HUMMINGBIRD SOFTWARE

Hail Loss Estimate Report

Aug 11 2023 Minnesota Hail Storms · 2023-08-11

Prepared by Hummingbird Software
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Classification: Confidential

This report presents a per-building physical damage and insurance loss estimate for the Aug 11 2023 Minnesota Hail Storms. Estimates are produced by a parametric physical damage model calibrated to peer-reviewed hail literature and adjusted by a behavioral claim risk model developed from U.S. Census, attorney density, housing market, and vacancy data.

Executive Summary

On 2023-08-11, a hail-producing storm system affected the MN region, delivering peak hail of approximately 2.7" equivalent spherical diameter per MRMS radar. The storm affected 330,814 structures out of 3,366,968 in the modeled inventory, producing an estimated $124.1M in gross physical (roof) loss.

Metric	Estimate	Notes
Structures in affected area	3,366,968	Modeled building inventory
Structures with measurable damage	330,814	~0.1% of inventory
Gross physical (roof) loss	$124.1M	Replacement cost basis
Expected insurer claim payments	$28M–$40M	Property: after deductibles, ACV, uninsured
Auto glass & body loss (est.)	$191M–$301M	Windshield + body; comp claims
Combined estimated insurer exposure	$220M–$341M	Property + auto

Key Findings

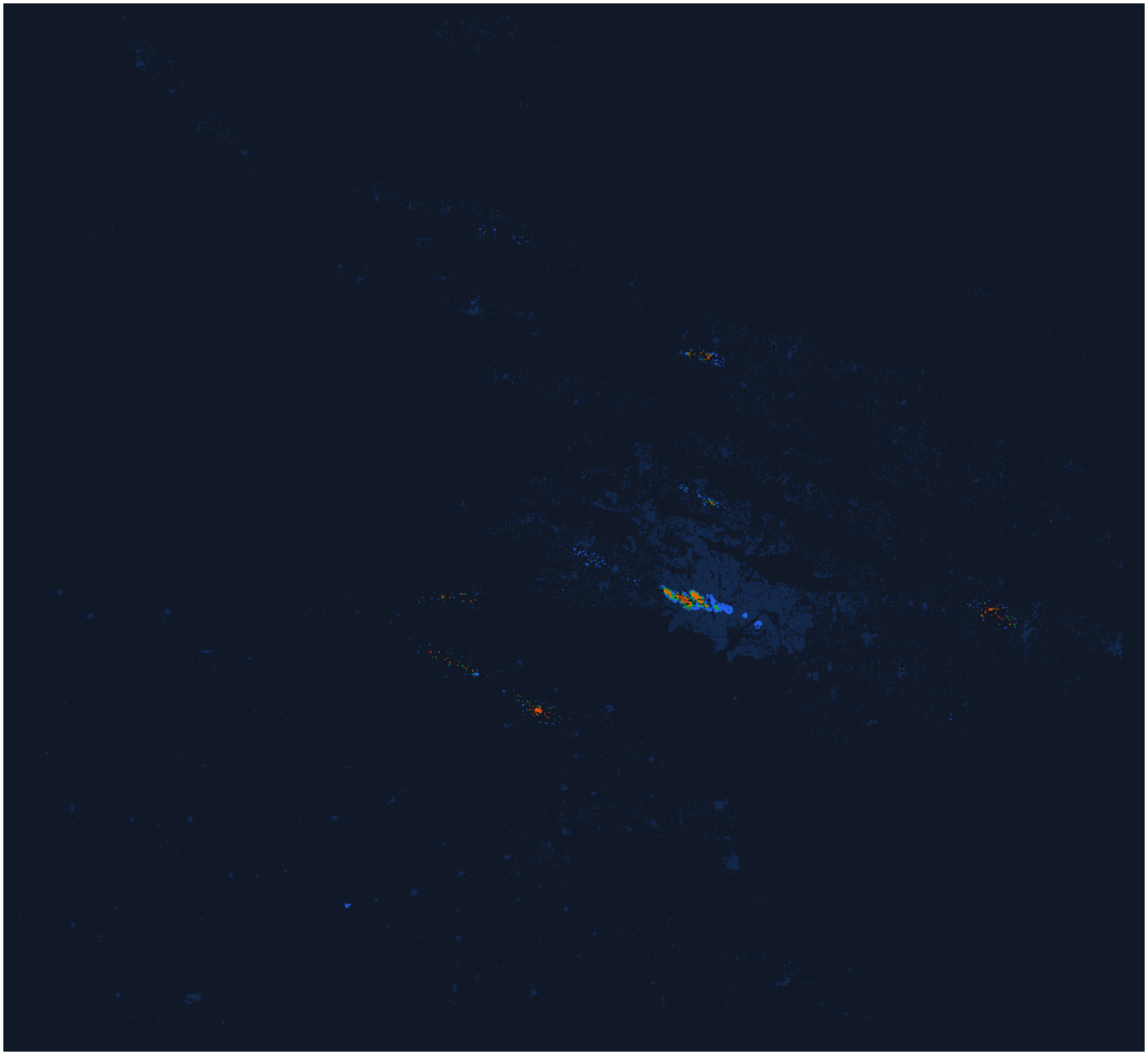
- **Peak hail reached 2.7" in the storm core.** 17.3% of hail-exposed buildings received ≥ 1" hail; 2.2% received ≥ 1.5". Damage severity is concentrated in a relatively small core footprint.
- **ACV depreciation is the dominant insurer retention factor.** The modeled building stock has a mean structural age of approximately 25 years. With a mean ACV factor of 0.07, the average building recovers roughly 7% of replacement cost under ACV policies. RCV endorsements (estimated ~72% of SFH policies) recover full cost.
- **MN attorney involvement: low-moderate market.** Minnesota markets show below-average attorney involvement. Cold-climate markets tend toward direct adjuster settlement. Estimated attorney involvement in filed claims: 10–18%.
- **Condo and apartment exposure is lower than SFH.** HOA master policies govern roof claims for condos (deductibles $10k–$25k). Apartment roof claims are filed by landlords on DP-3 policies. Neither produces the claim volume of SFH stock.
- **Behavioral cohort mix reflects market dispute culture.** Claim Cavalry tracts — the highest-dispute cohort — account for approximately 13.9% of damaged buildings in the modeled area. Mean Dispute Culture Index: 15/100.

