

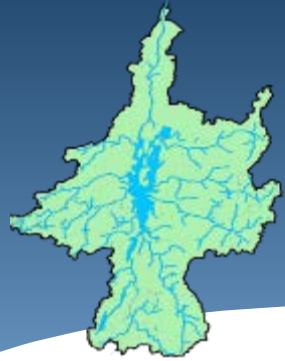
Building Mapping & Flood Damage Estimation for the Lake Champlain Basin

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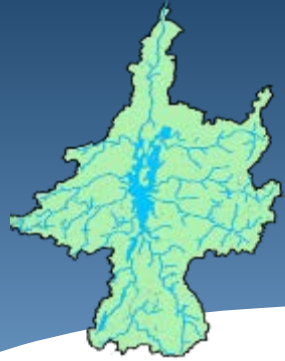




Overview

- Flood Mapping: Depth Damage Grid
- Building Mapping
- Building Damage Estimation
- Vermont Preliminary Results
- Next Steps- Depth Damage Functions

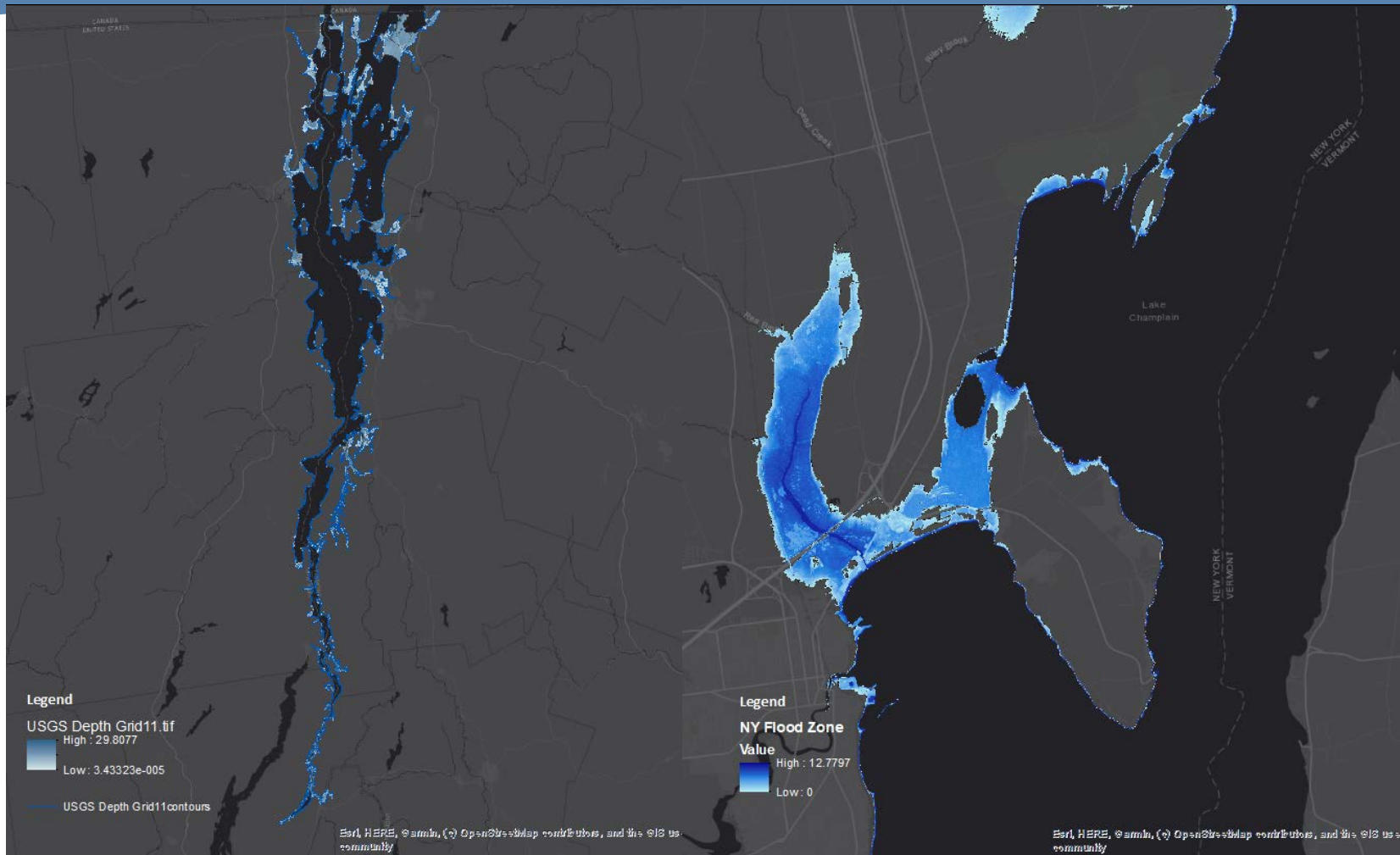
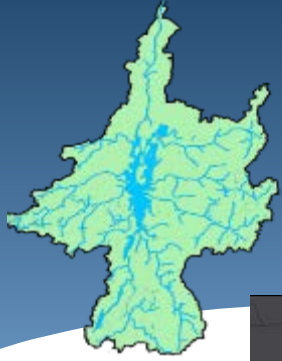




