

Housing Damage from the 2022 Kentucky Flood



Photo: Appalachian Citizens' Law Center

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Summary

Approximately 9,000 homes were damaged by the flood that occurred in southeast Kentucky in July 2022. It will cost an estimated \$450 million to \$950 million to rebuild those homes, depending on how many are relocated to safer, less flood-prone areas.

Nearly 22,000 people were living in homes damaged by the flood, 44% of whom are children or seniors. Many households with damaged homes are among those with the least ability to pay for repairs in all of Kentucky: 6 in 10 households with damaged homes reported annual incomes of less than \$30,000.

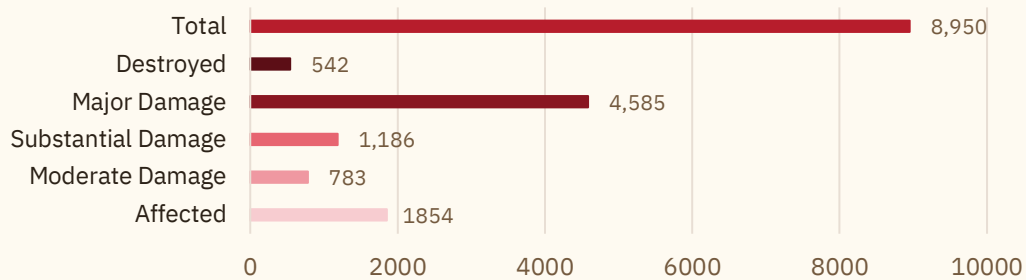
The first section of this report estimates the number of damaged homes. The second section estimates the cost to rebuild those homes. The third section examines the demographic backgrounds of households with damaged homes and the housing aid they have received to date from FEMA. The fourth section provides county-level housing damage estimates. The fifth section provides a brief conclusion.

I. Housing damage

In July 2022 severe storms dumped extreme precipitation across southeastern Kentucky over a five-day period, much of the rain falling on July 27th and 28th. With so much rain bearing down over such a short period of time—and given the area’s mountainous terrain— southeast Kentucky experienced catastrophic flooding and dangerous landslides. Widespread damage to the region’s housing stock occurred as a result.

In total, an estimated 8,950 homes were damaged or destroyed in 13 counties in Kentucky, based on home inspections performed by FEMA following the flood (figure 1). Damage categories are defined in figure 3.

Figure 1. Number of damaged homes by category



II. The cost to rebuild

To inform disaster recovery, this report estimates the cost of damage to the housing stock based on the cost to repair or replace homes. Two different approaches to rebuilding are examined. Under approach A (*Rebuild Where We Were*), homes would be repaired and replaced exactly where they were before the flood, regardless of risk from future floods. Under approach B (*Rebuild Safer Homes*), destroyed homes and most homes with major damage would be replaced in *new* locations with lower flood risk. The figure below describes each approach and provides the cost for each.

Figure 2. Summary of total damage costs

Rebuild Approach A: <i>Rebuild Where We Were</i>	Rebuild Approach B: <i>Rebuild Safer Homes</i>
<p>This approach would replace only destroyed homes. It would repair homes with moderate, substantial, and major damage. It would not relocate any homes and would not elevate any homes, though some repair may include flood mitigation that makes the home somewhat safer in the event of flooding (such as installing flood vents during the repair of a damaged foundation or the relocation of mechanical components if they are being replaced). It would not repair any of the 1,854 homes in the Affected damage category. Replaced homes will be two bedroom, 1,000 - 1,200 sq ft homes on average.</p> <p style="text-align: center;"><i>Replace (but not relocate) 542 destroyed homes</i></p> <p><i>Repair 6,554 homes with major, substantial, or moderate damage</i></p>	<p>This approach would replace destroyed homes <i>and</i> some homes with major damage, and it would relocate these homes to less flood-prone areas, making them safer from future flood risk. This approach would repair homes with any level of damage. Replaced homes will be two bedroom 1,000 - 1,200 sq ft homes on average. In contrast to approach A, replaced homes will be built on new land that must be purchased (avg. cost of \$35,000).</p> <p style="text-align: center;"><i>Replace and relocate 542 destroyed homes</i></p> <p style="text-align: center;"><i>Replace and relocate 4,161 homes with major damage</i></p> <p><i>Repair 4,247 homes with major, substantial, moderate, or affected</i></p>
<p>Total cost \$453,490,359</p>	<p>Total cost \$957,509,380</p>

