



IDNR Damages™

Flood Damage Calculation Program

Version 4.31

Users Manual V. 4.31.0

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By

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## Reporting Bugs and Suggestions

Please submit all bug issues and program suggestions to [wes.cattoor@illinois.gov](mailto:wes.cattoor@illinois.gov)

## About Damages

The IDNR/Water Resources has published a software product to the public domain named 'IDNR Damages™. IDNR Damages™, currently in version 4.31, is a software modeling tool used to determine the average annual flood damages from multiple storm events, the frequency structures are flooded, the economic benefits of flood control projects, flood easement costs, and the total damage occurring from a single flood event. IDNR Damages™ provides a user-friendly interface that is intuitive and is used by consultants, planners and government employees.

## **IDNR Damages user's manual**

The IDNR Damages™ software and manual was developed with the State of Illinois resources and is therefore in the public domain. It may be used, copied, distributed or redistributed freely, but it is requested that Illinois Department of Natural Resources be given acknowledgement for the use of this work.

The use of the software described in this manual is limited to its terms and conditions that must be accepted prior to installing the software. The software can be downloaded for free from the IDNR internet site at [www.dnr.illinois.gov/WaterResources/Pages/IDNRRDamages.aspx](http://www.dnr.illinois.gov/WaterResources/Pages/IDNRRDamages.aspx)

THE IDNR does not provide technical support for this software. IDNR does except all comments related to software issues or recommendations to improve the program. IDNR does not accept comments regarding program issues related to improperly entered data.

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## Forward

The Illinois Department of Natural Resources' IDNR Damages™ is software that calculates damage values that occur for multiple flood events. This will allow a user to determine the flood damage from a single event, determine the average annual damages a structure is expected to experience, estimate the cost for flood easements and the frequency structures are flooded.

The software was coded at the United States Geological Service in Champaign, Illinois with Microsoft Visual Basic 6.0 for Windows by Joshua Gioja. Nils Oberg modified the code in versions 4.3 and later.

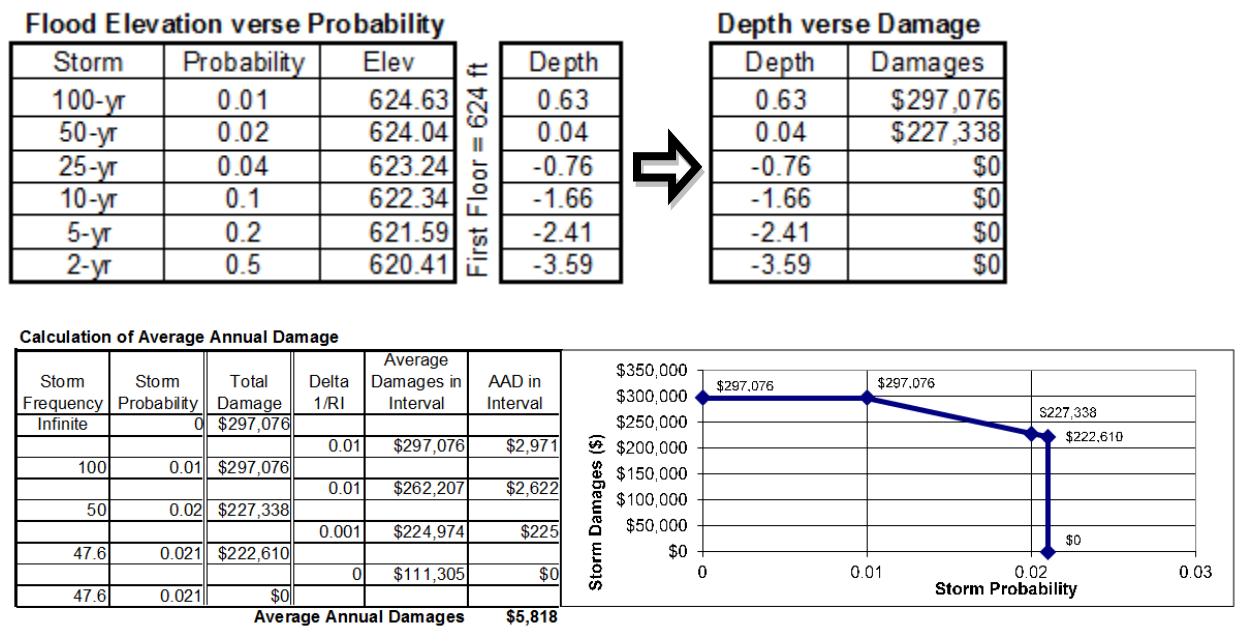
Many of the OWR staff in the Engineering Studies staff contributed to the development of the software including: Rick Gosch, Loren Wobig, Rita Lee, Bill Milner, Brad Winters and Wes Cattoor. The OWR Director of the Office of Water Resources was Arlan Juhl and the Manager of the Division of Water Resources Planning was Rick Gosch during the development of this version of the software. The User's Manual was written by Wes Cattoor and edited by Rick Gosch.

# CHAPTER 1 - INTRODUCTION

## Software Computation Philosophy

The IDNR DAMAGES™ program uses flood elevation versus probability data, water depth versus damage data and structure survey to correlate the water depth to the flood elevation to calculate average annual damages for a particular structure. The flood elevation versus probability data is obtained from a hydraulic modeling such as HEC-RAS, HEC -2, or FEQ. The water depth versus damage data can be obtained from the USACE, FIA, other published sources, or based on interviews with owners of damaged structures.

