SPRINKLER EFFECTIVENESS

A study of the numbers behind sprinkler saves

November 2019

Minnesota State Fire Marshal Division

Background

In the 15-year period from Jan. 1, 2004, through Dec. 31, 2018, there were 49,880 building fires[1] in Minnesota for an average of 3,325 per year. The majority of these building fires occurred in structures considered "in normal use." Table 1 shows a breakdown of the building status of these fires.

Table 1 – Building Status When Fire Occurred

Condition	Number of Fires	Percentage of Fires
In normal use	42,574	87.0%
Vacant and secured	1,584	3.2%
Vacant and unsecured	1,402	2.9%
Idle, not routinely used	1,177	2.4%
Under construction	532	1.1%
Being demolished	445	0.9%
Undetermined	445	0.9%
Building status, other	438	0.9%
Under major renovation	354	0.7%
Not reported	929	
	49,880	100.0%

In the majority of these building fires, no automatic fire extinguishing system was present. For a breakdown, see Table 2.

Table 2 – Presence of an Automatic Fire Extinguishing System

None present or reported	42,696	85.7%
Undetermined	3,022	6.0%
Subtotal – None/unknown	45,718	
Partial system present	140	0.3%
Present	4,022	8.0%
Subtotal – System present	4,162	

For this 15-year period, some sort of fire extinguishing system was present in 4,162 building fires (8.3 percent); these were either partial systems or systems protecting the entire building.

Type of Extinguishing System

The type of system was identified in 2,731 of the 4,162 building fires where a fire extinguishing system was present. The most common type of automatic extinguishing system involved was a wet-pipe sprinkler system followed by a dry-pipe sprinkler system. All other types of fire extinguishing systems represented a low percentage of the fires. See Table 3.

[1] Does not include confined fires, such as an internal chimney fire or one contained to a cooking vessel on a stove.

Table 3 – Type of Automatic Extinguishing System Involved

System Type	Number of Fires	Percentage of Fires
Sprinkler Systems		
Wet-pipe sprinkler	2,350	86.0%
Dry-pipe sprinkler	219	8.0%
Other sprinkler	47	1.7%
Subtotal	2,616	95.8%
Other Extinguishing Systems		
Carbon dioxide	8	0.3%
Dry chemical	52	1.9%
Foam	8	0.3%
Halogen-type	10	0.4%
Special hazard, other	37	1.4%
Subtotal	115	4.2%

Fire Extinguishing Operation and Effectiveness

There were 2,970 building fires where an automatic fire extinguishing system was present and its operation was reported. In the many of these incidents, the fire was too small to activate the system (45.5 percent).

Table 4 – Automatic Extinguishing System (AES) Operation

Fire too small to activate system	45.5%
Operation of AES, other	0.3%
System did not operate	8.9%
System operated and was effective	39.8%
System operated and was not effective	2.3%
Undetermined	3.2%

When the fire was large enough to activate the automatic extinguishing system, the extinguishing system was effective in controlling the majority of the fires (93.6 percent). This involved all types of fire extinguishing systems. When only fire sprinkler systems were included, the effectiveness was slightly better (95.6 percent) than all types of systems.

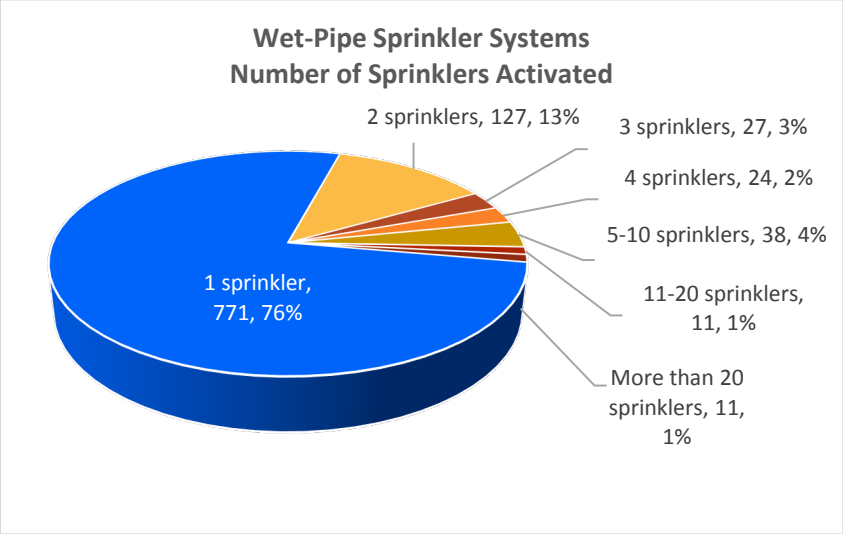
There were 1,118 sprinkler activations following a building fire during this 15-year period. Table 5 shows a breakdown of the sprinkler activations by the type of sprinkler system.

