



PROTECTING MONTPELIER: STRATEGIES FOR FLOOD RISK MITIGATION

Capstone Group 2
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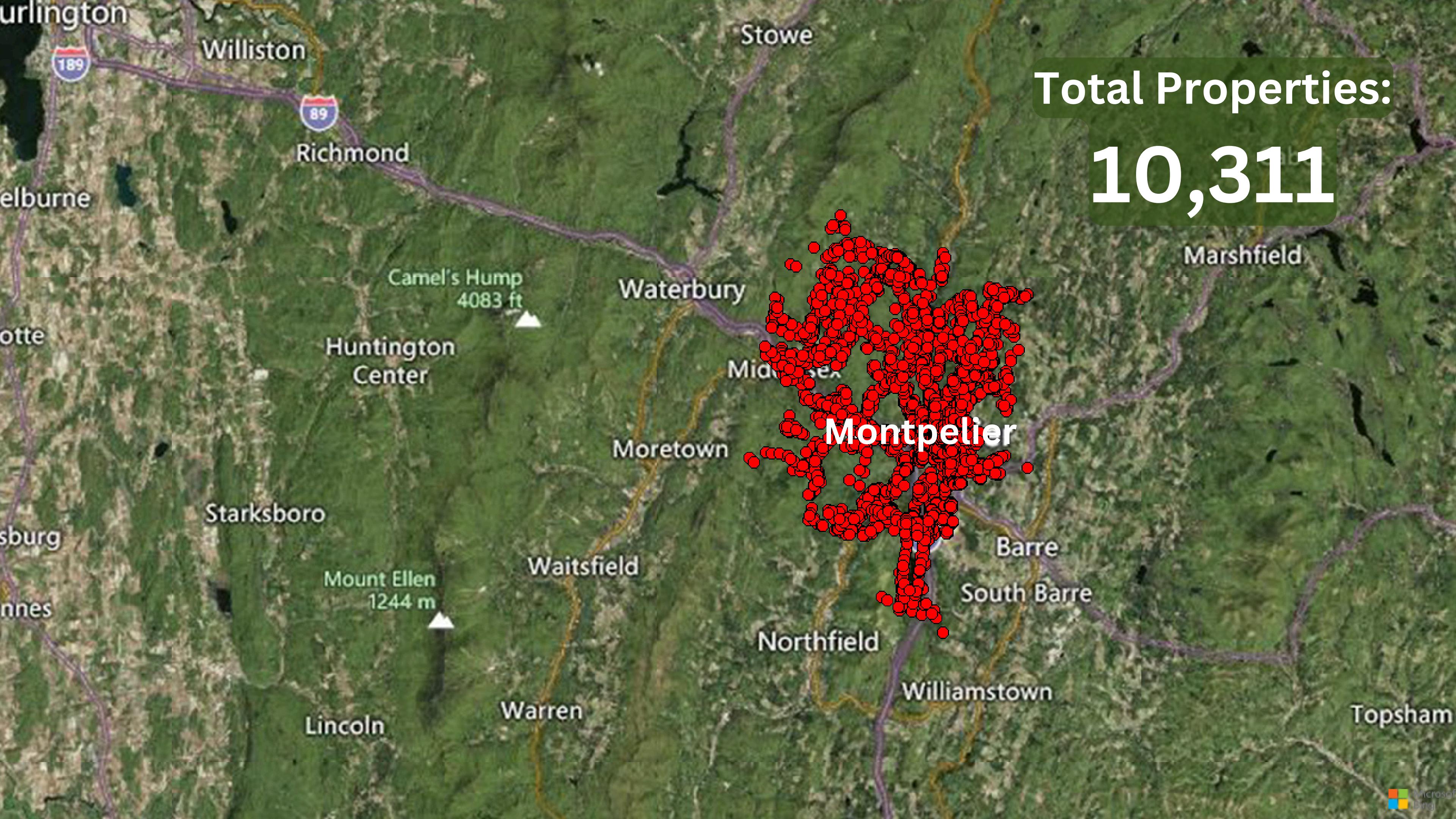
SIDHANT KUMAR

"The historic flooding last month has had a deep impact on our state. In my travels to Hardwick, Montpelier, Ludlow and many areas in between, it has been heartbreaking to see the damage inflicted on people's homes, businesses, and to our natural landscape."

– VERMONT SECRETARY OF STATE

Ref: <https://www.montpelier-vt.org/610/Flood-Guide>

Total Properties:
10,311



90%

of natural disasters within the United States involve flooding.

Floods cause more economic damage, loss of life, and property than any other natural hazard.



Ref: <https://www.montpelier-vt.org/610/Flood-Guide>

Ref: <https://www.dhs.gov/natural-disasters>

MONTPELIER, VT HISTORICAL REFERENCE

JULY FLOOD, 2023

Downtown Montpelier local roads submerged by floodwaters

Transportation Disruptions

Extensive flooding throughout the **Winooski River** valley

FEMA 1 Percent Annual Chance Flood

DATA SUMMARY

Making a Comprehensive Dataset

Address Fabric:
10,311 properties

Unique Property Types:

R	Residential	6935
X	Exempt	2522
B	Business	590
M	Mixed-Use	264

No Missing Values in the most critical fields:

- Unique Property ID
- Address Details: City, State, ZIP Code
- Geographic Information: Latitude, Longitude, Location Code

Number of Invalid ZIP Codes	0
Number of Records with Incorrect State	0
Total Number of Duplicate Rows	0
Number of Unique ZIPCODEs	6

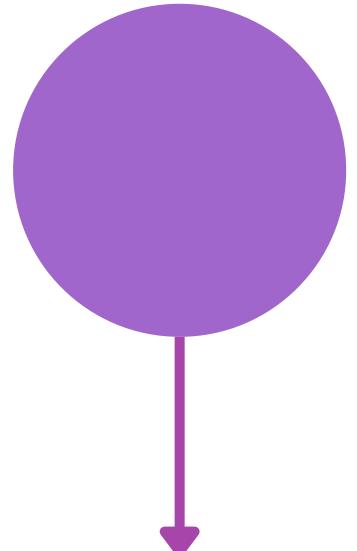
A mere **23%** of organizations use geospatial and location intelligence (GLI) capabilities within their business intelligence (BI) and analytic platforms, according to Gartner research.

<https://www.gartner.com/smarterwithgartner/add-location-to-your-analytics>

ADDRESS FORMATTING & GEOCODING

Standardized addresses and geocoded using

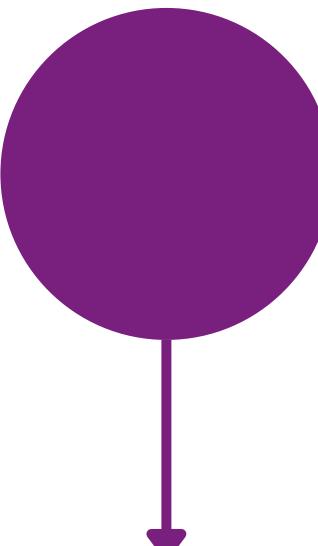
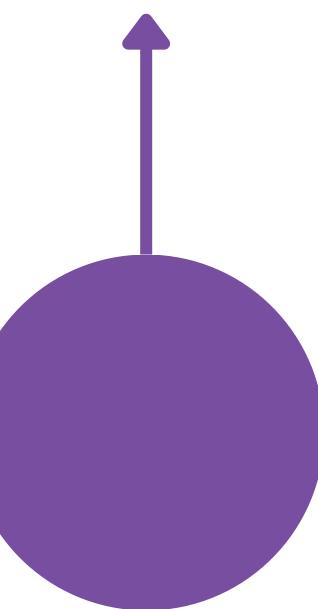
Precisely's
Geoaddressing -
Geocode API



ENRICHMENT

Fetched flood risk data using

Precisely's
GraphQL -
Floodrisk API



MERGING

Combined enriched datasets into a comprehensive data source.

Total unique records:

10,170

Flood risk data: Insights for Insurance Companies

- **High Flood Risk:** 238 Goodnow Rd, Montpelier, VT, is in an AE flood zone.
- **Proximity to Winooski River:** Increases flood vulnerability.
- **Flood History:** FIRM data shows past flooding.