In order to estimate rebuilding costs we combined data on damaged homes from OpenFEMA with the repair and replace cost estimates shown in figure 3. OpenFEMA is a database of applications for FEMA aid. It includes demographic and housing information from each FEMA aid applicant, results of the FEMA inspection (e.g. water levels, home habitability and destruction, aid eligibility) and the amount and type of aid granted. We excluded application records that we could confidently identify as duplicates and included only those applications that were classified as destroyed, uninhabitable, or that were affected by flood waters (see appendix A). Given that OpenFEMA only includes households that applied for FEMA aid, our estimates likely do not include all homes damaged by the flood and thus may be conservative.

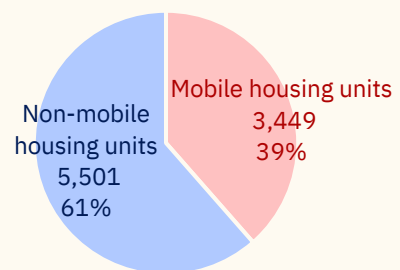
We grouped homes into five damage categories based on the water level reported in the FEMA inspection, which are defined in figure 3. The rebuild action (repair, replace in same location, etc.) for homes in each damage category are provided in figure 3. For example, destroyed homes are replaced in the same location under scenario A and replaced in a new location under scenario B. Per home cost estimates were developed in collaboration with regional experts Housing Development Alliance and H.O.M.E.S. Inc, who have been repairing and rebuilding flood-damaged homes.

Figure 3. Damage category definitions and per home repair & replacement costs

Damage Category	Definition	Rebuild Approach A: <i>Rebuild Where We Were</i>		Rebuild Approach B: <i>Rebuild Safer Homes</i>	
		Action	Cost per home	Action	Cost per home
Destroyed	Deemed "Destroyed" by FEMA or high water mark is a second/third floor, attic, or over roof	Replace in same location	\$150,000	Replace & relocate	\$185,000
Major	If house/apartment, high water mark is 2" or higher or first floor; if mobile home, high water mark is 1" or higher on first floor	Repair	\$70,000	Replace & relocate, except repair 1/2 of houses/apts with 2-13" of water	\$185,000 or \$70,000
Substantial	If house/apartment, high water mark is 1" on the first floor	Repair	\$30,000	Repair	\$30,000
Moderate	High water mark in a finished basement or a crawlspace where mechanical components are impacted	Repair	\$20,000	Repair	\$20,000
Affected	High water mark in an unfinished basement or a crawlspace where mechanical components are <i>not</i> impacted, or high water mark is over access road	Exclude	N/A	Repair	\$3,500

Figure 4. Damaged homes by residence type

Both mobile housing and non-mobile housing were damaged by the disaster. In developing damage categories, we distinguish between mobile homes (manufactured homes and travel trailers) and non-mobile homes (homes, townhouses, apartments, etc.). A mobile unit is more likely to sustain major damage with even an inch of water on the first floor because walls must be removed in order to repair damaged flooring. About 4 in 10 damaged homes were mobile housing units (3,297 manufactured homes and 152 travel trailers).



The number of homes in each damage category are multiplied by per home repair or replace costs for each rebuild approach to yield the total costs for the homes in each damage category found in figure 5. For example, we multiplied 542 destroyed homes by a \$150,000 replacement cost to yield a total cost of \$81.3 million for the destroyed homes under approach A. Additional notes on data sources and methodology can be found in appendix A.