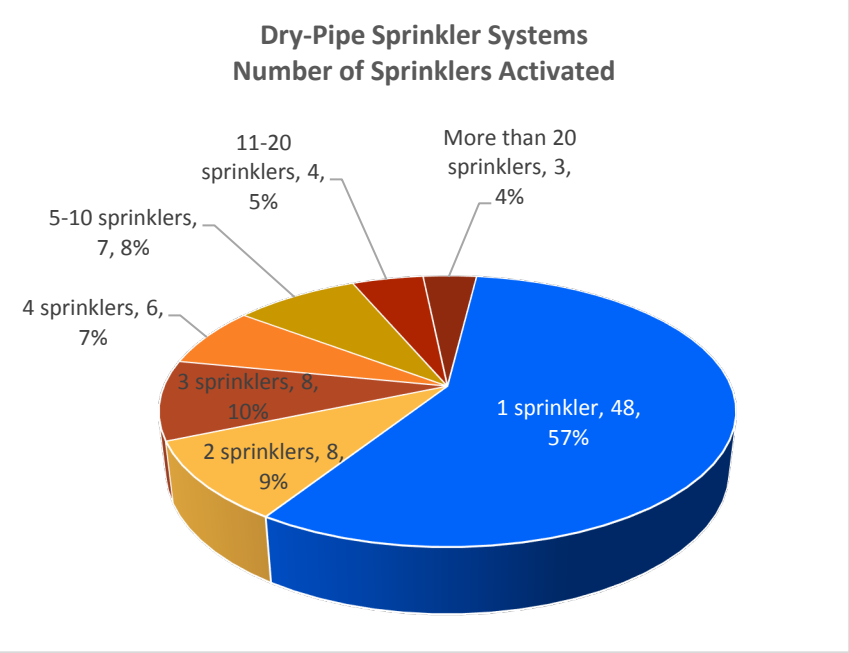
Table 5 – Sprinkler Activations by System Type

System Type	Number of Activations	Percentage of Activations
Wet-pipe sprinkler system	1,016	90.9%
Dry-pipe sprinkler system	84	7.5%
Other sprinkler system	18	1.6%
Total	1,118	100%

Number of Sprinklers Activated

Wet-pipe systems tended to activate the fewest number of sprinklers. This is because water is always in the sprinkler pipe so there is no delay in water delivery following sprinkler activation. With other types of systems, there is often a delay in water delivery time (up to a minute).



