## Harvey An 'Unprecedented' Disaster, Could Unload 25 Trillion Gallons Of Water

As I sit in my house in Houston, TX, I try to wrap my mind around the staggering numbers seen thus far by Harvey. Estimates are that up to 25 trillion gallons of water could fall on the state of Texas as a result of this historic storm.

Harvey has forced scientists outside of their comfort zone and into a realm of theoretical, given the unprecedented rainfall totals. Experts will commonly discuss the need to build architectural structures to withstand one hundred year floods or one thousand year floods. These numbers are based historical records and probability distributions.

When determining the anticipated severity of a 100-year flood, scientists determine the $1 \%$ annual exceedance probability. Probability distribution functions are built on stream gauge data from around the United States, measuring stream flow under normal and extreme conditions. This builds a normal distribution, from which scientists can determine the upper 1\% probability. Since the $1 \%$ probability flood has a 1 in one hundred chance of occurring, scientists deem this the one hundred year flood. A 500-year flood would have a $0.2 \%$ chance of occurring in any given year.

When dealing with the extreme ends of the probability distribution function, there are errors in calibrating the magnitude and likelihood of a scenario. This is because there are simply fewer data points supporting the extreme flooding and extreme drought conditions. Measurements and data will center around the mean and thus extreme variations from the mean become less reliable.

That is why scientists find themselves largely in uncharted territory with flooding from Hurricane Harvey. Estimates are that up to 50 inches of rain could fall in parts of Texas over the course of a few days. That is larger than the entire year's average rainfall in Houston.

To put into perspective, the estimated total rainfall in Texas as a result of Harvey, at 25 trillion gallons of water would equal rainfall over the entire United States of
0.38 inches.

Below is a table of every state in the United States and Washington D.C. along with how much water would cover each state if the equivalent Harvey rainfall fell in the state.

| State | Ranking | Area (Cubic M) | Harvey Rainfall Across State (In) |
| :---: | :---: | :---: | :---: |
| Alaska | 1 | 1,717,854,000,000 | 2.2 |
| Texas | 2 | 695,621,000,000 | 5.4 |
| California | 3 | 423,970,000,000 | 8.8 |
| Montana | 4 | 380,838,000,000 | 9.8 |
| New Mexico | 5 | 314,915,000,000 | 11.8 |
| Arizona | 6 | 295,254,000,000 | 12.6 |
| Nevada | 7 | 286,351,000,000 | 13.0 |
| Colorado | 8 | 269,601,000,000 | 13.8 |
| Oregon | 9 | 254,805,000,000 | 14.6 |
| Wyoming | 10 | 253,336,000,000 | 14.7 |
| Michigan | 11 | 250,494,000,000 | 14.9 |
| Minnesota | 12 | 225,171,000,000 | 16.5 |
| Utah | 13 | 219,887,000,000 | 16.9 |
| Idaho | 14 | 216,446,000,000 | 17.2 |
| Kansas | 15 | 213,096,000,000 | 17.5 |
| Nebraska | 16 | 200,356,000,000 | 18.6 |
| South Dakota | 17 | 199,742,000,000 | 18.7 |
| Washington | 18 | 184,665,000,000 | 20.2 |
| North Dakota | 19 | 183,112,000,000 | 20.3 |
| Oklahoma | 20 | 181,035,000,000 | 20.6 |
| Missouri | 21 | 180,533,000,000 | 20.6 |
| Florida | 22 | 170,304,000,000 | 21.9 |
| Wisconsin | 23 | 169,639,000,000 | 22.0 |
| Georgia | 24 | 153,909,000,000 | 24.2 |
| Illinois | 25 | 149,998,000,000 | 24.8 |
| Iowa | 26 | 145,743,000,000 | 25.6 |


| New York | 27 | 141,299,000,000 | 26.4 |
| :---: | :---: | :---: | :---: |
| North Carolina | 28 | 139,389,000,000 | 26.7 |
| Arkansas | 29 | 137,732,000,000 | 27.1 |
| Alabama | 30 | 135,765,000,000 | 27.4 |
| Louisiana | 31 | 134,264,000,000 | 27.7 |
| Mississippi | 32 | 125,434,000,000 | 29.7 |
| Pennsylvania | 33 | 119,283,000,000 | 31.2 |
| Ohio | 34 | 116,096,000,000 | 32.1 |
| Virginia | 35 | 110,785,000,000 | 33.6 |
| Tennessee | 36 | 109,151,000,000 | 34.1 |
| Kentucky | 37 | 104,659,000,000 | 35.6 |
| Indiana | 38 | 94,321,000,000 | 39.5 |
| Maine | 39 | 91,646,000,000 | 40.7 |
| South Carolina | 40 | 82,932,000,000 | 44.9 |
| West Virginia | 41 | 62,755,000,000 | 59.4 |
| Maryland | 42 | 32,133,000,000 | 115.9 |
| Hawaii | 43 | 28,311,000,000 | 131.6 |
| Massachusetts | 44 | 27,336,000,000 | 136.3 |
| Vermont | 45 | 24,901,000,000 | 149.6 |
| New Hampshire | 46 | 24,216,000,000 | 153.9 |
| New Jersey | 47 | 22,588,000,000 | 164.9 |
| Connecticut | 48 | 14,357,000,000 | 259.5 |
| Delaware | 49 | 6,447,000,000 | 577.9 |
| Rhode Island | 50 | 4,002,000,000 | 931.0 |
| District of Columbia | 51 | 176,750,000 | 21,079.5 |

At the end of this historic storm it will surely be ranked as one of the largest natural disasters to hit the United States.

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