Commerce City Stats, Brittany Brown

Statistics:

Home Fires are becoming more deadly, twenty years ago you had 15-17 minutes to safely escape your home during a home fire. Now, due to our synthetic furnishings, home fires can become deadly in less than 2 minutes. In home fires, 89% of all fire fatalities the cause of death is smoke inhalation. You have a 15% greater chance of dying in a home fire now, than you did 40 years ago due to the thermal inertia of our fuels. What this means is that it takes less heat, and less energy to break down the furniture in our homes than it did 40 years ago and fires become deadlier quicker, this smoke is produced faster, and this smoke is what kills almost 90% of all individuals who die in a residential fire. (HFSC)

The average response for a fire department upon dispatch is about 9-12 minutes, with home fires becoming deadly within less than 2 minutes it is imperative that early notification and fast suppression can occur! The SACFD's average response to a residential structure fire is 8 minutes, which is still 4 times longer than the time after which a fire begins deadly. (HFSC and SACFD)

Sprinklers make up this difference, in fact, fire deaths can be reduced by 85-90% with residential fire sprinklers, with over 2230 annual fire deaths occurring in residential occupancies, that's six fatalities every single day. If residential sprinklers were widely accepted the rate of annual fire deaths in residential occupancies could be reduced by 1,895-2,007 fatalities every year and lessen the daily date to potentially less than one death per day due to fire (NFSC and USFA, NFPA)

The average cost of a residential structure fire is over 6.8 billion dollars in direct property damage annually, over $62,000-$78,000 per occurrence on average for each residential structural fire. With residential fire sprinklers that rate can be reduced to approximately $2,000. This means that not having residential fire sprinklers is actually a 3,013.4%-3,800% increase in damages! Residential fire sprinklers actually reduce the potential for damage by over 97%. (NFPA and HFSC)

96% of the time when a residential fire occurred in an occupancy with residential fire sprinklers the fire was contained to one room, leading to the reduction of this 97% of property damages. In 89% of the home fires with operating sprinklers, only one operated. In 99.5 percent, five or fewer operated. This means that 15% of the time two heads operated, but in almost all cases the fire was controlled enough to keep the ceiling temperatures down so that only one head operated, leading to the compartmentalization of keeping the fire within one room 96% of this time. (NFPA and HFSC)

Residential fire sprinklers help firefighters too, firefighter injuries are actually 78% lower in residential occupancies that have fire sprinkler systems. (NFPA)

Residential Fire Flow (NFA Model)

$$Length\ times\ Width\ divided\ by\ 3\ times\ number\ of\ floors\ times\ percentage\ of\ involvement$$

This example, a 2000 square foot home, one story at considered 50% involvement, will need over 333 Gallons of water to put out this fire.

$$40feet\ (L) \times 50feet(W) = 2000\ sqft \div (3)Factor \times .5(level\ of\ involvement) = 333.33\ Gallons$$

At 20% Standard deviation

$$333.33\ GPM \times .2 = 66.666\ GPM, 333.33\ GPM = appox.400\ Gallons$$

$$3333.33 - 66.666\ GPM = approx.266\ Gallons$$

The average water put on a 50% involved structures fire according to this model is about 333 Gallons.

In a 1-head design, at 13 GPM flowing for 8 minutes, the rate of water is 104 Gallons, less than 32% of the average fire flow in gallons from the Fire Department.

In a 2-head design flowing at 26 GPM for 8 minutes, the rate of water is 208 Gallons, less than 63% of the average fire flow in gallons from the Fire Department.

The quantification of damage, however, at an increase of 3,013.4% is significant in sprinklered fires.