Flood Risk Output

Parameters	Values
PreciselyID	P0000NOKH4MW
Address	238 GOODNOW RD, MONTPELIER, VT 05602
FloodID	2343500
FemaMapPanelIdentifier	50023C0431E
FloodZoneMapType	P2P
StateFIPS	50
FloodZoneBaseFloodElevationFeet	AE0545
FloodZone	AE
BaseFloodElevationFeet	0545
CommunityNumber	500106
CommunityStatus	R
MapEffectiveDate	2013-03-19
FloodHazardBoundaryMapInitialDate	1974-02-15
FloodInsuranceRateMapInitialDate	1984-08-15
AddressLocationElevationFeet	533
Year100FloodZoneDistanceFeet	0
Year500FloodZoneDistanceFeet	515
ElevationProfileToClosestWaterbodyFeet	533.77298
DistanceToNearestWaterbodyFeet	193
NameOfNearestWaterbody	Winooski River

FLOOD RISK SOLUTIONS FOR PROPERTY INSURANCE

Clustering based Risk Assessment

Categorizes properties by flood risk

Underinsurance Identification

Identifies underinsured properties

CLUSTERING-BASED RISK ASSESSMENT

for Insurance

Insurance companies need a more accurate and data-driven way to categorize risk levels for different properties.

Better risk categorization can improve pricing strategies, enhance customer satisfaction, and reduce losses.

Precisely APIs

propertyAttributesByAddress

floodrisk data

(Using Address details from Address Fabric)

Total addresses:

4184

**Which customers are
at the highest risk of
flood damage *based
on their location?***

40%

of all flood claims occur in low-to moderate-risk areas.

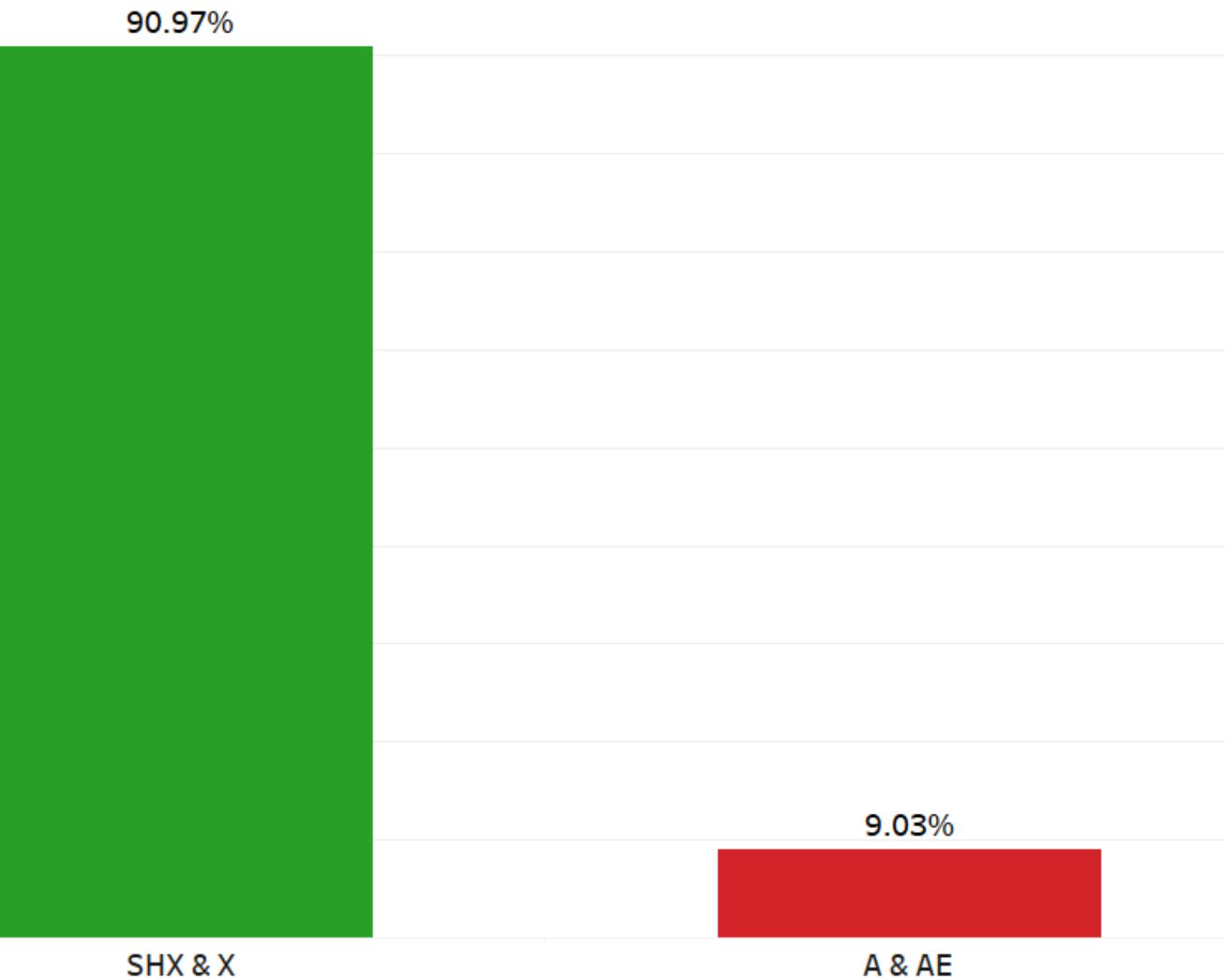
Flood insurance is an important safeguard, even for those in areas of low risk.

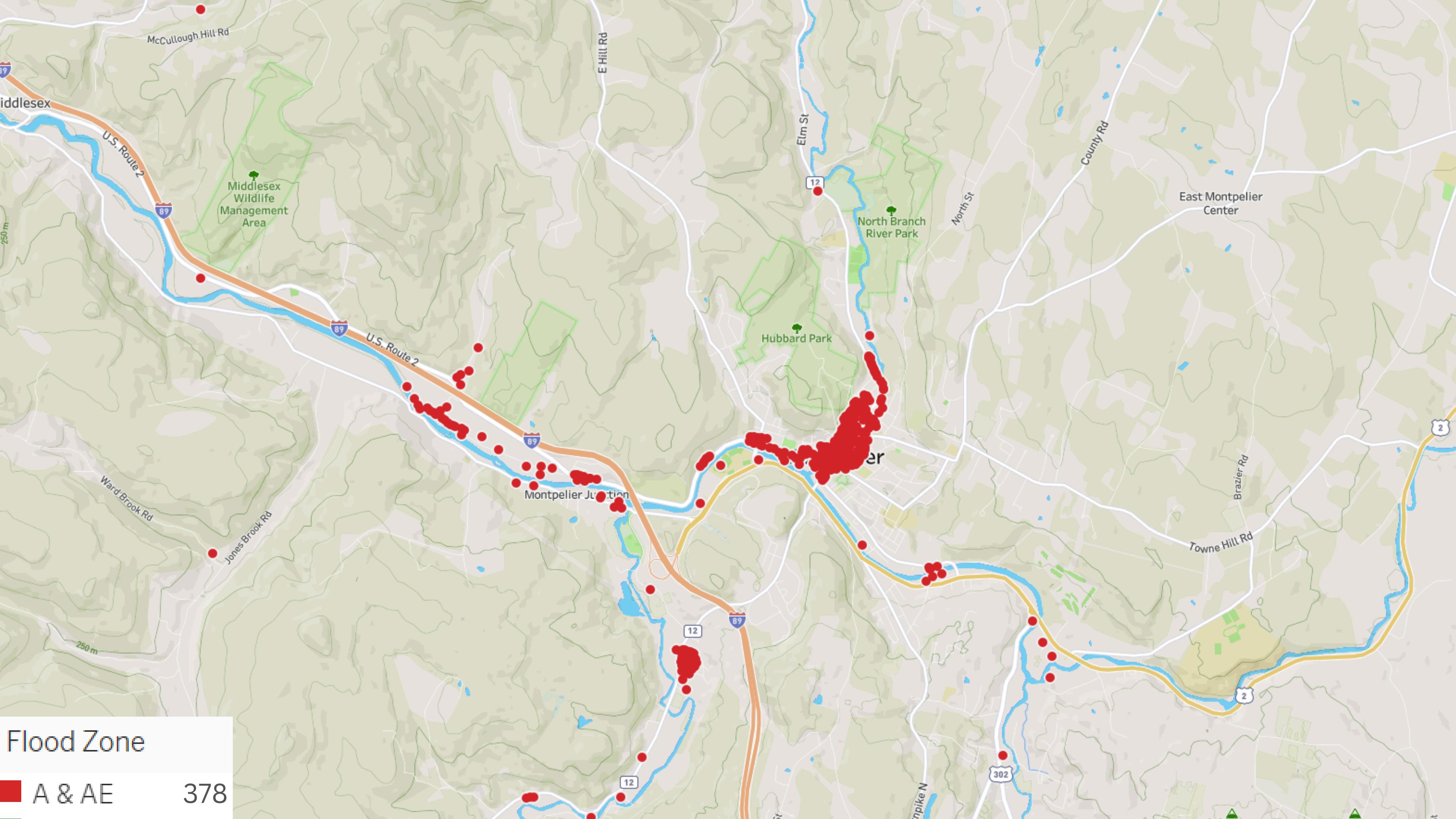
Reference: <https://www.floodsmart.gov/flood-risk>

