Hazus 6.1 Release Notes

November 2023

FEMA

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Overview

Welcome to the Release Notes for Hazus 6.1, FEMA's natural hazard risk assessment GIS-based software. This document provides you with an in-depth look at the software enhancements, data improvements, and methodology updates to expect in this release. This document also includes information on software requirements, known software limitations, and future release plans for the Hazus program. Below are some of the major highlights found in this new version of Hazus:

Hazus 6.1 Highlights

- **Updated Earthquake Damage Functions, Building Types, and Design Levels**: This version includes over 4,000 new capacity and fragility functions supporting the latest seismic provisions of the International Building Code (IBC) and International Residential Code (IRC), making the earthquake model more accurate than ever. Earthquake building mapping schemes were developed for the nation from site-specific data, including parcel data and construction year information and are now provided at the census tract level, replacing the ~20-year-old statewide building type schemes.

- **Updated Hurricane Mapping Schemes for General Building Stock (GBS)**: This version of Hazus includes newly updated hurricane mapping schemes based on updated wind building characteristics to support the higher standards of the wind requirements of the International Building Code (IBC).

- **Earthquake Advanced Engineering Building Module (AEBM) Annualized Loss Capability**: You can now perform site-specific and detailed annualized loss estimation in earthquake scenarios.

- **Comprehensive Data Management System (CDMS) Optimization and File Geodatabase Enablement**: Enhanced support for importing inventory from file geodatabases in CDMS, improving the data management system.

- **Increased Resolution for Tsunami Damages**: Improved the granularity of depth and velocity measurements for more precise tsunami damage assessments.

- **Elimination of Security Vulnerabilities**: We've addressed all levels of security vulnerabilities identified through extensive scanning to ensure a secure user experience.

- **Expansion of the Flood Damage Function Library**: This release adds several hundred new damage functions for floods, enhancing the flood model's robustness.

- **Installation Modernization**: The installation process has been streamlined and now features a new graphical user interface for ease of use.

1. Introduction

The Hazus 6.1 release is a significant update that marks the last Hazus version for ArcGIS Desktop. This version includes numerous enhancements aimed at improving the software's capabilities for risk assessment and mitigation planning. To read more about the Hazus Program's plan for continuing to provide GIS-based natural hazard risk assessment software, navigate to Section 9 of this document.

1.1. Software Requirements for Hazus 6.1

The following system specifications are recommended for optimal performance of Hazus 6.1. While the software may operate on systems with lower specifications, adhering to these recommendations will ensure a more efficient and reliable user experience. Failure to meet these specifications could result in diminished software performance, including slower calculation speeds and potential system instability.

- Hardware:
  - Computer Speed: 2.4 GHz
  - RAM: 8 GB
  - Disk Space: 100 GB recommended
- Software:
  - ArcGIS: Version 10.8.2 Basic
  - Operating System: Windows 10 or 11, 64-bit (Pro & Enterprise)
  - Extensions: Esri's Spatial Analyst required for Flood and Tsunami analysis
  - Frameworks: Windows 4.8 .NET Framework
- Graphics:
  - Video/Graphics Adapter: 24-bit video card with at least 128 MB of video memory
  - Screen Resolution: 1078 x 768 or higher

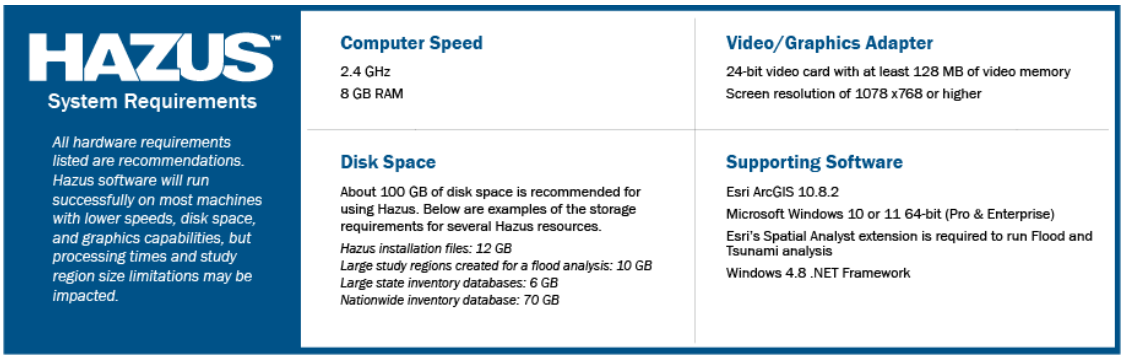

Figure 1. Hardware and Software Requirements for Hazus 6.1.

Software Enhancements Notes

2. General Software Enhancements

This section outlines improvements made to enhance the performance and reliability of the Hazus software. The modifications span across various functionalities, optimizing computational algorithms and refining user interface elements to facilitate a more streamlined and precise analytical process.

2.1. Enhanced Installation Process

- **Description:** Hazus 6.1 has been updated to use InstallShield 2022, approved on FEMA's Technical Reference Model (TRM), ensuring a secure and compliant installation process.
- **Key Benefits:**
  - Provides a more secure, robust, and easy to use installation process.
  - Ensures compliance with system software prerequisites.
  - Reduction in time it takes to install Hazus.
- **Methodology:** Updated Hazus to install all components using InstallShield 2022.
- **Reference ID:** 81074

2.2. Improved Summary Reports

- **Description**: Global Summary Reports (GSR) and Quick Assessment Reports (QAR) now feature logical rounding in the final reports totals for each column, ensuring accuracy of the results.
- **Key Benefits**:
  - Ensures results accuracy.
- **Methodology**: Updated QARs and GSRs to have logical rounding and summing in results tables. This is now consistent across all (i.e., if <10 is a default, Hazus will round and sum to nearest 10s place for all columns).
- **Reference ID**: 83064

2.3. During Installation “HazusData” folders can be Setup on any Drive

- **Description:** Resolves the "Thread Not Started" error that occurs when users set up the HazusData folders on a drive different from the default C:\Drive during installation.
- **Key Benefits:**
  - Allows for more flexible data storage options.
  - Reduces the need for extensive troubleshooting.