Water Department Cost Benefit Analysis

2023 Water And Wastewater Rates Effective January 1, 2023

Residential Water Charges Gallons Used Over Monthly Minimum

Gallons	($) Per 1,000 Gallons
1,000 - 11,999	$5.45
12,000 - 17, 999	$5.75
18,000 - 29,999	$7.06
30,000 - 45,999	$10.62
46,000 and over	$15.65

$$Cost: 1000\ Gallons\ at\ \$5.45, \$5.45 \div 1000\ Gallons = \$0.00545/Gallon$$

$$\$0.00545 \times 333\ Gallons = \$1.81\ When\ the\ Fire\ Department\ Suppressses\ the\ Fire\ (Average)$$

$$\$0.00545 \times 266\ Gallons = \$1.45\ When\ the\ Fire\ Department\ Suppressses\ the\ Fire\ (Low)$$

$$\$0.00545 \times 400\ Gallons = \$2.18\ When\ the\ Fire\ Department\ Suppressses\ the\ Fire\ (High)$$

Sprinklers:

$$\$0.00545 \times 104\ Gallons\ (1\ head\ at\ 13\ GPM\ for\ 8\ minutes\ = \$0.57\ (One\ head)$$

$$\$0.00545 \times 208\ Gallons\ (2\ heads\ at\ 26\ GPM\ for\ 8\ minutes\ = \$1.13\ (two\ heads)$$

Fire Department: $1.81 and Fire sprinkler (One-head) $0.57

The lack of fire sprinklers is a 217.544% increase for the water department for water usage in fire sprinklers vs. fire department suppression operations on average.

Average Commerce City Stcutures Fires: 80 in which lines are pulled and water flowed. Assuming 50% involvement:

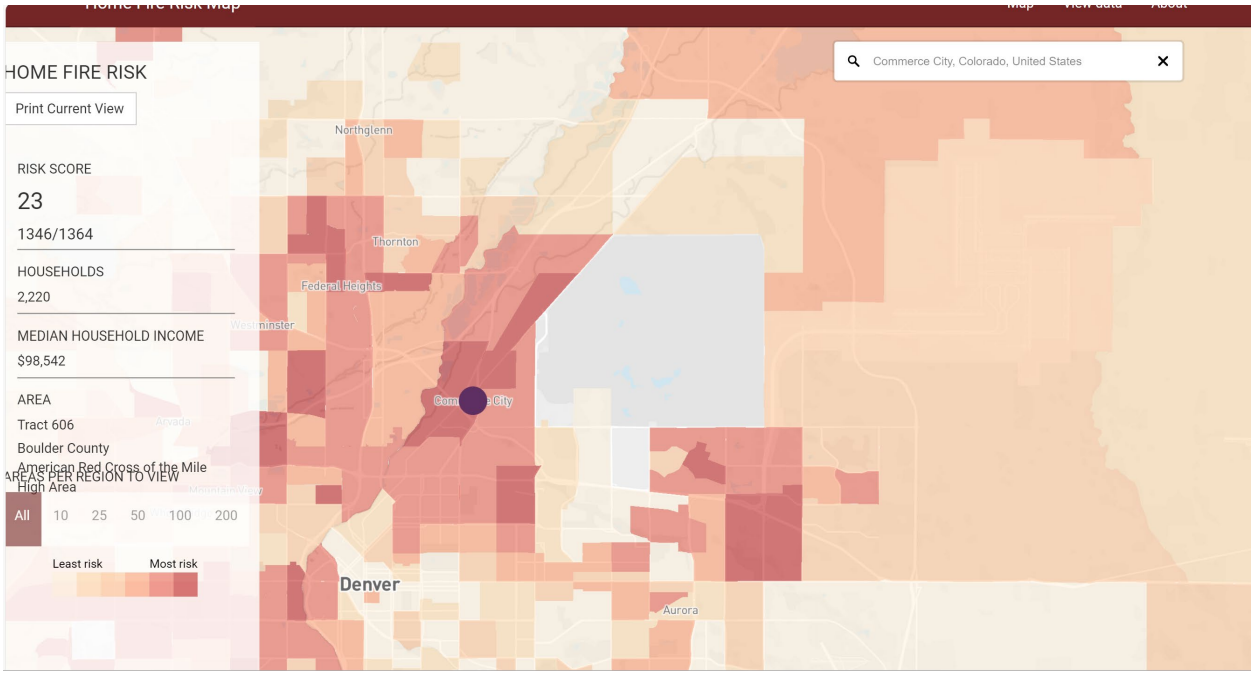
$$Fire\ Department: \$1.81 \times 80 = \$144.8$$

Vs.

