



Hazus 5.0

Release Notes

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FEMA

HAZUS™

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1. Overview

Hazus 5.0 was released on April 30, 2021. This version includes 149 software changes, summarized below. Each change summary includes a User Story, Acceptance Criteria, and Notes (if applicable).

User Stories describe a software change in plain language from the perspective of a Hazus stakeholder. **Acceptance Criteria** describe the conditions required for the software change to be considered complete. **Notes** summarize important limitations associated with a given software change. Changes are identified using a key (HAZ-XXX) that helps the Hazus Team track important information related to development projects. Hazus 5.0 includes the following general updates: For any questions related to the Hazus 5.0 release, please email the Hazus Team (FEMA-Hazus-Support@fema.dhs.gov) and include the HAZ-XXX key if available. Below is a summary of the Hazus 5.0 enhancements.

Software Architecture Upgrades

- Hazus runs with Esri ArcGIS 10.8.1
- Hazus uses Microsoft SQL Server 2019 for its backend database.
- Hazus uses Microsoft 2013 Access database engine.
- Hazus Package Region (HPR) files created in previous versions of Microsoft SQL Server can be imported into Hazus 5.0.

Modeling Capabilities for Puerto Rico and U.S. Virgin Islands

- Hurricane modeling capabilities were added for Puerto Rico and U.S. Virgin Islands through an extensive data development effort that generated island-specific inventory types and custom damage functions required for hurricane loss estimation. Terrain data and storm data for Hurricanes Maria, Irma, Hugo and Dorian were also integrated for Puerto Rico and U.S. Virgin Islands.
- The addition of coastline geography data for Puerto Rico and U.S. Virgin Islands supports coastal flood modeling for study regions in those territories.
- Short-term Shelter Needs modeling capabilities for earthquake and hurricane in U.S. Virgin Islands were made possible through the addition of demographic information about owners and renters.

Interface Modernization

- Outdated interface graphics were replaced with a suite of newly designed, streamlined graphics to improve Hazus 5.0 usability.
- Many outdated or non-functional menu items were removed from the Hazus 5.0 interface – especially for the Hazus Flood Model.

Data & Methods Corrections

- Specific occupancy types used for flood analysis were misaligned.

- Area-weighted calculations for flood model shelter estimates were incorrect.
- Non-structural and content losses in buildings with high damage were computed incorrectly in the Tsunami model.

2. General Software Changes

The changes below apply to functionality shared by all four hazard models contained in the Hazus software program.

2.1. HAZ-739: Establish backwards compatibility between Hazus 5.0 and Hazus 4.2.3 study regions

2.1.1. USER STORY

As a Risk Analyst, I want to be able to open HPRs created using Hazus 4.2.3 in Hazus 5.0 so that I still have access to valuable risk assessment work after upgrading to the latest version of Hazus.

2.1.2. ACCEPTANCE CRITERIA

- Hazus 4.2.3 study regions (HPRs) open in Hazus 5.0 with identical functionality.

2.2. HAZ-596: Upgrade Hazus architecture dependency from Microsoft .NET 3.5 to 4.8

2.2.1. USER STORY

As a Developer, I want the Hazus 5.0 install to successfully complete using the latest 4.8 .NET framework rather than 3.5 so that Hazus software relies on the latest FEMA-approved technological dependencies.

2.2.2. ACCEPTANCE CRITERIA

- All .NET Hazus binaries have been compiled using the 4.8 framework.

2.2.3. NOTE

Per the Hazus 5.0 install instructions both .NET 3.5 and 4.8 must be enabled on the user's machine.

2.3. HAZ-501: Update Puerto Rico General Building Stock database with new building footprints

2.3.1. USER STORY

As a Risk Analyst, I want to use the latest, best available building footprint data for Puerto Rico Hazus studies so that I can generate accurate risk assessment information for Puerto Rico.

2.3.2. ACCEPTANCE CRITERIA

- Confirm no errors in new lidar footprint dataset.
- Puerto Rico building counts are updated in Hazus SQL.
- Puerto Rico building values are updated in Hazus SQL.
- Puerto Rico building areas are updated in Hazus SQL.
- Median Year Built values for Puerto Rico are corrected (2010 Census update contained erroneous values).