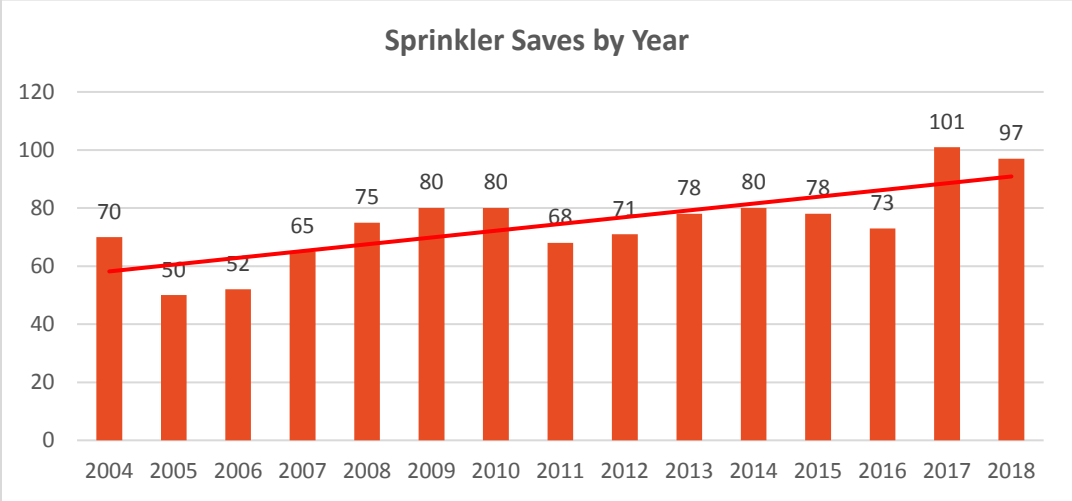


A total of 2,596 sprinklers were reported to have been activated in these 1,118 building fires (average of 2.3 sprinklers per fire). Most sprinkler systems are designed for at least five sprinklers to activate; many dry systems are designed for 15 or more. As can be seen on the previous page, the vast majority of the fires are controlled with four or fewer sprinklers.

Number of Sprinklers	Wet-Pipe Systems			Dry-Pipe Systems		
	Fires	Percent	Cumulative	Fires	Percent	Cumulative
1	771	76%	76%	48	57%	57%
2	127	13%	89%	8	9.5%	66.5%
3	27	3%	92%	8	9.5%	76%
4	24	2%	94%	6	7%	83%
5-10	38	4%	98%	7	8%	91%
11-20	11	1%	99%	4	5%	96%
More than 20	11	1%	100%	3	4%	100%

Sprinkler Saves by Year

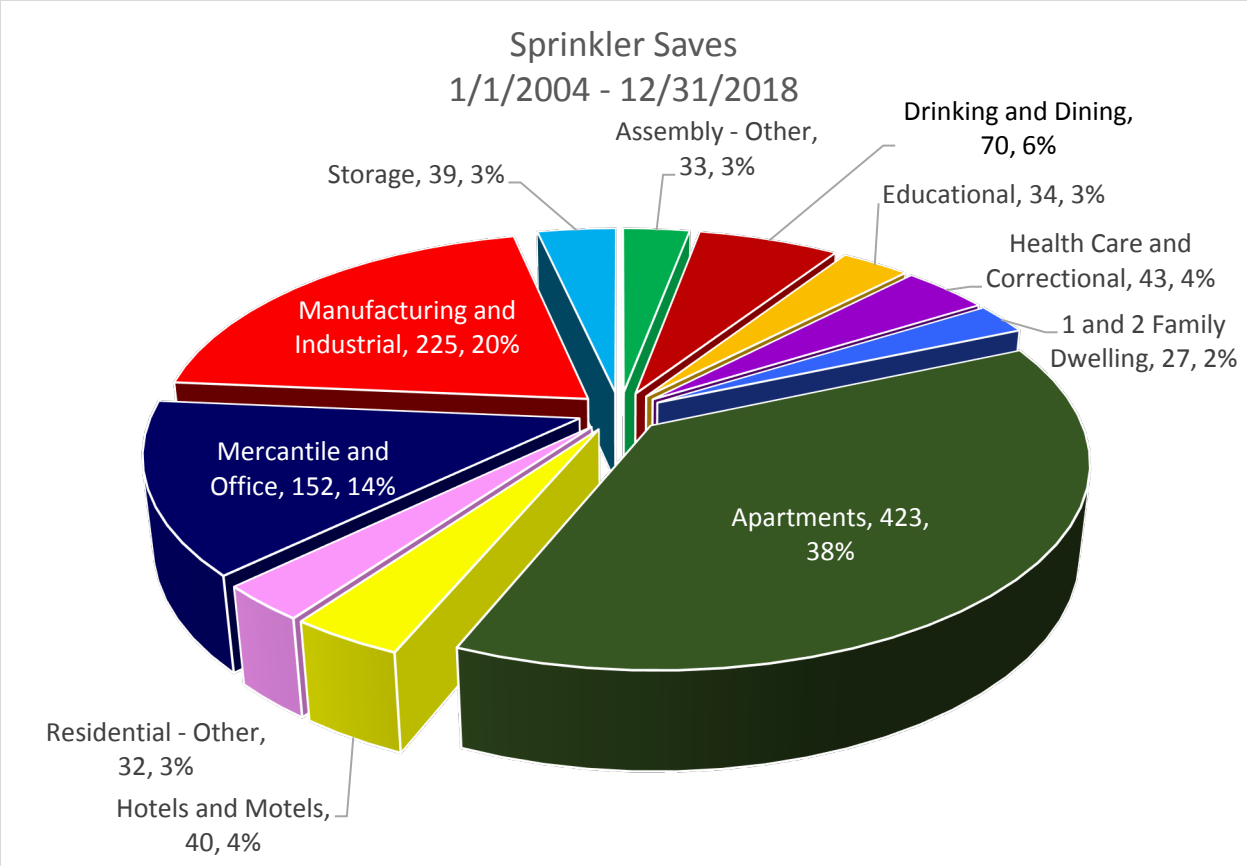
The following chart shows the number of sprinkler saves for the past 15 years in Minnesota. The red line shows the sprinkler save trend during that time.