CURRENT FLOOD ZONE DISTRIBUTION

Flood Zones	#Unique Properties	Description
A	3	
AE	375	
X	3638	
SHX	168	
	378	FEMA High risk
	3806	FEMA Low risk

Percentage of Unique Properties by Zones

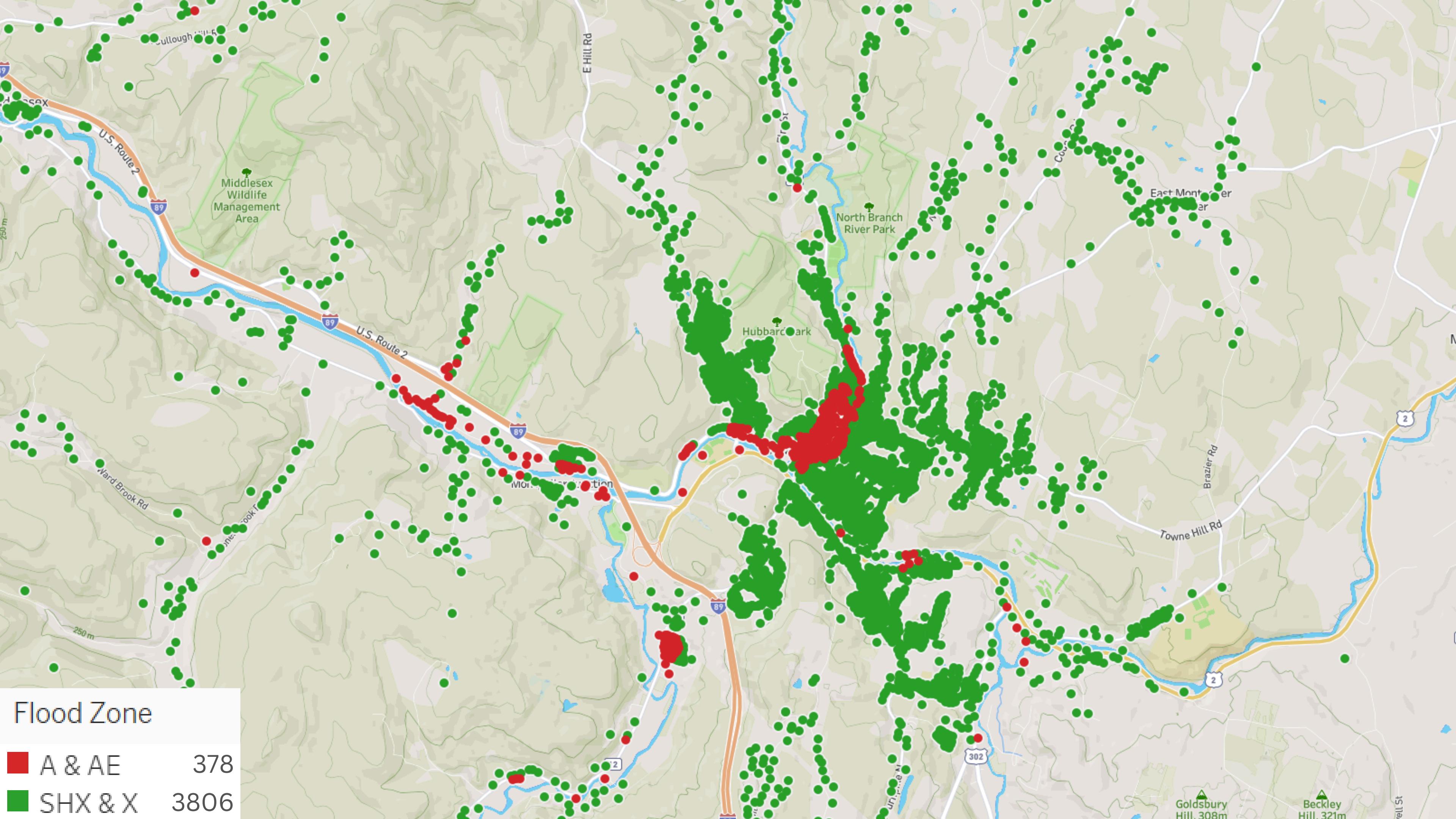




Flood Zone

A & AE

378



ENHANCING RISK ASSESSMENT WITH CRITICAL FEATURES

Distance-related features
(proximity to flood zones and elevation)

Distance Factor:
'Year100FloodZoneDistanceFeet'
'DistanceToNearestWaterbodyFeet'
'AddressLocationElevationFeet'

*Evaluate environmental hazard exposure
affecting property risk.*

**Property characteristics
and value**

Building Construction Type (Frame, etc.)
Exterior Walls (Wood Siding, etc.)
Roof Cover
Total Market Value

*Determine structural vulnerability for
accurate risk evaluation.*

**Geographic and
Flood risk data**

Flood Zone (AE, SHX, A, X)
Nearest Waterbody (Winooski River)

*Assess likelihood of hazards impacting
properties for better underwriting.*

Feature Selection:

Principal Component Analysis (PCA)
Feature Variance Analysis

Our Selected Features:

Building Construction Type (Frame)
Exterior Walls (Wood Siding)