Model Visualizations

Maps generated directly from per-building model output and census tract behavioral scores. Included for visual reference only.

Hail Damage by Building — Modeled Area

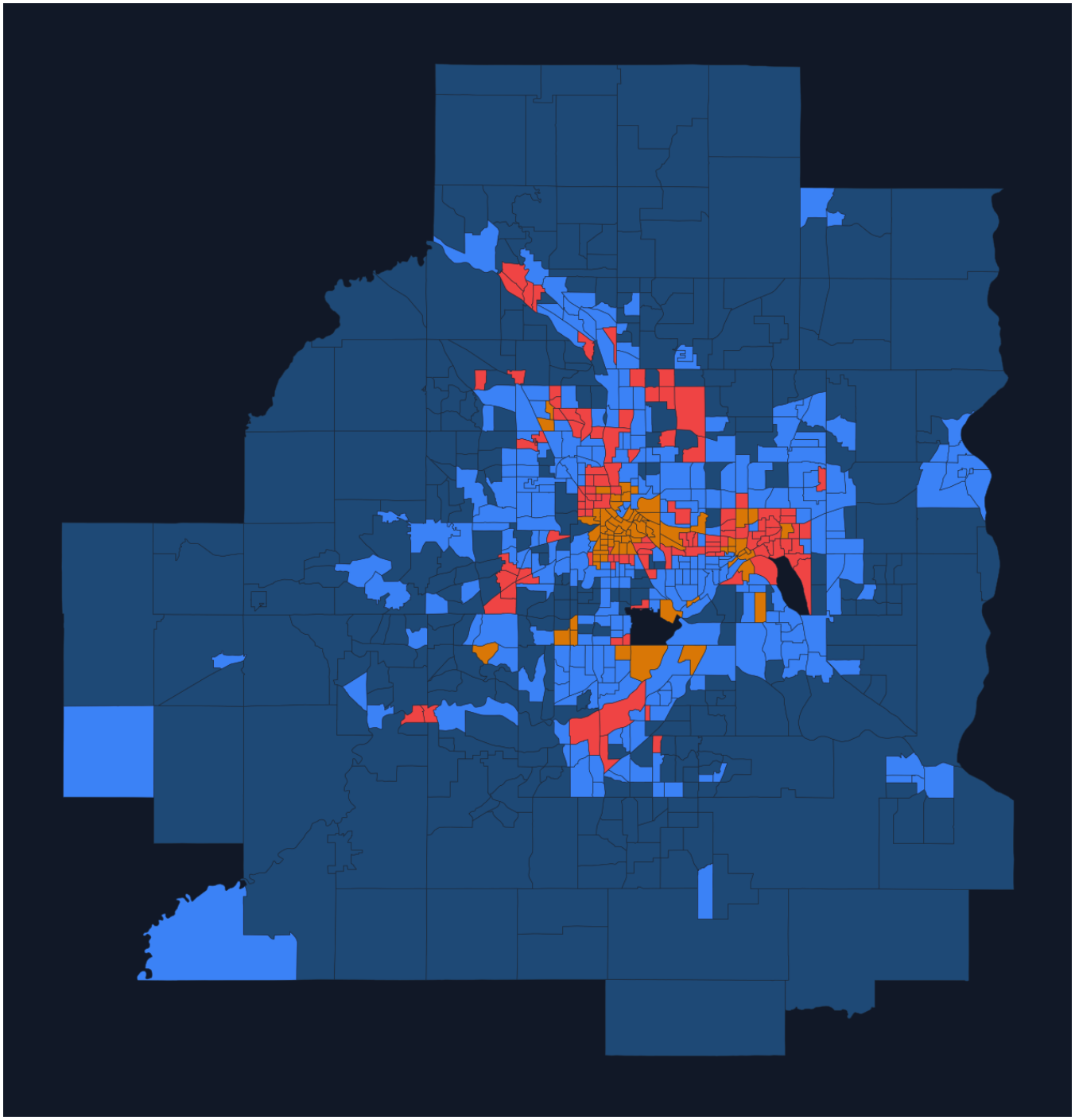
	Below Threshold	< 1%	No visible damage; sub-threshold MESH exposure
	Cosmetic	1–5%	Granule loss; functional life not reduced; low claim probability
	Functional	5–10%	Impact marks; reduced roof lifespan; potential claim filed
	Replacement Likely	10–20%	Field adjuster typically confirms partial replacement
	Replacement Warranted	20–35%	Full roof replacement estimate generated
	Complete Replacement	> 35%	Total loss of roof assembly; structural inspection recommended



Each point represents one building footprint centroid colored by damage tier.

Behavioral Claim Risk Cohorts — Census Tracts

Careful Keepers	Low FSI, low DCI — owner-occupants who settle directly with adjusters
Squeaky Wheels	Moderate financial pressure — actively engage adjusters; occasional attorney on larger claims
Duct Tape Dynasty	High FSI, deferred maintenance — elevated claim frequency; above-average attorney involvement
Claim Cavalry	High DCI — consistent attorney representation; maximum settlement extraction



Census tracts scored on Financial Stress Index (FSI) and Dispute Culture Index (DCI). Cohort assignment drives claim propensity and attorney involvement in the simulation.

1. Event Overview

Parameter	Value
Event name	Aug 11 2023 Minnesota Hail Storms
Event date	2023-08-11
Affected states	MN
Storm type	Supercell
Peak MRMS MESH	~68 mm (2.68")
MESH >= 25mm (1")	17.3% of hail-exposed buildings
MESH >= 38mm (1.5")	2.2% of hail-exposed buildings
MESH >= 50mm (2")	0.4% of hail-exposed buildings
Total modeled structures	3,366,968
Structures with damage	330,814

MRMS (Multi-Radar Multi-Sensor) Maximum Estimated Size of Hail (MESH) is the standard operational hail size indicator. MESH is known to underestimate peak stone size by 30–80% (Blair & Leighton 2012). A 0.75× Ortega (2018) correction factor is applied universally and calibrated into the physical damage model.