Sprinkler Saves by Type of Occupancy

Sprinkler systems have been around since the 1800s. They were originally developed to protect mills and manufacturing plants. As their effectiveness became more apparent, the insurance industry and the codes started to require them in more occupancies, such as mercantile, retail, storage and larger assembly buildings.

One of the more recent occupancies where sprinklers have been required is apartment buildings. Sprinkler protection has only been required in apartment buildings since 1989 (30 years). Apartment buildings have now become the leading occupancy for sprinkler saves, passing up long-protected properties such as manufacturing and industrial plants. See the following chart for a breakdown by occupancy.



Loss Reduction with Sprinklers

The Minnesota Fire Incident Reporting System collects damage estimates from fires. It shows a fire loss reduction for sprinkler-controlled fires in most types of occupancy.

Type of Occupancy	Average Loss – Sprinklers	Average Loss – No Sprinklers	Loss Reduction with Sprinklers
Assembly – other	$ 13,468.09	$ 126,499.13	89.4%
Drinking and dining	$ 39,771.01	$ 131,445.36	69.7%
Educational	$ 13,719.70	$ 260,512.85	94.7%
Health care and correctional	$ 62,549.33	$ 62,078.37	-0.8%
1- and 2-family dwelling	$ 22,937.04	$ 63,866.50	64.1%
Apartments	$ 37,976.47	$ 51,623.74	26.4%
Hotels and motels	$ 26,570.00	$ 93,831.49	71.7%
Residential – other	$ 20,419.35	$ 60,928.14	66.5%
Mercantile and office	$ 101,604.29	$ 147,549.22	31.1%
Manufacturing and industrial	$ 65,196.66	$ 208,477.29	68.7%
Warehouses	$ 121,394.74	$ 276,348.50	56.1%

Where Sprinkler Saves Are Occurring

Figure 1 is a pin map showing the location of sprinkler saves in Minnesota from 2009-2019.

