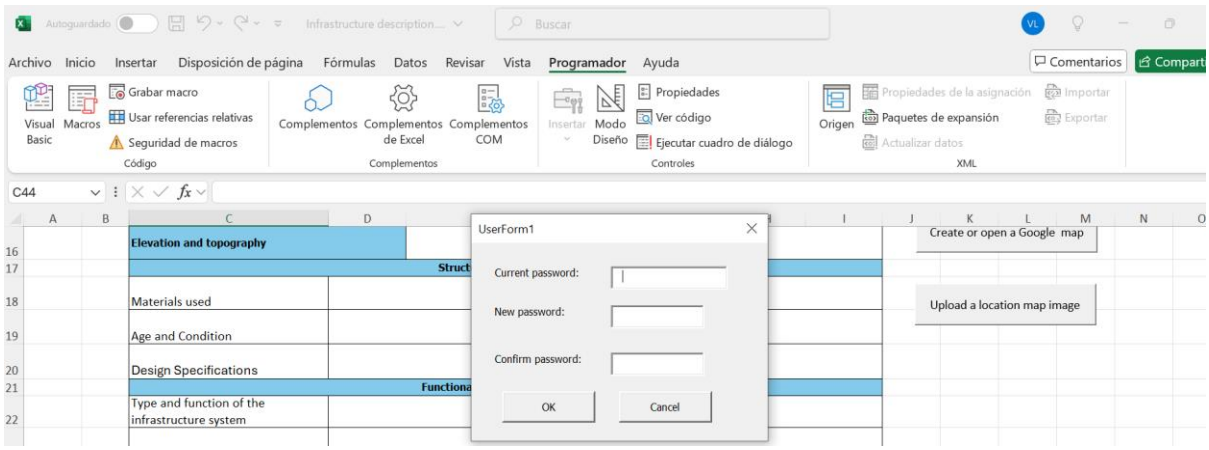
a. This is the VBA editor.



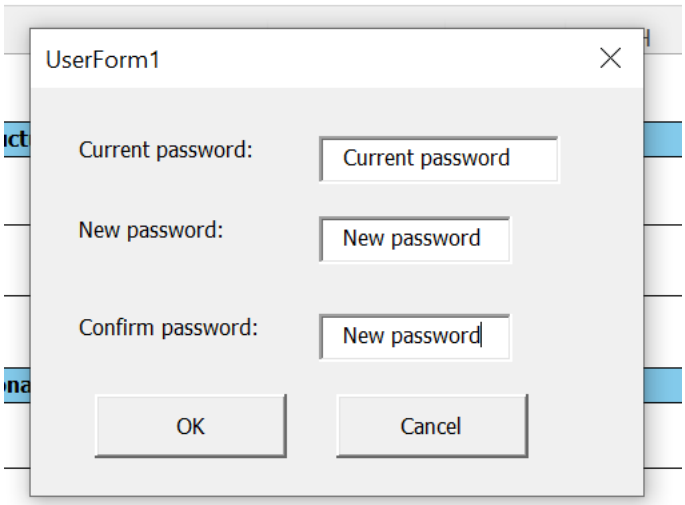
viii. Click on the "Execute macro" button, which is a green arrow on the upper ribbon of the VBA editor. You can also press F5.



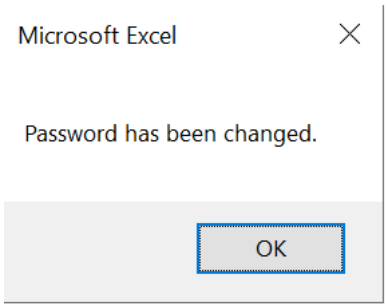
ix. When clicking on the green arrow, a screen asking for current and new credentials will be shown.



x. Fill the current, new, and confirm passwords and click "OK".



xi. The process will execute and change the password in all workbooks and all sheets. Finally a message will notify that password has been changed.



xii. Finally disable the "Developer" option before distributing the Calculator Tool.

Application and Database

The application is a system developed in C#. The source code is in GitHub, the repository name is "crelic". Inside the repository "crelic", in the folder "RCIA Project" is the user final application. It is a ".zip" file. And the source code of the C# application is in crelic/crelic folder.

