

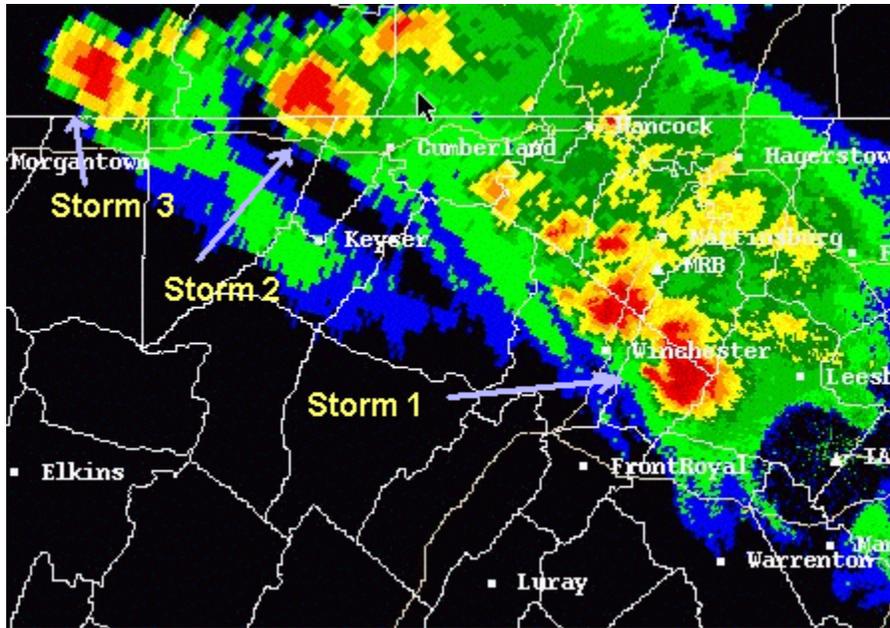
June 2, 1998 PA-MD-WV Tornado Outbreak

Frostburg F-4 Tornado

Report by Barbara McNaught Watson

Tuesday, June 2, began with a moderate risk of severe weather for the area. A tornado watch was issued at 4:00 pm for western Maryland and portions of West Virginia. A second watch was issued at 6:30 pm for areas to the east in Maryland, extreme eastern West Virginia and northern Virginia. Early in the evening, supercell thunderstorms developed over central Maryland. One dropped golf ball to tennis ball size hail in Montgomery County. Golf ball size hail moved east with the storm into Baltimore City. At this same time, tornadic thunderstorms were progressing southeast through western Pennsylvania. The storms were moving over the same area that was struck by tornadic storms just two nights previous.

Around 8:00 pm, one of these thunderstorms moved into Allegany County, Maryland. People began reporting sighting a funnel cloud to the county 911 center in Cumberland. The emergency operations center has is located on a hill top and has cameras mounted on a tower. They watched the progression of the funnel for 20 minutes. Over the next 3 hours, Three tornadic supercell thunderstorms (called mesocyclones) moved across western Maryland and the panhandle of West Virginia into Northern Virginia. One of these storms produced a 48 mile damage path that reached F4 as it crossed through the northern section of Frostburg, MD.



KLWX WSR-88D Composite Reflectivity at 9:32 pm EDT showing the progression of 3 tornadic supercells into Sterling's County Warning Area.

Storm 1: Green Spring - Levels, WV Tornado

After producing an 11 to 13 mile path of damage across Somerset County, Pennsylvania, this tornadic storm entered Allegany County. The tornado lifted on the northwest side of Savage Mountain. Funnel clouds were observed as the storm moved southeast across the county by numerous people. It was watched on camera by the 911 center in Cumberland for about 20 minutes beginning around 8:00 pm just south of Frostburg until around 8:20 pm when it briefly appeared to be touch down on Irons Mountain southeast of Cumberland. This is a rural area and no property damage was reported. Hail damage was observed in Oldtown, just south of Irons Mountain and along the C&O canal and Potomac River.