The flood elevation versus probability data and the structure's surveyed first floor elevation are combined to produce a depth versus probability relationship for each structure. The depth versus probability relationship is combined with the depth versus damage data to determine the probability versus damage dataset. The average annual damages is computed assuming a linear interpolation between the probability intervals versus average damage for each structure. To clarify this process, Figure 1 illustrates this with an example data set.



**Figure 1: Computation Example**

## Program History

Damages 3.7 – FORTRAN written model for operation in a DOS environment.

Damages 4.0 – Created in October 2002, the software added structure type, identification, value, contents value, first floor elevation, location along the river, low water entry, minimum damage elevation, indirect damage ratio and structure photo for individual structures. The program

added the ability to import multiple profiles from HEC-2, HEC-RAS, or single events from FEQ, UNET and/or GIS program output files. Version added ability to import structure data from any spread-sheet format. The software was compatible with Windows 95, 98 and 2000.

Damages 4.1 – Added, free format water surface import, results viewing outside of reports, table outputs, import multiple reaches from HEC-RAS, importing HEC-FDA, group editing for select parameters and other bug fixes.

Damages 4.21 – Added minimum reoccurrence interval, maximum reoccurrence interval, importing multiple RAS reaches, duplicate data, imported HEC-FDA data, structure location.

Damages 4.3 – Added calculating the minimum damage frequency, used minimum damage frequency in average annual damage calculations, added detailed output table under “Reports” “Tabular Reports”, added indirect only damage structures and added “Group” field in structures under the “Location & Elevation tab”.

Damages 4.31 – Fix 4.3 calculations bugs. Added “Initial Damages Value” output in detailed output table and Damages 3.70 Report.

## **Software Capabilities**

The IDNR DAMAGES™ program is designed to compute multiple storm event damages to determine the average annual damages of a structure or structures.

## **Documentation**

The IDNR DAMAGES™ package includes this User’s Manual as a guide to using the program. The manual introduces the computation theory of the program and gives instruction on how to create and run a multiple structure analysis and view output from the program.



## CHAPTER 2 - INSTALLATION

The program is installed using the 'IDNR DAMAGES 4.31 Install.exe' file

### Software Requirements

Before installing, ensure your computer has the minimum required hardware and software. The IDNR DAMAGES™ version 4.31 will run on a computer that has the following:

- An Intel based PC or compatible machine
- A hard drive with at least 1MB of free space
- An internet connection to download the program from the web
- A minimum of 256 MB of RAM
- A color video display
- A mouse
- MS Windows 95, 98, ME, NT 4.0, 2000, XP, Vista, or Windows 7

### Installation Procedure

IDNR DAMAGES™ version 4.31 should be installed by using the setup executable file.

To install the software on your hard drive, follow the steps listed below:

1. Go to [www.dnr.illinois.gov/WaterResources/Pages/IDNRDamages.aspx](http://www.dnr.illinois.gov/WaterResources/Pages/IDNRDamages.aspx) and download the setup file to a temporary location.
2. Execute the downloaded file and follow the setup instructions.

The program will install directly in the location you specified. There will not be a listing under the programs menu and no shortcut created on your desktop. A shortcut may be manually created.

### Uninstall Procedure

Go to the location you selected to install the files and manually delete the executable file. The program will not be listed in your control panel programs.

## CHAPTER 3 – ADDING AND EDITING DATA

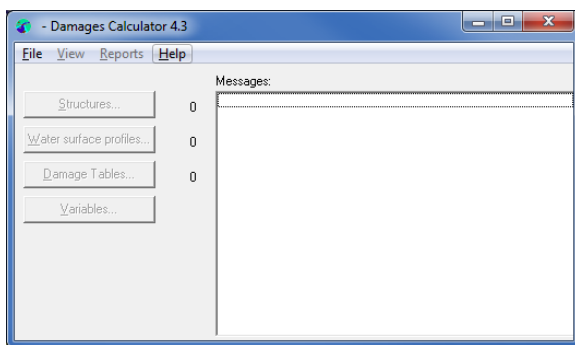
### Starting the Program

Start the IDNR DAMAGES™ by double clicking on the program icon as shown below in Figure 2.



**Figure 2: IDNR DAMAGES™ Desktop Icon**

When first opening the application, you will see the main window as shown below in Figure 3.



**Figure 3: IDNR DAMAGES™ main window**

Within the main window there are the following four options along the top menu bar:

**File:** This allows you to select the following options: New Project; Open Project; Save Project; Save Project As; Project Options; Import; Export; Open a recent file and Exit the program.

**View:** This allows you to open the Structures Window, the Water Surface Profiles Window or the Damage Tables Window. This function is the same as clicking on the top three buttons located on the left side of the main window.

**Reports:** The menu allows you to create various reports including a detailed output table, reports sorted by class or type and a Damage 3.70 report.

**Help:** This menu allows you to reference the contents file and the 'About' information.

Additionally on the main window there is a message window and four side buttons. The message window shows details once a project is open, created or modified. The four side buttons open additional windows for the necessary data input for the project. The number to the right of the top 3 buttons shows the number of elements inside each of those windows.