The application is a system to populate the CT database with DRIP data. The system is an '.exe' file that must be run to populate the 'Database' file containing the weighted hazard level for each upazila and the type of hazard. The CT is built from this data.

The steps explained below were executed to obtain from the DRIP the hazard data (type and hazard level) corresponding to all upazila (567 in total[5]),

The steps are as follows:

1. Obtain the DRIP data for the required upazila and hazard. There are two ways to do this:

The first way is to go hazard by hazard for each upazila:

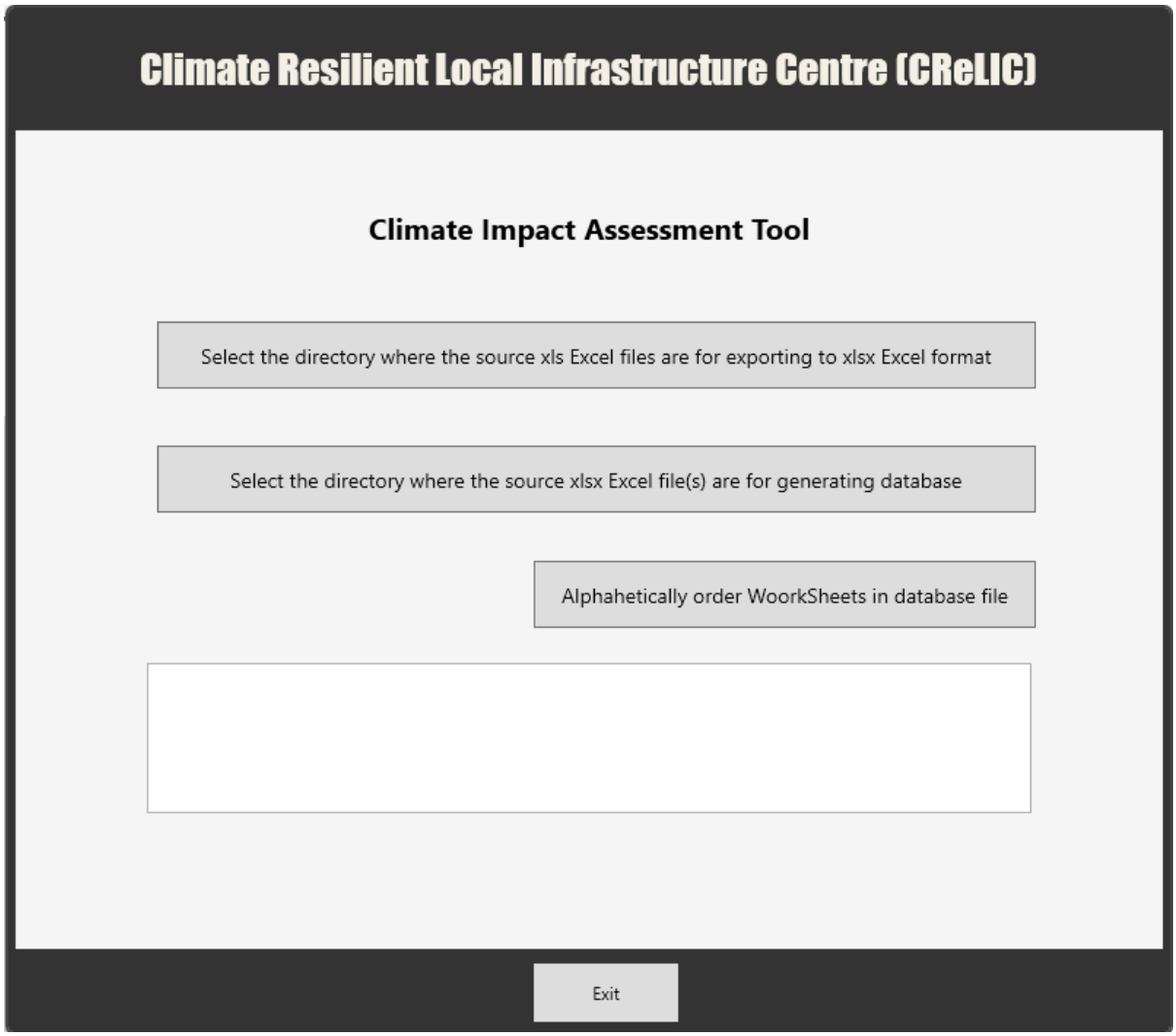
i. The DRIP web url is MapView - DRIP (plancomm.gov.bd).
ii. The output is a xls file that contains the hazard level for that upazila.

