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Example Procedure for Flushing an Actual School Building

April 6, 2020, Version 1

I. Background

Sometimes buildings are shutdown or experience long-periods of low occupancy and the water inside the property plumbing stagnates. Water can stagnate inside the building pipes and tanks, but also in the buried water service line that transports drinking water from its source to the building. Stagnation allows for contaminant levels of metals such as lead and copper to increase in the water. Microbes are also likely to grow. Under routine building water use, the amount of contamination in water is not typically a problem, but long stagnation periods can cause water quality to deteriorate to unacceptable levels. To remove this water from the property plumbing, a procedure was developed based on as-built construction drawings and experience inside the building. The procedure below is provided to help demonstrate the steps needed to flush the stagnant water from the plumbing of a specific building and replace it with fresh water from the water utility main buried out in front of the property.

This guidance was developed using as-built drawings for an actual building where the characteristics were known. **Factors of safety were not applied.** Due to non-ideal flows commonly encountered in plumbing, stated flushing times may need to be increased. In a prior study for flushing home interior faucets the factory of safety applied was 10. So, all flushing times may need to be 10% longer. No safety factors were applied.

Building Characteristics	
Year Built	2011
Size:	<ul style="list-style-type: none">• 2 floors (1st floor: classrooms, auditorium, two gyms, and cafeteria; 2nd floor: mechanical attic)• All water only located on first floor• The building area is 200,000 square feet, while the total area for the property (including sporting fields) is 3,378,152 square feet• There are 12 different building sections (A, B, C, D, E, F, G, H, J, L, K) and each has various uses.
Water Transport and Use on Property:	<ul style="list-style-type: none">• A public water system (PWS) delivers chloraminated drinking water to the property through a buried service line.• PWS water used for drinking, appliances, hot water, and irrigation.• After passing through the water meter, an 8 inch PVC pipe service loop circles entire school campus [3,481 feet, volume 9,089 gallons]. Some branches exist that convey water to a field house, concession stand, and yard hydrants (a 2 inch existing fire hydrant branches off from the fire line around the building to near the concession stand, and few others are located outside the building).• 4 inch irrigation pipe line also branches off from the fire line around the building. In this document, flushing of the irrigation line is not included. The building service line and building itself is only the focus.• Water enters the school building by traveling through this loop, and then into a 4 inch ductile iron pipe [160 ft, volume 104 gallons]
Devices:	<ul style="list-style-type: none">• Two point-of-entry water softeners (52.36 gallons each, one used at a time)• Four water heaters (130 gallons each)• Total four hot water recirculation loops, one heater for each loop (a 150°C loop for the kitchen and three 120°C loops for domestic water)

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- There are a total of 363 individual water outlets in the building: (81) cabinet/classroom sinks, (25) water bubblers (also known as drinking water fountains), (33) showers, (5) mop/service sinks, (92) bathroom sinks, (127) toilets.
- There may be point-of-use filtration devices on water fountains or kitchen faucets.

Plumbing Type:

- Soldered copper pipe inside the building

II. To Prepare for Flushing

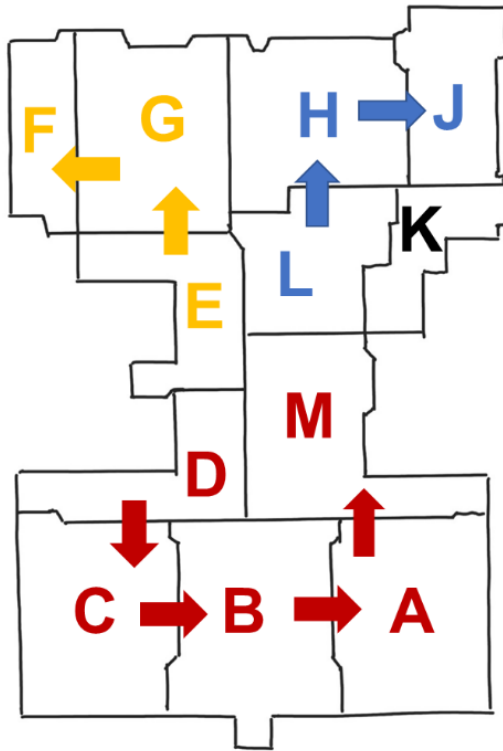
1. Remove faucet aerators where possible. Replace them after flushing. Removal will allow water flowrate to be faster.
2. Remove point-of-use filters and replace them after flushing. Removal will protect them from accumulating contaminants during flushing, and will allow water flowrate to be faster.
3. Remove shower hoses and shower heads and replace them after flushing.
4. Consider minimizing the number of fixtures open at a time. The more fixtures you open at the same time, the slower the water can be flowing inside the building.
5. Turn off automatic motion fixtures where possible. This will ensure the fixture continually flushes, and reduce the amount of labor to keep the flushing from stopping flow.
6. Water heaters need to be shut off and cool down. The recirculation loop also has to cool down. Scalding can occur if the water temperature is too high. Make sure to drain and flush water heaters.
7. Disinfection may be needed for the water softener, other appliances, and plumbing, but this guidance ONLY pertains to turning over water.
8. *No safety factor was added*, so longer flushing time may be required.
9. Make sure to flush all the toilets in the bathroom after flushing in accordance with guidance below. Toilet flushing was not considered in the amount of water needed to flush and also affects water movement in the building. These are low-flow toilets.
10. No other locations should be flushed until one section is completely flushed.