2.3.3. NOTE

Refer to Hazus release notes (U.S. Territories Data Update) for additional details regarding the Territory inventory updates: <https://www.fema.gov/flood-maps/tools-resources/flood-map-products/hazus/release-notes>

Spot checking dasymetric Census Blocks for Puerto Rico based on Land Use Land Cover with the lidar building footprints, indicate that in some areas as many as 25% of buildings are located outside the developed areas of the dasymetric blocks possibly indicating the flood Level 1 losses in those area may underestimate the hazard.

2.4. HAZ-437: Deprecate unused or misleading interface items

2.4.1. USER STORY

As a Risk Analyst, I want Hazus software menus to include only options that correspond to functional loss modeling tools so that I can understand Hazus loss modeling capabilities and avoid confusion associated with nonfunctional menu options.

2.4.2. ACCEPTANCE CRITERIA

- 30 Hazus menu changes identified during the 2020 Hazus interface audit were completed. Including:
 - Removal outdated Agricultural Flood Loss model
 - Removal of Flood What Ifs
 - Removal of Quick Look and Enhanced Quick Look
 - Removal of Non-Functional Analysis Run menu items

2.4.3. NOTE

Most of the deprecation of unused items occurred in the Flood Model, several items, such as High Potential Loss Facilities remain in the Earthquake, Hurricane and Tsunami models.

2.5. HAZ-404: Integrate Microsoft SQL Server Management Studio into the Hazus 5.0 installation

2.5.1. USER STORY

As a Risk Analyst, I want the option to install SQL Server Management Studio while I install Hazus so that I can access backend Hazus databases for risk analysis projects.

2.5.2. ACCEPTANCE CRITERIA

- Yes/No option to install SSMS is provided to user on Hazus installation screen.
- Choosing “Yes” to install SSMS does not significantly increase Hazus installation time.
- Hazus download file size is not significantly increased.

2.6. HAZ-376: Update terminology used throughout Hazus interface

2.6.1. USER STORY

As a Risk Analyst, I want to interact with software that uses the latest FEMA terminology so that I can leverage clear, accurate, and modern federal resources for risk management.

2.6.2. ACCEPTANCE CRITERIA

- 18 interface terminology changes identified during the 2020 Hazus interface audit are complete. Including:
 - The term “lifeline” is replaced by the terms “utility system” and “transportation system” in the flood GUI and metadata.
 - Dollar exposure and loss units are explicitly defined as Thousands of Dollars in the Essential Facility, Transportation and Utility Systems and General Building Stock Flood Inventory and Results GUI’s.
 - Dollar exposure and loss units are explicitly defined as Dollars in the Vehicle flood Inventory and Results GUI’s.
 - Debris parameters in the flood model are explicitly described as weight in tons.
 - Bridge loss in the flood model GUI is explicitly described as probability of failure rather than percent loss to align with the technical methodology.

2.7. HAZ-250: Update graphics used throughout Hazus interface

2.7.1. USER STORY

As a Risk Analyst, I want to use intuitive, modern software for risk modeling so that I can easily characterize risk in my community.

2.7.2. ACCEPTANCE CRITERIA

- All outdated graphics identified during the 2020 Hazus interface audit are removed or replaced by redesigned graphics.
- Problems with graphic displays are minimized.

2.7.3. NOTE

New graphics may render inconsistently on some screen resolutions due to challenges with the treatment of graphics in the Hazus code base.

2.8. HAZ-12: Update Hazus metadata files

2.8.1. USER STORY

As a Risk Analyst, I want to have access to the latest information about data used as input into Hazus models so that I can understand Hazus model results.

2.8.2. ACCEPTANCE CRITERIA

- Metadata RTFs delivered with Hazus contain up-to-date information about HIFLD Open data layers, Puerto Rico and U.S. Virgin Islands inventory data upgraded Nov. 30, 2019, and contacts.
- Flood specific metadata now correctly open in the peril specific metadata viewer in the flood model.
- Unused metadata .rtfs have been deprecated.
- Feedback from Independent Verification & Validation testing is incorporated into metadata files.

2.8.3. NOTE

Hypertext links in the Hazus metadata viewers do not function, however, they can be copied and pasted to a browser.

Most flood specific metadata files for utility and transportation inventories are place holders since there are no flood specific attributes for these systems.