2. Physical Damage Assessment

2.1 Building Inventory

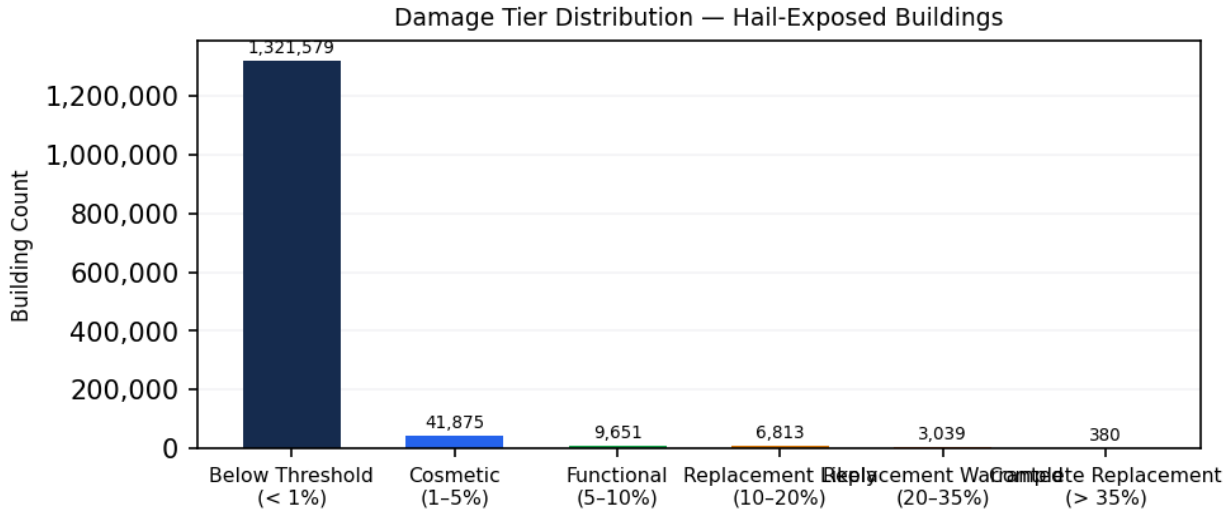
The structural inventory was sourced from Overture Maps Foundation building footprints. Occupancy types reflect the Overture structural classification mapped to HAZUS categories. Building footprint areas are computed from polygon geometry.

Type	Description	Total Bldgs	Damaged	% Damaged
RES1	Single-Family Home	1,383,337	330,814	23.9%

Note: Inventory reflects buildings in the modeled hail swath. Full event total: 3,366,968 structures.

2.2 Damage Tier Distribution

Damage ratio (DR) represents the fraction of a building's replacement cost value affected by hail impact. Tiers follow HAAG Engineering and Xactimate industry conventions.

