



The Building 5 Flood: The Little Cap that Couldn't

First There Was a Sink

The Goddard Space Flight Center uses thousands of gallons of water every day for the needs of the 9,000-plus people who come here to work. To meet this need, Goddard has a water tank on site and a comprehensive water supply system. It also has a plumbing maintenance department, whose function is to keep the water flowing at normal rates for all the washing, watering, and working that goes on every day at Goddard.

Back in the 1960s, Building 5 had mostly large open bullpen configurations with drafting tables spread across open work areas. Accompanying those open spaces were often sinks, drinking fountains, and kitchen areas, where people gathered to eat and talk during the day. During the '70s, as computers began to shape the nature of work, many of the open spaces were converted into offices, often leaving no room for the sinks and kitchen-like amenities.

One of those sinks, in the center section, second floor of Building 5, was removed one day, probably sometime in 1976, to make a hallway between the newly configured offices. As the pipes bringing hot and cold water to the sink protruded directly through a cinder-block wall, instead of removing them completely, the pipes were capped off and left sticking out. No records exist of the repair job and no one using that hallway thought much about the little stubs (See **Figure 1**).

Decades ago, much of the routine maintenance—like capping off a sink’s water lines—was done by an in-house maintenance crew that operated fairly loosely with respect to paperwork. Some records of such mundane repairs were thrown out when technicians retired, or when the in-house shop was finally closed and all such maintenance moved to contractor support.

In any event, there were no records of this particular sink repair in Building 5, or notes of why the copper feed lines were capped with *steel caps* instead of copper. Using dissimilar metals was against the plumbing code even then, due to the potential for corrosion problems that can arise. The dissimilar metals create a galvanic process that slowly eats away the steel, which can lead to failure of the coupling. Did a technician temporarily cap the pipes and intend to replace the steel caps with copper later? Did a worker use the wrong parts unknowingly?

No one knows why the steel caps were used, but the pipes and their steel caps held on for over 30 years. During this time, they received as many as 17 coats of paint. This made them a bit less unsightly, but also helped hide the galvanic corrosion going on inside the pipes. The caps did give some clues as to their inevitable fate, dripping and leaking now and then, leaving telltale marks on the walls. These leak stains were also painted over from time to time and the caps were left to the fate of the relentless, slow, self-destructive dance at work where threads of the copper pipes, still under constant water pressure, embraced the little steel caps.



Figure 1: Rust Stains Indicating Imminent Plumbing Failure (Discovered after the Fact). Source: NASA Image.

The Water Tank Gets Painted

Over the decades, while Hubble was built and serviced 4 times, the faithful Goddard Water Tank, with a helping hand from gravity, continued to supply water at a healthy 50 psi (pounds per square inch) for the Center including to the two copper pipes barely protruding from the block wall in building 5. In 2009, the Tank was due for a new coat of paint, which meant taking it off-line for several months. Without the Tank, pumps are used to maintain water pressure across the Center for daily use and for fire suppression if needed. Those pumps are normally used for filling the Water Tank and can generate a higher pressure than the nominal 50 psi generally maintained in the Goddard water system. However, when the pumps are running, pressure check valves and a pressure relief system are in place to maintain close to the nominal 50 psi in the water system.

So, while the Water Tank was getting a fresh coat of paint, the pumps were whirring away to maintain pressure. However, something wasn't quite right with the pumps. The system pressure spiked to as much as 30 psi above nominal, although not out of spec for the system as a whole. Unfortunately, the tired little steel caps apparently found the added pressure too much to bear.

Sometime after 4 a.m. on the morning of October 3, 2009, a Saturday, the cap on the hot water line had done all it could, and finally let go. Thousands of gallons of water poured onto the floor, down the hall, into offices, through ceilings, into elevator shafts, dripped on computers, equipment and papers, and bled up into drywall. The deluge soaked everything downhill of where the little sink had once been used for washing hands and rinsing out coffee mugs.

One piece of good fortune that day was the presence at Goddard of a plumber. The plumber arrived shortly after the flood was discovered around 6 a.m., and shut off the water and set about recapping the hot water pipe. While he was capping it, the cold line cap decided it too had had enough. It popped off, joining in the flood. The cold line was quickly shut off, but the damage to Building 5 was already extensive. By Monday morning, dozens of people were without an office to work in, and had to be relocated. The clean-up and investigation both got underway. By the time the reports were written, the total cost was estimated at over \$400,000, because of a few parts likely costing less than \$5 (See **Figures 2** and **3**).

How could a mistake that small, yet with such consequences, have been made, overlooked, and ignored for so many years under the noses of people who manage far more sophisticated systems than simple plumbing pipes? How did what is everybody's concern become nobody's responsibility, even though anybody could have seen that somebody needed to do something about it? What does it really mean that safety is everyone's job? What does it mean that it takes the eyes and ears of everyone here to make the environment a safe and secure place to work?

Meanwhile, the Water Tank went back to maintaining its gravity-assisted 50 psi, and to faithfully pushing water down through all the pipes of Goddard and out to bathrooms, labs, and kitchen sinks across Goddard. What other weak spots might be hiding in the system? What would it take to reveal another weakness that could threaten property or even life at the Center?

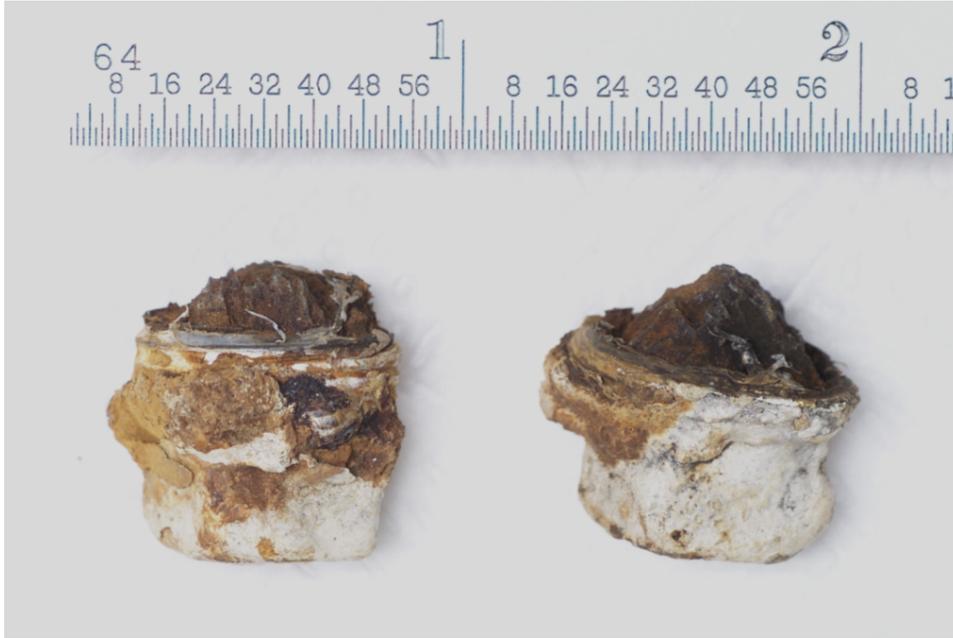


Figure 2: Pipe Plugs Recovered from Building 5 Flood Incident Site. Source: NASA Image.



*Figure 3: Hot Water and Cold Water Pipe Fittings Removed from Building 5 Plumbing System.
Source: NASA Image.*