III. Step-by-Step Procedure (you may need 2 or more people per team to do this)

Once flushing in the utility room [K] is completed, three teams can likely work at the same time to flush blue section together [L, H, J], yellow section together [E, F, G], and red section together [D, C, B, A, M]. All building water enters through the utility room [K].

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Fixture water flowrate before the softener was assumed to be 1 gallon per minute, and all other fixtures are assumed to have a flowrate of 0.34 gallons per minute based on prior work in the building. Shower head fixtures are assumed to have a flowrate of 2.1 gallons per minute.



Flushing multiple fixtures at the same time (up to 3 fixtures) is probably okay, but if water pressure or flowrate drops where the amount of water flowing out of the faucets slows down, fixtures should be flushed at least 50% longer than the recommended flushing time.

*Measure flowrate is recommended if recommended flushing time below is more than 5 minutes. To measure flowrate easily, fill a cup, milk jug, or volumetric cylinder or and measure how long it takes to fill the container.

The International Association of Plumbing and Mechanical Officials (IAPMO) recommends at least 5 minutes of flushing at each drinking water fountain, water cooler, bottle filler and other end point device. These 5-minute flushing times are not included below.

Figure 1. Building map divided by sections according to plumbing plan.

1. Begin by bringing fresh water from the utility main to the building

NOTE: the building water enters the school campus and circles around a buried pipe loop. It is important that this loop be flushed before the building is flushed. Because large amounts of water volume will be used and discharged, this action should be coordinated with the public water supplier.

- Flush hydrants on campus to remove the replace water in the PVC pipe service loop that circles entire school campus [3,481 feet, volume 9,089 gallons].
- It is unknown how long this action will take as hydrant flowrate will depend on a number of factors. Monitor water condition until clear, temperature stable and disinfectant is detected at the level the utility is providing it to the school.

2. Move to the building utility room [10 hours of flushing + softener + water heaters + recirculation loops cleaning]

The next step focusses on flushing the buried water service line that transports water from the on-campus pipe loop to the building entry point.

- Connect a hose to the spigot that is the first water outlet once the service line enters the building. About 104 gallons of water may exist in that service line that connects the loop to the building. Turn on the spigot to flush water and have someone monitor the spigot doesn't leak and janitor sink doesn't overflow or spill out. **Flush this location for at least 1 hour and 42 minutes.** At the end, shut this off.

The next step focusses on the water softeners and water heater tanks.

- Go to spigot located after the water softening system. The volume of each softener is 52.36 gallons each. Flush each softener for **at least 52 minutes and 22 seconds.**

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Because softeners are designed in parallel, a manual override may be required to switch which softener is in use.

- c. Go to the water heaters, valve off the heater tank and connect a hose to each heater tank to drain all by gravity. **Flush each heater tank for 6 hours and 24 minutes** to remove remaining water by connected hose. Valve off the heater tank, there are 4 water heater tank, 130 gallons each.

**As soon as water heater is completed flushing, hot recirculation loops should also be drained. If hot water faucets are flushed before the hot water recirculation system is drained and refilled, fresh water will not be flushed out of the hot water faucets.*

** While hot recirculation loop is drained, flushing at cold water fixtures can be started but not hot water faucets until the loop is completely drained first. After all four loops are drained hot water fixtures now can be flushed.*