Damage Estimation Workflow



Depth Damage Grid

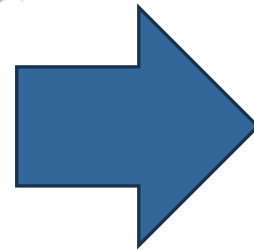
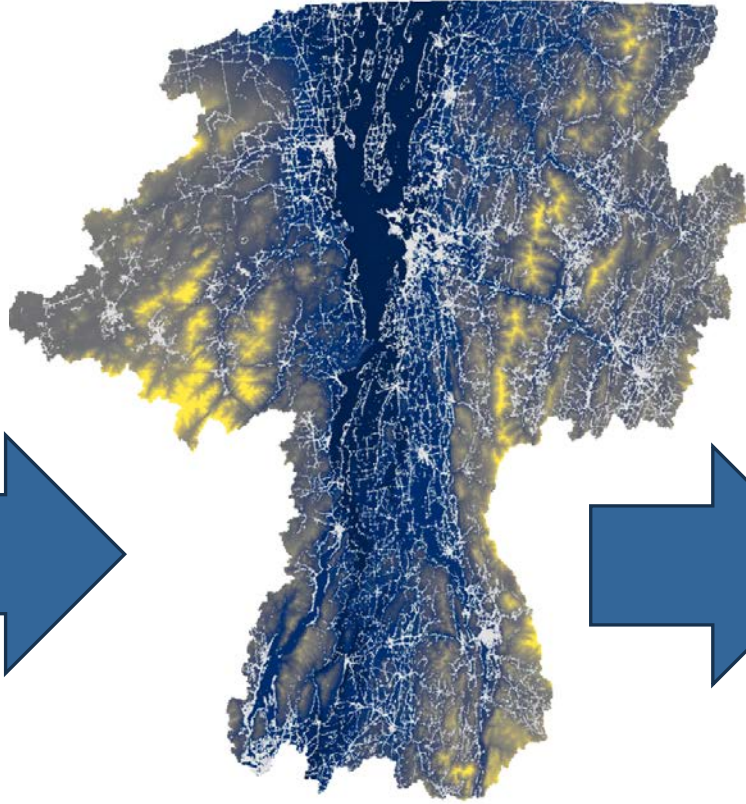
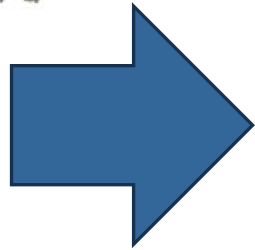
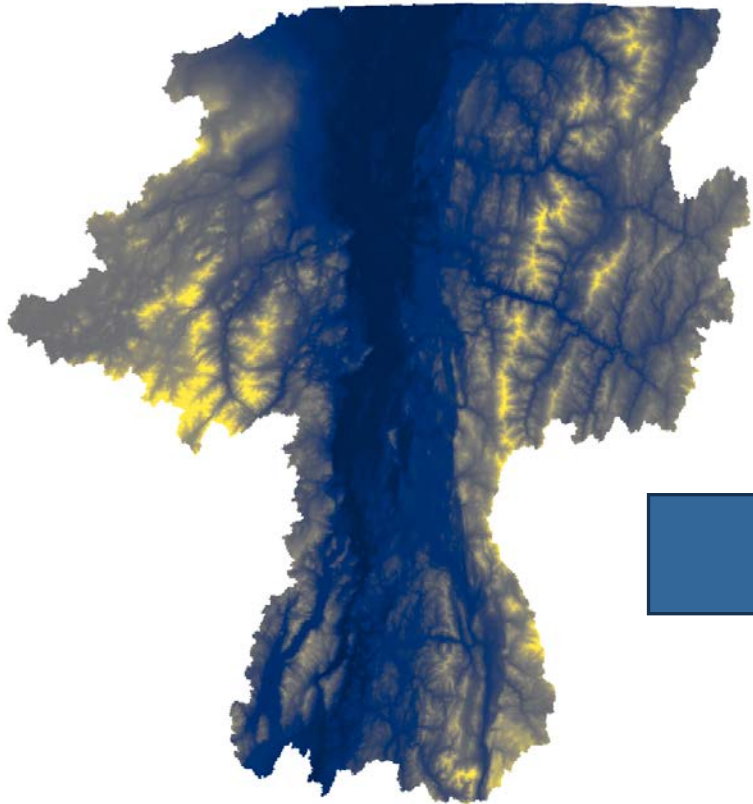
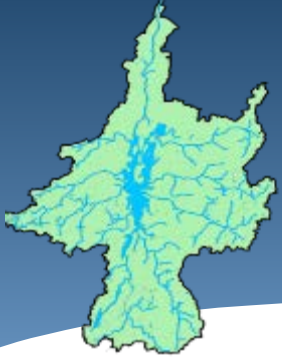


