



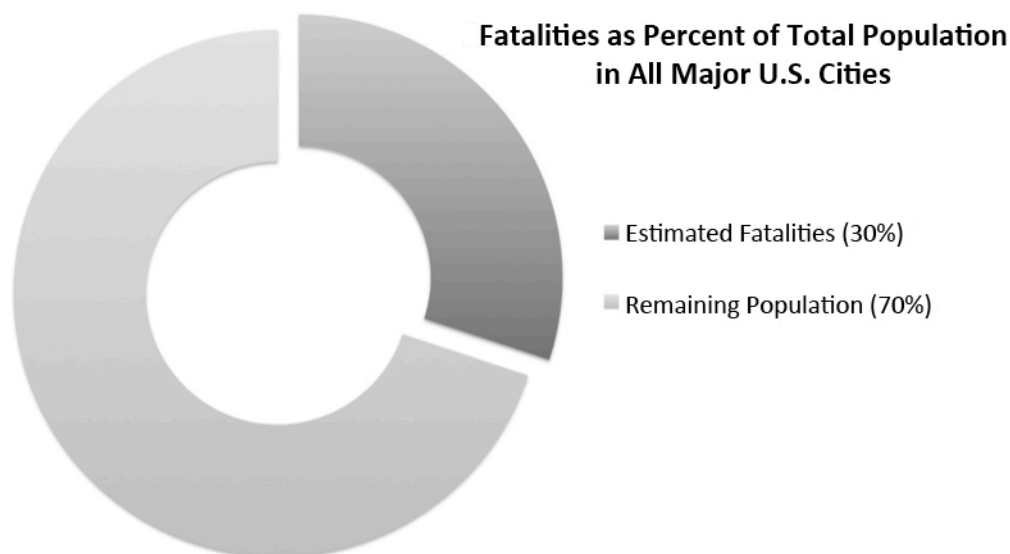
Estimated U.S. Fatalities from a Russian Nuclear Retaliation

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Using data from NUKEMAP¹, Global Zero charted the estimated number of U.S. fatalities from a Russian nuclear retaliatory attack using mobile intercontinental ballistic missiles, the Topol-25 and Topol-M, and multiple independently-targeted reentry vehicle-equipped RS-24 missiles. The retaliation scenario consisted of 145 total nuclear warheads – 37 warheads fitted to either the Topol-25 or Topol-M, each with a 550-kiloton yield, and 108 warheads fitted to RS-24 missiles, each with a 250-kiloton yield.² In this scenario, 30% of the total population of the top 145 most populated U.S. cities would perish.

Detonation heights were selected at the optimal burst altitude to maximize fatalities: 1,803 meters for a 550-kiloton nuclear missile yield and 1,386 meters for a 250-kiloton nuclear missile yield. NUKEMAP's casualty model, which differentiates fatalities from injuries, is drawn from an ambient population database that estimates the average number of people in an area within 24 hours, capturing not just where populations live but where they work or spend time.³

Population estimates for the top 145 most populated U.S. cities are from 2015 U.S. Census data.⁴