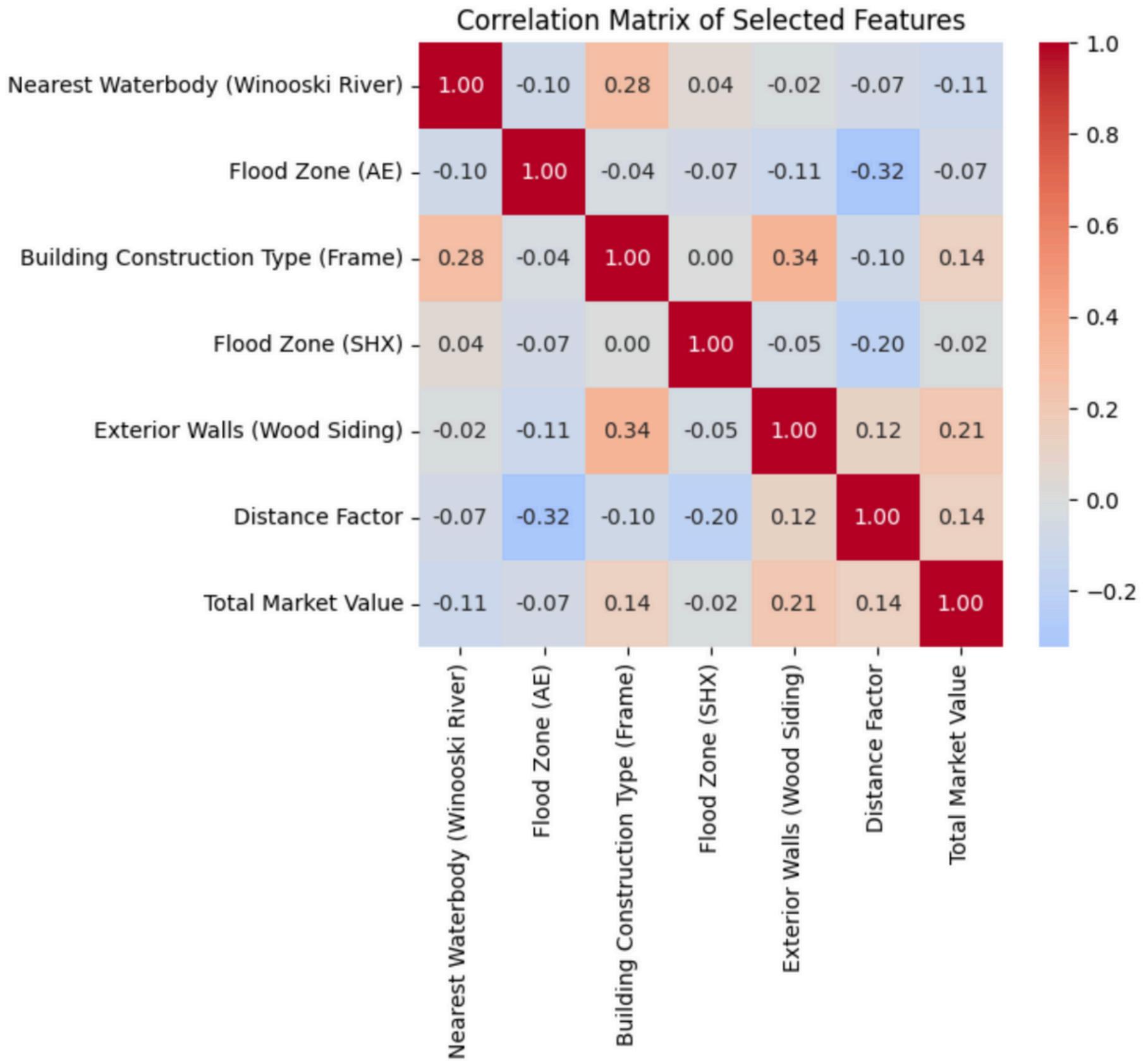
vulnerability
to damage

Flood Zone (AE)
Flood Zone (SHX)
Total Market Value
Nearest Waterbody (Winooski River)

exposure to
natural
hazards

Distance Factor:
Proximity to 100-Year Flood Zone
Nearest Waterbody Distance
Elevation Above Sea Level

risk from nearby
water bodies and
elevation
differences



DEFINING CLUSTERS:

K-means Clustering:

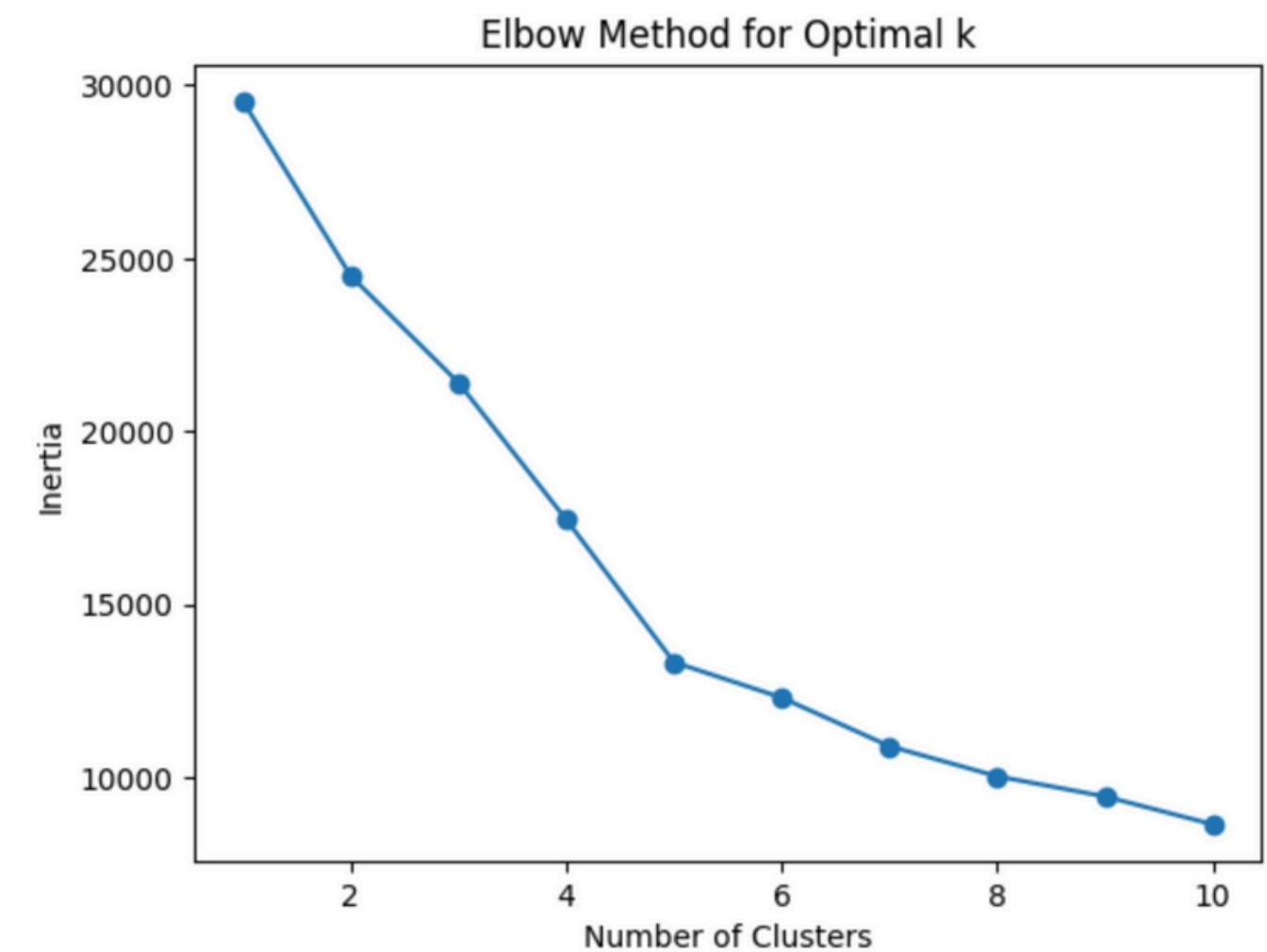
Segmented properties based on selected features.

Clusters:

Grouped properties with shared risk factors, allowing for differentiated risk levels.