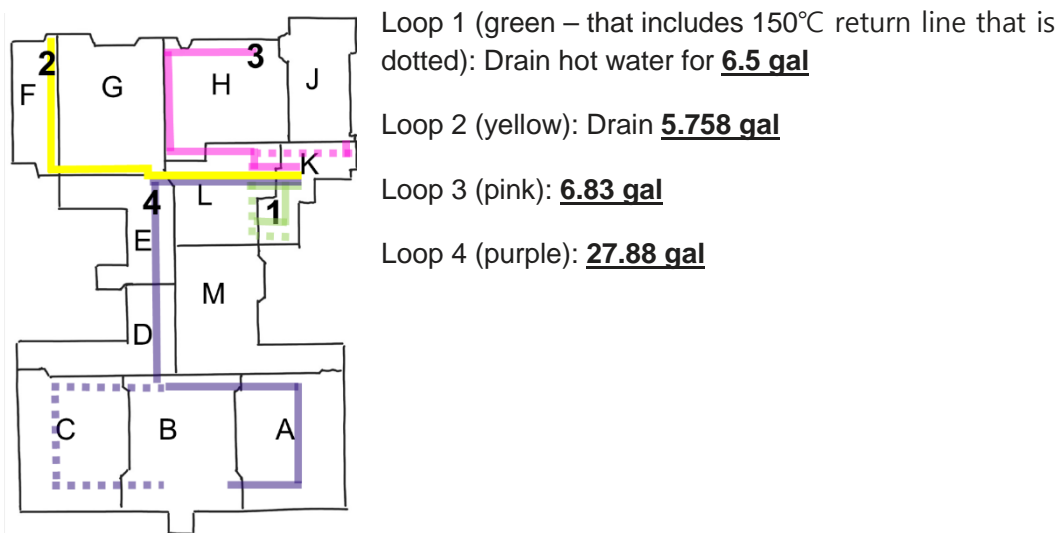


Figure 2. The school building layout is shown along with the location of the utility room and four hot water recirculation loops. Each recirculation loop contains a different volume of water. The length and volume of the recirculation loop are calculated from the heater tank and to the farthest fixture of the hot return line. After draining all four loops, flushing for hot water at each fixture should be a lot

- d. Go to the bathroom in the utility room [A-306R]. This is the closest fixture to the entry point after the water softeners and heater tanks. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush the cold water for **at least 103 min (35.01 gal)**.
 - ii. Flush the hot water for **at least 4 sec (0.06 gal)**.
- e. Go to lavatory sink in the utility room. This is the first location within the hot recirculation line in the utility room. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush the cold water for **at least 50 min (17.11 gal)**.
 - ii. Flush the hot water for **at least 4 sec (0.02 gal)**.
- f. Go to men's bathroom [A302M]. This is second location within the hot recirculation line in the utility room. There are 3 sinks. Open all 3 sinks at the same time.
 - i. Flush the cold water for **at least 8 sec (0.378 gal)**.
 - ii. Flush the hot water for **at least 19 sec (0.32 gal)**.

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- g. Go to lavatory sink in the utility room. This is the farthest fixture within the utility room from the building entry point that is also involved in hot water recirculation line.
 - iii. Flush the cold water for **at least 12 min (4.10 gal).**
 - iv. Flush the hot water for **at least 3 min (1.02 gal).**
- h. Go to women's bathroom [A302W]. There are 3 sinks. Open all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - i. Flush the cold water for **at least 45 min (46.55 gal).**
 - ii. Flush the hot water for **at least 1 min 18 sec (1.34 gal).**

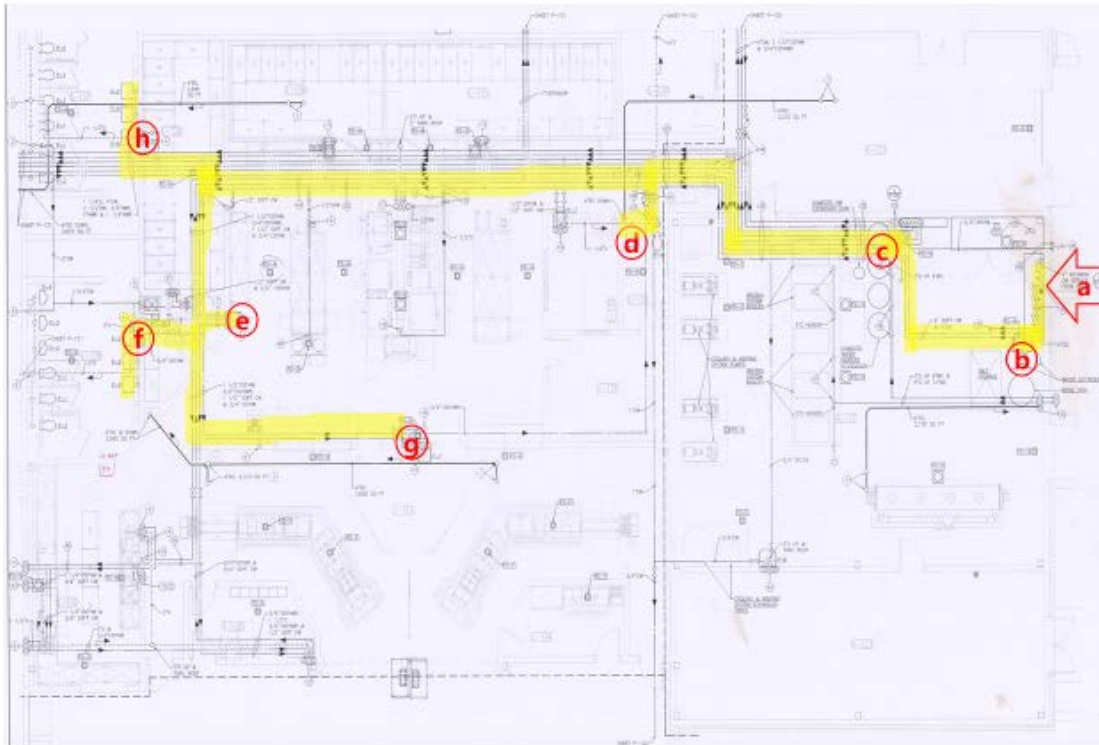


Figure 3. Detail flushing guidance of utility room [section K]

3. Move to building section L – mostly bathrooms and student showers [67.45 minutes of flushing]
 - a. Go to bathroom [E102A]. There is only one sink.
 - i. Flush the cold water for **at least 8 min (2.73 gal).**
 - ii. Flush the hot water for **at least 49 sec (0.274 gal).**
 - b. Go to student shower [E102S]. There are 7 showers in the room. For the shower heads, 2.1 gpm flowrate was used.