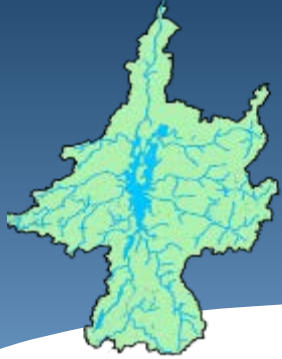
Flood mapping of the 106 foot flood stage using USGS depth grid developed from flood lake gage data across the US portion of the study region.

<https://pubs.er.usgs.gov/publication/sir20185169>

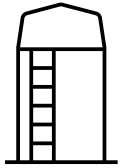


Building Mapping





Damage Estimation



Building Attribution Mapping Specific Hazus Land Use Categories

NY

Spatial join buildings & [NY state parcel centroids](#) -> match NY 3- digit property type code to Hazus occupancy table using [SIC conversion](#) -> [manually clean up](#) final Hazus codes using other parcel field descriptors. Manually determine codes for buildings that were not matched.

*Of the NY Counties impacted by the flood zone, Clinton was the only one that makes parcel data available for free.

VT

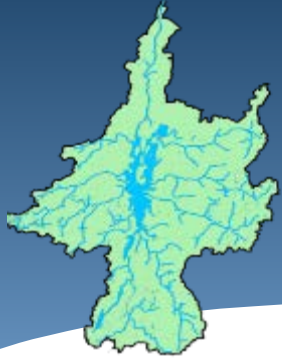
Spatial join [E911 point file](#)-> match E-911 site type category field to Hazus occupancy table -> use [VT parcel polygons](#) to determine occupancy type for any missing fields -> [manually clean up](#) final Hazus codes using other E-911 and VT parcel field descriptors.

*VT parcel data descriptors were not specific enough to match occupancy type with those alone.



Table 1-2: Hazus Building Occupancy Classes, from Hazus Technical Manual.

| Label | Occupancy Class | Example Descriptions |
|----------------------------|--|--|
| Residential | | |
| RES1 | • Single Family Dwelling | House |
| RES2 | • Mobile Home | Mobile Home |
| RES3 | Multi Family Dwelling RES3A Duplex RES3B 3-4 Units RES3C 5-9 Units RES3D 10-19 Units RES3E 20-49 Units RES3F 50+ Units | Apartment/Condominium |
| RES4 | • Temporary Lodging | Hotel/Motel |
| RES5 | • Institutional Dormitory | Group Housing (military, college), Jails |
| RES6 | • Nursing Home | |
| Commercial | | |
| COM1 | • Retail Trade | Store |
| COM2 | • Wholesale Trade | Warehouse |
| COM3 | • Personal and Repair Services | Service Station/Shop |
| COM4 | • Professional/Technical/ Business Services | Offices |
| COM5 | • Banks | |
| COM6 | • Hospitals | |
| COM7 | • Medical Office/Clinic | |
| COM8 | • Entertainment & Recreation | Restaurants/Bars |
| COM9 | • Theaters | Theaters |
| COM10 | • Parking | Garages |
| Industrial | | |
| IND1 | • Heavy | Factory |
| IND2 | • Light | Factory |
| IND3 | • Food/Drugs/Chemicals | Factory |
| IND4 | • Metal/Minerals Processing | Factory |
| IND5 | • High Technology | Factory |
| IND6 | • Construction | Office |
| Agriculture | | |
| ARG1 | • Agriculture | |
| Religion/Non-Profit | | |
| REL1 | • Church/Non-Profit | |
| Government | | |
| GOV1 | • General Services | Office |
| GOV2 | • Emergency Response | Police/Fire Station/EOC |
| Education | | |
| EDU1 | • Grade Schools | |
| EDU2 | • Colleges/University | Does not include group housing |