2.9. HAZ-233: Upgrade Hazus software architecture

2.9.1. USER STORY

As a Risk Analyst, I want to have access to a new version of Hazus with upgraded system architecture so that I can rely on the latest technology and software security features for risk analysis.

2.9.2. ACCEPTANCE CRITERIA

- Hazus installs with Esri ArcGIS 10.8.1, and programs present after installation include Hazus 5.0, Microsoft SQL Server 2019, Microsoft .NET Framework 4.8 and 3.5 enabled, and Microsoft Access Engine 2013.
- Microsoft Report Viewer 2005, Microsoft Visual J# 2.0, Microsoft Access Engine 2007 32bit and 2010 64 bit, and Microsoft C++ 2010 redistributables are not present in the control panel after installation of Hazus.
- Enhancements and defects addressed for Hazus 4.2 Service Packs 1, 2, and 3 are present.
- Hazus HPRs from previous versions of Microsoft SQL Server can be successfully imported and exported.
- Hazus Flood Hydrology & Hydraulics model test cases run with performance metrics comparable to Hazus 4.2.3 (e.g. failed reaches, runtime, losses).

3. Flood Model Software Changes

The changes below apply to functionality in the Hazus Flood model.

3.1. HAZ-39: Add coastline data for Puerto Rico & U.S. Virgin Islands

3.1.1. USER STORY

As a Risk Analyst, I want coastline data for Puerto Rico and U.S. Virgin Islands to be included in Hazus software so that I can evaluate coastal flood risk using Hazus.

3.1.2. ACCEPTANCE CRITERIA

- Coastal Level 1 and 2 scenarios run successfully for Puerto Rico and U.S. Virgin Islands.

3.1.3. NOTE

There are very small portions of the easternmost coast of Puerto Rico and small outer islands of St. Thomas and St. John where the U.S Geological Survey (USGS) Digital Elevation Model (DEM) coverage is insufficient to support Level 1 flood analysis. The USGS NED program was notified, and users may mosaic other coverage or 0 elevation raster data in these areas to support analysis.

3.2. HAZ-504: Convert all type 1 & 2 coastline data to type 0

3.2.1. USER STORY

As a Developer, I want Hazus coastline data currently classified as small and large islands (1 and 2) to be classified as mainland (Type 0) so that the Hazus coastal flood model can run without crashing.

3.2.2. ACCEPTANCE CRITERIA

- Personal geodatabase with Hazus coastline data stored in Program Files/x86/Data/FL has Type 0 for all coastlines.

3.2.3. NOTE

Geometry errors with complex coastlines or coastlines where small island segments are included in the analysis may still occur. We advise users to deselect these from the analysis where possible.

3.3. HAZ-307: Update USGS DEM download function to work with latest USGS API

3.3.1. USER STORY

As a Developer, I want to Incorporate changes to USGS DEM API format and download location into Hazus so that Hazus can fetch the latest USGS GeoTIFF DEM data for flood and tsunami risk analysis.

3.3.2. ACCEPTANCE CRITERIA

- Version of Hazus with USGS changes for FL and TS installs on test machines.
- Test cases for Level 1 flood and tsunami downloads DEM and runs without issues for new GeoTIFFs.

3.4. HAZ-729: Correct the misalignment of specific occupancy types in flood analysis (debris and all General Building Stock results)

3.4.1. USER STORY

As a Risk Analyst, I want all Hazus flood analysis procedures working according to the methodology described in the Hazus technical manuals so that risk information produced by Hazus is credible.

3.4.2. ACCEPTANCE CRITERIA

- Hazus debris and General Building Stock loss calculations use exposure values that correspond to the correct specific occupancy type (6 occupancy types have been using incorrect building area and valuation data).

3.5. HAZ-611: Correct the flood area-weighted shelter calculation

3.5.1. USER STORY

As a Risk Analyst, I want Hazus to determine the number of people likely to seek shelter after a flood according to the percent area flooded in each Census Block multiplied by the total population (rather

than multiplying by the population in individual age and income categories) so that shelter parameter modifications can be applied correctly.

3.5.2. ACCEPTANCE CRITERIA

- When shelter seeking population demographic parameters are modified to 100%, Hazus estimates that 100% of the population will seek shelter based on the percentage of the block that is flooded.