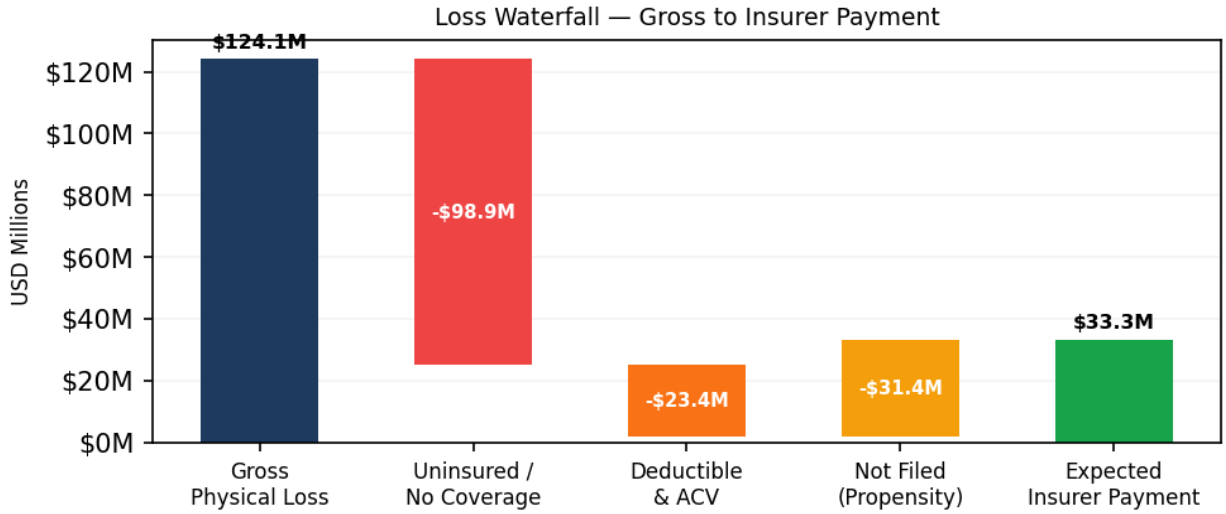


Tier	DR Range	Count	% Exposed	Typical Outcome
Below Threshold	< 1%	1,321,579	95.5%	No visible damage; sub-threshold MESH exposure
Cosmetic	1–5%	41,875	3.0%	Granule loss; functional life not reduced; low claim probability
Functional	5–10%	9,651	0.7%	Impact marks; reduced roof lifespan; potential claim filed
Replacement Likely	10–20%	6,813	0.5%	Field adjuster typically confirms partial replacement
Replacement Warranted	20–35%	3,039	0.2%	Full roof replacement estimate generated
Complete Replacement	> 35%	380	0.0%	Total loss of roof assembly; structural inspection recommended

3. Property Insurance Loss Estimate

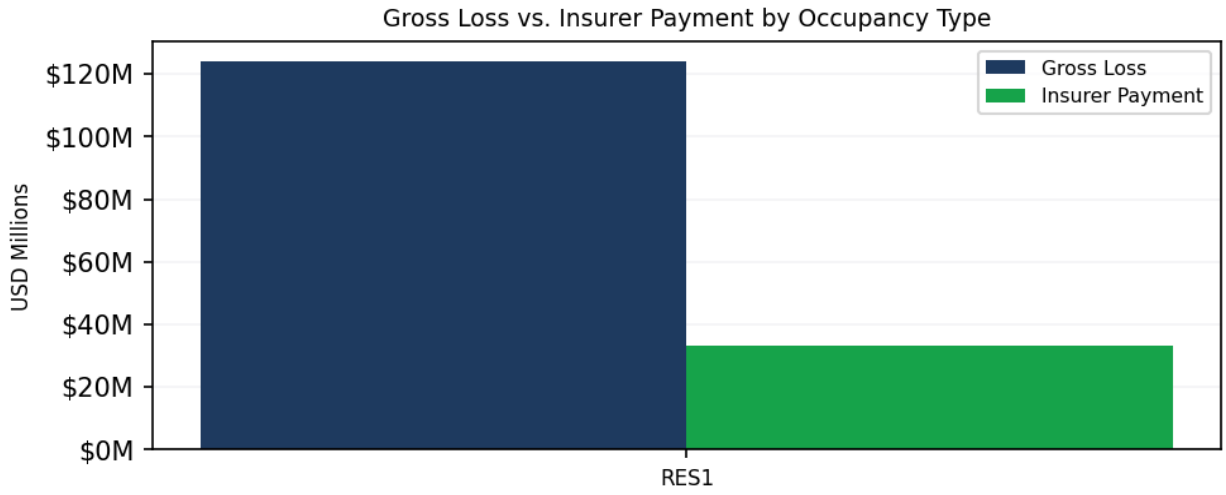
The gross physical loss represents full replacement cost of hail damage. Insurers' actual claim payments are substantially lower due to: (1) uninsured or inadequately insured properties, (2) deductibles, (3) actual cash value (ACV) depreciation on older roofs, and (4) the fraction of insured policyholders who choose not to file a claim.

3.1 Loss Waterfall



The waterfall shows how $124.1M in modeled gross physical loss reduces to approximately $33.3M in expected insurer claim payments before behavioral adjustment. Scaled to the full event (330,814 damaged buildings) yields an estimated **$28M–$40M in property insurer payments**.

3.2 Loss by Occupancy Type



Type	Damaged Bldgs	Gross Loss	Insurer Pmt	Loss Ratio	Mean ACV Factor	P(Atty|Claim)
RES1 — Single-Family Home	1,383,337	$124.1M	$33.3M	26.8%	0.07	0.3%

Condo caveat: HO-6 (unit-owner) policies cover interior damage only — not the roof. The HOA master policy governs the building envelope, typically with a $10,000–$25,000 per-occurrence deductible. Condo structures show a very low loss ratio as a result.