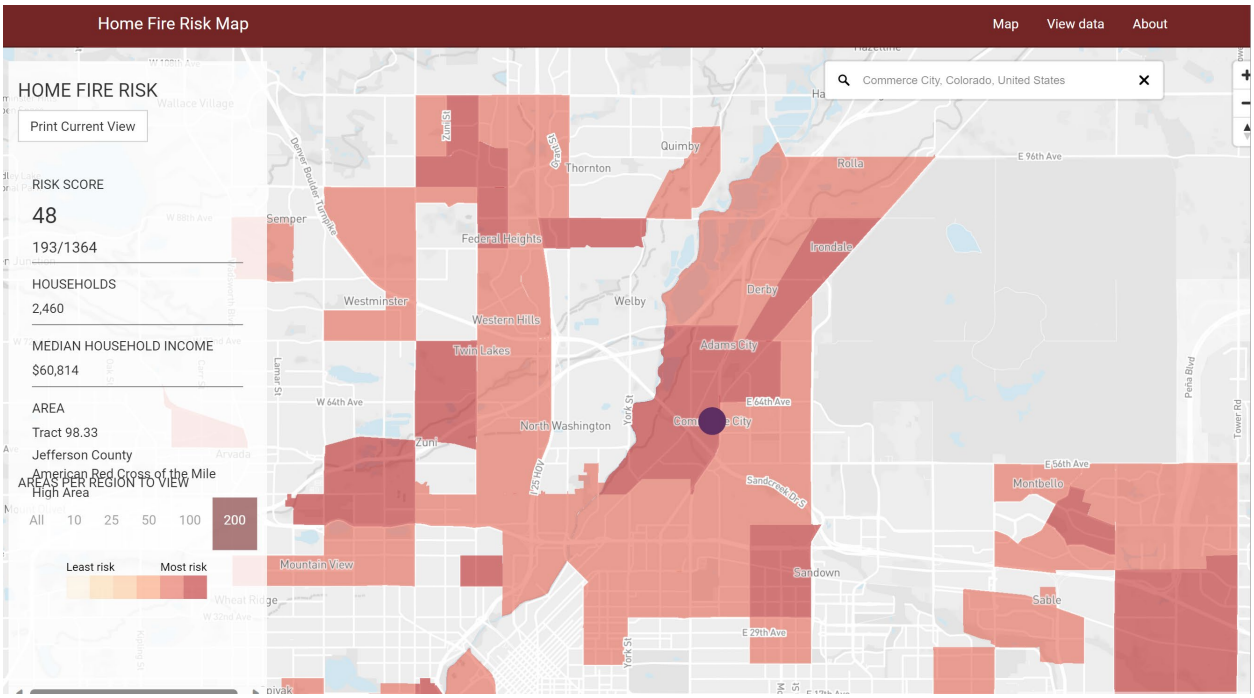
$$Fire\ Sprinkler\ Systems: \$0.57 \times 80 = \$45.60$$

Fire Deaths so far in 2023: 1762 total, 15 deaths specifically in Colorado, The Fire Death Rate is 10.3 per 1,000,000 with a relative risk of 0.8 meaning as analyzed per capita against the national average. One-two-family homes had a death rate of 8.3 deaths per 1,000 fires, the highest rate in residential properties within this occupancy classification.

Commerce City Stats, Brittany Brown



Red Cross Home Fire Risk Index. Commerce City is High.