- **Methodology:** Modified the system behavior to correctly locate and aggregate study regions when HazusData Inventory or Region folders are setup on a drive other than the C:\Drive.
- **Additional Notes:** This limitation was initially encountered in Hazus 5.1 and is also present in Hazus 6.0.
- **Reference ID:** 65816

2.4. CDMS File Geodatabase Support for All Inventories

- **Description:** Hazus 6.1 allows users to import any type of inventory data via a file geodatabase into CDMS, improving speed, performance, and the ability to handle large datasets.
- **Key Benefits:**
  - Enables easier and faster inventory data import into CDMS.
  - Improves CDMS performance.
- **Methodology:** Enabled file geodatabase imports in CDMS for all types of inventories.
- **Additional Notes:** This enhancement also improved known CDMS GUI issues. Users are now able to see all text and buttons within the CDMS interface in the field mapping windows, throughout the entire process.
- **Reference ID:** 81260, 79590

2.5. Updated Microsoft (MS) Access Database Engine

- **Description:** Hazus 6.1 runs on MS Access v16 2016 (32-bit), ensuring that the supporting software is within Microsoft's extended support until October 2025.
- **Key Benefits:**
  - Keeps supporting software up to date.
  - Ensures use of supported technologies.
- **Methodology**: Updated the build to run with MS Access v16 2016 (32-bit).
- **Additional Notes**: If this version of MS Access is not currently on the machine, Hazus will recognize this as a required prerequisite and automatically install it for users during the Hazus installation process.
- **Reference ID**: 81057

2.6. Updated Hazus Logo in Crystal Summary Reports

- **Description**: The updated Hazus logo has replaced the outdated logo in all Crystal Summary Reports.
- **Key Benefits**:
  - Modernizes the Hazus branding.

- Enhances visual consistency across reports.

- **Methodology**: Replaced outdated logos with the current Hazus logo.
- **Reference ID**: 64048

2.7. Optimized Study Region Aggregation

- **Description**: Hazus 6.1 no longer aggregates unnecessary agriculture data when creating a study region, improving performance.
- **Key Benefits**:
  - Improves speed and performance.
  - Reduces errors during the study region creation.
  - Reduces state inventory and study region file sizes.
- **Methodology**: Code modification to skip agriculture data aggregation.
- **Reference ID**: 63467

2.8. Resolved Duplicate Watershed Naming in HUC8 Tables

- **Description**: When users select to create their study region by watershed, Hazus 6.1 addresses duplicate names in HUC8 watershed tables. Names are now appended with primary state identifiers and, when needed, additional region identifiers to ensure uniqueness, such as "Black (Arizona)" and "Black (Riverside, California)."
- **Key Benefits**:
  - Eliminates confusion from duplicate watershed names.
  - Enhances accuracy for users in study region creation based on watersheds.
- **Methodology**: Updated names in both syWatershed and hzWatershed tables with state or region distinctions.
- **Reference ID**: 79394

2.9. Enhanced Security Vulnerability Remediation

- **Description:** Hazus 6.1 has undergone comprehensive security vulnerability remediation. This release ensures a stronger, more secure software environment, free of critical, high, and moderate vulnerabilities, with substantial progress in addressing low-level vulnerabilities.
- **Key Benefits:**
  - Bolsters the software's resilience against potential security threats.

  - Enhances user confidence in Hazus' security framework.
  - Continuous improvement in maintaining code quality.

- **Methodology:** Security assessments identified vulnerabilities across different areas, including memory leaks, style redundancies, and potential resource mismanagement. Remediation steps involved the following.
  - Correcting memory allocations to prevent null pointer vulnerabilities.
  - Addressing and eliminating detected memory leaks.
  - Removing redundant code initializations and unused methods.
  - Ensuring password management best practices, such as avoiding passwords in comments or using empty passwords.
  - Addressing high-level vulnerabilities, including buffer overflow risks, access control in databases, and resource management.

- **Reference ID:** 83182

2.10. Consistent Terminology in Reports

- **Description**: Hazus 6.1 introduces consistent terminology in all Crystal Reports across all models. All reports use the terms “User-Defined Facilities” and “Emergency Operations Centers” across all models, to align with Hazus user and technical manuals.
- **Key Benefits**:
  - Eliminates confusion by using uniform terminology.
  - Enhances clarity and ease of understanding in reports.
- **Methodology**: Reviewed and modified text in Crystal Reports to ensure consistent terminology is used for User-Defined Facilities and Emergency Operations Centers.
- **Reference ID**: 63225

3. Earthquake Enhancements

3.1. Removal of Hazus Query Wizard in Earthquake Model

- **Description**: The Hazus Query Wizard has been removed from the Selection Menu in the Earthquake Model.
- **Key Benefits**:
  - Prevents software crashes related to the deprecated feature.

- Reduces confusion for users by eliminating non-functional menu items.

- **Methodology**:
  - Removed the Hazus Query Wizard from the Selection Menu in Hazus Earthquake Model.

- **Reference ID**: 63507

3.2. Special Characters are Allowed in Earthquake Scenario Names

- **Description**: Hazus 6.1 allows users to include special characters in scenario names, offering greater flexibility to import U.S. Geological Survey ShakeMap scenarios.

- **Key Benefits**:
  - Provides more flexibility in naming scenarios.
  - Enhances compatibility with other systems like USGS ShakeMap.

- **Methodology**: Code modifications were made to support Unicode 'NVARCHAR' characters in earthquake scenario names.

- **Additional Notes**: There is still a character limit of 40 characters for the scenario names.

- **Reference ID**: 79601

3.3. Updated Earthquake Mapping Schemes

- **Description**: Hazus 6.1 features updated Earthquake Mapping Schemes, providing you with the best available earthquake vulnerability attribution data for your analyses.

- **Key Benefits**:
  - Access to up-to-date and reliable earthquake vulnerability attribution data.
  - Better identify vulnerable areas and communities.
  - Improved internal testing for state databases.