Figure 5. Total rebuild costs by damage category¹

	Degree of home damage	Number of homes	Rebuild Approach A: <i>Rebuild Where We Were</i>		Rebuild Approach B: <i>Rebuild Safer Homes</i>	
			Cost to replace/repair per home	Total cost	Cost to replace/repair per home	Total cost
Total housing repair/replace cost	Destroyed	542	\$150,000	\$81,300,000	\$185,000	\$100,270,000
	Major Damage	4,585	\$70,000	\$320,945,722	\$185,000 or \$70,000	\$799,505,743
	Substantial Damage	1,186	\$30,000	\$35,590,243	\$30,000	\$35,590,243
	Moderate Damage	783	\$20,000	\$15,654,394	\$20,000	\$15,654,394
	Affected	1,854	Excluded	\$0	\$3,500	\$6,489,000
			8,950		\$453,490,359	

Over 500 homes were destroyed and over 4,500 sustained major damage (figure 5). If homes are repaired or replaced where they were (as in approach A), the total cost would be about \$450 million. Relocating and replacing many of the homes to less flood-prone areas (as in approach B) would raise the total cost to over \$950 million.

The biggest cost difference between rebuild approaches A and B can be found in the cost to rebuild homes that sustained major damage. The cost to repair majorly damaged homes is over \$320 million under approach A. Under approach B, to *relocate and replace* most of these homes rather than repair them it would cost nearly \$800 million (figure 5). (Another flood risk mitigation option to use when repairing homes is to elevate them. We do not include this option in either of our approaches but expect that elevating homes during repairs would yield a total cost more than approach A and less than B.)²

While approach B has a higher total cost in the short run, it is critical to examine the cost effectiveness of both approaches over the long run as severe flooding becomes more common in the region.³ Consider the following scenario: three flood events that are each *half as severe* as the 2022 disaster (as measured by housing damage) occur in southeastern Kentucky in the next fifty years. Under approach A, rebuilding after this flood will cost \$453 million and rebuilding after each of the next three floods will cost \$227 million each, bringing the total cost to \$1.13 billion. Under approach B, rebuilding after the 2022 flood will cost \$958 million and rebuilding after each of the next three floods will each cost \$44 million (assuming homes relocated after the 2022 flood are in safer locations and do not suffer damage in future floods), bringing the total cost to \$1.08 billion.⁴

¹ The number of homes in figures 1 and 4 are rounded to the nearest whole number.

² The cost to elevate a home up to 6 ft is approximately \$15,000 to \$20,000.

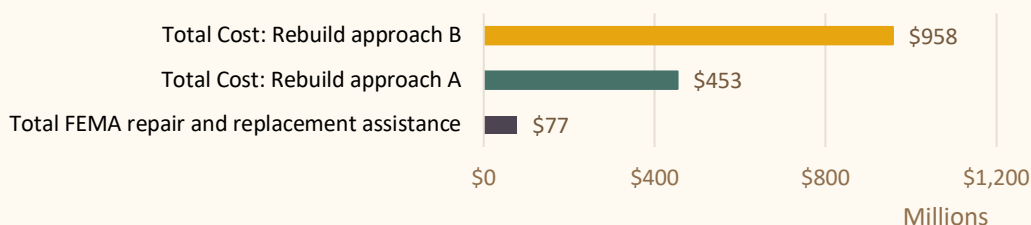
³ In 2018, the Kentucky Division of Water concluded that "Given the uncertainty of future rainfall, temperature trends, and future development, future flood conditions and costs from flood damages will likely continue to increase unless considerable actions are undertaken by stakeholders at all levels of government, the private sector, and by private citizens."

⁴ Under approach B, estimated repair costs for affected, moderate damage, substantial damage, and 424 majorly damaged homes (that will be repaired and *not relocated*) total \$87.38 million. Future floods that are half as severe would each cost \$43.6 million (or, half of \$87.38).

In this scenario, the total cost under approach B is lower than under approach A in the long run because approach B prevents future damage by relocating homes to less flood-prone areas. This doesn't even account for the many lives that would likely be saved in future floods, nor does it account for the significant time and resources thousands of families would save by not having to repair their homes multiple times. Incorporating those factors underlines the many advantages posed by approach B.

For those deemed eligible, FEMA does offer repair and replacement assistance under its Housing Assistance program. Sixty-six percent (66%) of damaged homes have received some FEMA repair or replacement assistance, totaling \$77 million in awards. This \$77 million in FEMA awards will cover only 8 to 17% of the estimated \$453 to \$958 million in total housing damages (figure 6).