Number of clusters = 5

Identified using the Elbow method

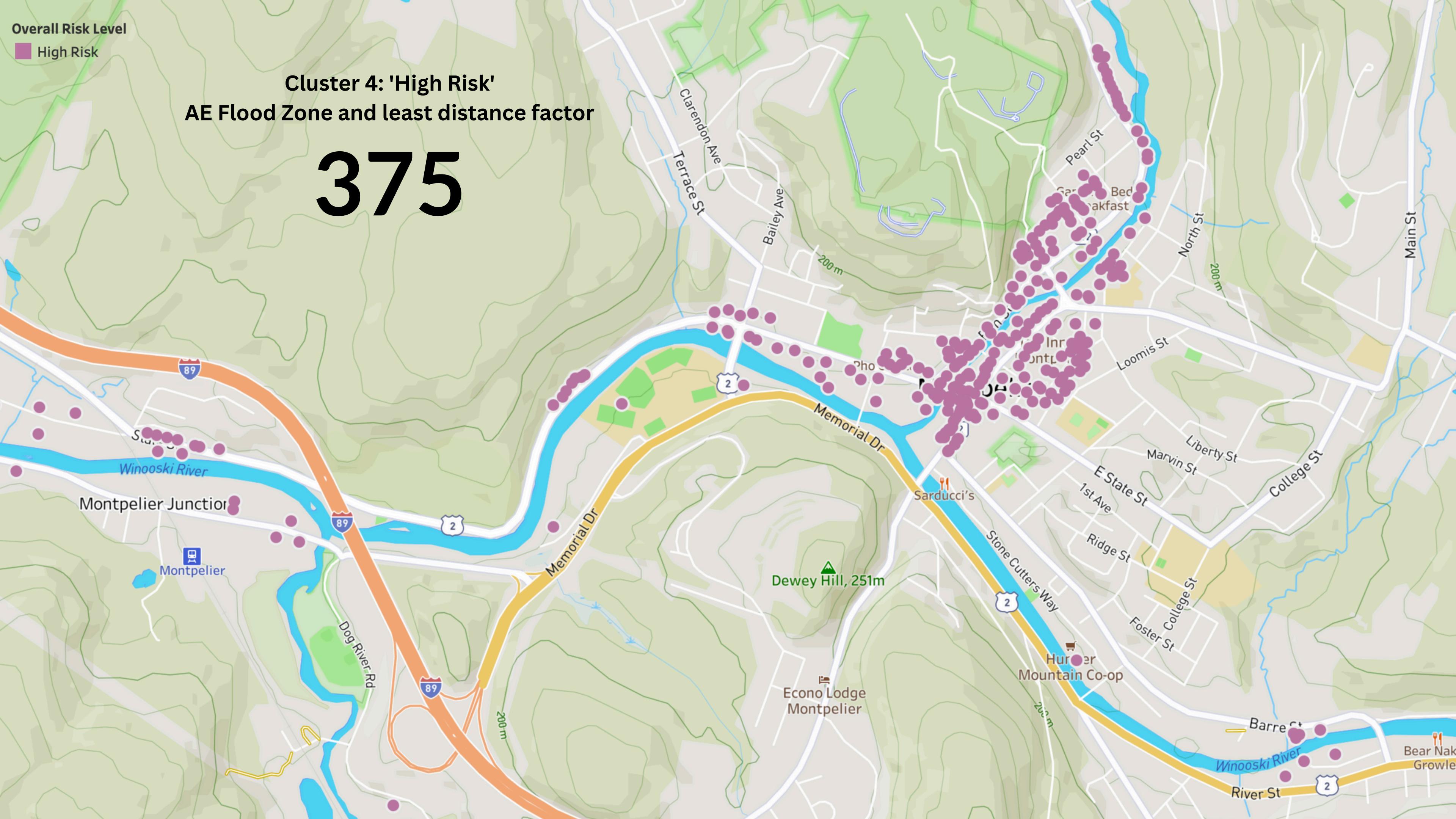


Output from the Elbow method

Overall Risk Level
High Risk

Cluster 4: 'High Risk'
AE Flood Zone and least distance factor

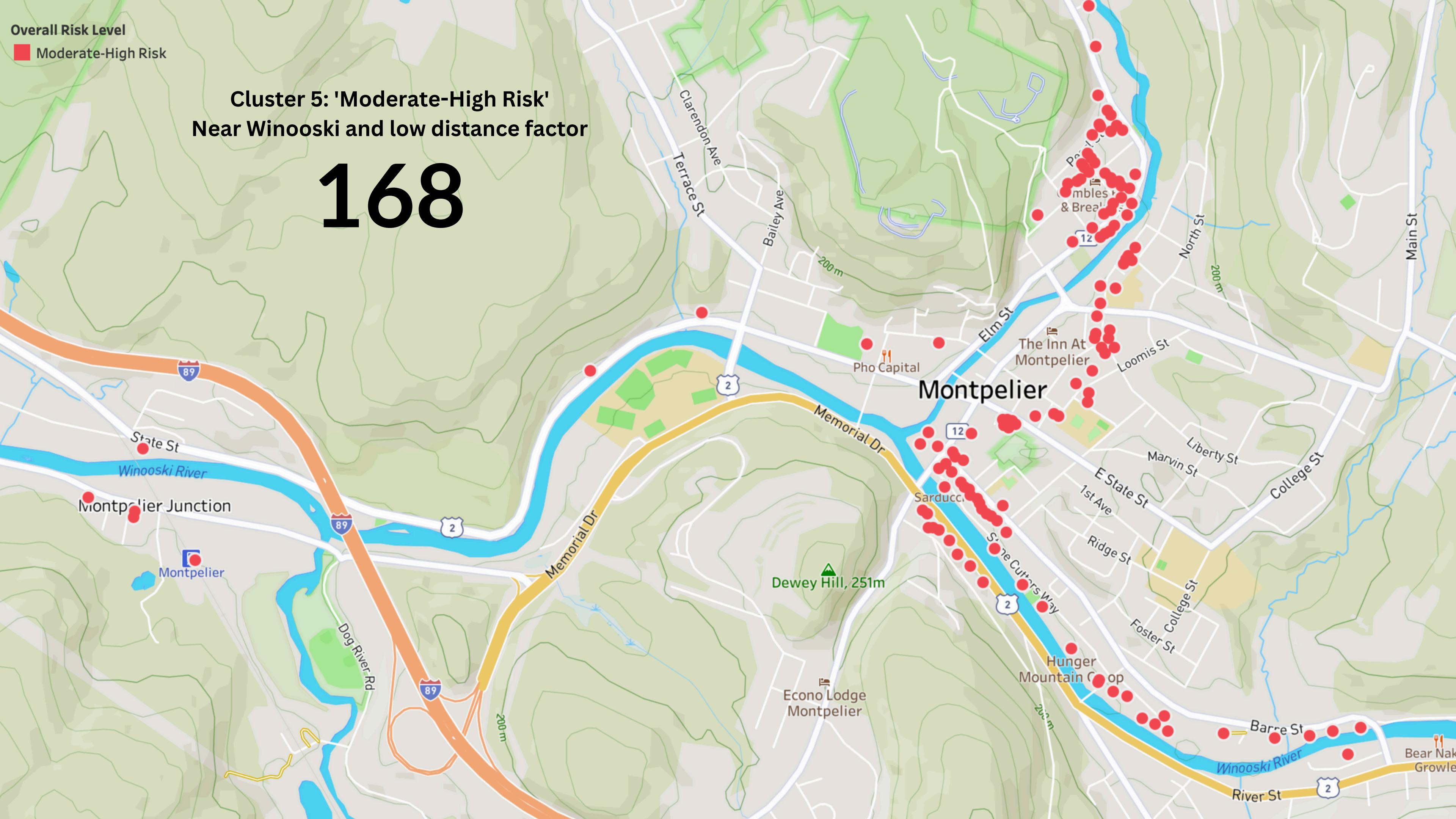