- **Methodology**: Site specific data provided by the USACE National Structure Inventory (NSI) for almost 125 million structures supplemented with parcel data that included wall and structure type information, as well as construction year were leveraged. Open Street Map (OSM) and Skyscraper Page data were leveraged for over 60 million footprints to improve the NSI height data and better classify the low, mid, and high rise Hazus building types. Additional parcel data records were obtained from California counties for over 6 million structures that provided structure type data. Two new seismic design levels were added to accommodate the higher resistance on the International Building Code (IBC) era construction. FEMA's Build Codes Save (BCS) study was utilized to apply the IBC adoption history for the highest risk seismic states at the jurisdiction level. Design levels assignments were based on the USGS hazard map design spectral ground motion thresholds for low and mid\high rise buildings. The FEMA Building Code Adoption Tracking (BCAT) information was leveraged to ensure correlation between all high seismic risk jurisdictions and design levels

including tracking of jurisdictions where code levels are weakened. This update was conducted after all state database updates to counts, area and values were made for our Hazus 6.0 release, ensuring the latest and most accurate information. The enhanced data were used to create unique census tract level mapping schemes to replace the outdated state level schemes and provide significantly more accuracy in assessment of risk and potential losses to help communities, States and other stakeholders identify vulnerabilities and develop mitigation strategies.

- **Reference ID**: 82074

3.4. Renamed Lifelines in Earthquake Model Reports to Utility or Transportation for More Accurate Descriptions

- **Description**: The term "Lifelines" has been renamed in Earthquake Model Crystal Reports to avoid confusion and are replaced with more accurate terminology of Transportation or Utilities.
- **Key Benefits**:
  - Improved clarity and consistency in report terminology.
- **Methodology**: To ensure that terminology is consistent and up to date across Hazus and all user and technical manuals.
- **Reference ID**: 63994

3.5. Removal of Outdated Earthquake Export Tool

- **Description**: An outdated export tool has been removed from the Earthquake model.
- **Key Benefits**:
  - Cleaner, more streamlined user interface.
  - Reduction in potential errors or crashes.
- **Methodology**: The tool was removed from the installation folders and ArcGIS toolbox.
- **Additional Notes**: FEMA's open source Hazus Export Tool is still fully functional and should be used to replace the outdated export tool.
- **Reference ID**: 63585

3.6. Deprecation of Non-functional Multi-hazard Average Annualized Loss (AAL) Option

- **Description**: The non-functional Multi-hazard AAL option has been removed from the Earthquake model.
- **Key Benefits**:
  - Reduced user confusion by removing non-functional options.

- **Methodology**: The option was removed from the user interface and any associated reports were also removed.
- **Reference ID**: 63534

3.7. Anchor Field Added to Potable Water and Natural Gas Facilities

- **Description**: An anchor field has been added to Potable Water and Natural Gas Facilities in the Earthquake model.
- **Key Benefits**:
  - Enhanced user interaction with inventory datasets.
  - Improved data granularity for better analysis.
  - Aligned expected results with Hazus user and technical manuals.
- **Methodology**: A new column was added to the relevant inventory tables and tested to ensure proper functionality matches what is described in the user and technical manuals.
- **Reference ID**: 63509

3.8. New Seismic Design Level Fragility and Capacity Curves

- **Description**: Added 4,752 new seismic design level fragility and capacity curves. These are now available across all occupancy and building types in the damage functions GUI for structural capacity and fragility, as well as nonstructural drift and acceleration sensitive damages.
- **Key Benefits**:
  - Improved accuracy in assessing structure vulnerability to earthquakes.
  - Allows users to assess the benefits of building to higher IBC standards.
  - Enhanced risk mitigation capabilities.
- **Methodology**: A new suite of capacity and fragility functions was developed to support the higher design requirements associated with the seismic provisions of the International Building Code (IBC). These are specifically based on spectral seismic design threshold ground motions provided by the USGS hazard maps for both low and mid\high rise buildings. These increase the seismic resistance and provide the capability to model losses avoided as a result of IBC era construction in high-risk areas based on the updated Hazus 6.1 building mapping schemes.
- **Reference ID**: 63460

3.9. Updated Field Name in Shelter Window

- **Description**: The "ShortTermNeeds" field in the Shelter Window has been updated for clarity.
- **Key Benefits**:

- Improved user understanding of displayed information.

- **Methodology**: The field name has been updated to "People Needing Shelter".
- **Reference ID**: 63450

3.10. Average Annualized Loss (AAL) for Advanced Engineering Building Module (AEBM) is Available in Earthquake Model

- **Description**: Users can now run Average Annualized Loss (AAL) on the Advanced Engineering Building Module (AEBM) in the Earthquake model.
- **Key Benefits**:
  - Greater depth and flexibility in earthquake risk analyses.
  - Improved risk assessment results for site-specific analyses.
- **Methodology**: Code updates were made to allow AAL calculations that annualize the losses across all return periods using the AEBM.
- **Reference ID**: 33761

3.11. Optimized ShakeMap Scenario Bounding Box

- **Description**: The bounding box for ShakeMap scenarios has been optimized to improve the search criteria for earthquake data.
- **Key Benefits**:
  - More efficient discovery of relevant ShakeMap events and scenarios.
  - Improved data relevancy for study regions.
- **Methodology**: The bounding box was adjusted to better align with the study region's area.
- **Reference ID**: 33512

3.12. Earthquake ShakeMap Scenario Restriction Resolved

- **Description**: Identified and fixed an issue where a ShakeMap scenario, once run in one region, can't be rerun in another region.
- **Key Benefits**:
  - Enables users to use the same ShakeMap for different study regions.
  - Addresses a common use-case for larger ShakeMap scenarios like Cascadia or New Madrid.
- **Methodology**: Removed restrictions that prevented users from being able to rerun a ShakeMap scenario.
- **Reference ID**: 79730

3.13. Deletion Issue in Earthquake Scenario Wizard Resolved

- **Description**: Identified an issue where some earthquake scenarios cannot be deleted from the Earthquake Scenario Wizard.
- **Key Benefits**:
  - Streamlines the user experience by allowing removal of unneeded scenarios.
  - Ensures a cleaner and more organized workflow.
- **Methodology**: Removed restrictions that prevented users from being able to delete an earthquake scenario.
- **Reference ID**: 77198

3.14. Ensure Alignment of Default Facility Type Analysis Parameters

- **Description**: Default facility type analysis parameters are updated to align with technical manual.
- **Key Benefits**:
  - Ensures consistency between software and manual.
  - Provides clear guidance to users on default parameters.
- **Methodology**: Checked Economic Loss parameters across various facility types and compared them with respective tables in the Earthquake Technical Manual, addressing discrepancies.
- **Reference ID**: 75357

3.15. Earthquake Duration Threshold Discrepancy in Hazus

- **Description**: Identified a hardcoded discrepancy in the earthquake duration threshold in Hazus' code. The previous M 7.2 value was used in code for the threshold for long duration earthquakes but does not match the technical manual which specifies M 7.5. This has been fixed to match the M 7.5 threshold described in the technical manual.

