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Sprinkler Piping Obstruction Investigation
An Innovative Approach

DOE Fire Protection Conference

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NFPA 25 Requirement

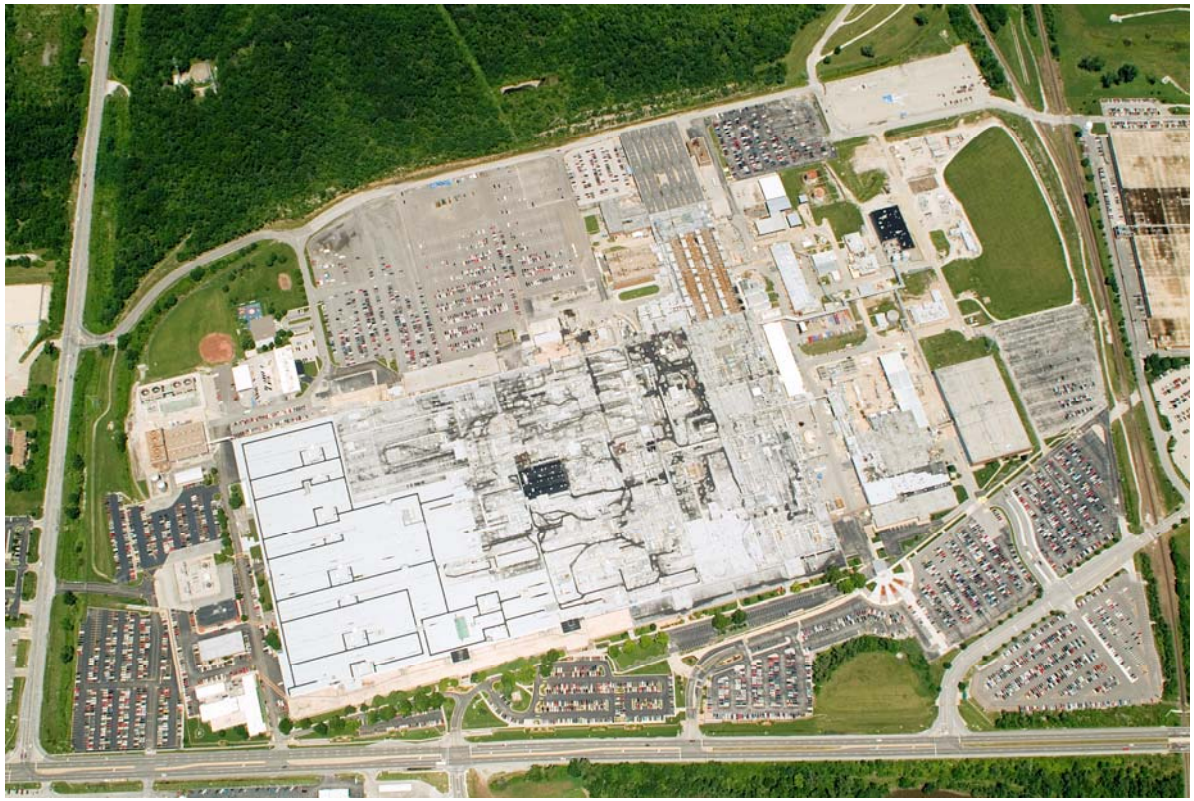
- 14.2.1 An inspection of piping and branch line conditions shall be conducted every **5 years** by **opening a flushing connection** at the end of one main and by **removing a sprinkler** toward the end of one branch line for the purpose of inspecting for the presence of foreign organic and inorganic material.

- 14.2.1.1 Alternative nondestructive examination methods shall be permitted.

- 14.2.1.2 Tubercules or slime, if found, shall be tested for indications of microbiologically influenced corrosion (MIC).