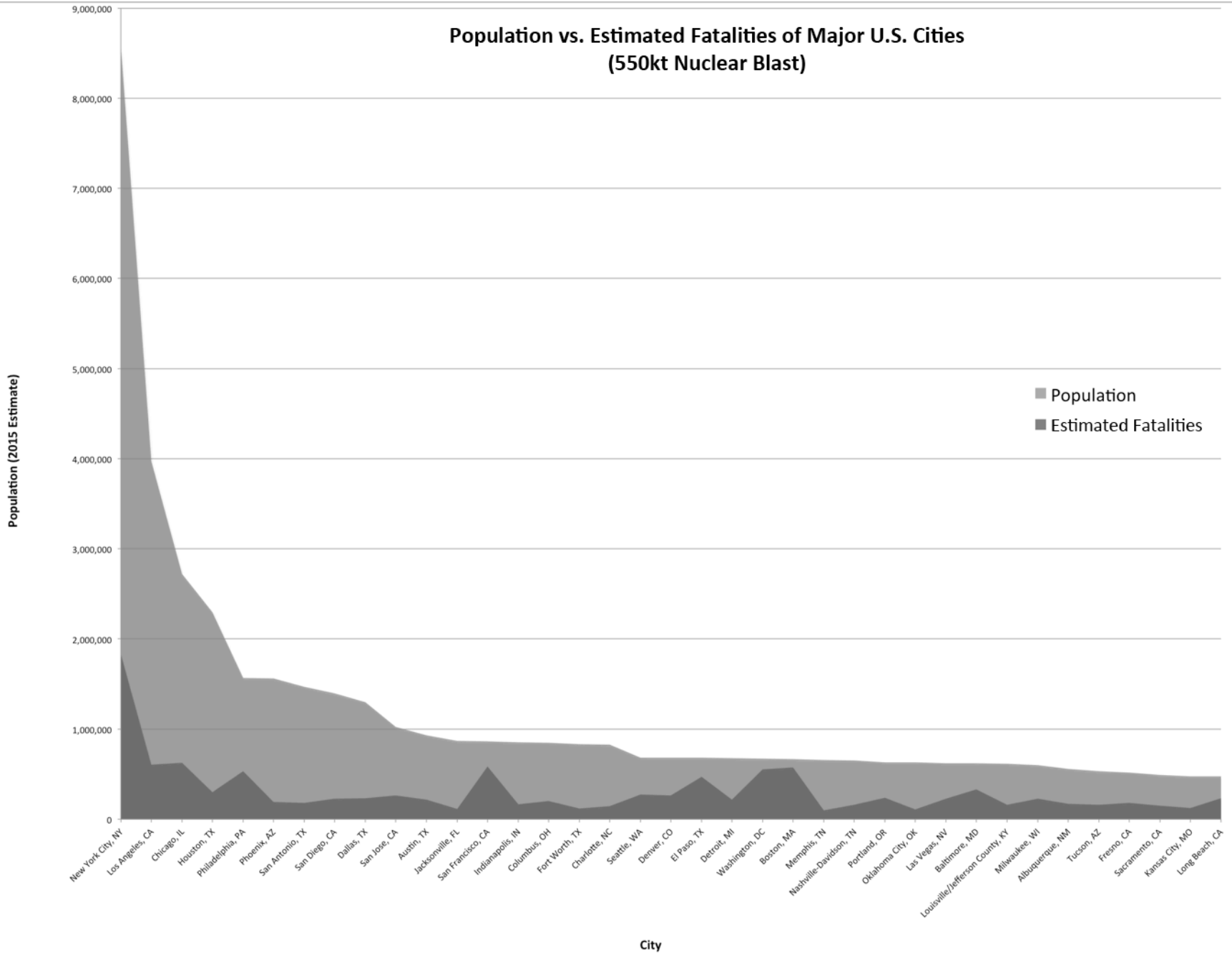
¹ Alex Wellerstein, "NUKEMAP," *Restricted Data: The Nuclear Secrecy Blog*, 2012, accessed August 16, 2016, <http://nuclearsecrecy.com/nukemap/>.

² This assumes the day-to-day deployment of 100 Russian mobile missiles in hidden field locations, of which U.S. surveillance and strategic forces find, track and destroy approximately one-third, 36 missiles. Bruce Blair, private communications.