First, go to section 1, and turn all three showers at the same time.

 - i. Flush the cold water for **at least 1 min and 40 sec (10.52 gal).**
 - ii. Flush the hot water for **at least 4 sec (0.4 gal).**

Next, go to section 2, and turn two showers at the same time.

 - i. Flush the cold water for **at least 40 sec (2.83 gal).**
 - ii. Flush the hot water for **at least 8 sec (0.5 gal).**

Next, go to section 3, and turn one shower on.

 - i. Flush the cold water for **at least 1 min and 20 sec (2.43 gal).**
 - ii. Flush the hot water for **at least 12 sec (0.4 gal).**

Finally, go to section 4, and turn one ada shower on.

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- i. Flush the cold water for **at least 1 min and 56 sec (4.05 gal).**
 - ii. Flush the hot water for **at least 2 sec (0.06 gal).**
- c. Go to student shower [E101S]. There are 7 showers in the room.
First, go to section 4, and turn one ada shower on.
 - i. Flush the cold water for **at least 17 sec (0.61 gal).**
 - ii. Flush the hot water for **at least 2 sec (0.06 gal).**Next, go to section 5, and turn all three showers at the same time.
 - i. Flush the cold water for **at least 1 min and 56 sec (4.05 gal).**
 - ii. Flush the hot water for **at least 4 sec (0.4 gal).**Next, go to section 6, and turn two showers on.
 - i. Flush the cold water for **at least 5 sec (2.83 gal).**
 - ii. Flush the hot water for **at least 8 sec (0.5 gal).**Finally, go to section 3, and turn one shower on.
 - i. Flush the cold water for **at least 1 min and 9 sec (2.43 gal).**
 - ii. Flush the hot water for **at least 12 sec (0.4 gal).**
- d. Go to bathroom [E102B]. There are two sinks. Turn both faucets on.
 - i. Flush the cold water for **at least 35 sec (0.4 gal).**
 - ii. Flush the hot water for **at least 12 sec (0.13 gal).**
- e. Go to bathroom [E101B]. There are two sinks. Turn both faucets on.
 - i. Flush the cold water for **at least 35 sec (0.4 gal).**
 - ii. Flush the hot water for **at least 12 sec (0.13 gal).**
- f. Go to single shower room [E101A].
 - i. Start flush the sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush the cold water for **at least 31 min (10.68 gal).**
 - ii. Flush the hot water for **at least 10 sec (0.06 gal).**
 - j. Then shower. Fixture water flowrate is assumed as 2.1 gpm for both cold and hot.
 - i. Flush the cold water for **at least 5 sec (0.12 gal).**
 - ii. Flush the hot water for **at least 9 sec (0.05 gal).**
- k. Go to bathroom [E101R]. There is only one sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - iii. Flush the cold water for **at least 15 min and 30 sec (5.26 gal).**
 - iv. Flush the hot water for **at least 15 sec (0.08 gal).**

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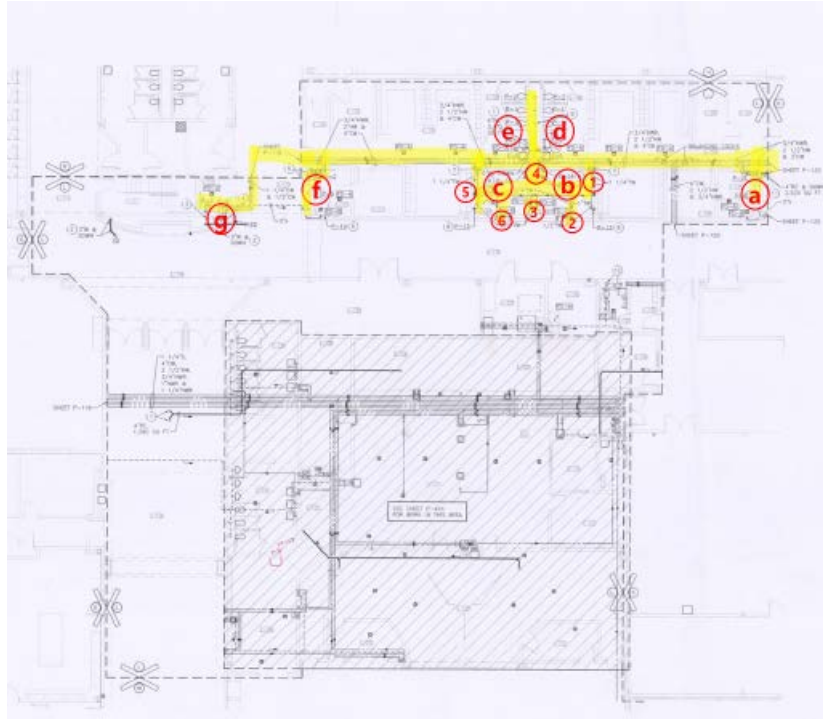