- Large building does not permit extended flushing to exterior
- Code permits alternative methods

The Kansas City Plant



- 23 million sq. ft. under single roof
- 1000 ft. x 2000 ft.
- 145 sprinkler systems
- 30-60 year old sprinkler systems
- Concern that tubercles from underground mains were in the overhead
- Photos (~100) taken from removed piping showed minimal issues

Options
1. No further action based on photos and based testing
2. Do more investigation

NFPA 25 Sprinkler Obstruction Investigation Issues at the KCP

- 5 year piping inspection is impractical due to physical arrangement of the facility
- Obstruction investigations near the exterior walls raised some concerns which warrants further investigation
- Other adverse conditions:
  - Age of systems
  - Frequent system modifications and testing brings fresh water
  - Microbiologically Influenced Corrosion (MIC) tests showed some colonies
  - Concern that extreme tuberculation in the yard mains had broken loose and migrated to the overhead

But Good News - Photos taken of removed piping showed minimal issues

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Obstruction Investigation (Second Step)

14.2.2* An obstruction investigation shall be conducted for system or yard main piping wherever any of the following conditions exist:

(1) Defective intake for fire pumps taking suction from open bodies of water
(2) The discharge of obstructive material during routine water tests
(3) Foreign materials in fire pumps, in dry pipe valves, or in check valves
(4) Foreign material in water during drain tests or plugging of inspector's test connection(s)
(5) Plugged sprinklers
(6) Plugged piping in sprinkler systems dismantled during building alterations
(7) Failure to flush yard piping or surrounding public mains following new installations or repairs
(8) A record of broken public mains in the vicinity
(9) Abnormally frequent false tripping of a dry pipe valve(s)
(10) A system that is returned to service after an extended shutdown (greater than 1 year)
(11) There is reason to believe that the sprinkler system contains sodium silicate or highly corrosive fluxes in copper systems
(12) A system has been supplied with raw water via the fire department connection
(13) Pinhole leaks
(14) A 50 percent increase in the time it takes water to travel to the inspector's test connection from the time the valve trips during a full flow trip test of a dry pipe sprinkler system when compared to the original system acceptance test

Several factors indicate the need to do more

Flushing Sprinkler Systems

Two methods commonly used for flushing sprinkler piping:

- Hydraulic method - flowing water from the yard mains, in the same direction in which water would flow during a fire
  - Not possible in this large building
  - Might draw tubercles deeper into the piping
- Hydropneumatic method - uses compressed air to blow a charge of water from the branch lines back into feed mains back to the risers
  - Uses less water and could be done but pipe breakage is likely and would be expensive over electronic manufacturing areas

Traditional methods are not practical

Statistical Sampling
(An Alternative Approach)