- **Key Benefits**:
  - Ensures consistency between Hazus software and the technical manual.
  - Provides accurate assessments for "long duration" shaking based on documented thresholds.

- **Methodology**: Reviewed code to identify hardcoded discrepancies and adjusted the value to match the threshold provided in Section 5.6.1.1 of the Earthquake Technical Manual.

- **Additional Notes**: This threshold is used in probabilistic scenarios and Average Annualized Loss (AAL) calculations and is now consistent for both.

- **Reference ID**: 30375

3.16. New Earthquake Analysis Capability in American Samoa (AS), Guam (GU), and Northen Marianas Islands (MP)

- **Description:** Enabled earthquake analysis capability in AS, GU, and MP using the newly developed and updated the General Building Stock (GBS) and mapping scheme data.
- **Key Benefits:**
  - Provides a critical new earthquake modeling capability for the Pacific Territories.
- **Methodology:**
  - GBS data were developed, and code modifications made to enable earthquake analysis in Pacific Territories.
  - Currently only ShakeMap, user-supplied, and arbitrary earthquake scenario types are supported.
- **Additional Notes:** No USGS probabilistic data are integrated for return period or annualized losses. Read more about the data creation under Section 7. Inventory Enhancements item 7.4 in this document.
- **Reference ID:** 78755, 78789

4. Flood Enhancements

4.1. Functional Utility Inventory Thresholds Updated

- **Description**: Hazus 6.1 brings updates to thresholds used for utility inventory functionality to match the latest technical manual.
- **Key Benefits**:
  - Improved accuracy of functional utility assessments.
  - Consistency with the latest technical guidelines.
- **Methodology**: Research and tests were conducted to ensure that functionality thresholds match those in the Inventory Technical Manual. Note that equipment heights listed in analysis parameters are not used in the analysis and may differ from the 0-value provided in the Inventory Technical Manual. A comment is included in the utility damage function parameters to indicate the assumptions made in estimating equipment height.
- **Reference ID**: 82057

4.2. Level 1 Coastal Loss Model Analysis Fix

- **Description**: A defect in the level 1 coastal loss model, where Hazus was inaccurately applying the different coastal zones (A/CA/V), was identified, and resolved.
- **Key Benefits**:
  - Identification and troubleshooting of issues related to incomplete loss results.

  - Improved reliability of wave zone data.
  - More accurate flood risk assessment.
  - Aligns functionality with user and technical manuals.

- **Methodology**: Research and validation activities were conducted to correct inaccuracies in the zone grid produced during the level 1 coastal analysis. Hazus was inadvertently discarding the building losses occurring in the V zone in level 1 scenarios. This fix can significantly increase previous losses in severe coastal scenarios where buildings may be exposed to wave action.
- **Reference ID**: 81442, 81441, 75936, 65818

4.3. Renamed Replacement Cost Column

- **Description**: The Replacement Cost column in the Flood GUI has been renamed to "AverageCost."
- **Key Benefits**:
  - Updated terminology for clarity.
- **Methodology**: Hazus GUI and underlying SQL tables were updated so that Replace Cost column is now referred to as the AverageCost.
- **Reference ID**: 79613

4.4. Shelter Module Optimization

- **Description**: Shelter module in flood was optimized to improve the speed of the module.
- **Key Benefits**:
  - Faster computation times for flood shelter analyses.
- **Methodology**: Research spikes were conducted to identify and implement optimization opportunities to increase the speed of the shelter module in flood. Geometry validation checking at runtime was removed as unnecessary since all Hazus census block geometries are validated when loaded into state data.
- **Additional Notes**:
  - Benchmark runtime is 9 seconds for shelter in 6.1 vs 9 minutes in 6.0.
  - Results are available for all census blocks.
- **Reference ID**: 78784

4.5. Reactivating Functional Menu Items

- **Description**: Research was conducted to reactivate functional menu items that are still useful but were previously turned off.

- **Key Benefits**:
    - Restored access to the Inventory→General Building Stock→First Floor Height Above Grade default and user defined elevation values by foundation type and flood hazard type.
    - Restored access to the Analysis→Parameters→Shelter weighting and modification factors for shelter seeking population by age and income.
- **Methodology**: A list of potential items to be reactivated was created and vetted.
- **Reference ID**: 78501

4.6. New Depth Damage Function Tables Integrated

- **Description**: The Hazus Depth Damage Function (DDF) libraries for structure and content damage functions were updated with new well established and reviewed damage functions. These represent a significant expansion of the Hazus flood DDF libraries and are aligned by Hazus occupancy type, coastal and riverine flood hazards.
- **Key Benefits**:
    - Access to updated damage functions for accurate loss estimates.
- **Methodology**: Following a FEMA flood damage function review of nearly 100 potential sources of additional structure and content damage functions. Almost 300 new structure and 400 new content damage functions were added to the Hazus library from multiple USACE sources, the FEMA Benefit Cost Toolkit, FEMA Coastal Probabilistic Flood Risk Assessment (PFRA) studies and the Coastal Resilience Center.
- **Reference ID**: 66244

4.7. Updated Field Name in Shelter Window

- **Description**: The field name "ShortTermNeeds" in the Results | Shelter Window has been updated for clarity to “People Needing Shelter”.
- **Key Benefits**:
    - Improved user understanding of displayed information.
- **Methodology**: The field name has been updated to "People Needing Shelter".
- **Reference ID**: 64001

4.8. Terminology Update for First Floor Elevation

- **Description**: The term "First Floor Elevation" has been updated to "First Floor Height Above Grade" for consistency with the Technical Manual.
- **Key Benefits**:
    - Consistent terminology across Hazus and its documentation.