## Developing a New Project

These are the steps that are required to create a project. It is critical that the structures are added after all other data is entered. Since the program computes the average annual damages per structure as the structure data is entered, the program will become unstable if a structure is entered prior to other required data. The steps that are required are as follows:

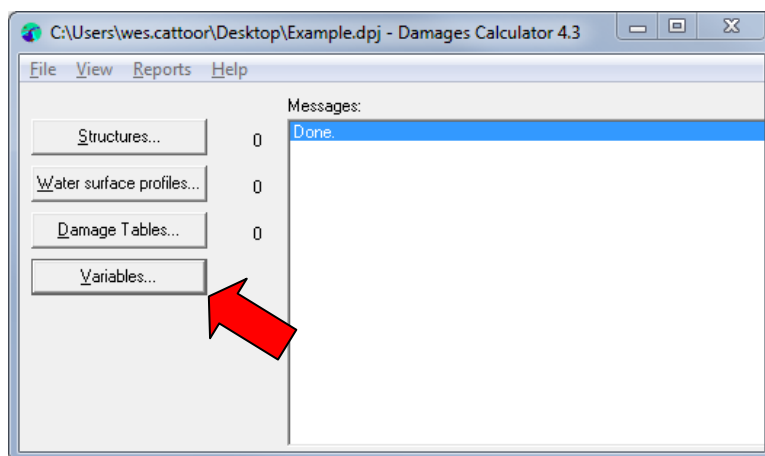
1. Create a new project
2. Enter variables information
3. Enter water surface profiles
4. Enter damage tables
5. Enter Structure data
6. Output results

## Create a New Project

In the main window select **File** menu and go to **New Project**. This will bring up the standard windows “Save as” window. Navigate to the location where you would like to save your project to. Fill in the file name with the required IDNR Damages extension “.dpj”. Upon completion of the information, click the “Save” button.

## Enter Variables Information

Variables input provide calculation parameters necessary to compute the average annual damages, capitalized damages, contents damages, indirect damages and provide title information for reports created. To enter variables data, select the Variables button from the main window.



**Figure 4: Variables Button Location on main window**

The screenshot shows a window titled "Variables" with a menu bar containing "Form" and "Help". The main area contains seven input fields, each with a label and a text box:

- Minimum recurrence interval for AAD (years):
- Maximum recurrence interval for AAD (years):
- Header for report pages:
- Indirect damages (percent of direct damages):
- Time for capitalizing damages (years):
- Interest rate for capitalizing damages:
- Default contents value (% of structure value):

At the bottom center of the window is a button labeled "Done".

**Figure 5: Variables Window**

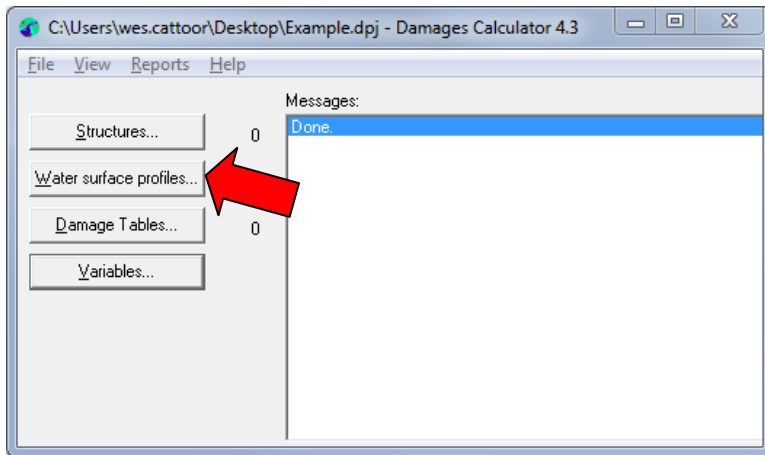
The Variables window contains the following fields:

- **Minimum recurrence interval for AAD (years)** – The minimal value in years utilized in the AAD calculation. This value must be greater than zero.
- **Maximum recurrence interval for AAD (years)** – The maximum value in years that the AAD calculation will compute to. If left blank, the AAD calculation will go out to a zero probability.
- **Header for report pages** – The text that will appear at the top of reports.
- **Indirect damages (percent of direct damages)** – The value of damages added to the structural and content damage to cover additional damages in addition to structural damages.
- **Time for capitalizing damages (years)** – The time in years utilized for converting the average annual damages into a capitalized damage cost.
- **Interest rate for capitalizing damages** – The interest rate utilized for converting the average annual damages into a capitalized damage cost.
- **Default content value (% of structure value)** – The default value that the structure value is multiplied by to determine the contents value.

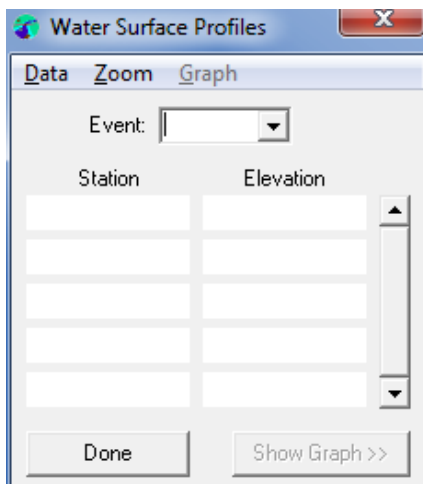
Upon completing this data, click on the **Done** button to exit the window.

## Enter Water Surface Profiles

The water surface consists of the event (or storm frequency in years), the station and the elevation. Each event can contain multiple station-elevation relationships. The event defines the reoccurrence probability. The station is a reference location that correlates with a structure location. Each defined station has a single water surface elevation for each given event. To enter water surface data, select the Water Surface Profiles button from the main window.



**Figure 6: Water Surface Profile Button Location on main window**



**Figure 7: Water surface profile window**

From the Data pull down menu bar in the Water Surface Profiles window, the user can import, export, add, delete and change frequency of a profile.