375

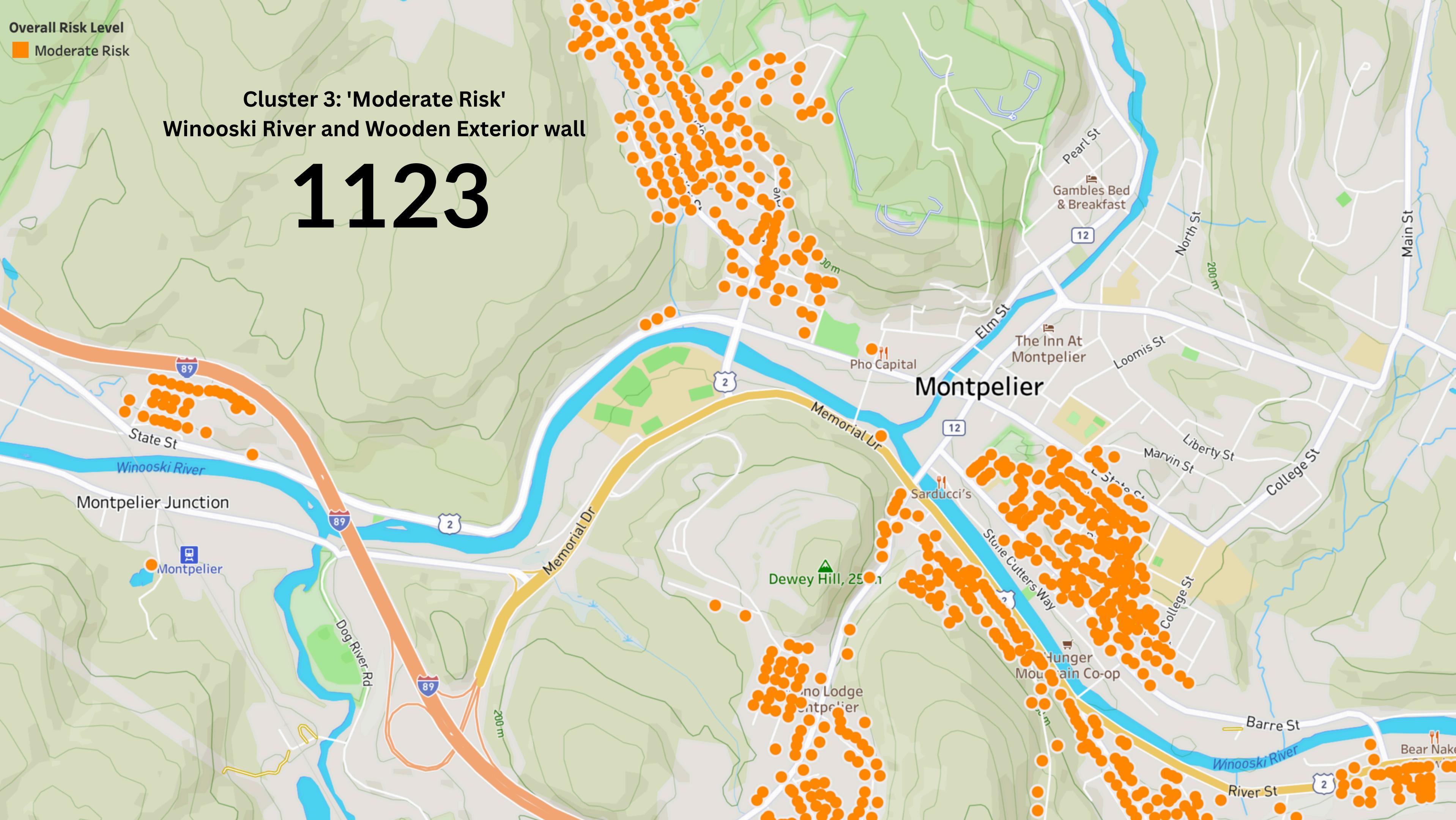


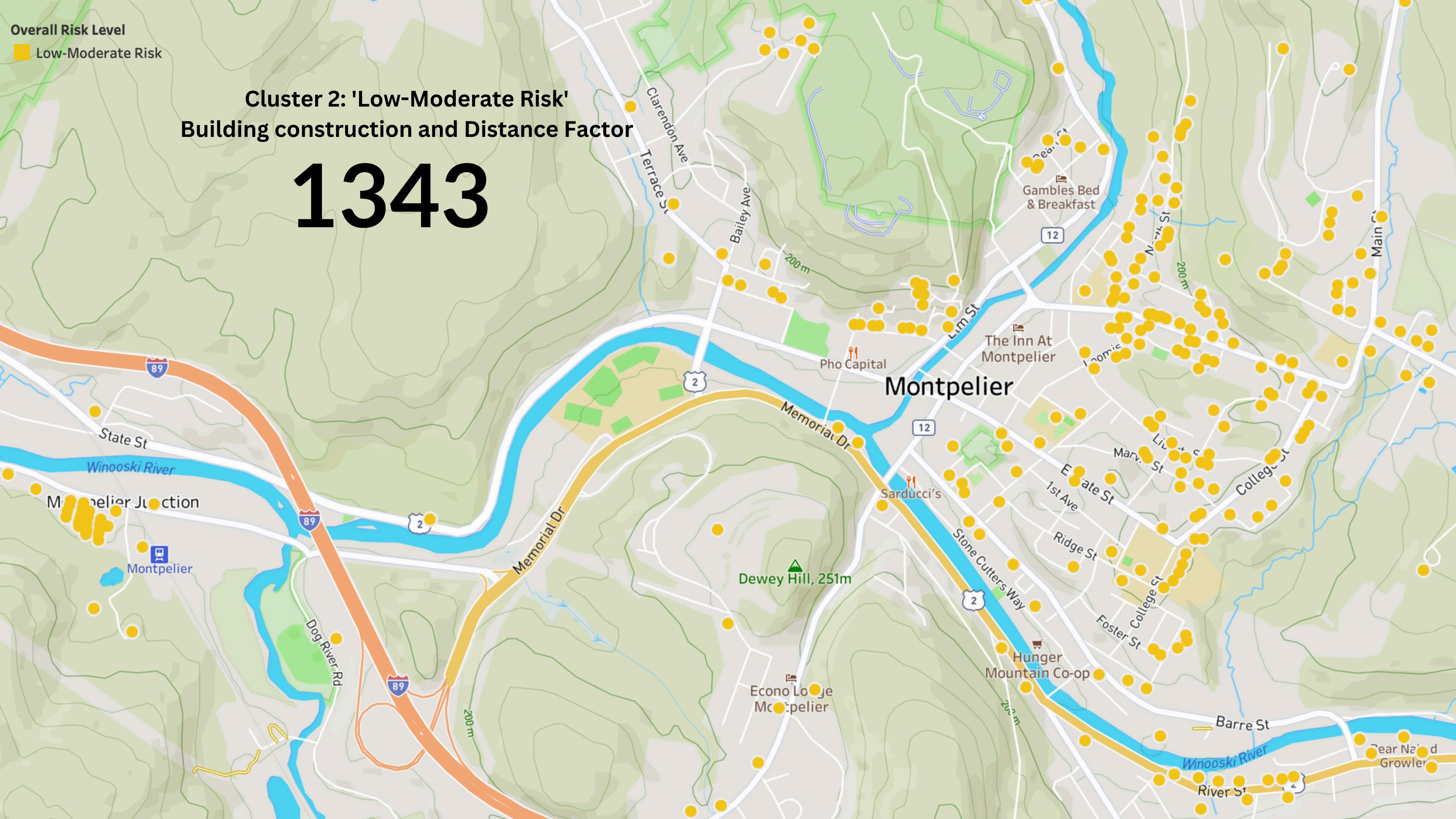
Overall Risk Level
Moderate-High Risk

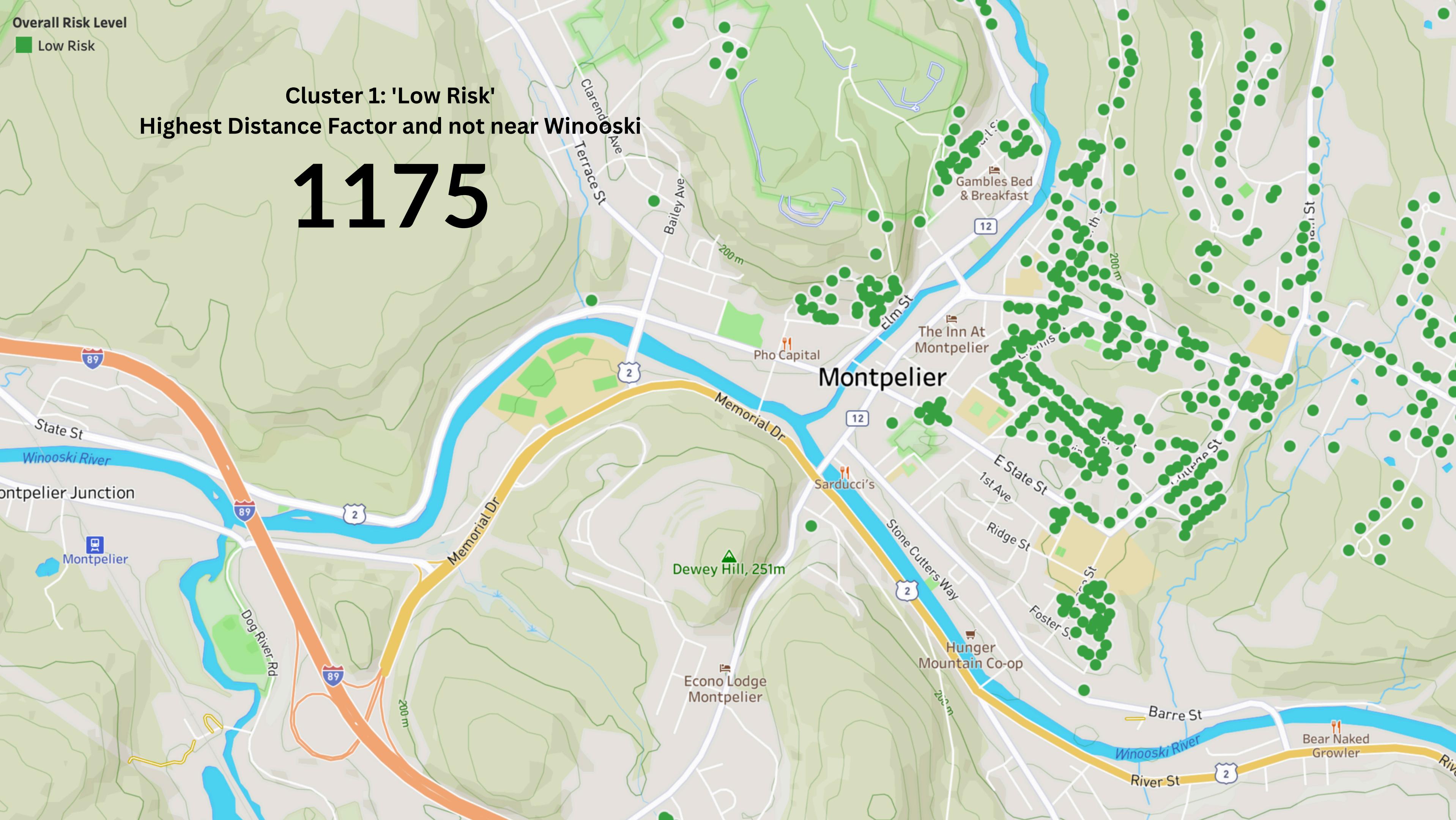
Cluster 5: 'Moderate-High Risk'
Near Winooski and low distance factor