- **Methodology**: The GUI was updated to reflect this change.
- **Reference ID**: 63595

4.9. Update Default Vertical Datum for Coastal Level 1

- **Description**: The default vertical datum for coastal still water level 1 has been updated to NAVD88.
- **Key Benefits**:
  - Modernized data standards for flood risk assessment.
- **Methodology**: The default settings in the GUI were updated to NAVD88.
- **Reference ID**: 63533

4.10. Remove "Data" from Window Title

- **Description**: The word "Data" has been removed from the end of the Transportation Systems Inventory window title.
- **Key Benefits**:
  - Simplified and streamlined UI.
- **Methodology**: The GUI was updated.
- **Reference ID**: 63437

4.11. Removed Sub-headers in Building Classifications Window

- **Description**: Sub headers in the Building Classifications window have been removed.
- **Key Benefits**:
  - Cleaner and more streamlined UI.
- **Methodology**: The GUI was updated to remove all sub-headers in the building classifications window.
- **Reference ID**: 63436

4.12. Essential Facilities Non-Functionality and Time to Restoration

- **Description**: Enhancements ensure that "DaysTo100Functional" results are shown only for nonfunctional essential facilities. Functional facilities based on depth are shown with 0 days to functionality.
- **Key Benefits**:
  - More accurate and clear presentation of essential facility functionality data.

- **Methodology**: Code corrections and validations were performed so that restoration days to functionality are not applied to functional facilities.
- **Reference ID**: 63275

4.13. Essential Facility Losses in Riverine Regions

- **Description**: A defect in the flood riverine scenarios prevented the calculation of Essential Facility losses is fixed.
- **Key Benefits**:
  - Correction of essential facility loss calculations.
  - Enhanced reliability for riverine scenarios.
- **Methodology**: Code correction was made in the hzFlAnEFDmg.modAnEF module, and additional testing was conducted to prevent future errors.
- **Reference ID**: 79984

4.14. Demographics GUI Field Display

- **Description**: Absence of DecadeYearBuilt & MedianYear fields in the flood region Demographics table of Hazus GUI.
- **Key Benefits**:
  - Comprehensive demographic data review.
  - Supports assessments of pre- and post-FIRM structures.
  - User-friendly interface with complete data.
- **Methodology**: Investigation into why these fields weren't displayed, followed by GUI modifications.
- **Reference ID**: 77100

4.15. Combined Coastal & Riverine Reports

- **Description**: A defect that prevented generation of the Global Summary Report for combined coastal and riverine flood scenarios is fixed.
- **Key Benefits**:
  - Seamless generation of summary reports.
  - Accurate and comprehensive data representation.
- **Methodology**: Diagnosed and corrected errors preventing report generation.
- **Reference ID**: 77076

4.16. Demographics Inventory Mapping

- **Description**: Certain columns in the demographics inventory mapping are inaccessible, unlike other perils.
- **Key Benefits**:
  - Full access to all demographic mapping categories.
  - Improved user experience.
- **Methodology**: Expansion of mapping capabilities to include all demographic categories. Updated the 'absv_Demographics' view in HazusModel to include missing demographic fields.
- **Reference ID**: 63778, 77133

4.17. Shelter Parameter and First Floor Elevation (FFE) Dialog Updates

- **Description**: Reestablish previously functional Shelter Parameters and First Floor Elevation dialogs.
- **Key Benefits**:
  - Enhanced user control and customization.
  - Improved software stability and performance.
- **Methodology**: Following the assessment performed in 4.5, code corrections and UI improvements were completed.
- **Reference ID**: 63773

4.18. Emergency Center Nonfunctional Results Updated

- **Description**: Hazus 6.1 addresses an issue where the Emergency Center Nonfunctional results were not updating correctly in reports and table summaries. This led to discrepancies, particularly with the Crystal Report for EOC facility functionality.
- **Key Benefits**:
  - Consistent results reported across all reports and table summaries.
  - Improved confidence in delivering accurate results.
- **Methodology**: Issue was identified in the Crystal Report where EOCs were always shown as non-functional. This issue was specific to EOCs and didn't impact Hospitals or Schools. Corrections were applied to ensure proper functionality reporting.
- **Reference ID**: 63757

4.19. Essential Facilities Functionality Status Resolved

- **Description**: In previous Hazus versions, an issue was identified where the "Days to 100% Functionality" were displayed regardless of whether a facility was marked as non-functional. This issue was especially noticeable when non-default functionality depth parameters were set.
- **Key Benefits**:
  - Correct display of "Days to 100% Functionality" based on facility status.
  - Improved accuracy in report generation and assessment of facility functionality.
- **Methodology**: The defect was noticed in scenarios where the default functionality depth varied. The summary report failed to consider the non-functional parameter when estimating days to functionality. Necessary fixes were implemented to rectify the issue.
- **Reference ID**: 63676

4.20. Transportation Systems Terminology Updated

- **Description**: For more accurate descriptions of the data, the window titled "Damage Functions for Transportation System" in Hazus is renamed to "Damage Functions for Transportation Systems - Bridges Only".
- **Key Benefits**:
  - Enhanced clarity for risk analysts using the software.
- **Methodology**: The renaming reflects a more specific categorization, ensuring that risk analysts can better understand and effectively use Hazus results for risk management.
- **Reference ID**: 63440

5. Hurricane Enhancements

5.1. Applied Research Associates (ARA) - Verification and Validation of Topographic Speedup Parameters for Caribbean Territories

- **Description**: Hazus 6.1 incorporates validation of the Case4id hurricane wind building characteristics from ARA to allow the application of topographic speedup on building losses for the Caribbean territories.
- **Key Benefits**:
  - Ensures accurate and validated hurricane modeling based on updated data.
  - Enhanced confidence in the results, especially for Caribbean territories.