4. Hurricane Model Software Changes

The changes below apply to functionality in the Hazus Hurricane model.

4.1. HAZ-284: Enable Hazus hurricane modeling for Puerto Rico and U.S. Virgin Islands

4.1.1. USER STORY

As a Risk Analyst, I want to leverage new wind damage functions, building types, and hurricane hazard data developed for Puerto Rico and U.S. Virgin Islands in Hazus so that I can quantify and communicate hurricane risk in high-risk U.S. territories.

4.1.2. ACCEPTANCE CRITERIA

- New damage functions for Puerto Rico and U.S. Virgin Islands are incorporated into Hazus.
- New wind building types for Puerto Rico and U.S. Virgin Islands are incorporated into huListofWindBuildingTypes and related tables in Hazus.
- Terrain data (Surface Roughness) are incorporated into huTerrain, huTerrainB tables for Puerto Rico and U.S. Virgin Islands.
- Tree coverage and collection factors data (Tree Parameters) are incorporated into huTreeParameters, huTreeParametersB tables for Puerto Rico and U.S. Virgin Islands .
- Tract inland distance by direction data (Distance Inland) are incorporated into huCensusBlock (state data), huTractInlandDistance (syHazus) tables for Puerto Rico and U.S. Virgin Islands.
- Hugo wind field data are converted from 2000 to 2010 census geometry and incorporated into Hazus at huHistoricWindSpeedResults.
- Hurricanes Maria, Irma, Hugo and Dorian added to Hazus historic storm list for Puerto Rico and U.S. Virgin Islands.
- Probabilistic hurricane hazard data for the Caribbean basin are added to Hazus for Puerto Rico and U.S. Virgin Islands.
- New damage functions and wind building types are integrated into Hazus mapping schemes in the huBldgMappingList, huGbsOccMapping, huGbsOccMappingList, huGbsOccMappingListExt, huBldgMapping, huBldgMappingList, huBldgMappingListExt tables

under Hazus_Model tables in Puerto Rico and U.S. Virgin Islands state databases and backend data model.

- Statewide aggregation for Puerto Rico and U.S. Virgin Islands shows hurricane-specific inventory under the Hazus General Building Stock.
- Hazus Hurricane analyses run successfully, and results are generated correctly for Puerto Rico and U.S. Virgin Islands.

4.1.3. NOTES

Due to a lack of SLOSH basins in Hazus for Puerto Rico and U.S. Virgin Islands, Level 1 combined surge and wind loss modeling is unavailable and HU analysis for combined HU and FL regions are run at the Tract level by default for Hawai'i, Puerto Rico and U.S. Virgin Islands.

Maria and Irma historic data are based on observed wind field modeling developed by the NIST National Windstorm Impact Reduction Program (NWIRP). Maria windspeeds for Puerto Rico for each tract are based on the mean windspeed for all buildings in that tract.

Probabilistic wind loss modeling for Puerto Rico and U.S. Virgin Islands are enabled, however, probabilistic storm tracks are unavailable.

4.2. HAZ-543: Optimize storm file viewing for deterministic Hurrevac hurricane scenarios

4.2.1. USER STORY

As a Risk Analyst, I want the list of Hurrevac hurricane storm files available to import into Hazus as hazard data to be sorted intuitively so that it is easier to locate hazard data and calculate losses for storms of interest.

4.2.2. ACCEPTANCE CRITERIA

- The storm file list is sorted by decreasing date (newest on top).
- Storm file list loads faster than before enhancement based on sorting tests.
- Storm file list does not include storms that either did not make landfall or had under 50 mile per hour winds.

4.3. HAZ-260: Integrate Hurricane Season 2019-2020 wind hazard data into Hazus

4.3.1. USER STORY

As a Risk Analyst, I want to have access to observed wind field data for 2020 hurricanes where available so that I can model losses for the latest disasters using best available hazard data.

4.3.2. ACCEPTANCE CRITERIA

- Wind tracks and speed data (observed when available) for all storms from 2020 and 2019 causing more than \$1 Billion in damage are added to Hazus backend tables and data model (Hurricanes Hanna, Isaias, Laura, Sally, Delta, Zeta, Dorian, Douglas and Eta).
- Hazus models losses successfully using observed and modeled wind field data for hurricanes listed above.