Figure 6. FEMA housing assistance compared with total cost to rebuild



III. Income and demographics of flood-impacted families

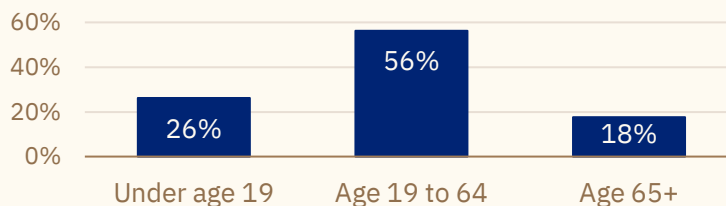
This section provides estimates on the income and demographics of households with damaged homes. These estimates are calculated from OpenFEMA data. Given that OpenFEMA only includes households that applied for FEMA aid, *the estimates here likely do not include all households with flood-damaged homes.*

Who lives in damaged homes?

There were 21,990 occupants living in the homes damaged by the disaster, nearly half of whom (44%) are children or seniors (figure 7). Damaged homes have an average of 2.46 occupants.

Damaged homes are virtually all (99.99%) the primary residence of the occupants. Though there are secondary residences damaged by the disaster, owners of secondary residences are not eligible for FEMA housing assistance so they are not captured in OpenFEMA data or this report. Sixteen percent (16%) of damaged homes are renters, which do not qualify for FEMA home repair assistance (though they can qualify for rental assistance under FEMA’s housing assistance program, which are captured in OpenFEMA data).

Figure 7. Age of people in damaged homes

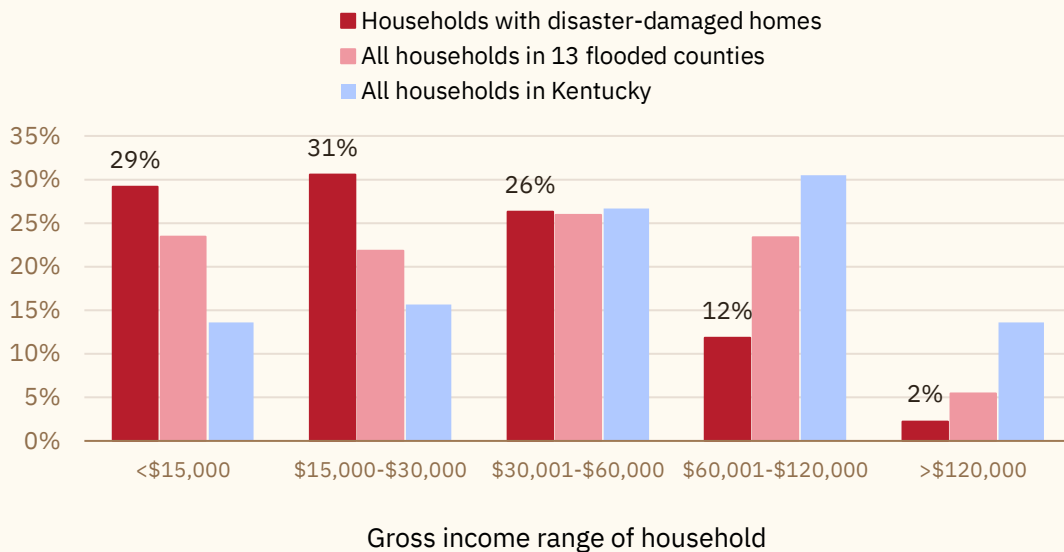


Can households with damaged homes afford repairs?

Households with damaged homes are among those with the least ability to pay for home repairs in all of Kentucky: there is a higher share of low-income households among homes damaged by the flood than among all households in the region or in the state (figure 8).

- Sixty percent (60%) of households with damaged homes have a reported gross annual income of \$30,000 or less.
- Twenty-nine percent (29%) of applicants with damaged homes are age 65 or older, with fixed incomes.

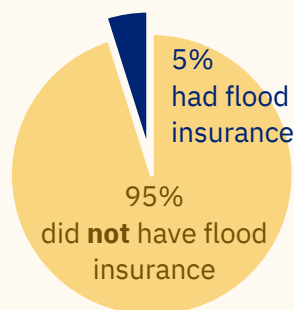
Figure 8. Income distribution of damaged homes compared with region and state



Source: Social Explorer, American Community Survey (ACS), 5-year survey, 2020, US Census Bureau.