The second way is searching all hazards for each upazila:

i. Within the DRIP web MapView - DRIP (plancomm.gov.bd), look for the 'Report' option, select division, district, upazila and select all the hazards and generate report for the selected upazila.

ii. The outputs are the reports for each hazard for the selected upazila. These reports must be downloaded one by one.
iii. The outputs are 'xls' Excel files that contain the hazards level for that upazila for all the hazards.

2. Execute the application
   i. Inside the folder 'Database/Application', there is a file named 'crelic.exe' that must be executed.
   ii. When executed, a screen will be displayed:



3. Click the first button: 'Select the directory where the source 'xls' Excel files are for exporting to xlsx Excel format'.
   i. To have the Excel 'xls' files available, you must select the directory where the files were downloaded in previous step, this directory could be the "download" directory or another, for example you could move the files from the download directory into the "download" directory inside de "RCIA Project Tool/Database/Application" directory (recommended).

ii. This step must be carried out because the files must be transformed to an Excel file with 'xlsx' extension.

4. The result of this action is that the 'xls' file(s) are converted to a 'xlsx' file and moved into the 'Origin' folder. The final path where the file(s) with data of the DRIP is/are:

   /Project/Application/Origin

   i. You can check that the file(s) is/are into the folder, they have the same name of the file downloaded from the DRIP ('.xls') with the 'xlsx' extension.
   ii. Working time depends on computer efficiency.

STEPS TO FILL THE DATABASE WITH THE xlsx FILE GOT IN PREVIOUS STEP

5. Open the file 'upazila.xlsx' inside the 'Administration' folder, the path is:

   /Project/Database/Application/Administration

   i. Review if the upazila you are downloading the data from is in the file "Upazila"
      i. On Worksheet 'Upazila' you must write the division, the district and the upazila name of the new(s) upazila on columns A, B and C respectively. For example, for the upazila 'Nachole' whose data was downloaded from the DRIP, the district is 'Ch. Nawaganj', and the division is 'Rajshahi'.
   ii. Alphabetically order the list by divisions, districts and upazilas.

6. In the application, select the second button 'Select the directory where the source xlsx Excel file(s) are for generating data base'
   i. Select the 'Origin' folder.
   ii. The application will fill the database with the data of the files in the 'Origin' folder, creating or updating a worksheet for each upazila.
   iii. Application will move the files to 'Backup' directory /Project/Database/Application/Backup
   iv. Press the button "Alphabetically order Worksheets in database file" to get a ordered database file.

7. The 'database' file will be uploaded to the CT according to the upazilas that are chosen as is explained in this document.
8. When two upazilas have the same name, the name of the district between brackets must be set for each upazila, for example:
   - Companiganj (Noakhali)
   - Companiganj (Sylhet)

   i. In this case, before the '.xlsx' file be generated by the application, the name inside the '.xls' (file downloaded from the DRIP) file must be changed and must be equal to the name set in 'upazila.xlsx' file into "Upazila" worksheet.

WEIGHTED VALUES

To fill the data in the "database.xlsx" file, the application takes the value from the ".xls" file (downloaded from the DRIP) and calculate the value according to the weight it gets from the "upazila.xlsx" file, worksheet "Hazard". It is as follows:

For example:

- The ".xls" file downloaded from DRIP for "Aditmari" upazila, for cyclone hazard is:

Cyclone Graph (Aditmari Upazila)	
Category	**Series 1**
Hazard Level	1,00
Exposure Level	2,00
Vulnerability Level	4,00
Risk Level	1,00

- The hazard level is "1,00". It means "Very Low" in the CT scale. So, it will be classified in the "Very Low" column of "database.xlsx" file:

Hazardous events at Upazila level	Hazard level classification from the field					
	Very high	High	Medium	Low	Very low	N/A
Data from the DRIP						

- The application will put the number in the "database.xlsx" file, worksheet "Aditmari", according to the value it gets into "upaila.xlsx" file, worksheet "Hazard", the left table, corresponding to "Cyclone", in this case is "9,5":