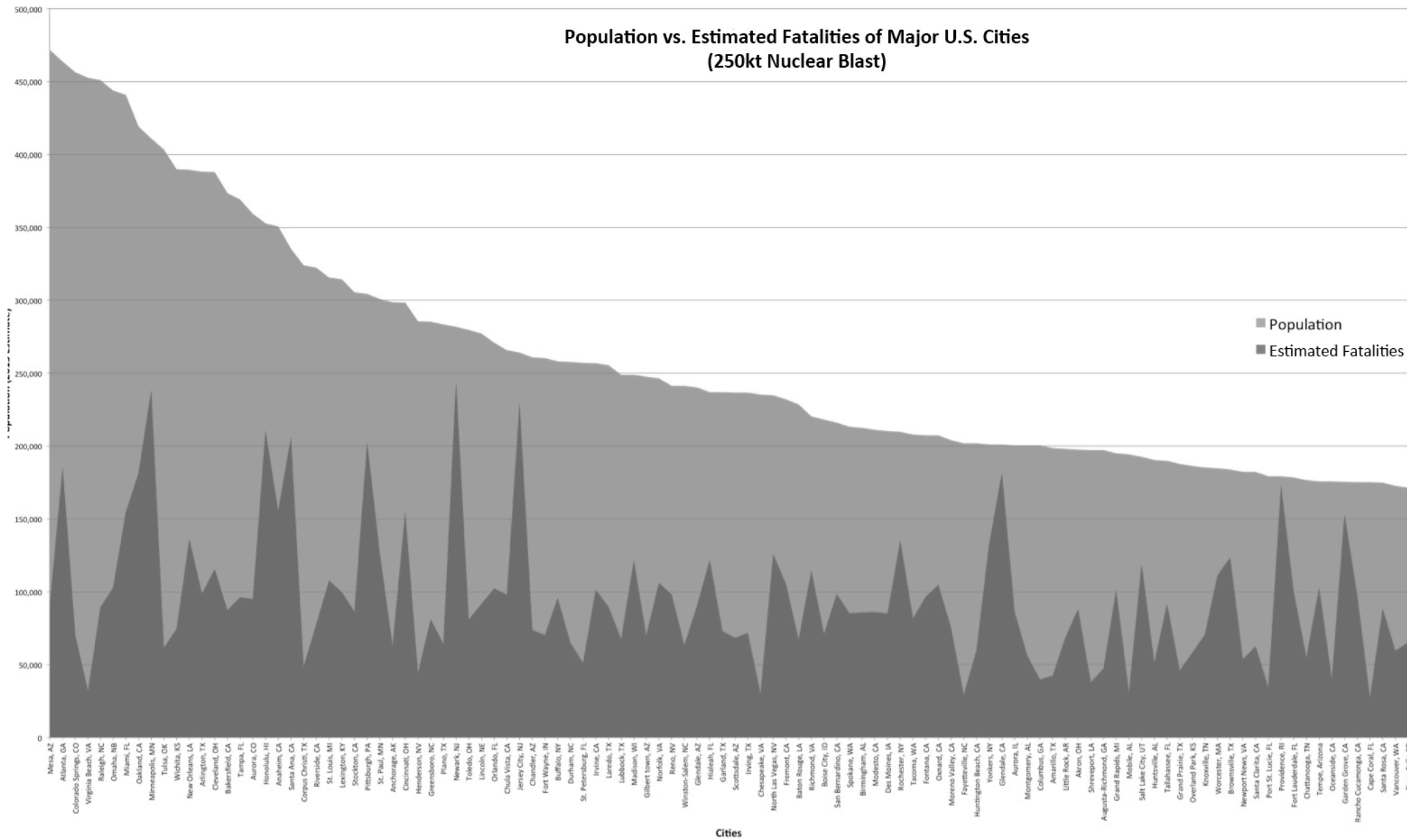
³ Alex Wellerstein, "How does the casualties model work?" *Restricted Data: The Nuclear Secrecy Blog*, 2012, accessed August 16, 2016, <http://http://nuclearsecrecy.com/nukemap/faq/#casualties>.

⁴ "Annual Estimates of the Resident Population for Incorporated Places of 50,000 or More, Ranked by July 1, 2015," *United States Census Bureau: American Fact Finder*, August 16, 2016, <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>.

Population vs. Estimated Fatalities of Major U.S. Cities (550kt Nuclear Blast)



Population vs. Estimated Fatalities of Major U.S. Cities (250kt Nuclear Blast)