Funnel cloud sightings were also reported from Patterson Creek as the storm crossed into the northern portion of Mineral County. A third tornado touched down as the storm neared the Hampshire County line. The path began just north of Donaldson School Road crossing a power company's access road. It then moved down the hill hitting some homes north of Donaldson (about 2 to 3 miles south of Green Spring). A gazebo was destroyed, houses lost some trim, shingles, a brick column, and trees were uprooted or snapped. A 500-pound concrete picnic table was lifted and tossed into a pool. About 24 trees

on just one property was lost. One eyewitness reported seeing A two funnel clouds dropping out of the sky and wrapping around each other.@ The Sheriff stated that Green Spring reported Atremendous hail@ with the storm and the NWS survey team saw a carpet of battered leaves on the ground the next day.

The tornado rose up over a mountain and down the other side. The sheriff=s office reported it on the ground near the town of Levels. Here the damage was mainly to trees. Hail was reported to have caused greater property damage. One orchard grower said he lost his entire crop to hail. Nearly 40 acres of peaches were destroyed.

The rotating thunderstorm (mesocyclone) was observed by Skywarn spotters as it moved southeast across Hampshire County into Frederick County, Virginia. It became predominantly a hail producer. Dime size to golf ball size hail was reported in Frederick and Clarke Counties. Then, at the same time the next tornadic storm was approaching Frostburg, this storm set down a fourth small tornado near Berryville. A barn was unroofed, a chimney was damaged and trees were uprooted. Because it was along the same radial as the larger Frostburg storm, the radar did not detect the storm=s rotation. The velocities were Arange folded@ which means that the radar can not assign a velocity value and it displays as purple. The low level reflectivity image, however, at this time, was showing a pronounced Ahook@structure which is indicative a tornadic storm.

The fifth and last touch down was another small tornado in western Loudoun County to a rural area south of Bluemont. Now the storm had moved out of the radial for the Frostburg storm and the velocities were being detected again. The WSR-88D Tornado Vortex Signature (TVS) alarmed. The survey team found some trees down along Snickersville Turnpike, but the area was too rural and not enough roads to pick up the path. Golf ball size hail was reported as the storm moved east of Middleburg. Fortunately, the thunderstorm became non-severe as it crossed Loudoun County into Fairfax County.

<u>County/State:</u>	Allegany	Allegany	Mineral	Clarke	Loudoun
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	County, MD (began in Somerset County, PA)	County, MD - Irons Mountain	and Hampshire Counties, WV	County, VA	County, VA
<u>Time:</u>	7:56 to 7:58 pm	8:21 to 8:22 pm	8:36 to 8:46 pm	9:50 to 9:51 pm	10:10 to 10:12 pm
<u>Time on ground:</u>	2 minutes	1 minute	10 minutes	1 minute	2 minutes
<u>Path Length:</u>	1 mile	2 mile	9 miles	2 mile	1 mile
<u>Path Width:</u>	100 yards	50 yards	150 yards	50 yards	50 yards
<u>Strength:</u>	F1	F0	F1	F0	F0
<u>Deaths/Injuries:</u>	0	0	0	0	0
<u>Damages:</u>	\$ 0 K	\$ 0 K	\$ 20 K	\$ 15 K	\$ 1 K
<u>Tor Watch:</u>	Valid 4:00 to 10 pm.	Valid 4:00 to 10 pm	Valid 4:00 to 10 pm	Valid 6:30 pm to Midnight	Valid 6:30 pm to Midnight
<u>Tor Warning:</u>	Issued at 7:29 pm	Issued at 7:29 and 8:05 pm	Issued at 8:05 pm for Mineral County / 8:25 pm for Hampshire County	No tornado warning. Severe Thunderstorm issued at 9:26 pm	<u>Severe Thunderstorm Warning:</u> 9:43 pm Tor Wng Issued at 9:55 pm
<u>Lead Time:</u>	27 minutes	52 and 16 minutes	31 minutes for Mineral County / 12 minutes for Hampshire County	24 minutes on Severe Thunderstorm Warning mentioning history as a tornado producer and that a tornado was possible	15 minutes