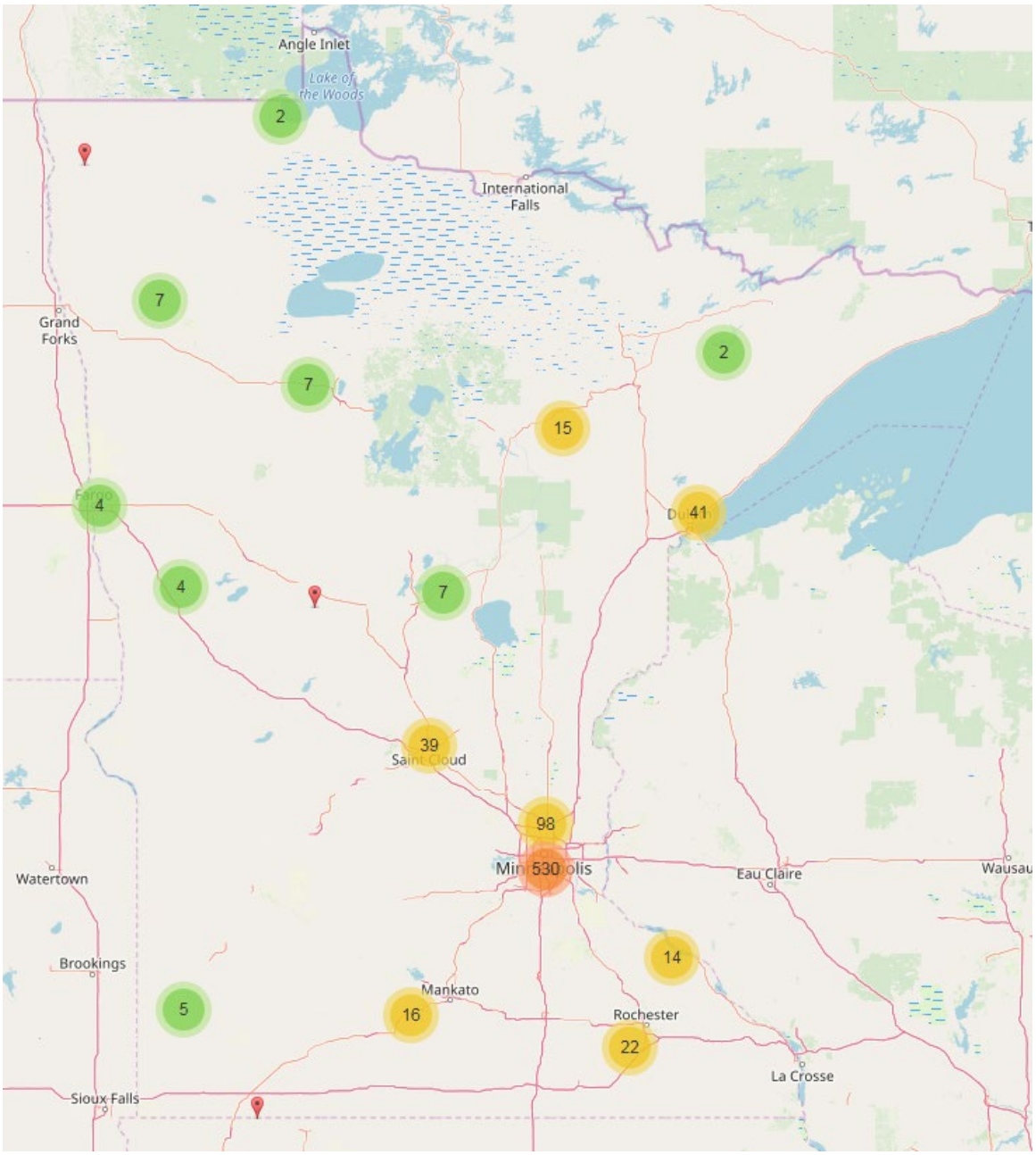


Figure 1

Figure 2 is a pin map of the Twin Cities metro area showing sprinkler saves from 2009-2019; the metro area experiences a large percentage of the sprinkler saves in Minnesota.

