# Structure-Level Flood Risk Database for Minot, ND as a Prototype for Leveraging National Building Outlines in Hazus Risk Model

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HAZUS
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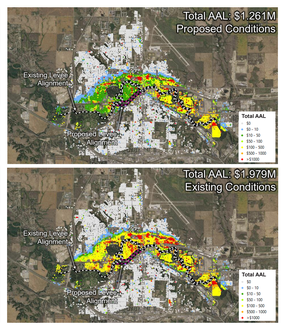
## What is Hazus?

Hazus is a freely available natural hazard loss estimation software managed and distributed by the Federal Emergency Management Agency (FEMA) and developed as an ArcGIS Desktop extension. FEMA is transitioning Hazus to an Open Source, web-based risk assessment platform called OpenHazus, where risk modeling experts, researchers, and mitigation planners can find analytical tools, data, and maps to help drive risk reduction across the U.S. Part of the OpenHazus initiative aims to generate a nationwide structure-level inventory dataset complete with unique identifiers and the attributes required to perform probabilistic flood risk analysis using Microsoft building outlines and Google plus codes. This nationwide structure database will dramatically increase the accuracy of basic, cost-effective risk assessments in communities across the U.S. and support the development of a national baseline flood risk analysis to drive actionable resilience measures.

## First Steps: Structure-Level Flood Risk in Minot, ND

In order for a structure-level nationwide inventory to improve upon the existing generalized baseline Hazus inventory, structure data must have reasonably accurate attributeAs a first step toward accomplishing this goal, the Hazus program and FEMA Engineering Services Division developed a structure-level flood risk database for Minot, North Dakota complete with unique identifiers from Google plus codes, building outlines from Microsoft and risk-related structure attributes including occupancy type, foundation type, and first floor elevation. These attributes were assigned using two different methods for comparison: first using a combination of local data and statistical distribution and second using census-based assumptions. Since census-based assumptions will be used to assign structure attributes to the final nationwide structure-specific Hazus inventory data, comparing these methods allows us to examine the difference between proposed Hazus attribute distributions and those found in more accurate local data.

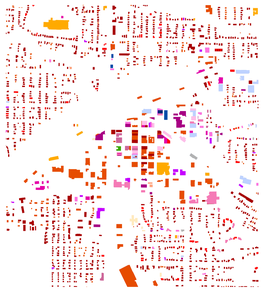
Each structure in the Minot database contains complete probabilistic flood risk metrics created by the FEMA Engineering Services Division for a citywide risk study using thousands of simulated flood hazard datasets - one of the most accurate flood hazard sources generated by FEMA. Average annualized flood loss estimates calculated using structure-specific data and these simulated flood hazard data were used to calculate the mitigation value of proposed levee construction along a downtown reach of the Souris River. Comparing the difference between flood risk calculated using locally-derived structure attributes and flood risk calculated using Hazus-derived attribute assumptions will allow us to isolate the uncertainty in risk driven by the quality of structure data.

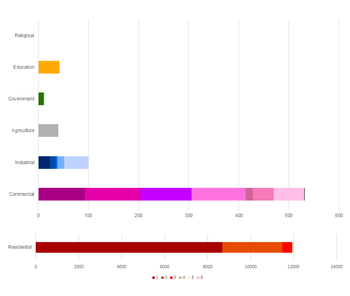




## Exploratory Results

### Occupancy Type

Occupancy types for the Hazus prototype structure dataset were assigned by distributing Census block occupancy type counts according to building footprint size. Occupancy types for the "local" structure dataset were taken directly from data collected by local jurisdictions. Hazus assumptions resulted in an 89% match with generalized occupancy category distributions found in local data, and a 63% match with exact occupancy category distributions. Occupancy types drive the distribution of remaining structure attributes for the Hazus prototype structure dataset (foundation type, first floor elevation, etc.), so these match values represent an important source of uncertainty for risk metrics derived from a future structure-specific Hazus inventory.