Storm 2: Frostburg, MD Tornado

This thunderstorm produced a long-lived tornado that was on the ground for about 48 miles. The tornado began near Mount Pleasant, Pennsylvania, passed by Salisbury (which was hit 2 nights earlier by another F2 tornado) and then moved into Maryland. It hit Finzel in Garrett County first, rose up and over Big Savage Mountain in Allegany County and then headed for Frostburg. The tornado traveled up and down over several mountain **ridges and valleys varying intensity between F2 and F3. Its intensity peaked at a low end F4 in Frostburg. Frostburg sits up on the Allegany Plateau at an elevation of around 2000 feet and the homes hit the hardest were exposed on the ridge tops to the tornado's full force.**

The National Weather Service in Sterling Virginia issued a warning 9:40 pm, but had already verbally given the warning to the Allegany County Communications Center in Cumberland. With this verbal warning, Frostburg sounded its warning sirens. A fire crew from the Frostburg Fire Department saw the tornado coming over Big Savage Mountain. It appeared as three funnels...a multi-vortex tornado. They put the word out over the radio as they headed for cover. The tornado hit the northern outskirts of the city and continued east to Eckhart Mines. The tornado had been predicted in the warning to hit Frostburg at 9:45 pm and struck right on the mark. People interviewed that saw the warning made a special note of that.

On Armstrong Avenue, four homes were destroyed or heavily damaged and cars were tossed as the tornado moved down a hillside. To some extent, the steep sloping hill protected these homes from experiencing even greater damage similar to what occurred on the next rise. Here, several more homes were destroyed and more cars were tossed. One two-story house was completely gone. All that remained was the basement and the plywood for the first floor. The car that was in the garage laid upside down about 100 feet away in the back yard. The mother and two children in the house rode out the storm in their basement under a table. They were unharmed. In fact, no one was seriously hurt or in need of transport to the hospital. Everyone either got the NWS warning or heard or saw the tornado coming and headed to their basement.

Eckhart Mines had heavily damaged to both homes and businesses. A number of which were considered totally destroyed including a new daycare that had just opened the day before. The tornado crossed over Route 40 just east of Clarysville. It crossed Interstate-68, traveled over

Dans Mountain flattening more trees. On the other side, the tornado ended just before hitting some residences along Route 53 about 2 miles north of Cresaptown.

In all, 29 homes were destroyed, 29 homes had major damage, 67 homes had minor to moderate damage. Threes businesses were damaged with one destroyed, Frostburg Elementary School had heavy damage and a church was damaged. Thousands of trees were destroyed.

The mesocyclone continued across Mineral and Hampshire Counties. It traveled just slightly south of the previous storm path. Funnel clouds were sighted as the storm passed. Several sightings came from the Fort Ashby area were one person said the spinning funnel was highlighted by lightning bolts coming out of it. As the storm crossed Frederick and Clarke Counties in Virginia one inch hail was again reported. The last severe report from this storm was golf ball size hail near The Plains in Fauquier County.

As the days followed, debris from Frostburg was found up to 100 miles away. A jacket, bought by a woman on June 2 in Frostburg, was found with the bag and receipt near Levels, WV, 25 miles away. A 400 acre farm in Gorman, Maryland, just across the river from Paw Paw, WV (about 27 miles from Frostburg) had debris strewn across it. The farmer found shingles, pieces of siding and insulation. House debris was found in Paw Paw, WV and into the northern tip of Frederick County, VA. A JC Penny catalog belonging to the family whose house was wiped off its foundation was found in Winchester, VA, 60 miles away, along with a piece of a high school diploma from a school in Frostburg. Another part of a high school diploma was found north of Berryville about 80 miles away. A bill that had been in a basement file cabinet in the Frostburg house was found in Sterling, VA which is about 100 miles from Frostburg.