Figure 4. Detail flushing guidance of [section L]

4. Move to building section H – large gym and bathrooms on each corner [82.35 minutes of flushing]

- a. Go to mop sink [F115C].
 - i. Flush the cold water for **at least 17 sec (0.095 gal).**
 - ii. Flush the hot water for **at least 12 sec (0.06 gal).**
- b. Go to men's bathroom [F115M]. There are 5 sinks. Turn the three sinks that are furthest from the entrance.
 - i. Flush the cold water for **at least 6 min and 18 sec (6.43 gal).**
 - ii. Flush the hot water for **at least 24 sec (0.4 gal).**Turn the other two sinks at the same time
 - i. Flush the cold water for **at least 9 min and 30 sec (6.43 gal).**
 - ii. Flush the hot water for **at least 36 sec (0.4 gal).**
- c. Go to water bubblers next to men's bathroom. There are two water bubblers. Turn both water bubblers at the same time.
 - i. Flush for **at least 24 sec (0.14 gal).**
- d. Go to women's bathroom [F115W]. There are 5 sinks. Turn the three sinks that are furthest from the entrance.
 - i. Flush the cold water for **at least 6 min (6.11 gal).**
 - ii. Flush the hot water for **at least 8 sec (0.13 gal).**Turn the other two sinks at the same time
 - iii. Flush the cold water for **at least 9 min (6.11 gal).**
 - iv. Flush the hot water for **at least 12 sec (0.13 gal).**
- e. Go to water bubblers next to women's bathroom. Turn two water bubblers at the same time.
 - i. Flush for **at least 24 sec (0.14 gal).**
- f. Go to cabinet sink in concessions [F115].
 - i. Flush the cold water for **at least 18 min and 54 sec (6.44 gal).**
 - ii. Flush the hot water for **at least 13 sec (0.07 gal).**

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- g. Go to women's bathroom [F114W]. There are two sinks. Turn both faucets at the same time.
 - i. Flush the cold water for **at least 13 min and 58 sec (9.49 gal)**.
 - ii. Flush the hot water for **at least 7 sec (0.07 gal)**.
- h. Go to men's bathroom [F114M]. There are two sinks. Turn both faucets at the same time.
 - i. Flush the cold water for **at least 26 sec (0.14 gal)**.
 - ii. Flush the hot water for **at least 9 sec (0.14 gal)**.
- i. Go to women's bathroom [E207G]. There are three sinks. Turn all three faucets at the same time.
 - i. Flush the cold water for **at least 14 min and 17 sec (14.58 gal)**.
 - ii. Flush the hot water for **at least 12 sec (0.2 gal)**.
- j. Go to men's bathroom [E207B]. There are three sinks. Turn all three faucets at the same time.
 - i. Flush the cold water for **at least 30 sec (0.51 gal)**.
 - ii. Flush the hot water for **at least 10 sec (0.16 gal)**.

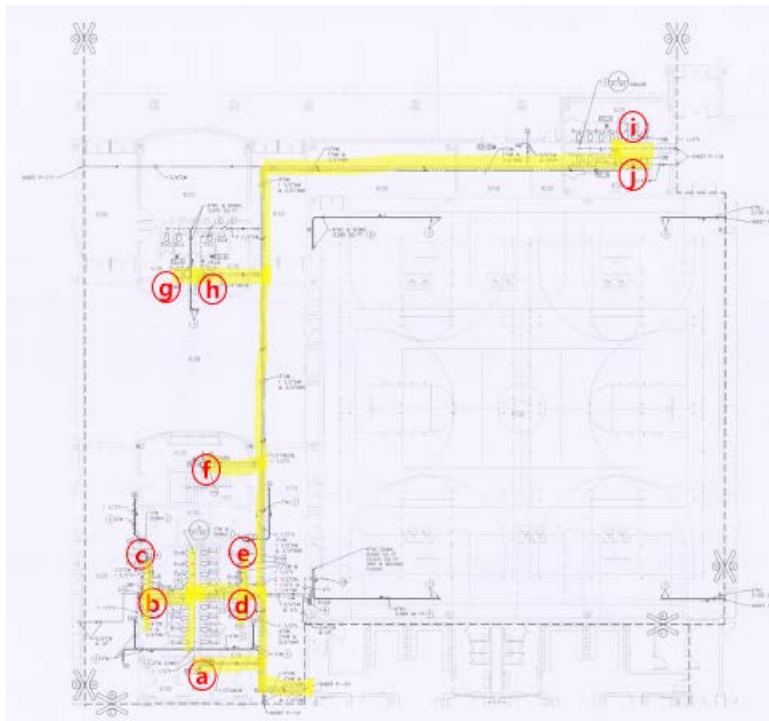


Figure 5. Detail flushing guidance of [section H]

5. Move to building section J – practice gym connected to large gym [1.5 minutes of flushing]
 - a. Go to water bubblers in the practice gym [E200]. There are two water bubblers. Fixture water flowrate is assumed as 0.68 gpm.
 - i. Flush cold water for **at least 1 min and 30 sec each (0.99 gal)**.