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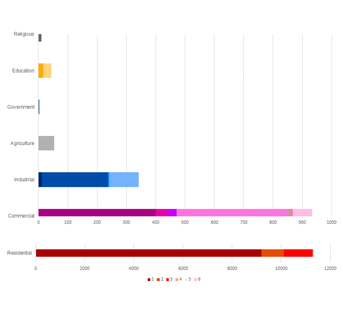
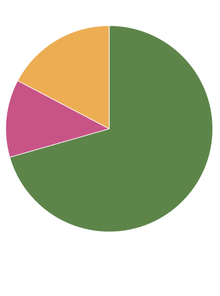


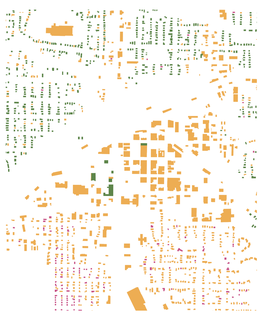

Local

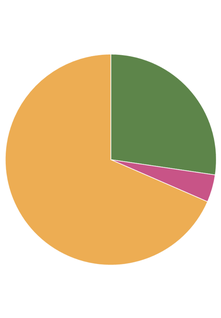
### Foundation Type

Foundation types for the Hazus prototype structure dataset were assigned according to Census block generalizations for median year built and entry date into the National Flood Insurance Program and statewide generalizations for foundation type distributions in each occupancy type. A percentage of structures meeting selection criteria for each occupancy and foundation type were randomly sampled for attribute assignment. Foundation types for the "local" structure dataset were assigned according to distributions derived by manually analyzing Google street view images of a subset of structures (200). The more generalized Hazus assumptions dramatically overestimate the proportion of structures with a basement in Minot, ND, which may lead to overestimation of flood risk from a nationwide structure prototype.




Hazus

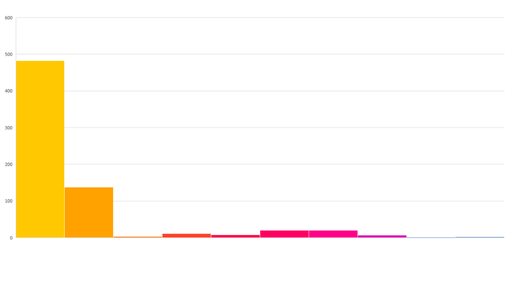




Local

### First Floor Elevation

First floor elevations for the Hazus prototype structure dataset were assigned according to statewide generalizations for height estimates based on foundation type, occupancy type, and timing of construction compared with National Flood Insurace Program participation. Height assumptions were converted to elevation using Lidar-derived digital elevation data. First floor elevations for "local" structure data were derived according to step count and foundation type distributions generated using a manual analysis of Google Street View images from a subset of structures (200). Hazus assumptions overestimate lower elevation structures, which could drive an overestimation in flood risk at a nationwide scale if a nationwide Hazus structure inventory is implemented using these attribution methods.

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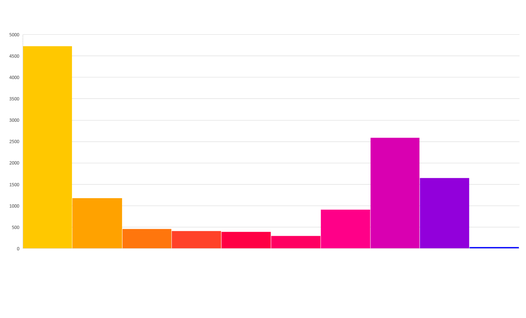


Local

## Flood Risk

**$ 1,120,219** Hazus

**$ 1,237,002** Local

## Next Steps

- Run attribution method for structure databases in Hawaii and Alabama, where structure attribute distribution can be compared with highly accurate CoreLogic parcel data in those states.
- Generate nationwide structure database with Hazus flood model attributes and documented uncertainties using Microsoft or Oak Ridge building footprints and above attribution method.