<u>County/State:</u>	Allegany, MD (Began near Mount Pleasant, PA)
<u>Time:</u>	9:43 pm (entered Allegany)
<u>Time on ground:</u>	10 minutes
<u>Path Length:</u>	8 miles
<u>Path Width:</u>	250 yards

<u>Strength:</u>	F4 Frostburg , otherwise F2-F3
<u>Deaths/Injuries:</u>	0 <u>Injuries:</u> 5 (none hospitalized
<u>Damages:</u>	\$ 5 Million 125 homes, 3 businesses, 1 school, 1 church
<u>Tor Watch:</u>	Issued at 4:00 pm valid until 10:00 pm
<u>Tor Warning:</u>	Issued at 9:40 pm
<u>Lead Time:</u>	3 to 13 minutes

Storm 3: New Creek - Burlington - Junction, WV Tornado

The third mesocyclone dropped an F2 tornado in Pennsylvania, tagged the northeast tip of West Virginia and moved into northwest Garrett County. The storm paralleled the path of the previous two, but again was a little more to the southwest. A funnel Cloud was sighted in Bloomington, MD, in Southeast Garret County. The tornado touched down on the next ridge... Green Mountain about 5 miles SW of Keyser, West Virginia or 3 miles NW of New Creek.

Trees were knocked down in the community of Cross. The tornado strengthened as it moved down the mountain and through New Creek at 10:37 pm. At the time, another funnel was also visible over the city of Keyser. In New Creek, a car was blown over, a garage was destroyed, trees were uprooted and snapped. A pine tree landed on one house and another house sustained wind damage. A nearby mobile home lost its skirting. A Good-sized hail@ was said to have accompanied the storm. A full-size Sycamore tree was picked up on the east side of New Creek and thrown to the other side of the highway.

The tornado moved up and over New Creek Mountain leveling all the trees through a heavily wooded area. It demolished (Ablew to pieces@) a mobile home as it came over the other side. Tornado was given its peak rating of a low end F2 here. It crossed Route 220 causing more tree damage and exterior damage to homes with heavy damage to outbuildings. It traveled along Route 50 hitting the Ridgeville area. A mobile home was rolled and a several buildings were damaged. It destroyed a barn near the Mill Creek Country Club, west of Burlington.

The tornado path continued 1.5 miles south of Burlington crossing Patterson Creek Road. It then traveled over Patterson Creek Mountain into Hampshire County and struck a mobile home community along Davy Road. Several

mobile homes were damaged. Five people were injured, but only one person would accept transport to the hospital for a head injury. One family lost everything. The tornado was rated an F1 in Hampshire County. It was assumed to have lifted over Fairview Mountain about 3 miles south of Junction (or 7.5 miles SW of Romney). An aerial survey would have been needed. No additional reports of damage have been received.

<u>County/State:</u>	Mineral and Hampshire Counties, WV
<u>Time:</u>	10:33 to 10:51 pm
<u>Time on ground:</u>	18 minutes (Estimated)
<u>Path Length:</u>	15 miles
<u>Path Width:</u>	150 yards
<u>Strength:</u>	Mineral - F1 to F2 Hampshire - F1
<u>Deaths/Injuries:</u>	0 <u>Injuries:</u> 5 (Hampshire Co)
<u>Damages:</u>	Mineral = \$ 250 K Hampshire = \$ 150 K
<u>Tor Watch:</u>	Expired at 10:00 pm, not reissued since warnings were in effect.
<u>Tor Warning:</u>	Issued at 10:01 pm and again at 10:34 pm.
<u>Lead Time:</u>	32 to 50 minutes on the first warning -1 to +17 minutes on the second warning

Summary:

Seven Tornadoes touched down in the Baltimore-Washington Forecast Office=s area of responsibility. Seven additional tornadoes touched down in Pittsburgh and State College=s area of responsibility with 5 in Charleston, West Virginia=s area. Close to 20 tornadoes ranging from F-0 to F-4 struck Pennsylvania, Maryland, West Virginia, and Virginia in this outbreak.

Talk of the potential for severe weather had begun early in the day and a tornado watch was issued by 4 pm. All the tornadoes but one had a tornado warning in effect with an average initial lead time of 23 minutes. One tornado had a severe thunderstorm warning with the

mention of the tornadic potential. Only 10 people were injured, no deaths, but damage in the millions.