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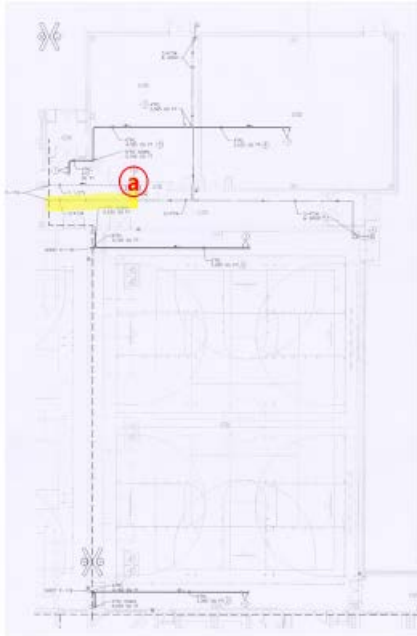


Figure 6. Detail flushing guidance of [section J]

6. Move to building section E – classrooms [228.97 minutes of flushing]

- a. Go to water bubblers next to storage room [A106]. Turn both bubblers at the same time. Fixture water flowrate is assumed as 0.34 gpm.
 - i. Flush cold water for **at least 22 min each (15.08 gal).**
- b. Go to men's bathroom [A108M]. There is only one sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 hour 18 min and 30 sec (26.7 gal).**
 - ii. Flush hot water for **at least 8 sec (0.04 gal).**
- c. Go to cabinet sink in the workroom [A108].
 - i. Flush cold water for **at least 2 min and 24 sec (0.81 gal).**
 - ii. Flush hot water for **at least 4 sec (0.03 gal).**
- d. Go to women's bathroom [A108W]. There is only one sink.
 - i. Flush cold water for **at least 3 min and 30 sec (1.19 gal).**
 - ii. Flush hot water for **at least 4 sec (0.03 gal).**
- e. Go to classroom [F104]. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - For sink 1,
 - i. Flush cold water for **at least 1 hour 8 min and 30 sec (23.3 gal).**
 - ii. Flush hot water for **at least 4 sec (0.03 gal).**
 - For sink 2,
 - i. Flush cold water for **at least 5 min and 24 sec (1.83 gal).**
 - ii. Flush hot water for **at least 4 sec (0.03 gal).**
 - For sink 3,
 - i. Flush cold water for **at least 7 min and 24 sec (2.5 gal).**
 - ii. Flush hot water for **at least 19 sec (0.11 gal).**
 - For sink 4,
 - i. Flush cold water for **at least 17 sec (0.095 gal).**
 - ii. Flush hot water for **at least 17 sec (0.095 gal).**
- f. Go to classroom [F105].

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- For sink 5,
- Flush cold water for **at least 7 min and 24 sec (2.5 gal).**
 - Flush hot water for **at least 19 sec (0.11 gal).**
- For sink 6,
- Flush cold water for **at least 17 sec (0.095 gal).**
 - Flush hot water for **at least 17 sec (0.095 gal).**
- For sink 7,
- Flush cold water for **at least 8 min and 5 sec (2.75 gal).**
 - Flush hot water for **at least 4 sec (0.03 gal).**
- For sink 8,
- Flush cold water for **at least 4 min and 7 sec (1.4 gal).**
 - Flush hot water for **at least 4 sec (0.03 gal).**
- Go to women's bathroom [F107W]. There is one sink.
 - Flush cold water for **at least 8 min and 6 sec (2.74 gal).**
 - Flush hot water for **at least 17 sec (0.095 gal).**
 - Go to men's bathroom [F107M]. There is one sink.
 - Flush cold water for **at least 8 min and 6 sec (2.74 gal).**
 - Flush hot water for **at least 17 sec (0.095 gal).**
 - Go to water bubblers nearby. Turn both faucets on.
 - Flush cold water for **at least 1 min and 12 sec (0.79 gal).**
 - Go to women's bathroom [G107G]. There are three sinks. Turn all three at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - Flush cold water for **at least 30 sec (0.51 gal).**
 - Flush hot water for **at least 8 sec (0.13 gal).**
 - Go to men's bathroom [G107B]. There are three sinks. Turn all three at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - Flush cold water for **at least 30 sec (0.51 gal).**
 - Flush hot water for **at least 8 sec (0.13 gal).**