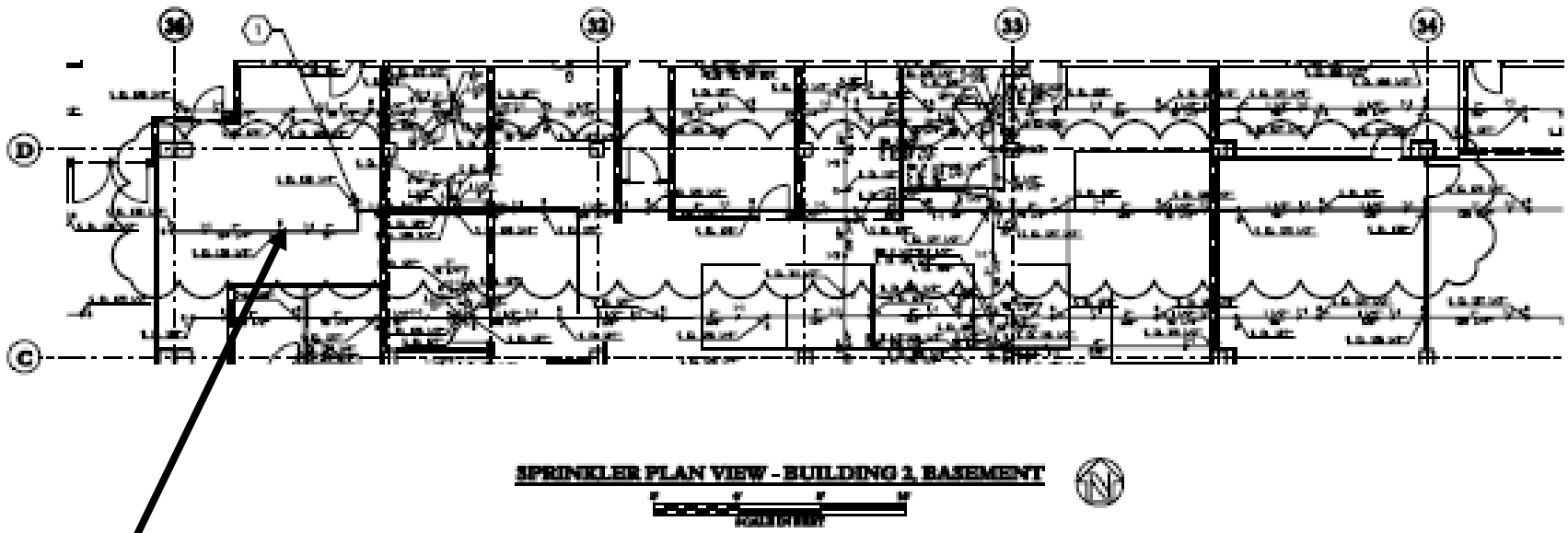
Sampling confidence

- 23 samples gives 90% confidence that 90% of the system is unobstructed
- 45 samples gives 90% confidence that 95% of the system is unobstructed
- 59 samples gives 95% confidence that 95% of the system is unobstructed