#### Manually Adding Water Surface Profiles

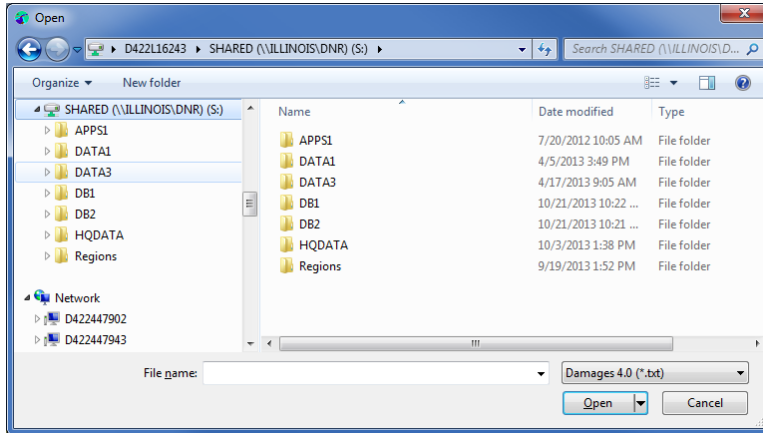
1. From the menu bar in the Water Surface Profiles window, click on Data, New Profile.
2. A New Profile dialog box will ask for the frequency of the event, in years.
3. The user then can add the station and elevations in the provided table.

The stations will be automatically sorted in ascending order.

#### Importing Water Surface Profiles

1. From the menu bar in the Water Surface Profiles window, click on Data, Import Water Surface Profiles.
2. An Open dialog box will pop up. Select the file type from the drop down menu in the lower right corner of this window.

3. Navigate to and select the file you wish to import and select Open.
4. All Profiles will be pulled into the Water Surface Profiles window.
5. Confirm all events, stations and elevations were imported correctly and make adjustments as needed.



**Figure 8: Import Water Surface Profiles Window**

Please be aware that many programs such as HEC-RAS have multiple formats which they can output data and that the damages software will only import one of those formats. If difficulties occur at importing data, copy data into an Excel file and save the file as a tab delimited file for importing into the IDNR Damages™ program.

### Water Surfaces Profiles Graph

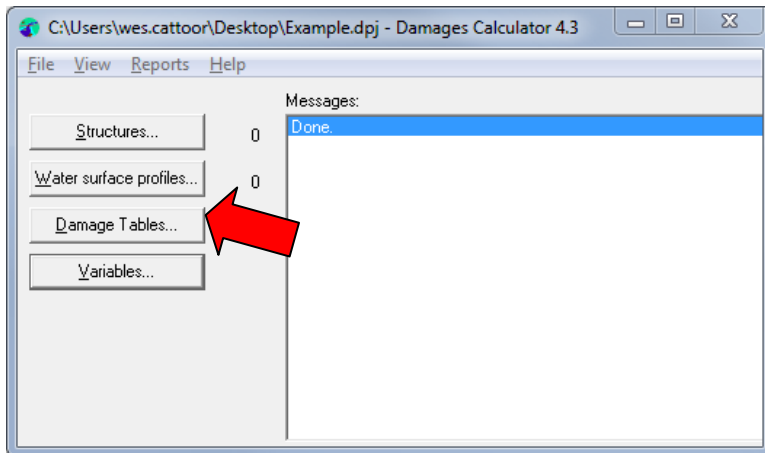


**Figure 9: Water Surface Profile Graph**

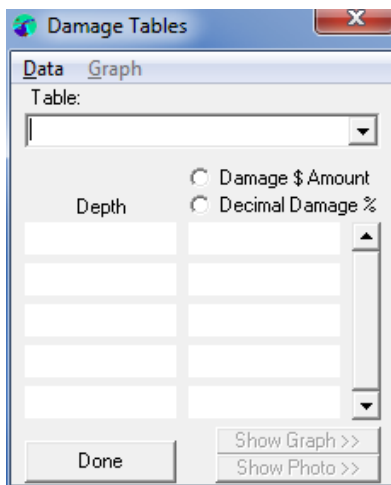
The graph can be toggled to either hidden or shown. With the graph shown, the user can modify the extents shown by changing the values of the maximum and minimum values of each axis. Additionally, in the menu bar, the user can select Graph, Profiles, Show All Profiles or Graph Structures, or Show All Structures to see how the defined structures relate to the graph based on structure station and structure first floor elevation.

## Entering Damage Tables

The Damages Tables relates the amount of damage, either as a percent of the structure value or a set value amount, to a structure at varying water depths. A water depth of zero typically relates to a structures first floor elevation. Be familiar with the damage curves that are being used and how they are intended to be used with various scenarios including walkout basements. To enter Damage Table data, select the Damage Tables button from the main window.



**Figure 10: Damage Table Button Location on main window**



**Figure 11: Damage Table Window**

From the Data pull down menu bar in the Damages Table window, the user can Import, Export, Add, Delete and Change the ID of the damage curve.

### Manually Adding Damage Tables

1. From the menu bar in the Damage Tables window, click on Data, New Curve.
2. A Create New Damage Curve dialog box will appear and the user can enter the code, description, if the damage data is to be entered as a percentage of the structure value or

direct dollar amount and if this is a structure and/or a contents damage curve, and then click ok.

3. The user then can add the depth and damage in the provided table.

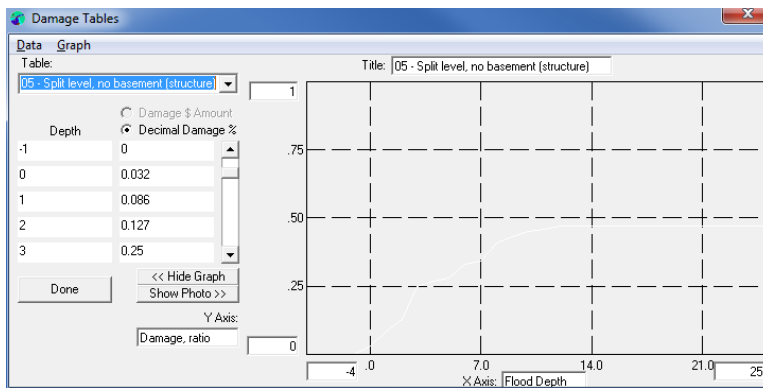
The depths will be automatically sorted in ascending order.