In addition, most households with damaged homes did not have insurance policies to cover flood damage. Generally, home insurance policies do not cover flood damage and flood insurance must be purchased as a separate or additional policy. As of 2022, these flood insurance policies cost Kentucky homeowners on average \$1,174 per year, according to FEMA – making them difficult to afford for many homeowners. Ninety-five percent (95%) of the homeowners of damaged homes did not have flood insurance (figure 9).

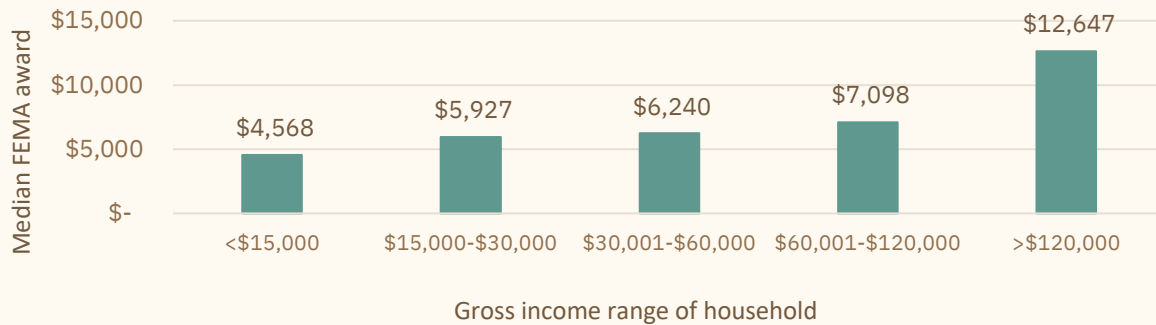
Figure 9. Damaged homes by insurance status



Households with *lower* incomes have received *less* FEMA housing assistance, not more (figure 10). Examining the drivers of award levels is beyond the scope of this report, but the following trends were observed:

- The median award of FEMA housing assistance for households with less than \$15,000 in annual income is sixty-four percent (64%) *lower* than the median award for households with more than \$120,000 in annual income.
- The median award of FEMA housing assistance for households with less than \$30,000 in annual income is sixty-four percent (24%) *lower* than the median award for households with more than \$30,000 in annual income (\$4,901 median award versus \$6,474 median award).

Figure 10. Average FEMA housing assistance award (median) by gross income range



IV. County-level estimates

Figure 11 summarizes *for each county* the number of homes by damage category, the total costs under each rebuild approach, FEMA housing assistance (total repair assistance plus replacement assistance), and FEMA housing assistance as the share of the total cost to rebuild.

The four counties of Breathitt, Knott, Letcher, and Perry experienced the most damage. The housing damage costs in these four counties is about 78% of the total housing damage. Interestingly, there is some variation between counties regarding the portion of damages that FEMA aid will cover compared to the costs that we have calculated. We have not identified drivers of that variation in this report.

Figure 11. County estimates of damaged homes, total rebuild costs, and FEMA housing aid

County	Breathitt	Clay	Floyd	Knott	Lee	Leslie	Letcher
Destroyed	223	6	32	92	2	1	61
Major Damage	880	128	476	843	8	53	1,156
Substantial Damage	59	91	146	247	1	23	290
Moderate Damage	65	40	64	137	1	19	199
Affected	190	93	133	365	3	43	413
Total	1,416	357	851	1,685	15	140	2,118
Cost: Rebuild approach A	\$98,082,890	\$13,372,495	\$43,765,208	\$83,003,447	\$944,000	\$4,971,333	\$102,722,507
Cost: Rebuild approach B	\$202,283,420	\$27,005,485	\$93,893,885	\$175,076,067	\$1,908,250	\$10,799,500	\$227,513,955
FEMA housing assistance	\$16,025,164	\$1,439,478	\$5,214,168	\$17,514,710	\$110,941	\$458,497	\$18,499,673
as % of Rebuild approach A	16%	11%	12%	21%	12%	9%	18%
as % of Rebuild approach B	8%	5%	6%	10%	6%	4%	8%