- Visual Inspection
- 23 Random Samples chosen by a Statistical Analysis program

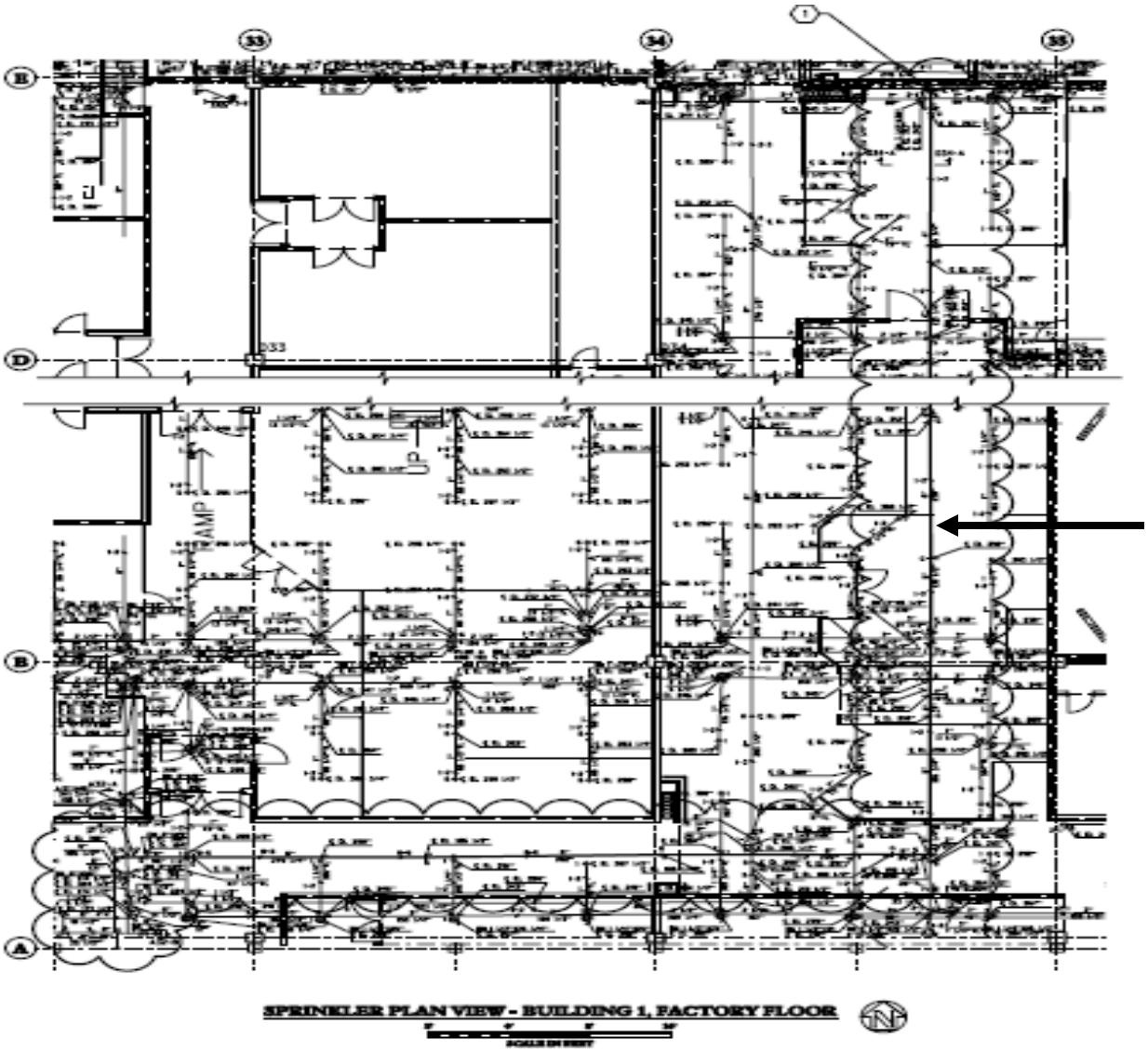
What is a sample

Engineering Judgment applied



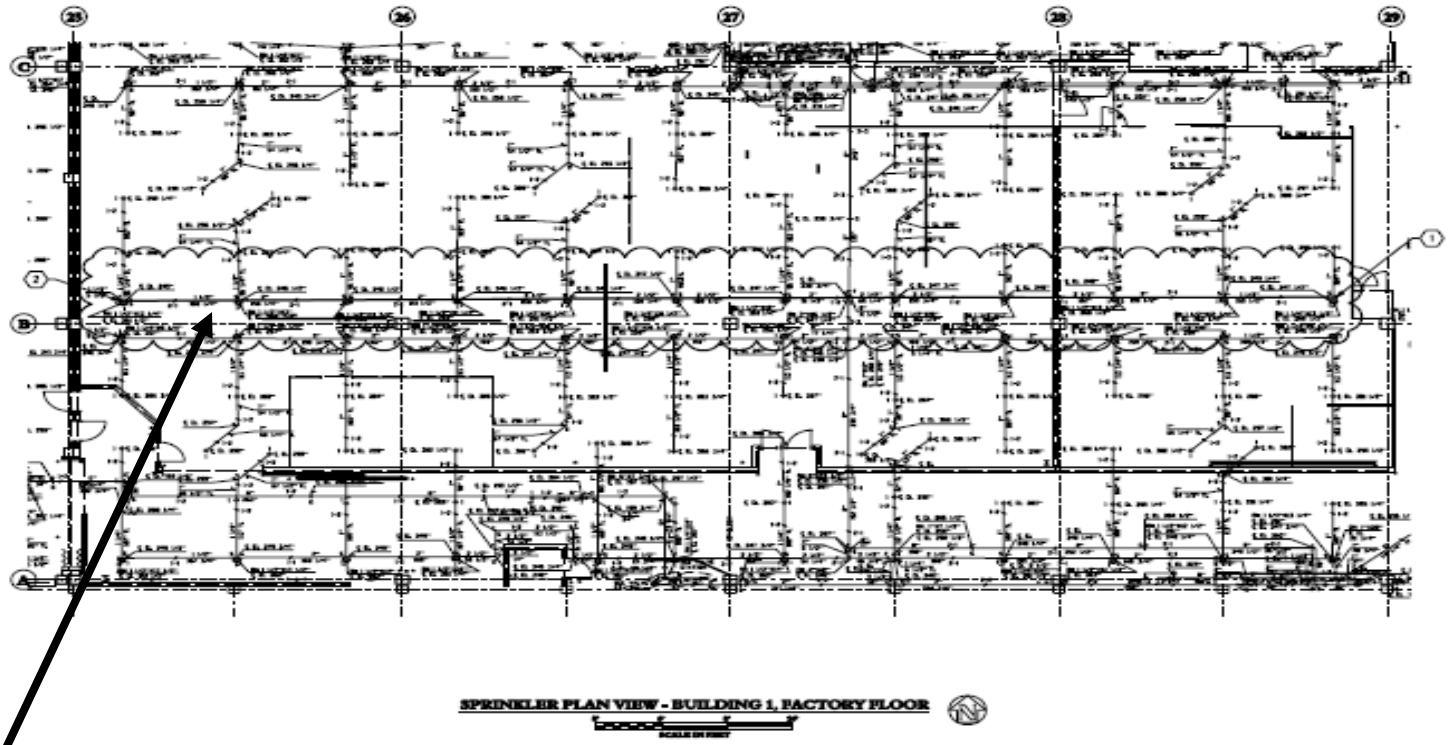
98 ft of branch line, 1 ¼-inch to 2-inch