Damage Estimation



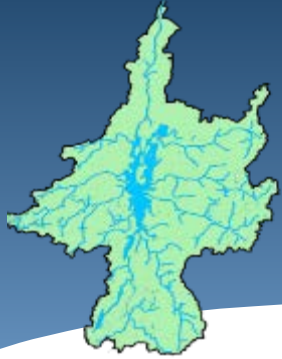
Building Attribution **Foundation Type**

All buildings assumed to be 1' slab on grade with the following exceptions

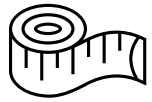
NY- Clinton County basement and crawl space data were included when it was available in the parcel layer.

VT- basement data was included for buildings where it was available for free through a realtor company.





Damage Estimation



Building Attribution

Building Height/Number of Stories

Residential Occupancy Type

8'/story

+ 6' attic

+ 4' basement

(exception is that most mobile home occupancy types considered 1 story)

Multi unit Residential

10'/story

+ 6' attic

+ 4' basement

All other Occupancy Types

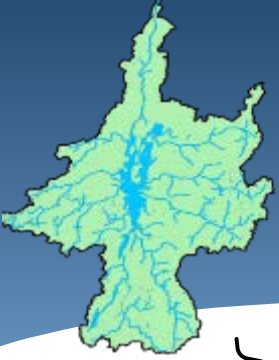
14' first floor

+10' subsequent floors

+ 6' attic



Damage Estimation

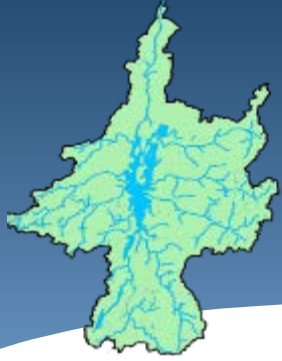


Building Attribution
Building Value & Content Value

CDMS is a HAZUS tool that validates user data to ensure that the data are Hazus compliant (e.g. appropriate domains, values, formats).

CDMS can enrich missing data from user provided buildings with *building value* and *content value* based on the CDMS algorithm that primarily uses census data with additional user provided attributes to calculate these values.