### Importing Damage Tables

1. From the menu bar in the Damage Tables window, click on Data, Import Damage Tables, From File. The user may import the internal tables instead of From File. Internal tables contain the 1985 FIA damage curves.
2. An Open dialog box will pop up. Select the file type from the drop down menu in the lower right corner of this window.
3. Navigate to and select the file you wish to import and select open.
4. Confirm all damage curves were imported correctly and make adjustments as needed.

Please be aware that programs may have multiple formats which they can output data and the damages software will only properly import one of those formats. If difficulties occur at importing data, copy data into an Excel file and save the file as a tab delimited file for importing into the IDNR Damages™ program.

### Damage Table Graph



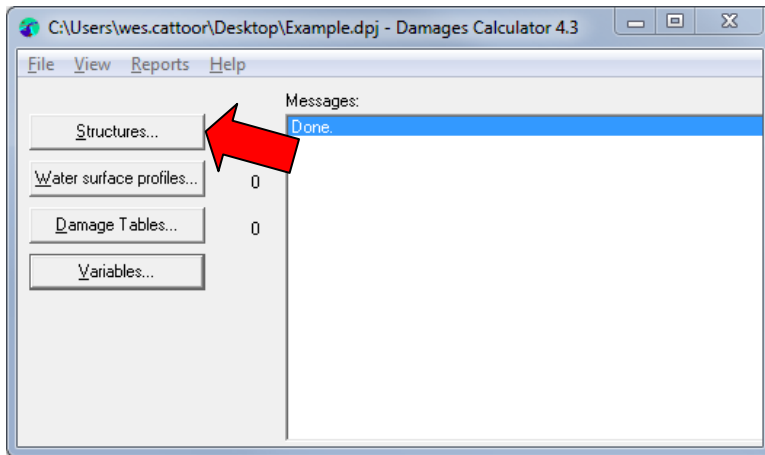
**Figure 12: Damage Table Graph**

The graph can be toggled to either hidden or shown. With the graph shown, the user can modify the extents shown by changing the values of the maximum and minimum values of each axis.

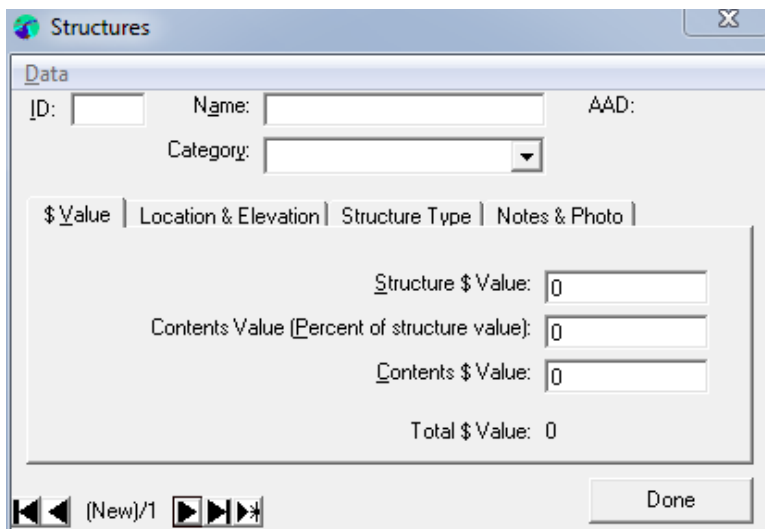
### **Entering Structure Data**

The structure data contains all information for defining the structure's flood damage. The structure data references information from the water surfaces profile and damage curves to reference all components together for the individual structure's damage.





**Figure 13: Structures Button Location on main window**



**Figure 14: Structures Window**

### Manually Adding Structures

There are three ways to enter a new structure. They are listed below.

1. From the menu bar in the Structure window, click on Data, New Structure
2. Place your cursor in the ID box a type a unique value in
3. Click on the right most arrow button located in the lower left hand corner of the Structures window

A Structures window will be blank allowing the user to manually enter in data.

### Importing Structures

1. From the menu bar in the Structures window, click on Data, Import Structures.

2. An Open dialog box will pop up. Select the file type from the drop down menu in the lower right corner of this window.
3. Navigate to and select the file you wish to import and select open. Depending on the file type to import, the program will automatically pull in data or prompt you to match column titles of the imported file to the Structure inputs.
4. If one or more structure imported match an existing structure ID, the program will prompt you if you want to overwrite the structure.

Confirm all structure data was imported correctly and make adjustments as needed.