Another Typical Sample



147 ft of feed main
4, 5, and 6-inch pipe

Another Typical Sample

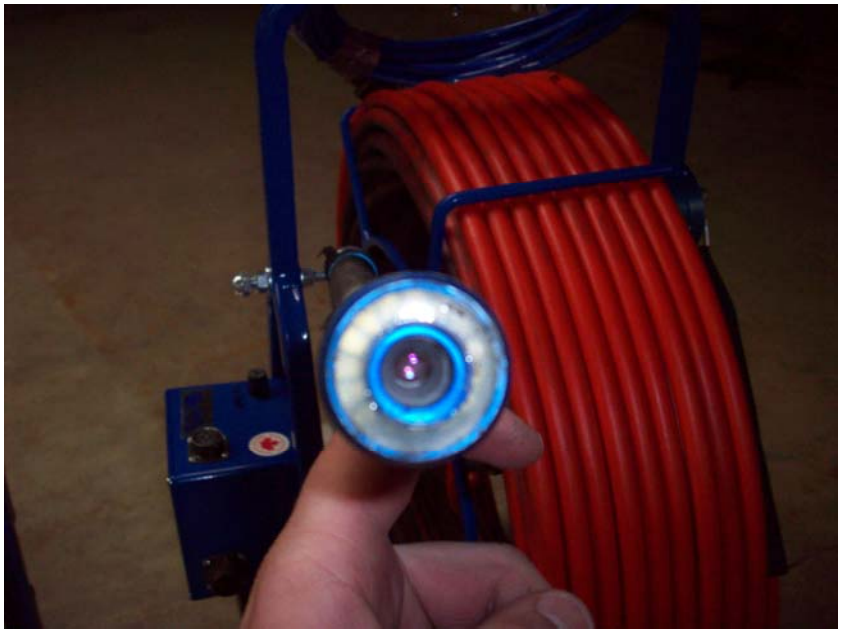


147 ft of cross main, 1 ½-inch to 3-inch

Typical Sample Location

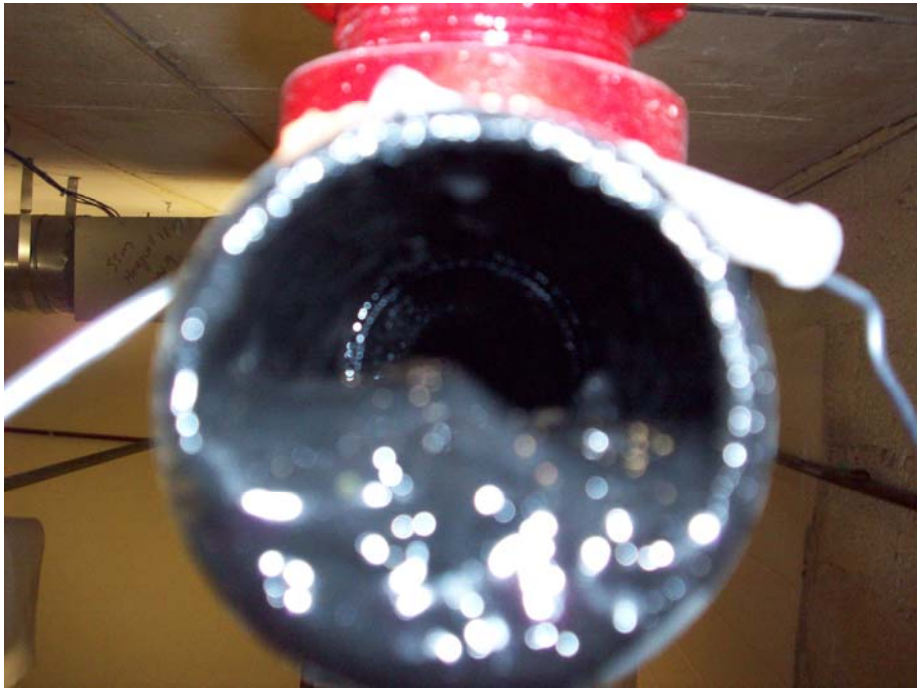
- Heights to 34 ft. – working through misc. piping and high voltage electrical
- Sample locations were modified slightly to avoid dangerous work conditions (exposed electrical, fall hazard) resulting in a slightly biased sampling

Camera



- RoboProbe digital video camera and recorder
- Full color and recording capability
- Due to access points, 8-12 ft. pipe sections were removed
- Older non-reamed 1 ¼ in. pipe had to be removed
- Camera cost - $10K