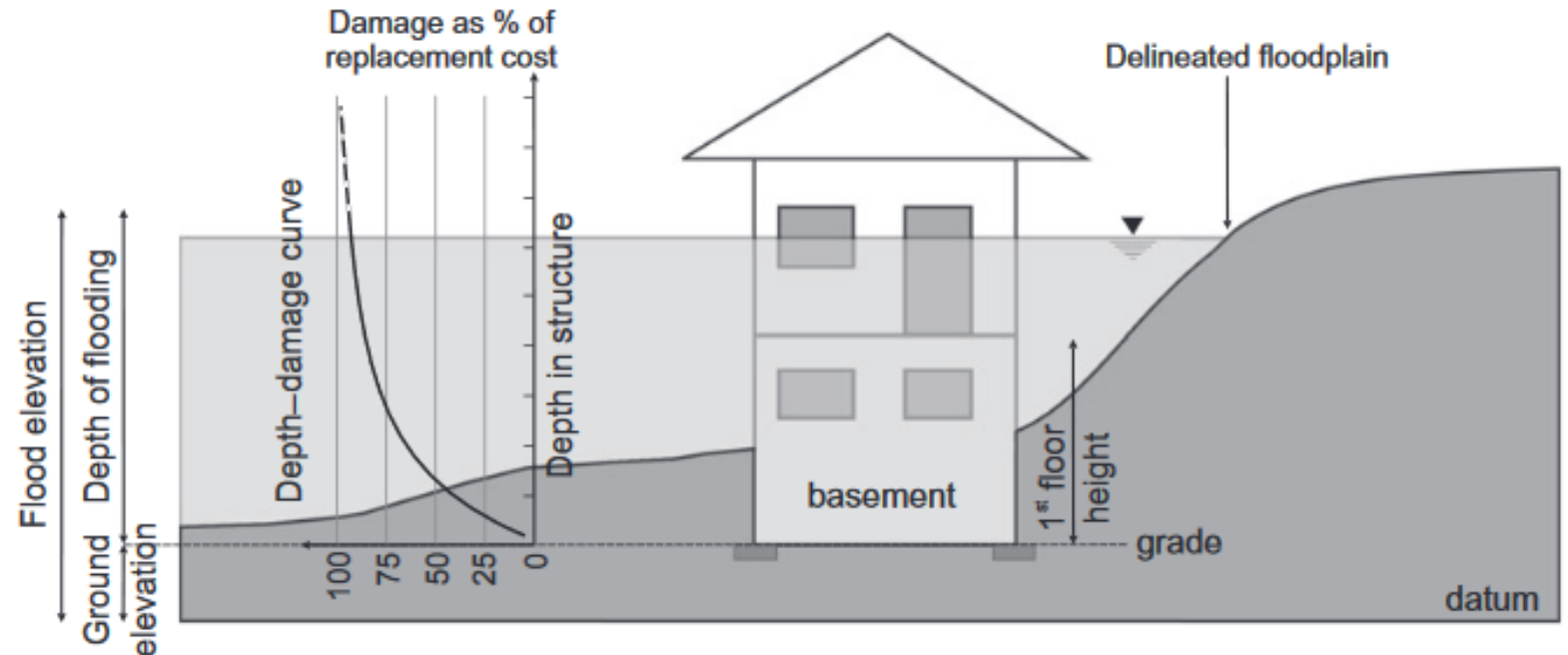


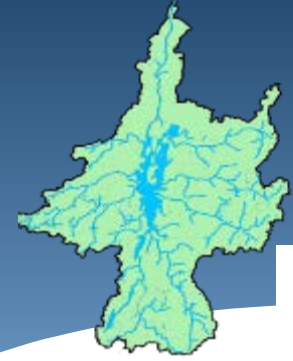
Damage Estimation

The depth damage function is a combination of occupancy type, foundation type, location, and number of stories.

The building value/contents values are used to estimate economic loss.

M. Nastev and N. Todorov





Damage Estimation

USER INPUTS

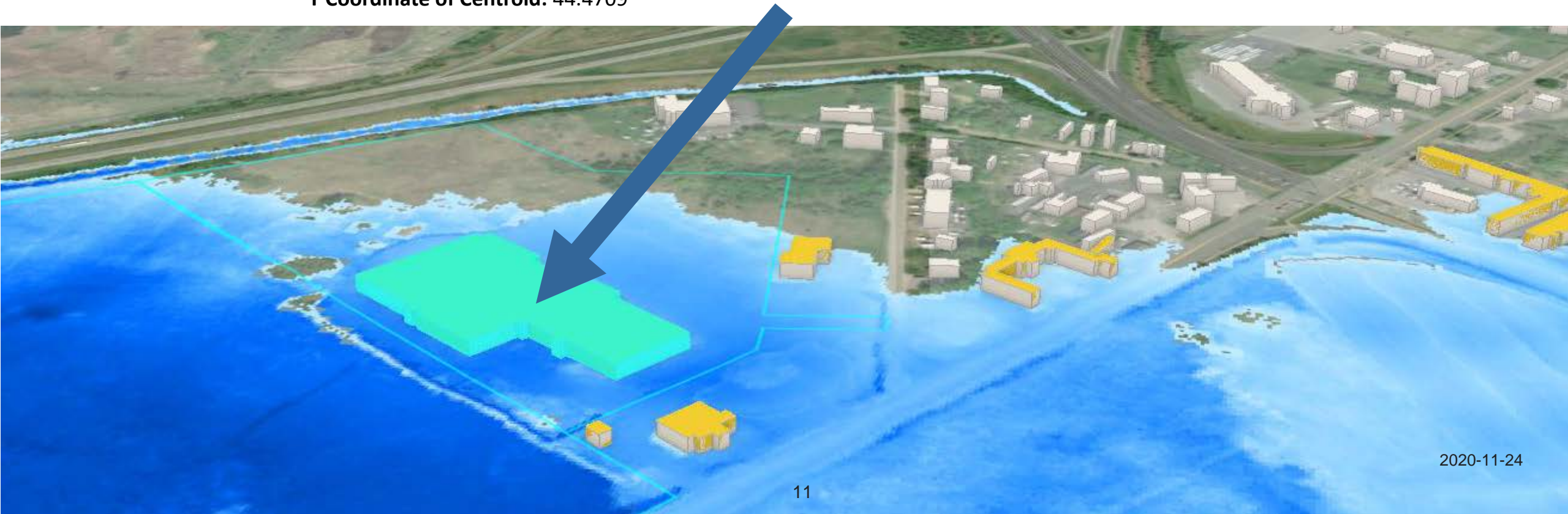
Occupancy Type: Industrial Light
Foundation Type: Slab on Grade
Number of Stories: 1
Building Height: 16'
Square Footage: 47,600
X Coordinate of Centroid: -73.2178
Y Coordinate of Centroid: 44.4709