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Tough Questions:

- Explain mathematically and hydraulically, why the ¾-inch meter is not appropriate. What is the safety factor required for meters? What standard deviation is allowable and why is the 1 inch more appropriate?
- What is the percentage of occupancies that will require a 2-head design, what are the worst-case hydraulic calculations for this area? What is the average square footage of homes within this requirement?
- The State of Colorado Water and AWWA do not require a backflow for P2904 Multi-purpose systems, in fact, this information is hardly quantifiable as P2904 Multipurpose systems are considered plumbing systems. What justification is a backflow without quantifiable substantiation? What other jurisdictions are solely doing P2904 Multi-purpose systems?
- The CRS for Water Districts in the state of Colorado requires fees to be reasonable, an increase of almost 1300% is not.
- Backflow and/or PRV ($535) to 1-inch tap ($7500+$535)

$$Percentage\ increase = 1301.87\%$$

This is an increase from just a backflow or PRV of over 1301.87%

- An increase in tap size, including line and meters from surrounding jurisdictions is about $10,000, as the median income of Commerce City is about $70,000. A tap increase of this magnitude is 1/7th the income of most citizens without substantiation, this is unprecedented.
- 2426 residential occupancies passed through the Commerce City Development Team Review Process from January 1st, 2023 through October 1st, 2023 (83.3% of the year, respectively, excluding any occupancy that would have required a 13R system). If 1-inch lines, taps, meters and Backflow and/or PRVs are required that would equate to roughly the following:

$$2426\ resdiential\ occupancies\ \times \$7{,}500\ cost\ with\ a\ 1\ inch\ line = \$18{,}195{,}000$$

$$2426\ at\ 83.3\%\ is\ \text{approx.}\ 2912\ \text{at}\ 100\%\ \text{(full year)}$$

$$2912\ resdiential\ occupancies\ \times \$7{,}500\ cost\ with\ a\ 1\ inch\ line = \$22{,}065{,}000$$

- What is the cost to the water department for parts, materials, labor etc. for the 1 inch line and what is the respective percentage of return? What is the average percentage of return for the current ¾ inch, 5/8 yolk meters? Why is there such a premium being charged for basic life safety?
- Cost of a residential fire sprinkler installation, $1.00 to $2.00 per square foot in new construction, $1.50 on average

$$\$2250\ average\ for\ a\ 1500\ sq\ foot\ home,$$

for this example

$$\$1.50 \times 2000\ sqft = \$3{,}000$$

- Average cost in the United States for a 1500 sq foot home is $248,000 at $165.00 per square foot.
- A sprinkler system for a 1500 sq foot home is thusly hardly 1% (0.0090725806) at 0.9% of the home's cost

$$\frac{\$2250}{\$248{,}000} = 0.0090725806$$

- and for 2000 sq ft is:

$$\frac{\$3{,}000}{248{,}000} = 0.0120967742$$

- A sprinkler system for a 2000 sq foot home is thusly hardly 1% (0.0120967742) at 1.2% of the home's cost

The median cost for square footage in Commerce City is approximately $260 sq/ft

$$2000ft \times \$260\ (cost\ per\ sq\ ft) = \$520{,}000$$

$$\frac{\$2250}{\$520{,}000} = 0.0043269231$$

- and for 2000 sq ft is:

$$\frac{\$3{,}000}{\$520{,}000} = 0.0057692308$$

Respectively, in Commerce City between 0.0043269231 **(0.4%)** and 0.0057692308 and **(0.5%)** of the total cost, with the cost of a 1 inch at cost:

$$\frac{\$7500}{\$520{,}000} = 0.0144230769$$

Almost (0.0144230769) 1.44% of the total cost of the house,

$0.0057692308\ to\ 0.0144230769$ is a 150% increase for simply the meter versus the entire cost of the sprinkler system per square footage.