Goop resulted in issues using the camera



Draining the Goop

Most samples required a slight flush in order to use the camera

Burlap bag used for collection of scale

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Some Typical Internal Pipe Pics

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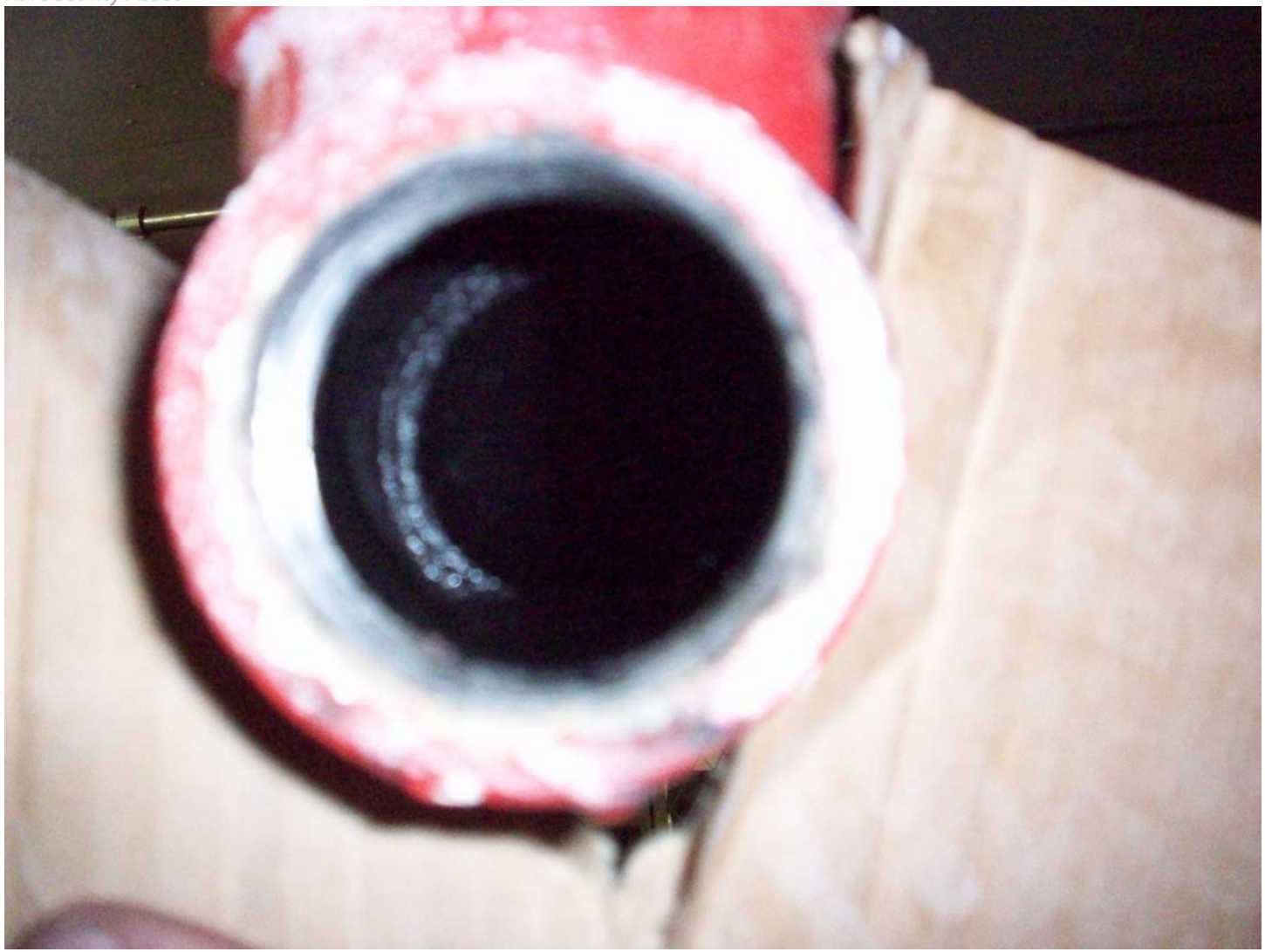

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POOLE FIRE PROTECTION

Typical debris found (**most** will not adversely affect sprinkler operation)