- **Methodology**:
  - Validated and tested application the Case4id data in Hazus 6.1 to ensure accurate application of topographic speedup parameters.
- **Reference ID**: 83063

5.2. Resolved RES3F Column Issue in General Building Stock (GBS) Inventory View

- **Description:** Addressed the issue of the RES3F column being blank in the GBS inventory view by square footage for hurricane Study Regions.
- **Key Benefits:**
  - Complete and accurate view of the inventory data.
- **Methodology:**
  - Implement the required SQL view fix.
  - Ensure all occupancy types are visible in the GBS inventory.
- **Reference ID:** 27077

5.3. Incorporation of Updated Hurricane Building Mapping Schemes

- **Description**: Hazus 6.1 includes updated Hurricane Mapping schemes delivered by Applied Research Associates (ARA). These support the new International Building Code (IBC) era wind provisions including debris protection in coastal and high wind areas developed by FEMA's Building Codes Save (BCS) study.
- **Key Benefits**:
  - Up-to-date mapping schemes for more accurate hurricane modeling.
  - Enhanced capabilities for running HU study regions.
- **Methodology**:
  - The final deliverables from ARA were incorporated into Hazus.
  - User Acceptance Testing was conducted to ensure the new mapping schemes are functional and producing realistic results.
- **Reference ID**: 82513

5.4. Duplicate "States Affected" in Historic Storms List are Removed

- **Description:** Correcting the duplicated "States Affected" entries for certain historic storm scenarios to provide accurate information.
- **Key Benefits:**
  - Improved accuracy and reliability of historical storm data.

- **Methodology:**
  - Inspected and rectified the "StatesAffected" in the table deliverable.
  - Ensured no duplicates are present in the 'NumStatesAffected' field.
- **Reference ID:** 77265

5.5. Hurricane Global Summary Report Updated

- **Description:** Updated the hurricane Global Summary Report to provide an option not to produce maps by default.
- **Key Benefits:**
  - Enhance user customization and report generation options.
- **Methodology:**
  - Ensured users can generate reports without default map production.
- **Reference ID:** 77221

5.6. Wind Building Characteristics Distribution GUI Issues Resolved

- **Description:** Addressed graphical errors in the Wind Building Characteristics window GUI to enhance usability.
- **Key Benefits:**
  - Improve user experience and accurate data editing capabilities.
- **Methodology:**
  - Fixed the error checks in the GUI.
  - Ensured stable and crash-free GUI operations.
- **Reference ID:** 77216

5.7. Resolved Data Overrun Issue in Global Summary Report

- **Description:** Technical edits were made to fix the data overrun issues in the hurricane module Global Summary Report.
- **Key Benefits:**
  - Consistency and accuracy in report data.
- **Methodology:**
  - Addressed data overrun issues in the Global Summary Report.
- **Reference ID:** 64039

5.8. Resolved Broken Depth Grid Source Links in Table of Contents for Surge Module

- **Description:** Rectified broken depth grid source links in the Table of Contents for both level 1 and 2 surge scenarios.
- **Key Benefits:**
  - Consistent and reliable mapping links in Hazus.
- **Methodology:**
  - Preserved depth grid hazard data for hurricane surge.
  - Ensured the preservation of mix0 surge depth grids when reopening surge regions.
- **Reference ID:** 63755

5.9. Updated Storm Track Dialog Manual Section Reference

- **Description:** Update references in the Define Storm Track Manually dialog to the appropriate User Manual sections.
- **Key Benefits:**
  - Up-to-date and relevant references for users.
- **Methodology:**
  - Replaced outdated section mentions with an updated general reference to the most recent Hazus Hurricane User Manual.
- **Reference ID:** 63746

5.10. Updated "ShortTermNeeds" Field Name in Shelter Window

- **Description:** Updated the "ShortTermNeeds" field name to "People Needing Shelter" for consistent terminology.
- **Key Benefits:**
  - Improved clarity and understanding for users.
- **Methodology:**
  - Replaced the term "ShortTermNeeds" with "People Needing Shelter" in the Results→Shelter window.
- **Reference ID:** 63449

5.11. Updated "Coastal Surge" to "Storm Surge" in Analysis Dropdown

- **Description:** Updated software terminology from "Coastal Surge" to "Storm Surge" for terminology consistency.

- **Key Benefits:**
  - Up-to-date terminology aligned with federal resources.
- **Methodology:**
  - Replaced the term "Coastal Surge" with "Storm Surge" in the Analysis menu.
- **Reference ID:** 63434

6. Tsunami Enhancements

6.1. Enabled Tsunami Modeling for Culebra, Puerto Rico

- **Description**: Hazus 6.1 now enables tsunami modeling for the municipio of Culebra in Puerto Rico.
- **Key Benefits**:
  - Provides valuable insight into the tsunami risk for Culebra.
  - Offers enhanced capabilities for local disaster preparedness.
- **Methodology**:
  - Randomized National Structure Inventory (NSI) points within dasymetric census blocks.
  - Enabled and tested tsunami modeling capabilities for Culebra.
- **Reference ID**: 81224

6.2. Deprecation of Hazus Query Wizard in Tsunami Model

- **Description**: The Hazus Query Wizard has been removed from the Selection Menu in the Earthquake (EQ) and Tsunami (TS) Models.
- **Key Benefits**:
  - Prevents software crashes related to the deprecated feature.
  - Reduces confusion for users by eliminating non-functional menu items.
- **Methodology**:
  - Removed the Hazus Query Wizard from the Selection Menu in both the EQ and TS Models.
- **Reference ID**: 63507

6.3. Simplification and Internal Consistency in Tsunami Results Menus

- **Description**: Hazus 6.1 introduces simplified and internally consistent tsunami results menus.