June 2, 1998 Tornado Outbreak set a number of firsts

The Green Spring, WV storm and the New Creek, WV storm produced the first tornadoes ever recorded in Mineral and Hampshire Counties. Tornado tracks greater than 3 miles are unusual in this part of the country and these reached 9 to 15 miles long. The long track nature of these tornadoes made them more likely to be reported. This is a very rural area with few roads between the mountains and valleys.

The Frostburg tornado was the first ever recorded F4 in Maryland. Maryland had deadly tornadoes strike back in 1944 and 1929, but the Fujita Damage Scale has only been applied since 1950. This is the strongest tornado to have struck the State since 1950. A strong F3 struck Gamber, MD on July 19, 1996 and a strong F2 struck Temple Hills/Camp Springs, MD with the remnants of Opal on October 5, 1995.

Maryland has recorded more tornadoes in the 1990s than it did the entire 40 years previous. While part of this can be attributed to more population and better reporting and recording of these events, these numbers still indicate that this has been an active tornado period for Maryland. In 1995, Maryland set a new record for tornadoes in one year with 24 tornadoes. The state average from 1950 to 1997 was only 4 tornadoes per year. If you factor in population and reporting, we believe the true average to be around 10 tornadoes per year and in fact, the 1990 average has been around 10 tornadoes per year. Using the 1990s average still puts 1994, 1995 and 1996 at more than twice the norm.

Indices from the 00 Z Sounding taken at Dulles Airport in Sterling, Virginia:

Table of indices from 00 Z JUN 3, 1998 IAD Sounding

Lifted Index.....	-6	BRN Shear....	103 (m/s) ²
Showalter Index....	-4		
Wet Bulb Zero.....	11,100 feet	Precip. Water.....	1.50 inches
K-Index.....	38	SR Helicity....	413 (m/s) ²
0-2 Km MoFlux.....	330	Cap Strength.....	2.1 }C
g/kg/hr			
Total Totals.....	53	Sweat Index.....	459

Acknowledgements:

Many people helped make the NWS warning services a success. Not only did the staff at the Baltimore-Washington Office do an outstanding job, but so did our friends at Pittsburgh who kept us briefed on what was coming our way. This was critical in the Frostburg case. Also, the Allegany Emergency Operations Center, the Mineral County Emergency Manager and the Sheriff=s Department in Hampshire County all played vital roles helping us to monitor what was happening. We also thank those who helped us survey damage. This includes the Fox 5-TV Chopper Team who flew us over the Frostburg damage, those who supplied us photographs and news articles, and those already mentioned above. Tornado damage surveys were completed by Barbara Watson, Steve Zubrick and John Billet.

Warnings Issued and Verifying Reports

638 pm EDTSVRCarroll CountyValid until 730 pm

643 pm Hail Winfield 0.75 inch

650 pm Hail 10 mi. S of Westminster 1.00 inch (4 to 5 minutes)

650 pm Funnel Cloud near Winfield

? Wind Hampstead Lost shingles off roof

658 pm Hail Finksburg 1.75 inch

Hail Deer Park 1.50 inch

3. 659 pm SVRBaltimore CountyValid until 800 pm

714 pm Hail Owings Mills 0.75 inch

10 mins of Hail Reisterstown Paint damage to cars

729 pm Hail Baltimore 1.00 to 1.75 inch

4. 711 pm SVRMontgomery CountyValid until 800 pm

720-735 pm Hail Damascus 1.00 to 1.75 inch (5 minutes)

725-750 pm Hail Olney-Sandy Springs 1.50 to 2.25 inch (vehicles dented)

5. 720 pm SVRDCValid until 755 pm

733 pm Hail NW DC 0.75 inch

Funnel Cloud - local news cameras.

Wind NE DC near N Capitol Several large trees down

Hail NE DC 1.00 inch

6. 720 pm SVRArlington CountyValid until 755 pm

7. 720 pm SVRFairfax CountyValid until 755 pm

723 pm Hail Great Falls 1.00 inch

8. 729 pm TORAlleghany CountyValid until 830 pm

801 pm Funnel observed by 911 center 1 mile southeast of Frostburg.