Warhead Yield (kt)	City	Population (2015 Est.)	Estimated Fatalities	% Population
550 kt	New York City, NY	8,550,405	1,828,270	21%
550 kt	Los Angeles, CA	3,971,883	606,140	15%
550 kt	Chicago, IL	2,720,546	625,890	23%
550 kt	Houston, TX	2,296,224	302,800	13%
550 kt	Philadelphia, PA	1,567,442	533,440	34%
550 kt	Phoenix, AZ	1,563,025	190,040	12%
550 kt	San Antonio, TX	1,469,845	179,180	12%
550 kt	San Diego, CA	1,394,928	229,590	16%
550 kt	Dallas, TX	1,300,092	234,280	18%
550 kt	San Jose, CA	1,026,908	266,080	26%
550 kt	Austin, TX	931,830	216,130	23%
550 kt	Jacksonville, FL	868,031	112,380	13%
550 kt	San Francisco, CA	864,816	583,350	67%
550 kt	Indianapolis, IN	853,173	168,350	20%
550 kt	Columbus, OH	850,106	204,590	24%
550 kt	Fort Worth, TX	833,319	118,320	14%
550 kt	Charlotte, NC	827,097	143,610	17%
550 kt	Seattle, WA	684,451	274,520	40%
550 kt	Denver, CO	682,545	266,290	39%
550 kt	El Paso, TX	681,124	472,140	69%
550 kt	Detroit, MI	677,116	216,840	32%
550 kt	Washington, DC	672,228	554,210	82%
550 kt	Boston, MA	667,137	572,410	86%
550 kt	Memphis, TN	655,770	97,630	15%
550 kt	Nashville-Davidson, TN	654,610	162,250	25%
550 kt	Portland, OR	632,309	239,720	38%
550 kt	Oklahoma City, OK	631,346	107,910	17%
550 kt	Las Vegas, NV	623,747	226,320	36%
550 kt	Baltimore, MD	621,849	332,380	53%
550 kt	Louisville/Jefferson County, KY	615,366	158,870	26%
550 kt	Milwaukee, WI	600,155	227,500	38%

550 kt	Albuquerque, NM	559,121	168,520	30%
550 kt	Tucson, AZ	531,641	161,960	30%
550 kt	Fresno, CA	520,052	180,430	35%
550 kt	Sacramento, CA	490,712	152,360	31%
550 kt	Kansas City, MO	475,378	125,650	26%
550 kt	Long Beach, CA	474,140	234,370	49%
250 kt	Mesa, AZ	471,825	91,860	19%
250 kt	Atlanta, GA	463,878	185,540	40%
250 kt	Colorado Springs, CO	456,568	70,090	15%
250 kt	Virginia Beach, VA	452,745	31,790	7%
250 kt	Raleigh, NC	451,066	89,320	20%
250 kt	Omaha, NB	443,885	103,000	23%
250 kt	Miami, FL	441,003	154,660	35%
250 kt	Oakland, CA	419,267	181,290	43%
250 kt	Minneapolis, MN	410,939	238,040	58%
250 kt	Tulsa, OK	403,505	61,630	15%
250 kt	Wichita, KS	389,965	74,510	19%
250 kt	New Orleans, LA	389,617	136,140	35%
250 kt	Arlington, TX	388,125	98,840	25%
250 kt	Cleveland, OH	388,072	115,620	30%
250 kt	Bakersfield, CA	373,640	87,410	23%
250 kt	Tampa, FL	369,075	96,310	26%
250 kt	Aurora, CO	359,407	94,990	26%
250 kt	Honolulu, HI	352,769	210,550	60%
250 kt	Anaheim, CA	350,742	155,590	44%
250 kt	Santa Ana, CA	335,400	205,950	61%
250 kt	Corpus Christi, TX	324,074	48,850	15%
250 kt	Riverside, CA	322,424	77,950	24%
250 kt	St. Louis, MI	315,685	107,860	34%
250 kt	Lexington, KY	314,488	99,860	32%
250 kt	Stockton, CA	305,658	86,600	28%
250 kt	Pittsburgh, PA	304,391	202,470	67%
250 kt	St. Paul, MN	300,851	126,070	42%