- **Key Benefits**:
  - Easier interpretation and display of tsunami analysis results.
  - Consistent representation across different views and damage states.
- **Methodology**:
  - Ensured consistent order and units across results tables.
  - Adopted consistent terminology and simplified casualty result headings.
- **Reference ID**: 63208

6.4. Resolved Inaccurate Casualty Numbers in Reports

- **Description:** Fixed inaccurate casualty numbers in tsunami summary reports when parameters were changed, and analysis rerun.
- **Key Benefits:**
  - Accurate casualty reports for decision-makers.
- **Methodology:**
  - Replicated the issue using a test scenario.
  - Addressed the discrepancies in the reporting mechanism.
- **Reference ID:** 79753

6.5. Updated Tsunami Damage Criteria for Specific Building Types

- **Description:** Parameters for tsunami damage criteria for Specific Building Types were refined to make evaluations more precise.
- **Key Benefits:**
  - Enhanced accuracy in predicting damages, ensuring better preparedness.
- **Methodology:**
  - Adjusted criteria for specific building types.
  - Fine-tuned the underlying data tables for more detailed evaluations.
- **Reference ID:** 63638

6.6. Improved Damage Assessment for Light Frame Buildings

- **Description:** Updated Hazus 6.1 to address an issue where damage to light frame buildings was being overestimated at low velocities and shallow depths.
- **Key Benefits:**

- A better representation of potential damage, leading to more effective preventive measures.

- **Methodology:**
  - Analyzed data from a specific region to observe the rapid damage assessment.
  - Updated the damage tables to reflect more realistic scenarios.
- **Reference ID:** 65436

7. Inventory Data Enhancements

7.1. Functional Utilities Thresholds

- **Description:** Updated functional utility thresholds to match Inventory Technical Manual, ensuring accurate data and methodologies.
- **Key Benefits:**
  - Improved accuracy in utility data evaluations.
- **Methodology:**
  - Compared values from our current system with the latest Inventory Technical Manual.
  - Made necessary changes to ensure functional utility thresholds now match Inventory Technical Manual.
- **Reference ID:** 82057

7.2. Resolved Coastline Data Issues for Hawaii

- **Description:** Updated the coastline data for Hawaii to better represent coastal areas.
- **Key Benefits:**
  - Consistent and accurate coastal data for risk assessments.
- **Methodology:**
  - Analyzed previous coastline geometries for discrepancies.
  - Used alternative trusted sources for corrections.
- **Reference ID:** 81443, 76838

7.3. Provided Earthquake Data in American Samoa (AS), Guam (GU), and Northen Marianas Islands (MP) Databases

- **Description:** Developed and updated the General Building Stock (GBS) and mapping scheme data to support earthquake modelling in AS, GU, and MP.

- **Key Benefits:**
    - Provides data for a critical new earthquake modeling capability for the Pacific Territories.
- **Methodology:**
    - GBS data were developed from the eixsitng tsunami data that included adding seismic building data and design levels. The design levels are based on the histoic seismic code adoption history and the latest FEMA Building Code Adoption Tracker (BCAT) data for the Pacific Territories. New earthquake mapping schemes are developed and assigned at the Census Tract level to support earthquake loss modeling for the territories.
- **Reference ID:** 78755, 78789

Software Limitations

8. Hazus 6.1 Limitations

This section outlines known limitations in the current version of the software. Each limitation is described, the impact on users is discussed, and potential workarounds are provided where applicable.

8.1. Building Exposure Anomalies from National Structure Inventory (NSI):

- **Description**: Anomalies have been observed in the building exposure and value data aggregated from the USACE NSI. These appear to be localized and include a severe underestimation of the residential exposure in Virginia Beach and misassigned residential occupancy types in New York City. There are relatively small numbers of residential buildings with erroneously high building areas and values noted in several areas, including ND and TX. We identified 24 single-family structures in Texas that were especially severe and have removed them from the 6.1 TX state database, resulting in a 6% decrease in the statewide building value exposure for single-family residential buildings.
- **Impact**: May lead to inaccurate risk assessment results.
- **Workaround**: Users should analyze building exposure and value for their Study Regions against population and other data, consult the Hazus Team for discrepancies and apply manual corrections if needed. Consult NSI FAQs for additional information: https://www.hec.usace.army.mil/confluence/nsi/technicalreferences/latest/frequently-asked-questions.
- **Versions Affected**: Hazus 6.0, Hazus 6.1
- **Reference ID**: 81223

8.2. Depth Grid Alignment Issue in Level 1 Flood Module

- **Description**: The multi return period depth grids developed by the level 1 flood hydrology and hydraulics (H&H) methodology do not consistently align with each other, potentially affecting flood risk assessment results.
- **Impact**: May cause smaller return periods losses to exceed larger return period losses (i.e., 100-year losses could exceed 500-year losses in some blocks).
- **Workaround**: The grids can be exported and aligned using Esri's Snap Raster feature. It is recommended to check all flood level 1 H&H results for the full suite of return periods to assess if this limitation affects your Study Region.
- **Versions Affected**: Hazus 6.0, Hazus 6.1
- **Reference ID**: 76729

8.3. Level 1 Hydrology and Hydraulics (H&H) Flood Module Limitations

- **Description**: Users may experience limitations associated with size and processing times when running level 1 flood H&H scenarios in Hazus.
- **Impact**: Limits the size of the flood Study Region users should create and the number of reaches users should select for riverine scenarios for optimal performance of the H&H module. For reference, Study Regions aggregated at the county level can take 6+ hours to complete and may include multiple failed reaches.
- **Workaround**: Recommend that users divide their Study Region into smaller sections, typically individual counties, to optimize generation of depth grids using the level 1 flood H&H module.
- **Versions Affected**: All Hazus Versions

8.4. Viewing Average Annualized Loss (AAL) Results in Earthquake Scenarios for the First Time Makes the Study Region Crash

- **Description**: When users are running AAL in earthquake scenarios, the Study Region will crash the first time they attempt to view the results.
- **Impact**: Users will experience an ArcMap crash upon trying to view AAL results in earthquake scenarios for the first time.
- **Workaround**: After initial software crash occurs, users should reopen the same earthquake Study Region and view results for AAL. This should enable users to view the results without issues.
- **Versions Affected**: Hazus 6.0, Hazus 6.1
- **Reference ID**: 76594

8.5. Crystal Reports Performance Issues in Earthquake Scenarios

- **Description**: Users have reported performance issues with Crystal reports taking an extended time to generate in earthquake scenarios.
- **Impact**: This can lead to significant delays in accessing loss reports, affecting the timely assessment of earthquake risks.
- **Workaround**: No current solution for initial report generation speed; however, users should export and save reports as a .pdf once they are generated, allowing you to open and refer to the reports swiftly after generating.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: 63993, 63994, RSA-108085