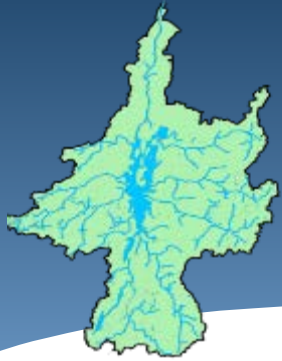
CENSUS

Building Cost: \$13,803,444 USD
Content Cost: \$20,705,166 USD (150% building cost)

HAZUS OUTPUTS

Building Loss: \$2,233,543 USD
Content Loss: \$6,568,559 USD



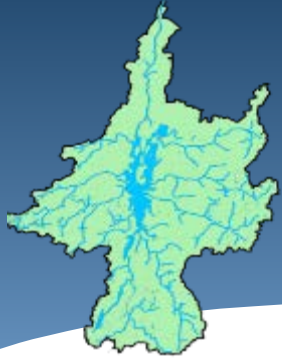


Hazus Preliminary Results- Vermont

Total Estimated Loss is

\$263,054,172



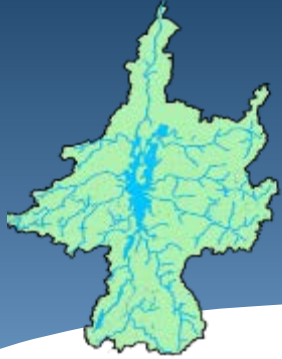


Hazus Preliminary Results- Vermont

| Specific Occupancy | Capital Stock Exposure | | Capital Stock Losses | | | |
|---|------------------------|--------------------|----------------------|--------------------|----------------|-----------------------|
| | Building Exposure | Contents Exposure | Building Loss | Contents Loss | Inventory Loss | TOTAL Loss |
| AGR1-Agriculture | 8,420,733 | 8,420,733 | 295,605 | 1,327,846 | 159,045 | 1,782,496 |
| REL1-Churches and Other Non-profit Org. | 1,499,508 | 1,499,508 | 167,745 | 1,267,159 | 0 | 1,434,904 |
| RES3A-Duplex | 652,871 | 326,435 | 132,016 | 81,886 | 0 | 213,902 |
| GOV2-Emergency Response | 2,604,327 | 3,906,491 | 255,694 | 752,867 | 0 | 1,008,561 |
| COM8-Entertainment & Recreation | 29,878,463 | 29,878,463 | 2,833,685 | 14,335,429 | 0 | 17,169,114 |
| GOV1-General Services | 8,767,095 | 8,767,095 | 232,059 | 1,513,824 | 0 | 1,745,883 |
| IND1-Heavy | 15,570,920 | 23,356,380 | 52,495 | 0 | 16,085 | 68,580 |
| RES2-Manuf. Housing | 11,197,543 | 5,598,772 | 10,229,787 | 5,114,893 | 0 | 15,344,680 |
| IND4-Metals/Minerals Processing | 256,560 | 384,840 | 8,661 | 64,222 | 9,496 | 82,380 |
| COM3-Personal and Repair Services | 3,144,594 | 3,144,594 | 0 | 64,885 | 0 | 64,885 |
| COM4-Professional/Technical Services | 72,927,483 | 72,927,483 | 10,435,781 | 16,048,307 | 0 | 26,484,088 |
| COM1-Retail Trade | 19,814,008 | 19,814,008 | 1,591,726 | 4,905,336 | 399,139 | 6,896,202 |
| RES1-Single Family Dwelling | 290,983,774 | 145,491,887 | 88,632,662 | 49,357,328 | 0 | 137,989,990 |
| RES4-Temporary Lodging | 402,412,449 | 201,206,225 | 16,965,192 | 33,007,354 | 0 | 49,972,546 |
| RES3B-Triplex / Quads | 4,711,906 | 2,355,953 | 1,874,383 | 921,578 | 0 | 2,795,961 |
| Scenario Total | 872,842,234 | 527,078,866 | 133,707,492 | 128,762,916 | 583,764 | 263,054,172.32 |