803 pm Hail Cumberland 0.75 inch

820 pm Hail Oldtown 1.00 + inch (leaf and roof damage)

9. 731 pmSVRBaltimore CityValid until 805 pm

10. 737 pm SVRHoward CountyValid until 840 pm

11. 737 pm SVRPrince Georges CoValid until 840 pm
805-820 pm Hail Laurel 1.00 to 1.75 inch
12. 737 pm SVRAnne Arundel CoValid until 840 pm
835 pm Hail Crofton 2.00 inch
Wind Annapolis Tree fell on car, windows broken
13. 805 pmTORAllegany CoValid until 850 pm
820 pm Hail Oldtown 1.00 + inch (leaf and roof damage)
821 pm Funnel observed by 911 center/spotter was thought to be on ground on Irons Mountain SE of Cumberland.
14. 805 pmTORMineral CountyValid until 850 pm
8 pm Funnel near Patterson Creek
835 pm F1 Tornado damage begins just before county line.
15. 825 pmTORHampshire CoValid until 910 pm
840 pm Tornado sighted near Donaldson - F1 Confirmed by survey
837 pm Hail damage in Green Spring 1.50 + inches
846 pm Tornado sighted in Levels - F1 Confirmed trees down
843 pm Hail damage in Levels to Orchards 1.75 inches
16. 843 pmSVRAnne Arundel CoValid until 915 pm
852 pm Hail Southern portion of county 0.75 inch
17. 848 pmSVRAllegany CountyValid until 935 pm
853 pm Hail Polish Mtn to Flintstone 0.75 inch
18. 854 pmTORFrederick Co. VAValid until 945 pm
922 pm Hail 4 E of Whitehall 0.75 inch

19. 918 pm SVR Berkeley County Valid until 1005 pm
20. 918 pm SVR Morgan County Valid until 1005 pm
21. 926 pm SVR Clarke County Valid until 1015 pm

950 pm Wind Berryville Trees uprooted; barn unroofed

950 pm Hail 4 N of Berryville 1.75 inch
22. 940 pm **TOR Allegany County** Valid until 1045 pm

943-950 pm Tornado - F4 confirmed - 8 mile track in county
23. 943 pm SVR Loudoun County Valid until 1045 pm

1004 Hail 3 E of Middleburg 1.75 inch
24. 955 pm **TOR Loudoun County** Valid until 1045 pm

Tree damage surveyed along Snickersville Turnpike
25. 1001 pm **TOR Mineral County** Valid until 1105 pm

1015 pm Funnel Sighted near Fort Ashby - no known touch downs
26. 1001 pm **TOR Hampshire County** Valid until 1105 pm

S of Springfield on Arnold Stickley Road - Dave Mayfield reported storm so strong that he could feel his foundation moving as he sat in the basement of his home.
27. 1024 pm **TOR Frederick Co. VA** Valid until 1110 pm

1100 pm Hail N of Winchester 1.00 inch
28. 1034 pm **TOR Mineral County** Valid until 1125 pm

Tornado sighted - F2 surveyed - New Creek to Junction - 12 miles
29. 1034 pm **TOR Hampshire County** Valid until 1125 pm

F1 surveyed (continued from Mineral) 3 miles to S of Junction
30. 1106 pm SVR Clarke County Valid until 1155 pm

1110 pm Hail Berryville 1.00 inch

31. 1129 pmSVRFauquier CountyValid until 1215 pm

1145 pm Hail The Plains 1.75 inch

Events outside of warnings:

1. 536 pmCarroll Co/ 10 miles S of TaylorsvilleHail - 0.75 inch
2. 704 pmMontgomery Co/ClarksburgHail - 0.75 inch
3. 708 pmFairfax Co/Tysons CornerHail - 0.75 inch
4. 729 pmBaltimore City ??Hail - 1.75 inch
5. 1110 pmPrince William Co./ Dale City Hail - 0.85 inch
6. 1115 pmAnne Arundel/AnnapolisWind - Blew out door, moved a car, blew out windows at Eastport Shopping Center, Downed wires and a tree on car at Horn Pt.