8.6. Tsunami and Earthquake Module Damage Parameters Saving Issue

- **Description**: There is a limitation where editing damage parameters in the tsunami and earthquake module only saves one tab's changes after closing at a time.
- **Impact**: This limitation restricts the ability to efficiently update multiple damage parameters.
- **Workaround**: While a direct solution is not currently available, the issue has been noted for further investigation and will be addressed in future updates.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: 63652

8.7. Inability to Map Building Count and Type from Tsunami Module Results Menu

- **Description**: In the tsunami module, General Building Stock (GBS) results by count and type cannot be mapped from the results menu.
- **Additional Notes**: Direct Economic Loss is not affected by this limitation.
- **Impact**: Users will be unable to use the results menu to map losses by square footage for both general and specific building type and counts.
- **Workaround**: Users can connect to the SQL database for their Hazus tsunami study region in ArcGIS and then map the results from the connected tables. For guidance, please refer to our YouTube training video, Hazus | Connect to a SQL Database in ArcGIS.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: RSA-18504

8.8. Essential Facility Record Prefix Issue in Hurricane Scenarios

- **Description**: When adding essential facility records in hurricane scenarios, CDMS uses a US prefix instead of a state-specific prefix.
- **Impact**: The use of an incorrect prefix could lead to data misalignment and potential issues importing Essential Facility data for future scenarios.
- **Workaround**: No workaround is currently present, but this issue has been logged and will be addressed in future updates. Please reach out to the Hazus Team if you have questions or need additional assistance in reference to this limitation.
- **Versions Affected**: Hazus 6.1

- **Reference ID**: RSA-18064

8.9. Omission of Certain Light Rail Segment Categories from Source Data

- **Description**: Omission of certain light rail segment categories from the Homeland Infrastructure Foundation-Level Data (HIFLD) source data could lead to under representation of light rail segments in metropolitan areas where many may be present, like Washington DC. The current HIFLD light rail facility methodology in Hazus only includes features with mode equal to 'LR' or 'SR', this eliminates many of the lines coming out of DC into Maryland (those that have a mode of 'CR' or 'HR').
- **Additional Notes**: The Railway Segment methodology in Hazus includes the HIFLD features with mode of 'AR', 'CR', 'HR'.
- **Impact**: Current methodology for light rail segments in Hazus baseline inventory could lead to under exposure of light rail segments in metropolitan areas.
- **Workaround**: Users are always encouraged to import improved data for all inventory types using CDMS and our Hazus Inventory Technical Manual as a guide. For additional guidance on CDMS, please refer to our YouTube training playlist, Hazus: Managing Inventory Data.
- **Versions Affected**: Hazus 6.1, Hazus 6.0
- **Reference ID:** RSA-18059

8.10. Tsunami Module's Dasymetric Boundary Limitation in Puerto Rico

- **Description**: The tsunami module's dasymetric boundaries for Puerto Rico excludes significant settlement areas due to incomplete NSI and footprints data at the time of creation.
- **Impact**: This may result in an underestimation of risk in affected settlement areas.
- **Workaround**: The issue requires a reevaluation of the dasymetric geometries using updated building data, which has been logged for future updates.
- **Versions Affected**: Hazus 6.1, Hazus 6.0
- **Reference ID:** RSA-18063

8.11. CDMS Demographic Data Query Errors

- **Description**: Users encounter errors when querying demographic data in CDMS due to outdated age range alignments.
- **Impact**: This prevents users from updating demographic data in Hazus via CDMS.

- **Workaround**: Please contact the Hazus Team and refer to the following reference ID for additional guidance on how to manually import the data via SQL Server Management Studio.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: RSA-18065, RSA-18066

8.12. Windfield Error in Hurricane Scenarios after Data Download

- **Description**: A windfield error occurs in the hurricane module when running scenarios for multi-state study regions combining the Caribbean and Contiguous United States (CONUS) or Hawaii and CONUS.
- **Impact**: Requires users to create multiple study regions for the same hurricane scenario if the impact area or Region of Interest (ROI) spans the Caribbean and CONUS or Hawaii and CONUS.
- **Workaround**: Ensure adherence to guidance that study regions for the Caribbean and CONUS or Hawaii and CONUS are not created together for hurricane scenarios to avoid data conflicts.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: 82060

8.13. Display Issue for Combined Wind and Surge Results by Building Type

- **Description**: In hurricane scenarios, the combined wind and surge results by building type are being saved to the appropriate table “huSurgeAssmBldgType” but are not displayed in the interface.
- **Impact**: This display issue may hinder users' ability to assess the combined effects of wind and surge on different building types efficiently.
- **Workaround**: Users can connect to the SQL database for their Hazus hurricane study region in ArcGIS and then map the results from the connected tables. For guidance, please refer to our YouTube training video, Hazus | Connect to a SQL Database in ArcGIS.
- **Versions Affected**: Hazus 6.1
- **Reference ID**: RSA-18065

Mapping the Future: Hazus and ArcGIS Pro Integration

9. Transitioning to ArcGIS Pro

As the GIS landscape advances, Hazus is adapting to stay at the forefront. In line with Esri's direction, we're preparing for Hazus 7.0 to integrate with the ArcGIS Pro platform, set for release next year. This move ensures that Hazus continues to benefit from the latest GIS innovations.

With Esri focusing on ArcGIS Pro and phasing out support for ArcGIS 10.8.2, this transition is a logical step forward. It's part of our commitment to providing a reliable and modern tool for the risk assessment community.

Looking ahead, we're excited about the opportunities this change will bring. The Hazus Program is dedicated to ensuring Hazus remains a valuable resource in the GIS and risk assessment fields. As we work on the specifics of this transition, we appreciate your understanding and patience.

To stay up to date with the Hazus Program on risk assessment guidance If you have questions or need further information about this transition, please don’t hesitate to reach out to FEMA-Hazus-Support@fema.dhs.gov. We're here to assist and value your feedback.

Hazus Help Desk Support

For any questions, concerns, or issues you may encounter, please reach out to our Help Desk at FEMA-Hazus-Support@fema.dhs.gov. We are committed to providing timely and effective support to ensure you can make the most out of Hazus 6.1.