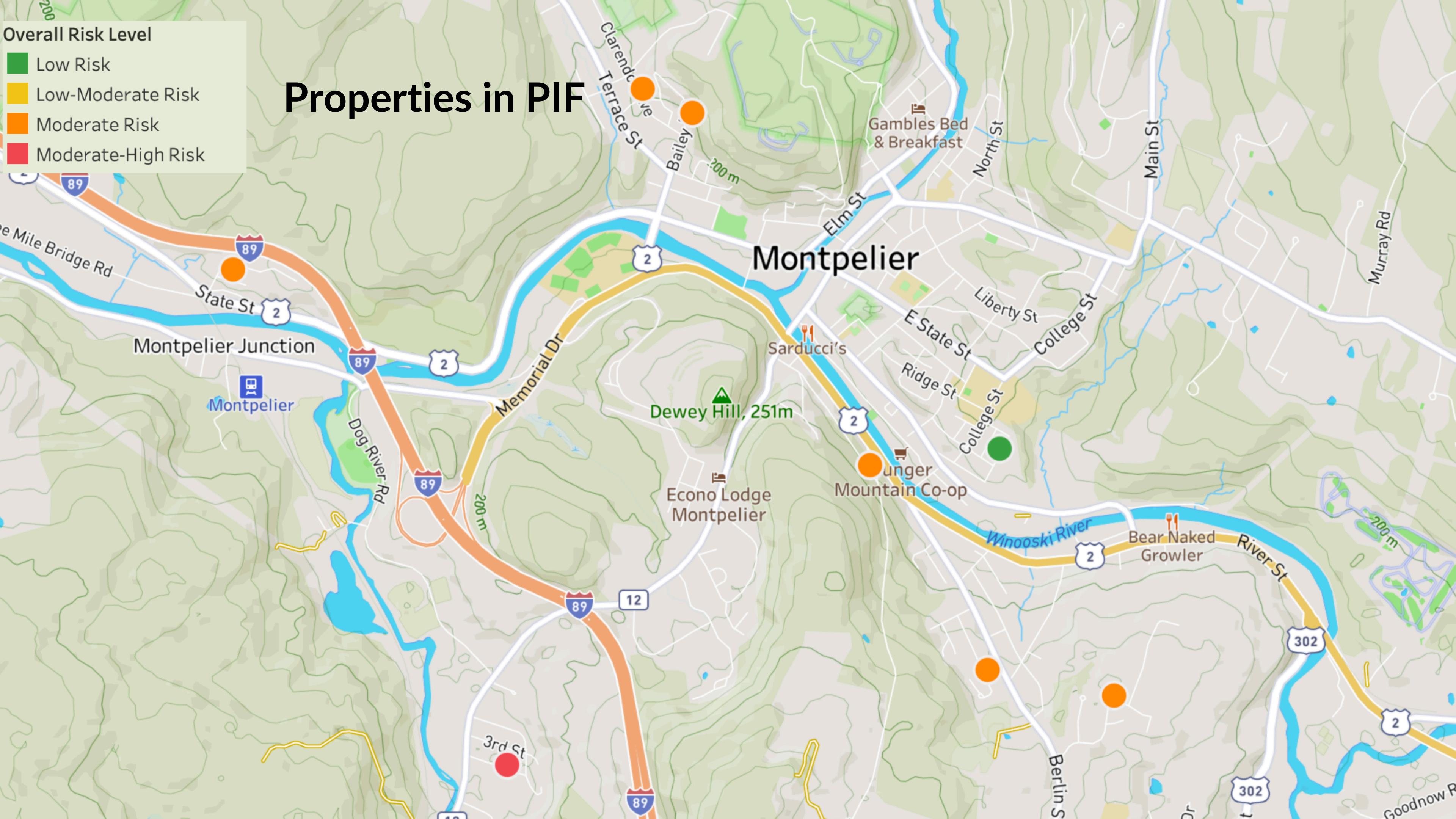
168











Flood Risk

risk-sharing partnerships
(e.g., co-insurance
models with reinsurers)

steady premium revenue:
low-premium loyalty
programs to increase
retention.

Cluster 4

high-margin policies to offset
potential losses

Cluster 5

Largest cluster = biggest
upselling opportunity.
customized policy bundles
with flood add-ons.

Cluster 3

Cluster 2

Minimal claims = reliable
profit margins

Cluster 1

Upsell multi-policy packages
with flood coverage as value
add

Which customers are *underinsured* ?

Flood insurance requirement in Montpelier: “The coverage should be at least the lesser of the loan amount or the maximum amount available (\$250k for single-family homes)”

Reference: <https://www.montpelier-vt.org/611/Flood-Insurance-Information>

UPSELLING Opportunities for Underinsured properties

Based on the **policy value** versus **assessed property value**

ITV Ratio:
Policy Value / Property's
assessed value

flagged properties as
“Underinsured” using
ITV Threshold = **80%**

“ReplacementCost” ~ “Policy Value”



Policy Value

Property Assessed Value

Adequacy of Policy Coverage

<https://www.libertyhomeguard.com/glossary/insurance-to-value/>

<https://davies-group.com/northamerica/knowledge/understanding-insurance-to-value-challenges/>