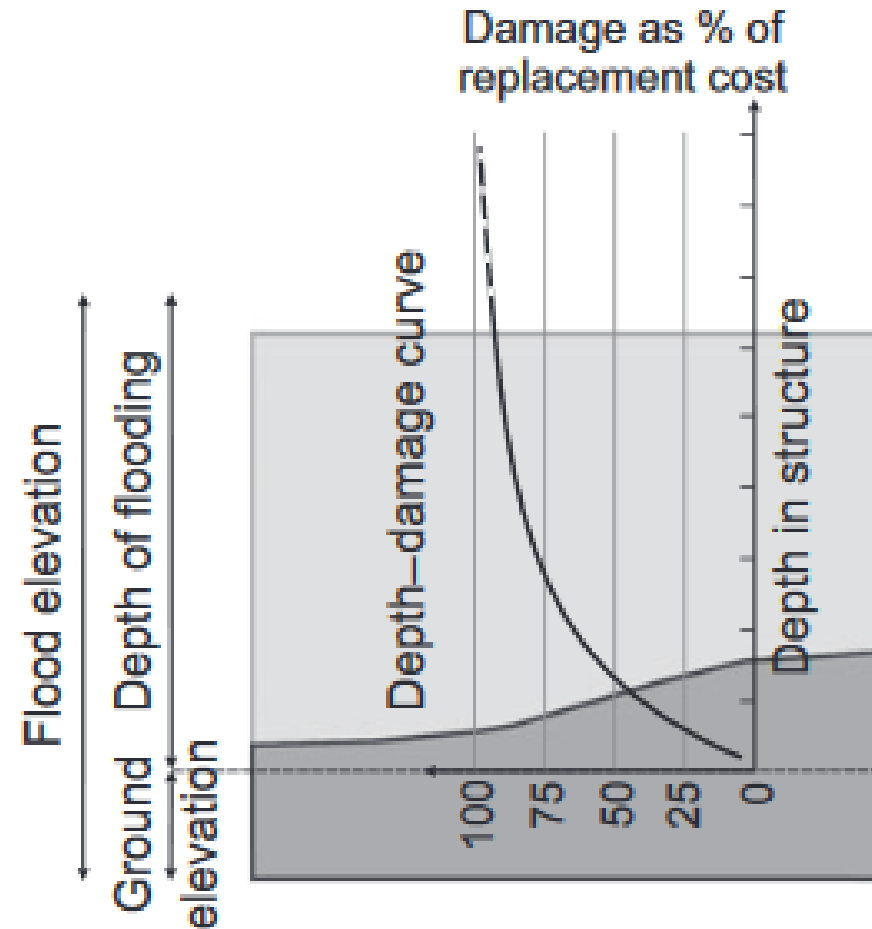


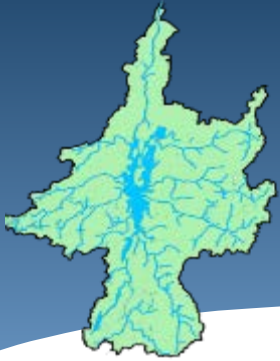
Next Steps



Stage Damage Tables

Developing a depth damage function to calculate damage at different levels of flooding.





Key Messages

- **State of the art flood damage estimation method that is replicable.**
- **106' is an extreme scenario, but we can extrapolate estimates for other flood levels.**
- **Complimentary to other project components.**
- **Scalable from an individual building, to neighborhood to entire LCB region.**
- **Mapping makes data more accessible.**



Thank You

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