3.3 Roof Age and ACV Impact

The single largest retention factor is ACV depreciation. The modeled building stock has a mean structural age of approximately 25 years. While buildings are not the same age as their roofs, structural vintage is used as a conservative proxy. Under a typical ACV schedule:

Roof Age	ACV Recovery Rate	Interpretation
< 5 years	100% of RCV	New roof — full replacement cost recovered
5–15 years	70–100% RCV	Moderate depreciation
15–25 years	30–70% RCV	Significant depreciation; many sub-deductible
25+ years	30% RCV (floor)	Substantial retention; insurer encourages upgrade credit

With a mean ACV factor of 0.07 across modeled structures, the average building recovers approximately 7% of replacement cost under ACV policies. Policies with RCV endorsements (estimated ~72% of SFH policies) recover full replacement cost.

4. Auto Insurance Loss Estimate

Auto losses from hail events are driven primarily by comprehensive (comp) coverage claims for windshield damage, body denting, and — in severe events — total loss.

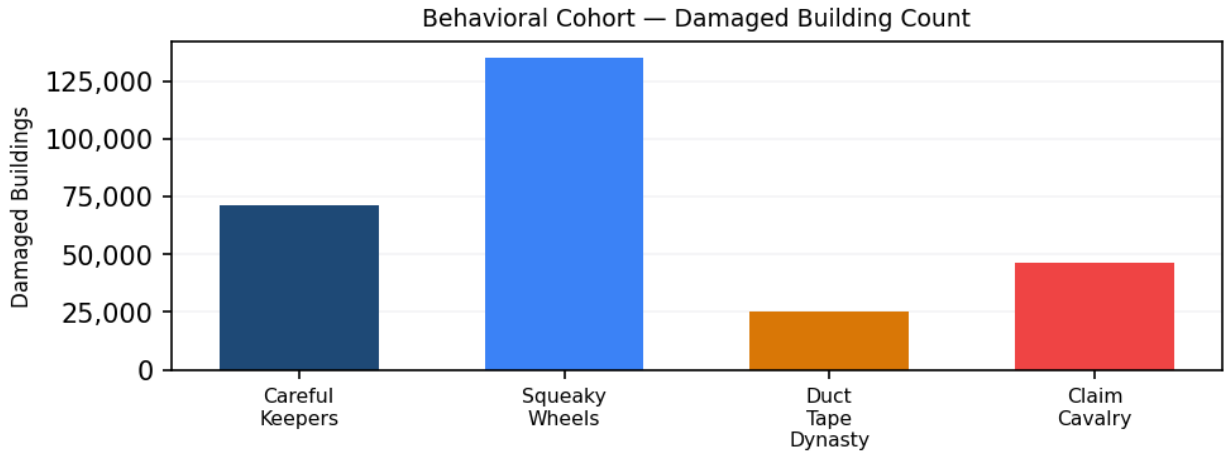
Input	Assumption	Basis
Residential structures in hail zone	330,814	SFH structures with measurable hail damage
Vehicles per household	1.5	ACS PUMS regional average
Outdoor exposure rate	40–55%	Garage ownership rate by MSA
Hail damage probability (outdoors)	40–50%	Function of peak stone size
Comp coverage rate	~72–75%	NAIC state data
P(claim | damaged & insured)	70–75%	Higher propensity than property (no ded. friction on glass)
Blended avg claim value	$2,100	60% glass-only ($450), 40% glass+body ($3,200)

Applying these parameters yields an estimated **$191M–$301M in auto comp claims**, with a central estimate of approximately $246M.

Scenario	Vehicles Affected	Est. Auto Loss	Assumption
Low	173,677	$191M	Conservative outdoor exposure; mostly garaged vehicles
Central	223,299	$246M	Base case; 45% outdoor exposure rate
High	272,921	$301M	Extended track; peak stone >2" over wider area

5. Behavioral Claim Risk Analysis

Behavioral scores are available for the following markets in this event's geography: **Minneapolis**. Each census tract is scored on Financial Stress Index (FSI) and Dispute Culture Index (DCI), then assigned to one of four behavioral cohorts that drive claim propensity and attorney involvement probability in the per-building simulation.