	A	B	C	D	E	F	G	H	I	J	K	L
1		Very high	High	Medium	Low	Very low		Very high	High	Medium	Low	Very low
2	cyclone	85,5	66,5	47,5	28,5	9,5		95x90/100	95x70/100	95x50/100	95x30/100	95x10/100
3	drought: kharif	36	28	20	12	4		40x90/100	40x70/100	40x50/100	40x30/100	40x10/100
4	drought: pre kharif	36	28	20	12	4		40x90/100	40x70/100	40x50/100	40x30/100	40x10/100
5	earthquake	9,2	7,7	6,2	4,2	2,1		10x92/100	01x77/100	10x62/100	10x42/100	10x21/100
6	erosion	54	42	30	18	6		60x90/100	60x70/100	60x50/100	60x30/100	60x10/100
7	flash flood	72	56	40	24	8		80x90/100	80x70/100	80x50/100	80x30/100	80x10/100
8	flood	90	70	50	30	10		100x90/100	100x70/100	100x50/100	100x30/100	100x10/100
9	landslide	45	35	25	15	5		50x90/100	50x70/100	50x50/100	50x30/100	50x10/100
10	salinity	45	35	25	15	5		50x90/100	50x70/100	50x50/100	50x30/100	50x10/100
11	sea level rise	63	49	35	21	7		70x90/100	70x70/100	70x50/100	70x30/100	70x10/100
12	storm surge	85,5	66,5	47,5	28,5	9,5		95x90/100	95x70/100	95x50/100	95x30/100	95x10/100
13												

  - This value corresponds to the weight of a cyclone, as explained in this document.
  - The formulas can be seen into the right table, in this case "95x10/100":

	A	B	C	D	E	F	G	H	I	J	K	L
1		Very high	High	Medium	Low	Very low		Very high	High	Medium	Low	Very low
2	cyclone	85,5	66,5	47,5	28,5	9,5		95x90/100	95x70/100	95x50/100	95x30/100	95x10/100
3	drought: kharif	36	28	20	12	4		40x90/100	40x70/100	40x50/100	40x30/100	40x10/100
4	drought: pre kharif	36	28	20	12	4		40x90/100	40x70/100	40x50/100	40x30/100	40x10/100
5	earthquake	9,2	7,7	6,2	4,2	2,1		10x92/100	01x77/100	10x62/100	10x42/100	10x21/100
6	erosion	54	42	30	18	6		60x90/100	60x70/100	60x50/100	60x30/100	60x10/100
7	flash flood	72	56	40	24	8		80x90/100	80x70/100	80x50/100	80x30/100	80x10/100
8	flood	90	70	50	30	10		100x90/100	100x70/100	100x50/100	100x30/100	100x10/100
9	landslide	45	35	25	15	5		50x90/100	50x70/100	50x50/100	50x30/100	50x10/100
10	salinity	45	35	25	15	5		50x90/100	50x70/100	50x50/100	50x30/100	50x10/100
11	sea level rise	63	49	35	21	7		70x90/100	70x70/100	70x50/100	70x30/100	70x10/100
12	storm surge	85,5	66,5	47,5	28,5	9,5		95x90/100	95x70/100	95x50/100	95x30/100	95x10/100

- The CT builds the "Aditmari" worksheet into the 'database.xlsx" file as follows, filled with all the hazards downloaded from the DRIP, where each hazard corresponds to one ".xls' file and transformed to a ".xlsx" by the CT:

Form 2. For UPAZILA LEVEL USES Hydrometeorological events observed by the local stakeholders						
Division: Rangpur						
District: Lalmonirhat						
Upazila: Aditmari						
Hazardous events at Upazila level	**Hazard level classification from the field**					
	Very high	High	Medium	Low	Very low	N/A
Data from the DRIP						
1. Cyclone					**9,50**	
2. Drought: Kharif			**18,60**			
3. Drought: Pre Kharif				**12,00**		
4. Earthquake		**7,70**				
5. Erosion	**54,00**					
6. Flash flood					**8,00**	
7. Flood	**90,00**					
8. Landslides					**5,00**	
9. Salinity					**5,00**	
10. Sea Level Rise					**7,00**	
11. Storm surges					**9,50**	

Abhaynagar | Adabor | Adamdighi | Aditmari | Agailjhara