4.3.3. NOTE

Where historic wind fields are based on observed data the term “observed” is included in the storm name field. For significant wind events FEMA works with the National Institute of Standards and Technology National Windstorm Impact Reduction Program (NWIRP) to incorporate field deployed anemometer measurements and develop an observed, rather than a modeled, wind field. Hazus loss results based on these observed wind fields are considered more accurate.

The high inland translation speed for Hurricane Zeta causes Hazus validation errors when using the Hurrevac .stm files. The Zeta historical wind field data excludes some inland areas in Georgia and northwards.

When selecting storms and study regions for Level 1 combined HU and FL losses, wind speeds with peak gusts greater than 50 mph are required.

4.4. HAZ-317: Replace incorrect National Hurricane Center storm track data for Hurricane Michael and Hurricane Olivia

4.4.1. USER STORY

As a Risk Analyst, I want to display hazard data from the National Hurricane Centers’ final advisory storm track for Hurricanes Michael and Olivia so that my hurricane loss modeling visuals align with best available information from authoritative federal agencies.

4.4.2. ACCEPTANCE CRITERIA

- Hazus displays final (rather than interim) storm track data for Michael and Olivia using the best track data from the National Hurricane Center and Central Pacific Hurricane Center.

5. Tsunami Model Software Changes

The changes below apply to functionality in the Hazus Tsunami model.

5.1. HAZ-411: Correct the computation of non-structural and content losses when the structure is considered destroyed

5.1.1. USER STORY

As a Risk Analyst, I want tsunami non-structural and content losses to be 100% when the structure is considered destroyed so that I can produce accurate tsunami losses in accordance with the Hazus tsunami methodology.

5.1.2. ACCEPTANCE CRITERIA

- Non-structural and Content loss ratios should be 100% for structures in “complete” structural damage state.
- Loss results for tsunami National Structure Inventory General Building Stock case studies should be higher than results calculated before the fix.

5.1.3. NOTES

This defect correction will result in increased non-structural and content losses for tsunami risk assessments completed in Hazus 5.0. Increases will vary by region and will likely be more significant with lighter frame construction (W1, W2, MH, etc.). A case study comparison completed for a tsunami scenario in Tillamook, Oregon showed an 80% increase for non-structural loss and increase of 15% for contents loss.

6. Earthquake Model Software Changes

The changes below apply to functionality in the Hazus Earthquake model.

6.1. HAZ-6: Enable shelter estimates for Hazus Earthquake study regions in U.S. Virgin Islands

6.1.1. USER STORY

As a Risk Analyst, I want to estimate the number of people likely to require public shelter resources following an earthquake in U.S. Virgin Islands so that I can plan for and communicate earthquake and hurricane risk in U.S. Virgin Islands.

6.1.2. ACCEPTANCE CRITERIA

- Add demographic data for owners, renters, and vacant housing to Hazus state database for U.S. Virgin Islands.
- Hazus earthquake and hurricane results for U.S. Virgin Islands show shelter needs estimates.

6.1.3. NOTES

Owner, renter, and vacant housing data for U.S. Virgin Islands was developed by the University of the Virgin Islands (UVI).

These owner/renter demographic updates are also used by the Hurricane Model.

Vehicle inventory and losses are unavailable for U.S. Virgin Islands.

6.2. HAZ-732: New Advanced Engineering Building Module (AEBM) Profiles from Building Codes Saves Study

6.2.1. USER STORY

As a Risk Analyst, I want to estimate the losses avoided from adopting and enforcing the latest International Building Codes so that I can plan for and communicate the benefits of the International Building Codes.

6.2.2. ACCEPTANCE CRITERIA

- Expand the AEBM profiles available in Hazus with the 4,752 new reflecting the two additional Design Levels developed for the "Building Codes Save" (BCS) Project; Very High Code (VC) and Severe Code (SC).

6.2.3. NOTES

"The Very High Code Design Level represents shaking (and code strengths) 1.5 times the High Code Design Level developed for the traditional Zone 4 hazard. Severe Code represents shaking 2.0 times the High Code level.

These are obtained from the BCS Report Appendix (available here:

https://www.fema.gov/sites/default/files/2020-11/fema_building-codes-save_study-appendices.pdf