250 kt	Anchorage, AK	298,695	62,860	21%
250 kt	Cincinnati, OH	298,550	154,710	52%
250 kt	Henderson, NV	285,667	44,050	15%
250 kt	Greensboro, NC	285,342	81,230	28%
250 kt	Plano, TX	283,558	64,120	23%
250 kt	Newark, NJ	281,944	243,870	86%
250 kt	Toledo, OH	279,789	80,910	29%
250 kt	Lincoln, NE	277,348	91,650	33%
250 kt	Orlando, FL	270,934	102,230	38%
250 kt	Chula Vista, CA	265,757	98,060	37%
250 kt	Jersey City, NJ	264,290	229,490	87%
250 kt	Chandler, AZ	260,828	73,750	28%
250 kt	Fort Wayne, IN	260,326	70,150	27%
250 kt	Buffalo, NY	258,071	95,840	37%
250 kt	Durham, NC	257,636	65,170	25%
250 kt	St. Petersburg, FL	257,083	51,220	20%
250 kt	Irvine, CA	256,927	101,410	39%
250 kt	Laredo, TX	255,473	89,810	35%
250 kt	Lubbock, TX	249,042	67,550	27%
250 kt	Madison, WI	248,951	121,540	49%
250 kt	Gilbert Town, AZ	247,542	70,030	28%
250 kt	Norfolk, VA	246,393	106,240	43%
250 kt	Reno, NV	241,445	98,180	41%
250 kt	Winston-Salem, NC	241,218	63,450	26%
250 kt	Glendale, AZ	240,126	90,380	38%
250 kt	Hialeah, FL	237,069	121,860	51%
250 kt	Garland, TX	236,897	72,870	31%
250 kt	Scottsdale, AZ	236,839	68,360	29%
250 kt	Irving, TX	236,607	71,740	30%
250 kt	Chesapeake, VA	235,429	29,940	13%
250 kt	North Las Vegas, NV	234,807	126,060	54%
250 kt	Fremont, CA	232,206	105,200	45%
250 kt	Baton Rouge, LA	228,590	67,200	29%

250 kt	Richmond, VA	220,289	114,680	52%
250 kt	Boise City, ID	218,281	70,940	32%
250 kt	San Bernardino, CA	216,108	98,560	46%
250 kt	Spokane, WA	213,272	85,190	40%
250 kt	Birmingham, AL	212,461	85,720	40%
250 kt	Modesto, CA	211,266	86,050	41%
250 kt	Des Moines, IA	210,330	85,120	40%
250 kt	Rochester, NY	209,802	135,130	64%
250 kt	Tacoma, WA	207,948	81,790	39%
250 kt	Fontana, CA	207,460	96,510	47%
250 kt	Oxnard, CA	207,254	104,810	51%
250 kt	Moreno Valley, CA	204,198	75,030	37%
250 kt	Fayetteville, NC	201,963	29,030	14%
250 kt	Huntington Beach, CA	201,899	60,030	30%
250 kt	Yonkers, NY	201,116	132,930	66%
250 kt	Glendale, CA	201,020	181,530	90%
250 kt	Aurora, IL	200,661	86,250	43%
250 kt	Montgomery, AL	200,602	56,210	28%
250 kt	Columbus, GA	200,579	39,780	20%
250 kt	Amarillo, TX	198,645	42,620	21%
250 kt	Little Rock, AR	197,992	68,550	35%
250 kt	Akron, OH	197,542	88,260	45%
250 kt	Shreveport, LA	197,204	37,990	19%
250 kt	Augusta-Richmond, GA	197,182	47,280	24%
250 kt	Grand Rapids, MI	195,097	101,250	52%
250 kt	Mobile, AL	194,288	30,690	16%
250 kt	Salt Lake City, UT	192,672	118,970	62%
250 kt	Huntsville, AL	190,582	51,260	27%
250 kt	Tallahassee, FL	189,907	91,810	48%
250 kt	Grand Prairie, TX	187,809	46,150	25%
250 kt	Overland Park, KS	186,515	58,230	31%
250 kt	Knoxville, TN	185,291	70,500	38%
250 kt	Worcester, MA	184,815	111,330	60%

250 kt	Brownsville, TX	183,887	123,560	67%
250 kt	Newport News, VA	182,385	53,650	29%
250 kt	Santa Clarita, CA	182,371	62,640	34%
250 kt	Port St. Lucie, FL	179,413	34,400	19%
250 kt	Providence, RI	179,207	173,140	97%
250 kt	Fort Lauderdale, FL	178,590	99,800	56%
250 kt	Chattanooga, TN	176,588	54,900	31%
250 kt	Tempe, Arizona	175,826	102,950	59%
250 kt	Oceanside, CA	175,691	40,370	23%
250 kt	Garden Grove, CA	175,393	153,250	87%
250 kt	Rancho Cucamonga, CA	175,236	97,700	56%
250 kt	Cape Coral, FL	175,229	27,270	16%
250 kt	Santa Rosa, CA	174,972	88,420	51%
250 kt	Vancouver, WA	172,860	59,630	34%
250 kt	Sioux Falls, SD	171,544	65,150	38%
Total		72,132,152	21,695,650	30%