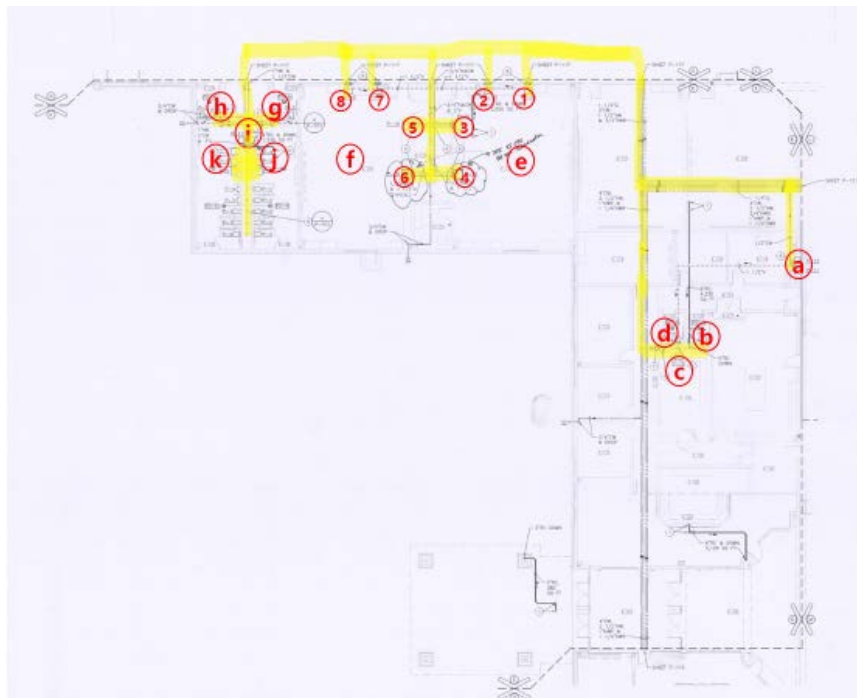


Figure 7. Detail flushing guidance of [section E]

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7. Move to building section F, G – auditorium, student kitchen [150.23 minutes of flushing]
- a. Go to service sink in the auditorium [F113]. This is the farthest location of the north side of the building. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 hour 12 min and 36 sec (24.67 gal).**
 - ii. Flush hot water for **at least 12 sec (0.06 gal).**
 - b. Go to water bubbler in room [F112].
 - i. Flush for **at least 34 sec (0.19 gal).**
 - c. Go to water bubbler in room [F110].
 - i. Flush for **at least 3 min and 58 sec (1.35 gal).**
 - d. Go to student kitchen [F102]. There are 6 sink sets. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.

For sink 1,

 - i. Flush cold water for **at least 1 hour 3 min and 30 sec (21.6 gal).**
 - ii. Flush hot water for **at least 1 min and 52 sec (0.63 gal).**

For sink 2,

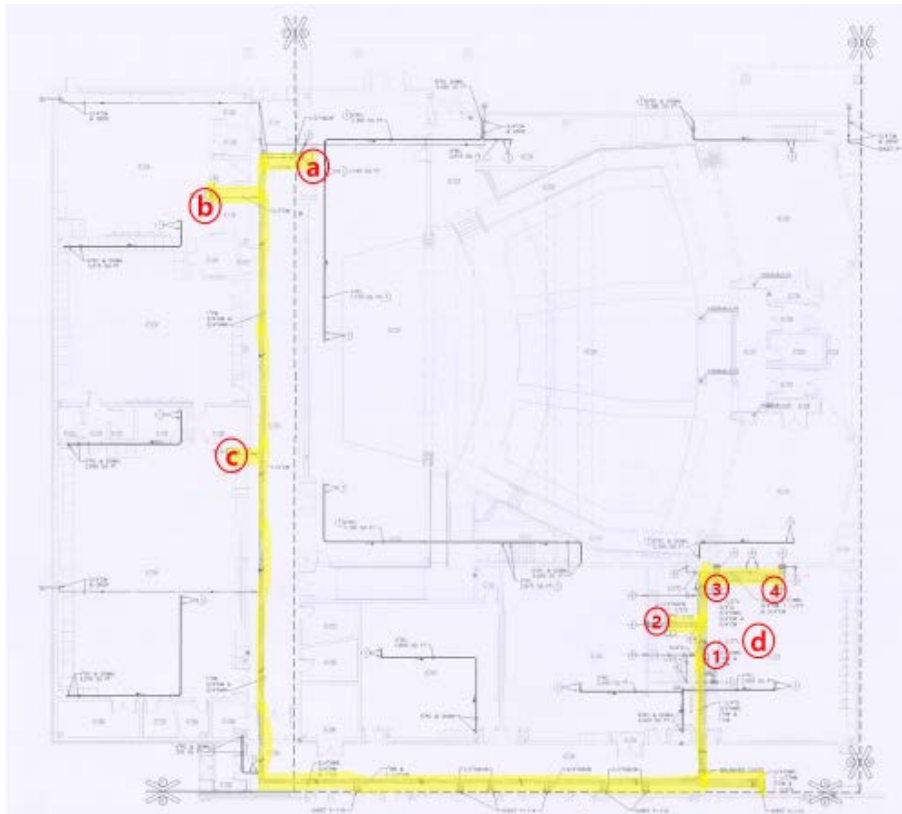
 - i. Flush cold water for **at least 1 min and 48 sec (0.61 gal).**
 - ii. Flush hot water for **at least 1 min and 48 sec (0.61 gal).**