Cohort	Bldgs Damaged	FSI (0–100)	DCI (0–100)	Behavioral Profile
Careful Keepers	71,570	32.6	10.9	Low FSI, low DCI — owner-occupants who settle directly with adjusters
Squeaky Wheels	135,347	47.4	14.2	Moderate financial pressure — actively engage adjusters; occasional attorney on larger claims
Duct Tape Dynasty	25,097	66.3	14.3	High FSI, deferred maintenance — elevated claim frequency; above-average attorney involvement
Claim Cavalry	46,146	60.0	28.8	High DCI — consistent attorney representation; maximum settlement extraction

5.1 MN Attorney Market Context

MN is a low-moderate-attorney-involvement market. Minnesota markets show below-average attorney involvement. Cold-climate markets tend toward direct adjuster settlement. The modeled mean attorney involvement rate across this event is 0.3%, with Claim Cavalry tracts driving the upper tail.

Market	DCI Median	Claim Cavalry %	Est. Attorney Rate	vs. This Event
MN (this event)	15/100	—	0.3%	1.0x (baseline)
Austin, TX	38/100	14%	18–25%	1.3–1.5x
Houston, TX	51/100	22%	25–35%	1.4–1.7x
Miami, FL	62/100	28%	30–40%	1.6–1.9x

6. Total Loss Summary

Coverage Line	Low	Central	High	Notes
Property — Residential	$20M	$27M	$32M	SFH, duplex, condo, apt; after deductibles + ACV
Property — Commercial	$8M	$6M	$8M	Retail, office, industrial; heavy deductibles
Auto — Comprehensive	$191M	$246M	$301M	Glass + body; outdoor exposure sensitivity
TOTAL	$220M	$273M	$341M	Before attorney adjustment; within 12-month development

The central estimate reflects a supercell hail event in a low-moderate-attorney market with structural vintage producing mean ACV factor of 0.07. Development over a 12–18 month claims tail is expected to be relatively linear — hail is not a long-tail line. Late re-opens are most likely driven by roof re-inspections on properties initially below adjuster threshold.

Confidence Note

This estimate is a pre-calibration output of the Hummingbird physical and behavioral model. The physical damage model has been calibrated to the Omaha 2022 storm but has not been validated against claims data for this specific event. Primary uncertainties: (1) the precise hail zone boundary and its effect on auto exposure, (2) the fraction of SFH policyholders on ACV vs. RCV schedules, and (3) post-event public adjuster or attorney solicitation campaigns. Access to actual settled claims data for this event would allow direct calibration and would substantially tighten the loss range.

7. Key Assumptions

Parameter	Value	Source / Basis
MRMS MESH data source	NOAA operational product	Multi-Radar Multi-Sensor, 24hr accumulation
MESH to stone size correction	0.75x (Ortega 2018)	Peer-reviewed; applied universally
Hail PSD model	Gamma, alpha=1.75 (Li et al. 2024)	Expected impacts per unit roof area
Fragility curve — unrated roof	Lognormal, theta=46mm, gamma=0.25	Calibrated to CoCoRaHS + IBHS data
Storm type multiplier	Supercell: 1.15x	Physics-based; supercell increases kinetic energy
Roof cost basis	$9.00/sq ft x 1.15 slope factor	RSMeans 2024 regional; standard slope factor
Building footprints	Overture Maps Foundation	Polygon centroids for MESH sampling
SFH insurance rate	85% with roof coverage	NAIC state data; approximate for event states
SFH deductible (flat)	Mean $1,750 (std dev $800)	Industry filing data; excludes wind/hail % policies
RCV policy rate — SFH	72%	Market estimate; national ~65%
ACV floor	30% of replacement cost	Industry standard
Condo HO-6 roof coverage	Near-zero	HOA master policy governs roof
Claim base rate — SFH	60% of insured, damage-adjusted	Pre-calibration estimate
Attorney base rate	10–18% (MN)	State-level prior; DCI-adjusted per tract
Attorney severity uplift	1.35x claim value	Mid-range for moderate-market states
Vehicles per HH	1.5 (outdoor rate: 40–55%)	ACS PUMS regional
Comp coverage rate	~72–75%	NAIC 2024 state averages
Blended avg auto claim	$2,100	60% glass ($450), 40% body ($3,200)

Sources: NOAA MRMS, Overture Maps, U.S. Census ACS 5-year, NAIC Annual Report 2024, NFIP claims database, RSMeans Construction Cost Data 2024, Blair & Leighton (2012), Ortega (2018), Li et al. (2024).

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