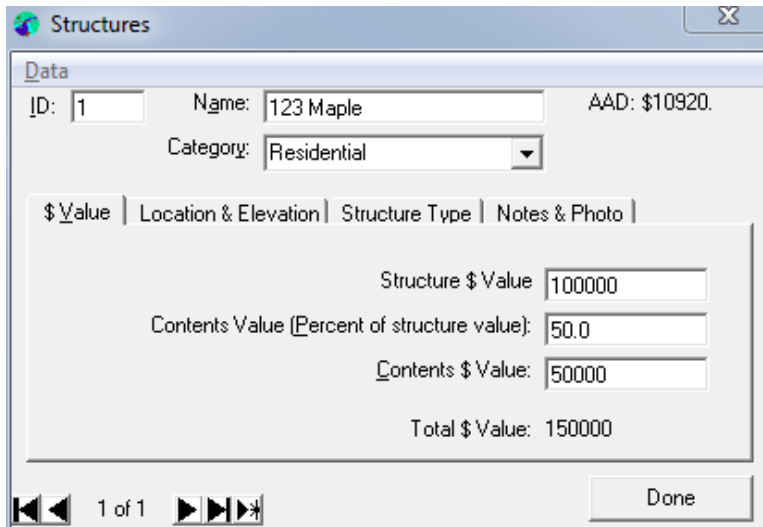
The structure window consists of four tabs of data entry with general structure information above. The tabs are \$ Value, Location & Elevation, Structure Types and Notes & Photo. The structure tabs Location & Elevations and Structure Type provide inputs to reference a damage curve and a station relative to the water surface profiles respectively. From the Data pull down menu bar in the structures window, the user can import, export, add, delete and change the ID of a structure.

The Structure Window contains the following header data inputs:

- **ID** – Unique numeric identifier for the structure. Once entered, it may only be changed through the data pull down menu. Typing in this box will either create a new structure with the ID or go to the existing structure with the ID.
- **Name** – A description for the structure. Examples are street address, parcel number and business or residents name.
- **Category** – A user entered text to be utilized for filtering and sorting of structure data. Typically used for a structure type, such as resident, business, industrial, vehicle, etc.

The Annual Average Damages (AAD) is automatically computed as data is entered.

The first structures tab labeled \$ Value, shown in Figure 15, provides all data inputs for the dollar value relating to the individual structure.



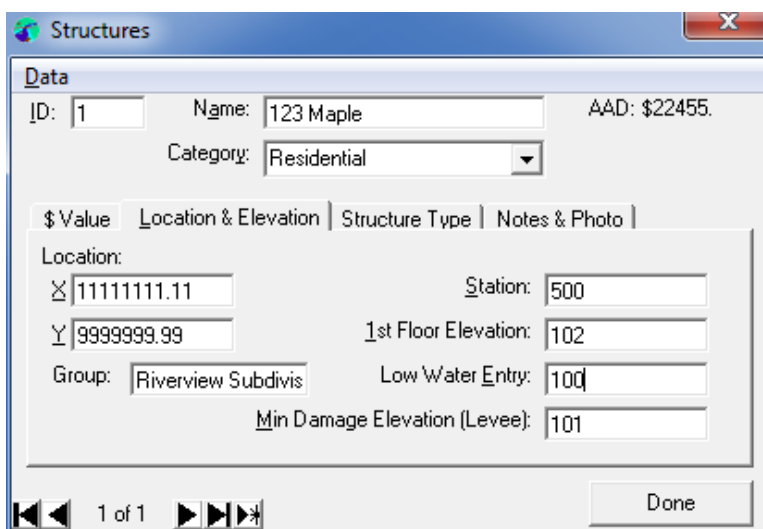
**Figure 15: \$ Value Tab of Structures Window**

The \$ Value tab has the following data inputs:

- **Structure \$ Value** – The dollar value of the structure only.
- **Contents Value (Percent of structure value)** – A ratio of contents \$ value from the structure \$ value. Completing this box will automatically fill the Contents \$ Value box.
- **Contents \$ Value** – The dollar value of items inside and independent of the structure. Completing this box will automatically fill the Contents Value (Percent of structure value).

The Total \$ Value is calculated by the sum of the Structure \$ Value and the Contents \$ Value.

The second structures tab labeled Location & Elevation shown in Figure 16.

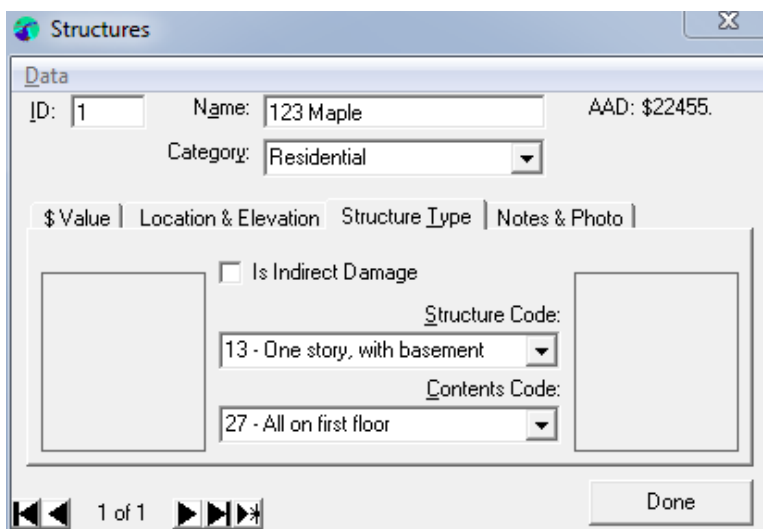


**Figure 16: Location & Elevation Tab of Structures Window**

The Location & Elevation tab locates the structure geographically and its location on the water surface profiles. The first floor elevation also corresponds to the zero depth of a damage curve. This tab has the following data inputs:

- **X** – The X coordinate location of the structure
- **Y** – The Y coordinate location of the structure
- **Group** – A user entered text to be utilized for filtering and sorting of structure data. Typically used for a location definition, such as subdivision, community, river reach range, etc.
- **Station** – The location of the structure relative to the water surface profile to determine flood frequency elevations at the structure. Water surface elevations are linearly interpolated between input points.
- **1<sup>st</sup> Floor Elevation** – The elevation referencing the zero depth of the structure’s damage curve. Typically this is the elevation of the main entrance into the building
- **Low Water Entry** – The lowest elevation that water is able to enter into the building. Examples are crawl space vents, basement windows or any door. This elevation must be exceeded for any damage to occur to the structure.
- **Min Damage Elevation** – The elevation water surface elevations must exceed for the water to reach a structure. Examples are levees and high surrounding ground. An optional elevation that must be exceeded for any damage to occur to the structure.