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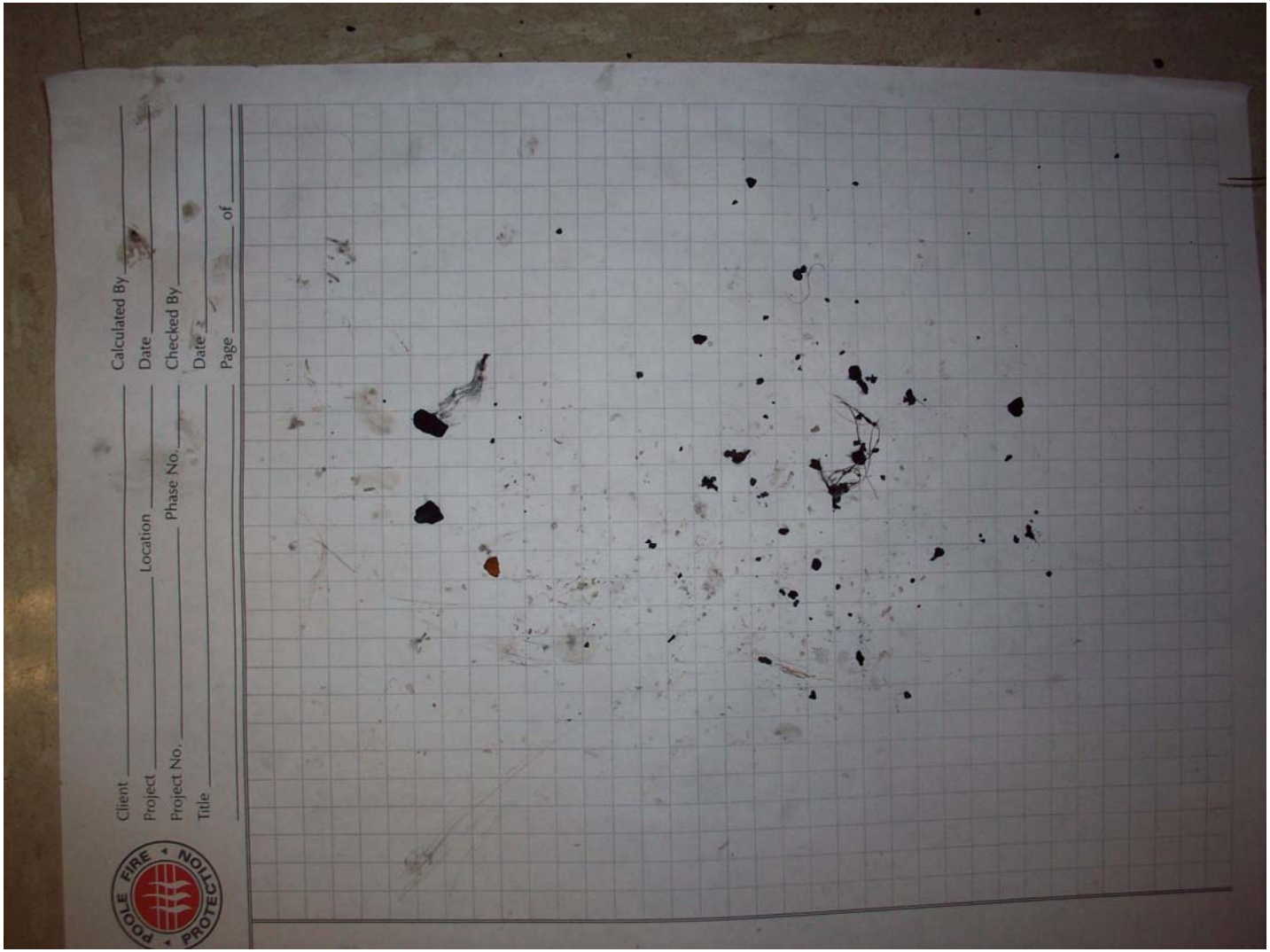

Summary

- A 1 in. particle removed from one system was tested and found to be calcium silicon based (not iron oxide) probably introduced during the original installation – thus a different issue.
- Significant scaling from another system warrants further study of that system.

Cost effective solution

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Free to a good home

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Detroit 8.2T engine

Allison automatic transmission

Hale 750 GPM single stage centrifugal pump

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18,000 miles

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