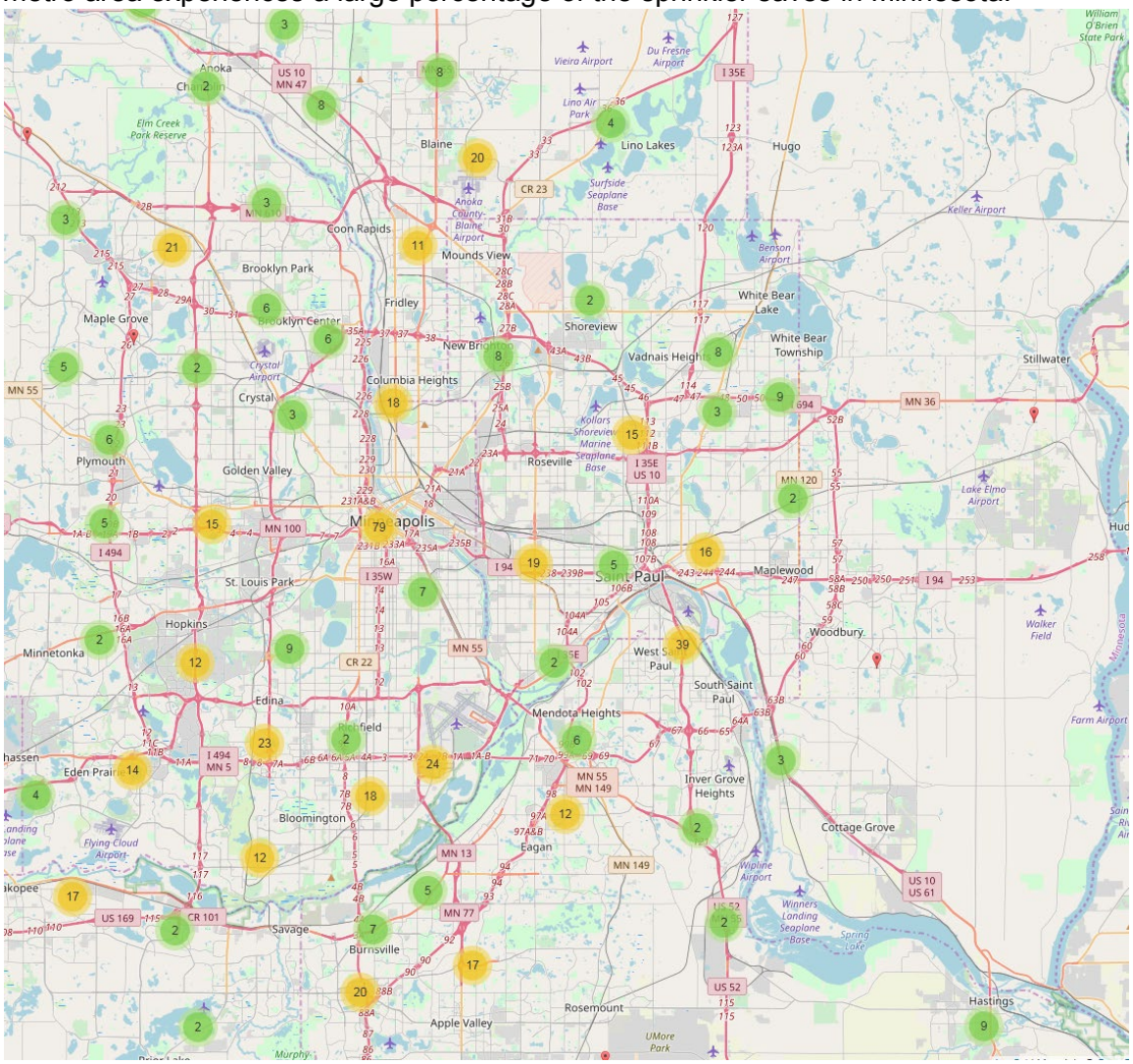


Figure 2

Here is a list of the 30 Minnesota communities that have experienced nine or more sprinkler saves from 2004 to 2018.

Minneapolis	164
Saint Paul	95
Bloomington	52
Duluth	44
Plymouth	38
Burnsville	37
Rochester	34
Saint Cloud	31
Eden Prairie	27
Blaine	24

Edina	22
Coon Rapids	20
Eagan	20
Maple Grove	20
Roseville	20
St. Louis Park	20
Shakopee	18
Brooklyn Park	17
South St. Paul	16
Mankato	15

Fridley	13
Minnetonka	13
Apple Valley	11
Winona	11
Brooklyn Center	10
Little Canada	10
Hastings	9
Hopkins	9
White Bear Lake	9
Red Wing	9