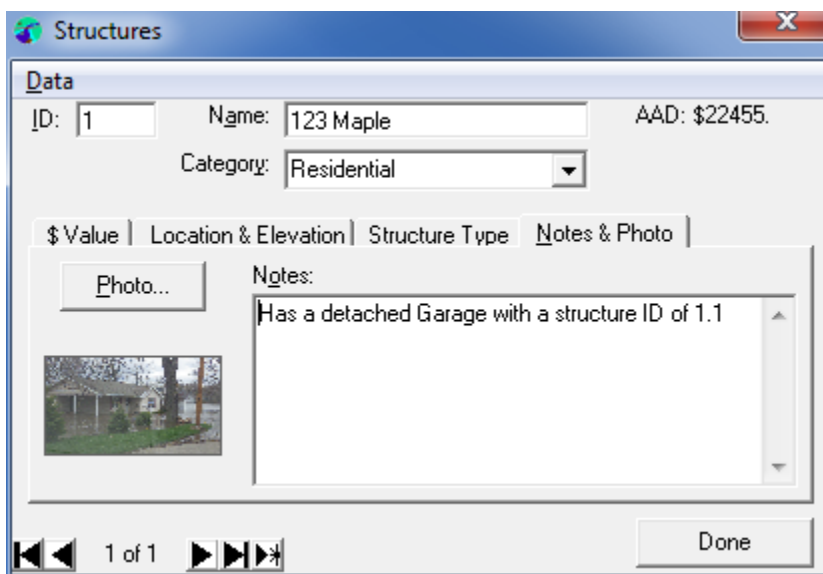
The third Structures tab labeled Structure Type defines which structure and contents damage curve shall be applied to the current structure. Additionally the user may specify that the structure shall only be applied as an indirect damage. The tab has the following inputs:



**Figure 17: Structure Type Tab of Structures Window**

- **Is Indirect Damage** (Checkbox) – Indicates if a structure damage value should only be applied as an indirect damage instead of a direct damage with the corresponding indirect damage (not common).
- **Structure Code** – A drop down menu of the defined structure damage curves to select the appropriate curve.
- **Contents Code** – A drop down menu of the defined contents damage curves to select the appropriate curve.

The final Structures tab labeled Notes & Photo allows the user to document any comments regarding the structure and link a photograph to the structure if desired. The tab is shown below in Figure 18.



**Figure 18: Notes & Photo tab of Structures window**

## CHAPTER 4 – VIEWING RESULTS

IDNR Damages™ allows the user to view the results of the data in various report formats or the direct average annual damages value can be viewed within the structures window. This value updates as the data is inputted.

From the main window, the Reports pull down menu contains tabular reports and Damages 3.70 report. The Tabular Reports has Sorted by Structure Class, Sorted by Structure Type and Detailed Output. The Sort by Structure Class or Type only provides the Class or Type, structure ID, Station, Structure AAD, the Total ADD for each class or type and the Total ADD for all classes or types. The Detailed Output created a report in tab delimited table for all variables inputted or computed for each structure. This data can be added to a GIS product for visually showing the results or added to an Excel pivot table to filter and sort data for further analysis and reports.

The Damage 3.70 report is in a report format that provides the most pertinent data for each structure and totals for all data. This report is also customizable by adding or removing sections of the report and filtering out structures based on multiple parameters.

### Creating Reports

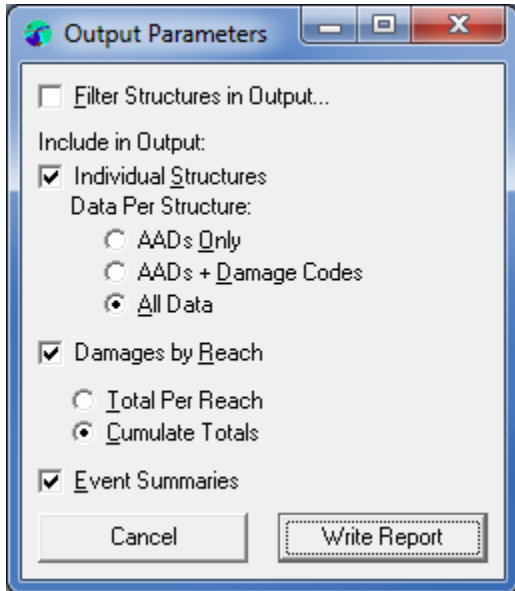
From the Reports pull down menu bar in the main window, the user can create report files.

#### Create a Damages 3.70 Report

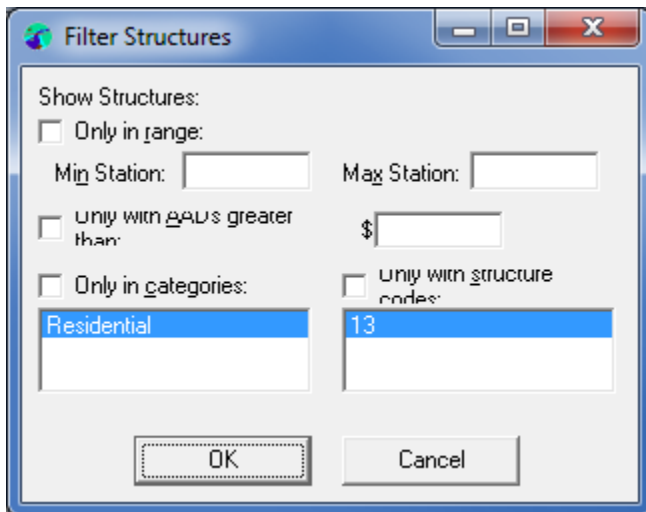
This produces a text file that is in a report format with options of damages by individual structure, by reach and by event. This format is best utilized to provide data for a report.