Neptune Mach 10 ¾ inch Water Meter

Operating Characteristics

Meter Size	Normal Operating Range @ 100% Accuracy (+/- 1.5%)	AWWA C715 Standard Type 1	Extended Low Flow @ 100% Accuracy (+/- 3%)
⅝"	0.10 to 25 U.S. gpm 0.02 to 5.68 m³/h	0.2 to 20 U.S. gpm 0.05 to 4.54 m³/h	0.05 U.S. gpm 0.01 m³/h
¾"	0.10 to 35 U.S. gpm 0.02 to 7.95 m³/h	0.5 to 30 U.S. gpm 0.11 to 6.81 m³/h	0.05 U.S. gpm 0.01 m³/h
1"	0.40 to 55 U.S. gpm 0.09 to 12.49 m³/h	0.75 to 50 U.S. gpm 0.17 to 11.35 m³/h	0.25 U.S. gpm 0.06 m³/h

Normal GPM Flow 13-26 GPM, Neptune Mach 10 ¾ inch rated at 35 GPM

$$13\ GPM\ (Single\ Head) \div 35GPM\ = 37.1\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 35GPM\ = 74.3\%$$

Safety Factor for a 1-head design 62.9% and 2-head design 25.7%

With ±1.5% =(±0.525) 35.525 GPM and 34.475 GPM

$$13\ GPM\ (Single\ Head) \div 35.525GPM\ = 36.6\%$$

$$13\ GPM\ (Single\ Head) \div 34.475GPM\ = 37.7\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 35.525GPM\ = 73.2\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 34.475GPM\ = 75.4\%$$

Safety Factor for a 1-head design 36.6%-37.7% and 2-head design 73.2%-75.4%

Neptune Mach T-10 ¾ inch Water Meter

Operating Characteristics

Meter Size	Normal Operating Range @ 100% Accuracy (+/- 1.5%)	AWWA Standard	Low Flow @ 95% Accuracy
⅝"	½ to 20 US gpm 0.11 to 4.55 m³/h	1 to 20 US gpm 0.23 to 4.5 m³/h	⅛ US gpm 0.03 m³/h
¾"	¾ to 30 US gpm 0.17 to 6.82 m³/h	2 to 30 US gpm 0.45 to 6.8 m³/h	¼ US gpm 0.06 m³/h
1"	1 to 50 US gpm 0.23 to 11.36 m³/h	3 to 50 US gpm 0.68 to 11.4 m³/h	⅜ US gpm 0.09 m³/h

Commerce City Stats, Brittany Brown

Normal GPM Flow 13-26 GPM, Neptune T-10 ¾ inch rated at 30 GPM

$$13\ GPM\ (Single\ Head) \div 30GPM\ = 43.3\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 30PGM\ = 86.6\%$$

Safety Factor for a 1-head design 43.3% and 2-head design 86.6%

With ±1.5% =(±.45) 30.45 GPM and 29.55 GPM

$$13\ GPM\ (Single\ Head) \div 30.45\ \text{GPM} = 42.7\%$$

$$13\ GPM\ (Single\ Head) \div 29.55\ \text{GPM} = 44\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 30.45\ \text{GPM}\ = 85.4\%$$

$$26\ GPM\ (Two\ Head\ Design) \div 29.55\ \text{GPM}\ = 88\%$$

Safety Factor for a 1-head design 42.7%-44% and 2-head design 85.4%-88%

Summary of Safety Factors:

Neptune Mach 10 ¾ inch Water Meter: Safety Factor for a 1-head design 36.6%-37.7% and 2-head design 73.2%-75.4%

Neptune Mach T-10 ¾ inch Water Meter: Safety Factor for a 1-head design 42.7%-44% and 2-head design 85.4%-88%

Assuming that a 2-head design at $\pm 1.5\%$ with either the Neptune Mach 10 or Neptune T10 (both ¾ inch design) the range of safety factors is worst case 73.2%-88% accounting for the $\pm 1.5\%$. So what is the safety factor required?

Assuming 10% (correlatively 8.5%-11.5%) with safety factor included from the manufacturer). These ¾ inch straight lays with ¾-inch yolks are adequate for existing ran lines for P2904 Systems.