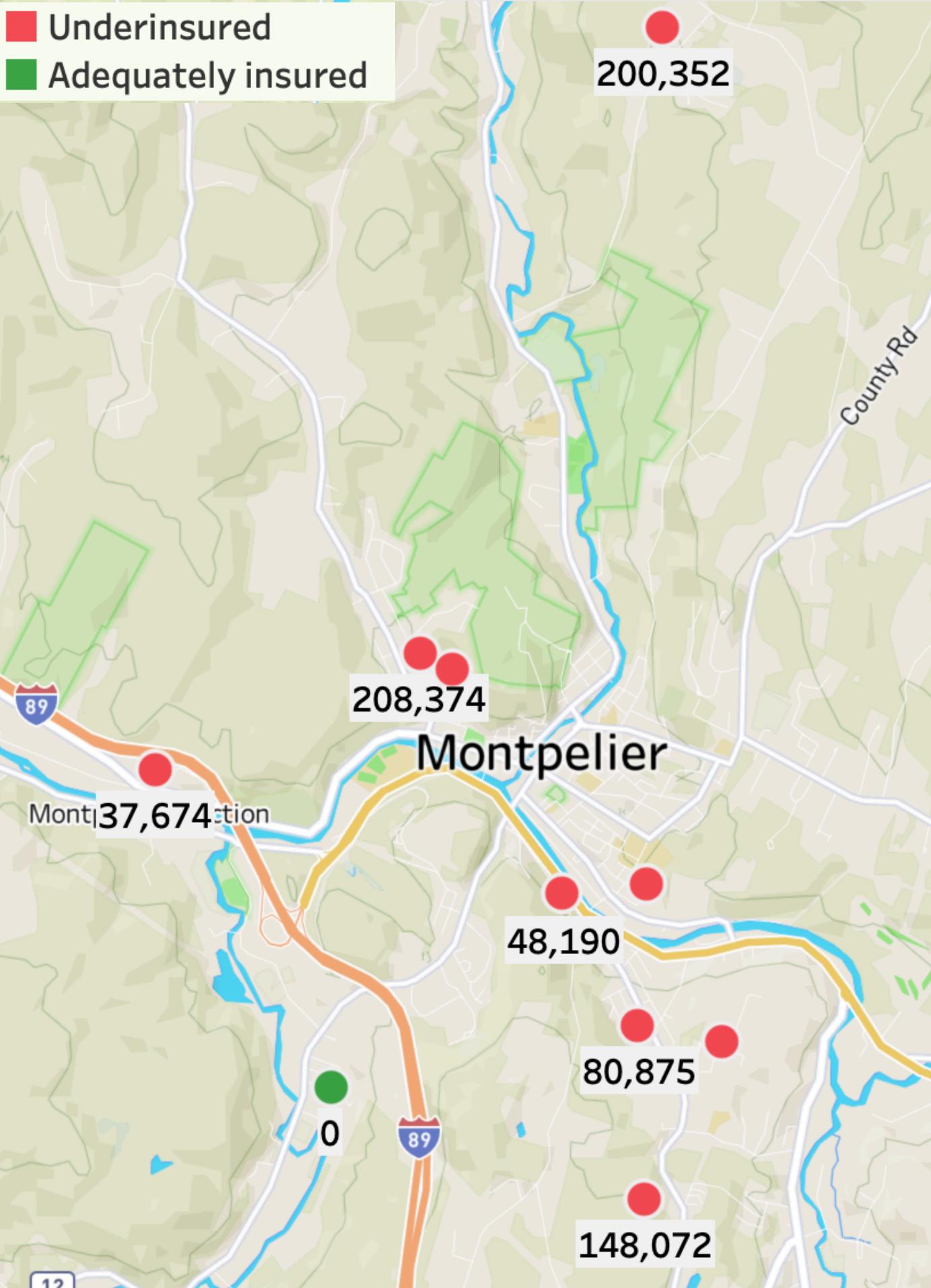
Properties in the PIF data: Montpelier

pbKey	PolicyNo	Policy Value	Property Assessed Value	Underinsured?	Underinsured Amount
P0000NOKCJ3T	479399	89010	137200	1	48190
P0000NOKCH6S	267803	105026	189200	1	84174
P0000NOKCH7Q	267804	105026	313400	1	208374
P0000NOKCMA1	267816	105026	142700	1	37674
P0000NOKCKSK	267815	86025	181400	1	95375
P0000NOKCLOH	498222	95269	40300	0	0
P0000NOKCJQT	267800	139642	367300	1	227658
P0000NOKCLZB	464303	105548	305900	1	200352
P0000NOKCKTJ	443488	113928	262000	1	148072
P0000NOKCJBY	267818	86025	166900	1	80875

Automated Report highlighting underinsured properties

Average underinsurance amount in Vermont:

\$147,689



P0000NOKCH7Q

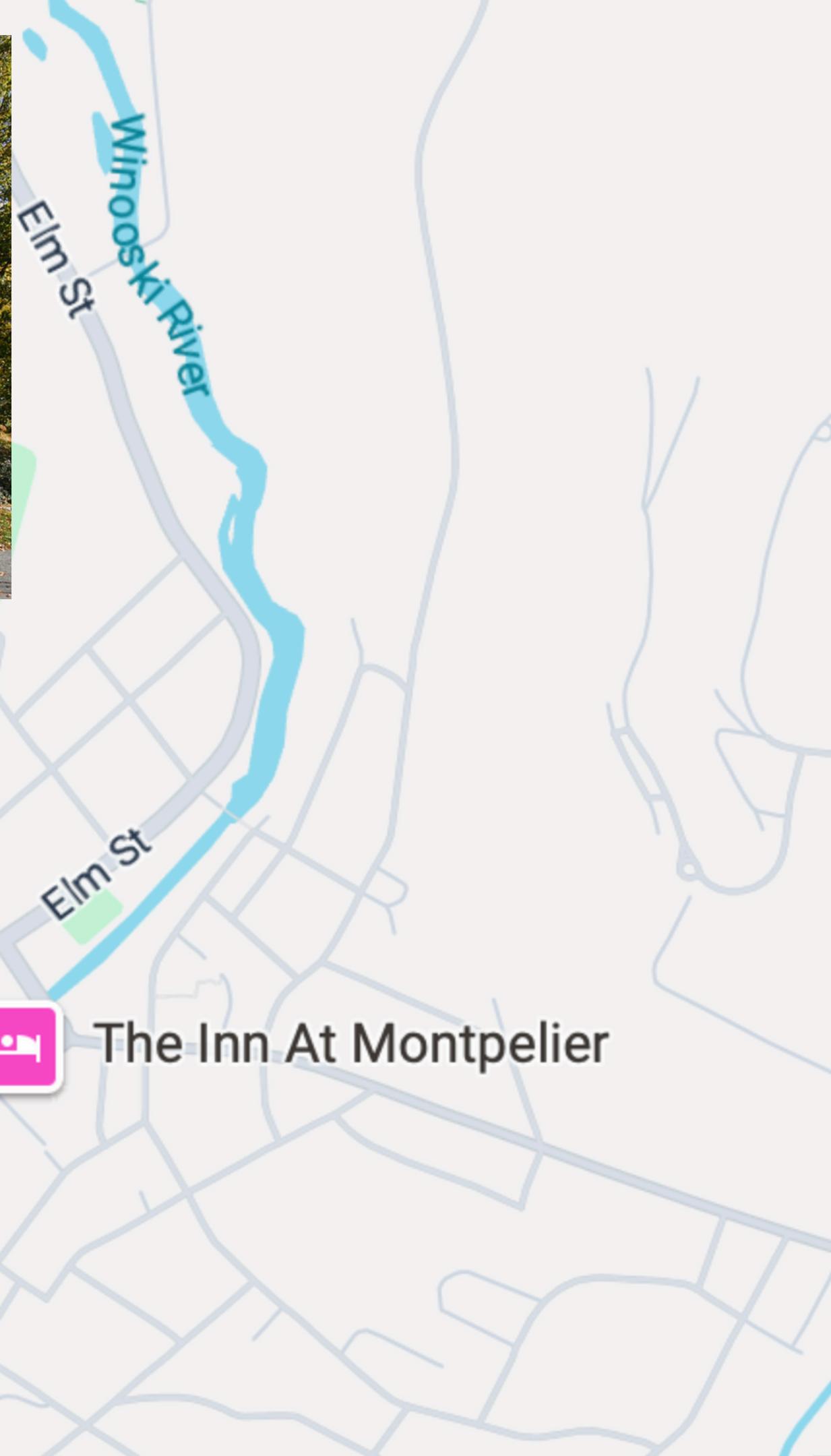
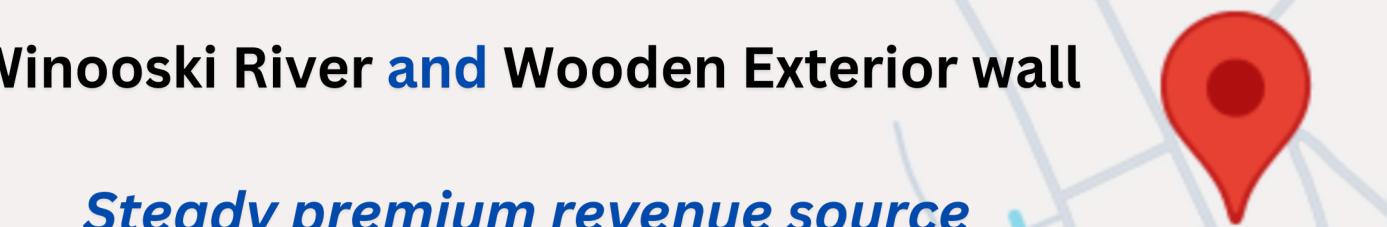
39 CLARENDON AVE, MONTPELIER, VT 05602

Underinsurance amount: \$208,374

Risk Cluster: Moderate Risk (Cluster 2)

Winooski River and Wooden Exterior wall

Steady premium revenue source





KEY BUSINESS OPPORTUNITIES

Targeted
Upselling
Opportunities

*Boost
Coverage,
Drive
Revenue!*

Enhanced
Underwriting
Decisions

July 2024 Floods



BARRE STREET FLOOD IMPACT

Multiple residential properties
flooded



BERLIN MOBILE HOMES

28 mobile homes condemned.
\$500,000 in road damage
recorded.



MONTPELIER COMMERCIAL PROPERTIES

Businesses experienced
up to 4 feet of water.

<https://www.vermontpublic.org/local-news/2024-07-11/a-kick-in-the-stomach-barre-city-floods-on-anniversary-of-last-years-destruction>

Montpelier's Rising Flood Risks

80% 

in the likelihood
of flooding

Increased Flood Frequency:

- Flood frequency has risen significantly with major events in 2023, and 2024 (source: Vermont Climate Assessment).
- Climate change is exacerbating flood risk, requiring an adaptive response from insurers.

Our Solutions:

- Clustering based risk assessment
- Underinsured properties Identification

Reference: https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2021-12/VT%20CAP%20Summary_Final_0.pdf

**Together, we can bridge
the gaps in flood risk
management, ensure
financial stability, and
build a more resilient
future for Montpelier
and beyond.**



Q&A