1. From the menu bar in the main window, click on Reports, Damages 3.70 Reports...
2. Browse to Location and assign a name to the file to create, click the Save button.
3. If a file has an identical name, it will ask to replace it, click yes or no.
4. The Output Parameter Window will appear allowing the user to add or remove parts of the report and decide how data will be displayed. An example of this window is shown below in Figure 19.
5. They user may Filter Out Structures in the output by selecting the check box. If selected, a Filter Structures window will appear as shown in Figure 20 and the user may specify the select filtering criteria and select OK.
6. Select the Write Report button on the Output Parameters Window.
7. The report output will be saved and will automatically open.

Similar steps are required for creating a Sort by Structure Class or Type excluding the option in step 4 to add parts to the report. The Detailed Output report does not allow adding parts or filtering structures.



**Figure 19: Output Parameters Window**



**Figure 20: Filter Structures Window**

### Create a Detailed Output Report

This produces a tab delimited text file containing all available data by structure. The output file can be imported into an Excel file or GIS for further analysis.

1. From the menu bar in the main window, click on Reports, Tabular Reports, Detailed Output...
2. Browse to location and assign a name to the file to create, click the Save button.
3. If a file has an identical name, it will ask to replace it, click yes or no.
4. The report output will be saved and will automatically open.



## **CHAPTER 5 – TROUBLESHOOTING**

### **The program crashes when I add structure data.**

Enter Variable information, Water Surface Profiles, and Damage Tables before entering structure data.

## **APPENDIX A - RESOURCES**

USACE Economic Guidance Memorandum (EGM) 01-03, Generic Depth-Damage Relationships.

Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures with Basements.

Economic Guidance Memorandum (EGM) 09-04, Generic Depth-Damage Relationships for Vehicles

USACE. 1995. "Hydrologic Engineering Requirements for Flood Damage Reduction Studies" EM 1110-2-1419

USACE. 1996. "Risk-Based Analysis for Flood Damage Reduction Studies" EM 1110-2-1619,

USACE. 2006. "Risk Analysis for Flood Damage Reduction Studies" ER 1105-2-101,

USACE. 1992a. "HEC-FFA: Flood Frequency Analysis, User's Manual." *CPD-59*. HEC, Davis, CA.

USACE. 2012. Economic Guidance Memorandum, 12-03, Unit Day Values for Recreation for Fiscal Year 2012.

# APPENDIX B – EXAMPLE OF REPORT OUTPUTS

Damages 3.70 Report (from Notepad)

```

Example - REPORT.txt - Notepad
File Edit Format View Help

STRUCTURE 1 STATION 500.000
STRUCTURE CODE 13
CONTENTS CODE 27
ESTIMATED VALUE $ 100000
CONTENTS VALUE( 50.00%) $ 50000.00
FIRST FLOOR ELEVATION 102.00
MINIMUM DAMAGE ELEVATION 100.00
BEGINNING OF DAMAGES ELEVATION 102.00
BEGINNING OF DAMAGES FREQUENCY 2.00
BEGINNING DAMAGE VALUE .00

FLOOD WATER FLOOD STRUCTURE CONTENTS TOTAL
FREQ ELEV. DEPTH % $ % $ $
5.00 104.50 2.50 21.50 21500. 31.85 15925. 37425.

A. A. D. = 13098.75

1 header
STATION A. A. D. 5.00-YEAR STRS $DAMAGE
.000
1000.000 13099. 1 37425.
SUMMARY 13099. 1 37425.

1 header
SUMMARY OF FLOOD DAMAGES
FREQUENCY NUMBER OF STRUCTURE CONTENTS TOTAL
(YEARS) STRUCTURES DAMAGES DAMAGES DAMAGES
5.00 1 21500. 15925. 37425.

TOTAL A.A.D. FOR 1 STRUCTURES IS 13098.75
INDIRECT DAMAGES (AT 15.00%)= 1964.81
TOTAL DAMAGES (DIRECT + INDIRECT) = 15063.56
CAPITALIZED DAMAGES ( 3.50% FOR 50 YEARS) = 353325.17

**A* AAD CALCULATION ASSUMES 0 DAMAGES AT 2 YEAR EVENT

```



## APPENDIX C - DETAILED OUTPUT VARIABLES

ID  
Name  
Category  
X  
Y  
Station  
1st Floor Elev  
Low Water Entry  
Min Damages Elevation  
Structure Value  
Ratio Content / Structure Value  
Content Value  
Total Value  
Indirect Structure  
Indirect Damage %  
Structure Damage Curve  
Contents Damage Curve  
Notes  
Photo  
Group  
Stage at (each profile)  
Beginning of Damages Elevation  
Beginning of Damages Frequency  
Depth at (each profile)  
Direct Damage at (each profile)  
Indirect Damages at (each profile)  
Min Direct Damages  
Total Damages at (each profile)  
Min Indirect Damages  
Direct AAD at (largest profile)+  
Min Total Damages  
Indirect AAD at (largest profile)+  
Total AAD at (largest profile)+  
Capitalized AAD