County	Magoffin	Martin	Owsley	Perry	Pike	Whitley
Destroyed	1	1	2	116	4	1
Major Damage	47	73	15	647	239	15
Substantial Damage	12	41	4	172	100	2
Moderate Damage	14	10	3	148	80	3
Affected	28	37	10	343	193	7
Total	102	162	34	1,426	617	27
Cost: Rebuild approach A	\$4,098,613	\$6,708,766	\$1,562,195	\$70,794,772	\$21,971,499	\$1,310,000
Cost: Rebuild approach B	\$9,165,630	\$14,548,133	\$3,180,079	\$142,601,757	\$45,928,276	\$2,920,250
FEMA housing assistance	\$359,503	\$786,557	\$231,759	\$11,877,855	\$4,332,298	\$109,275
as % of Rebuild approach A	9%	12%	15%	17%	20%	8%
as % of Rebuild approach B	4%	5%	7%	8%	9%	4%

V. Conclusion

The amount of FEMA assistance granted to households makes only a small dent in the cost to rebuild damaged homes. Other funding sources are highly unlikely to close that gap, which is in the hundreds of millions of dollars. The many low-income families with damaged homes will find it challenging or impossible to rebuild. Policymakers have the opportunity to take action that could not only repair damage from the 2022 flood but ensure families and communities are protected from future flood risks.

Appendix A. Data and methods

In order to estimate damage costs, we combined data on damaged homes from OpenFEMA with repair and replace cost estimates provided by regional housing experts.

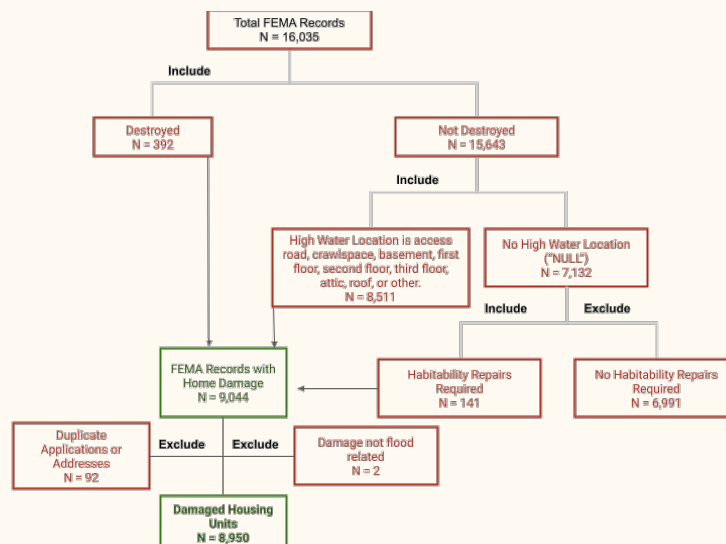
OpenFEMA is a database of applications for FEMA aid. Given that OpenFEMA only includes households that applied for FEMA aid, *it is highly unlikely that the data includes all homes damaged by the flood*. For example, FEMA housing assistance is only open to applicants whose primary residence was damaged by the disaster, meaning landlords (who rent housing that is not their primary residence) cannot seek FEMA housing assistance for their rental properties. OpenFEMA data may be subject to selection bias. For example, higher-income households may be more likely to apply for FEMA aid *ceteris paribus*, given that the application process requires time and resources that higher-income households may be more likely to possess.

OpenFEMA includes demographic and housing information from each FEMA aid applicant, results of a home inspection conducted by FEMA (e.g. water levels, home habitability and destruction, aid eligibility), and the amount and type of aid granted. In order to identify damaged homes, we began by using three OpenFEMA data fields: *destroyed*, *highWaterLocation*, and *habitabilityRepairsRequired*. We selected records that were true for at least one of these fields and excluded those that were not. Applying these criteria, we found 9,044 applications with damaged homes (figure 12).

Each of these 9,044 applications have completed FEMA inspections (field *inspnReturned* = "TRUE") and 7,536 of these (83%) were also deemed eligible for housing assistance (field *haEligible* = "TRUE") which is strong evidence for the reliability of these applications. The reliability of the remaining 1,508 applications is somewhat more questionable given that they have not been deemed eligible for housing assistance. However, damaged homes can be deemed ineligible for FEMA aid for reasons that are irrelevant to our research goal of identifying distinct housing units damaged by the disaster. Given the aforementioned evidence we do have for them (in fields *destroyed*, *habitabilityRepairsRequired*, and *highWaterLocation*), we assume they are damaged housing units and look at the housing assistance status field (*haStatus*) for evidence that raises significant doubt or indicates a duplicate record.

We find that 94 applications show *haStatus* values that raise significant doubt either that a) the application is a *distinct* housing unit or b) that *damage was caused by the disaster*. We have excluded these 94 applications. We have included the remaining 1,414 applications whose *haStatus* either a) do not provide enough information regarding the application to make an informed judgment on the reason for ineligibility, or b) do not raise significant doubt that the reason for ineligibility conflicts with our research goal.

Figure 12. Exclusion and inclusion tree for FEMA data record selection



We grouped homes into five damage categories –destroyed, major damage, substantial damage, moderate damage, and affected –based on the aforementioned fields of *destroyed*, *highWaterLocation*, and *habitabilityRepairsRequired* in addition to the *waterLevel* field. The high water location indicates the level of the home that was affected (e.g. basement, first floor) whereas the water level indicates the height of water in the home at that level (e.g. 1 in, 56 in). We assume that half of homes with a high water mark in the basement have unfinished basements and half have finished basements. We assume that half of homes with a high water mark in the crawlspace had mechanical components impacted and half did not have mechanical components impacted.

In developing the damage categories, we also used the OpenFEMA variable *residenceType* to distinguish between mobile (manufactured homes and travel trailers) and non-mobile homes (homes, townhouses, apartments, etc). A mobile unit is more likely to sustain major damage with even an inch of water on the first floor because walls must be removed in order to repair damaged flooring. The damage categories are described in figure 3 of the report.

The number of homes in each damage category (figure 1 in report text) are multiplied by per home rebuild costs for each of the two rebuild approaches (figure 3 in report text) to yield estimated total costs to rebuild damaged homes.

Cost estimates for each of the damage categories were developed in collaboration with regional experts Housing Development Alliance and H.O.M.E.S. Inc, who have been repairing and replacing flood-damaged homes. Figure 2 of the report provides a summary of each rebuild approach. Figure 3 provides per home repair and replace costs for each approach, and figure 13 provides a description of what we assume is included in each repair or replace cost.

Figure. 13 Description of assumed repair and replace costs

Repair / replace cost	Description
\$150,000	build a new 1000 - 1200 square ft, two-bedroom home with basic appliances included
\$35,000	cost of land for a new home
\$70,000	this repair cost includes most of the following: on first floor, cut and replace drywall, replace trim, replace appliances and kitchen and bathroom cabinetry, tear out and replace flooring, replace damaged windows and doors; in some instances electrical work will be needed; in crawlspace/basement, replace and elevate HVAC and duct work, water heater, and other mechanical components, install vapor barrier, and install flood vents; this cost estimate also assumes that some homes will require structural repairs to foundation, walls, etc. which is likely to push this estimate higher; however, others without severe structural damage may cost less than \$70,000
\$30,000	on first floor, tear out and replace flooring; in crawlspace/basement, replace and elevate HVAC and duct work, water heater, and other mechanical components located in basement/crawlspace, install vapor barrier, install flood vents.
\$20,000	in crawlspace/basement replace and elevate HVAC and duct work, water heater, and other mechanical components, install vapor barrier, and install flood vents
\$3,500	in crawlspace/basement install vapor barrier and install flood vents; for affected access roads, repair damaged driveways and culverts; this estimate is likely very low for some driveway and culvert repairs and too high for others that require only, for example, gravel replacement

In addition to damage cost estimates, we also summarized demographic, insurance, and housing statistics of households with damaged homes using additional fields in the OpenFEMA dataset. Calculations related to gross income range of households exclude 854 households that did not report their income. Data for the "\$60,001-\$120,000" income range for "All households in FEMA-designated counties" and "All Households in Kentucky" includes households with incomes of \$120,001 to \$125,000 (given how Census Bureau reports income data). Calculations of median FEMA housing assistance awards include only applications deemed eligible for FEMA housing assistance.