For sink 3,

 - i. Flush cold water for **at least 1 min and 48 sec (0.61 gal).**
 - ii. Flush hot water for **at least 1 min and 48 sec (0.61 gal).**

For sink 4,

 - i. Flush cold water for **at least 40 sec (0.23 gal).**
 - ii. Flush hot water for **at least 40 sec (0.23 gal).**



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Figure 8. Detail flushing guidance of [section F,G]

8. Move to building section D – classrooms, faculty kitchen [196.95 minutes of flushing]

- a. Go to cabinet sink in the exam room [A213D]. There is only one sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 hour 35 min and 18 sec (32.4 gal).**
 - ii. Flush hot water for **at least 6 sec (0.03 gal).**
- b. Go to cabinet sink in the work room [A202]. There is only one sink.
 - i. Flush cold water for **at least 15 min and 42 sec (5.4 gal).**
 - ii. Flush hot water for **at least 12 sec (0.06 gal).**
- c. Go to water bubbler next to room [A213A]. There is only one bubbler.
 - i. Flush cold water for **at least 48 sec (0.2 gal).**
- d. Go to women's bathroom [A210W]. There is only one sink.
 - i. Flush cold water for **at least 4 min and 48 sec (1.64 gal).**
 - ii. Flush hot water for **at least 35 sec (0.27 gal).**
- e. Go to men's bathroom [A213B]. There is only one sink.
 - i. Flush cold water for **at least 30 sec (0.17 gal).**
 - ii. Flush hot water for **at least 7.5 sec (0.043 gal).**
- f. Go to women's bathroom [A213G]. There is only one sink.
 - i. Flush cold water for **at least 30 sec (0.17 gal).**
 - ii. Flush hot water for **at least 7.5 sec (0.043 gal).**
- g. Go to men's bathroom [A210M]. There is only one sink.
 - i. Flush cold water for **at least 30 sec (0.17 gal).**
 - ii. Flush hot water for **at least 7.5 sec (0.043 gal).**
- h. Go to cabinet sink in life skills room [B102A]. There is only one sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 hour 5 min and 12 sec (22.16 gal).**
 - ii. Flush hot water for **at least 2 sec (0.04 gal).**
- i. Go to men's bathroom [B102B]. There is only one sink.
 - i. Flush cold water for **at least 6 min and 42 sec (2.28 gal).**
 - ii. Flush hot water for **at least 10 sec (0.06 gal).**
- j. Go to women's bathroom [B102G]. There is only one sink.
 - i. Flush cold water for **at least 5 min and 24 sec (1.84 gal).**
 - ii. Flush hot water for **at least 5 sec (0.03 gal).**

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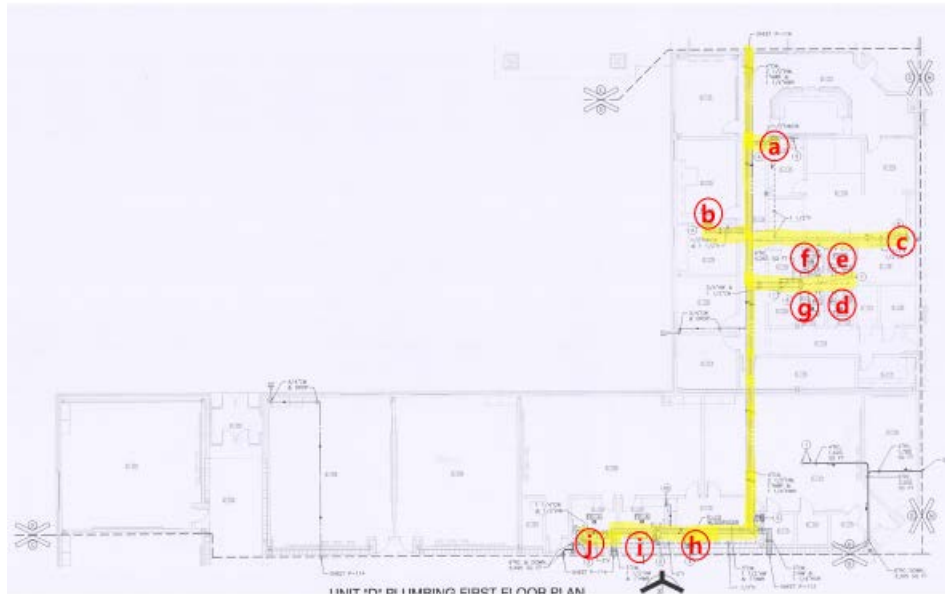


Figure 9. Detail flushing guidance of [section D]

9. Move to building section C – classrooms [120.53 minutes of flushing]

- a. Go to men's bathroom [B103B]. There are three sinks. Open all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - i. Flush cold water for **at least 6 min and 55 sec (7.06 gal).**
 - ii. Flush hot water for **at least 36 sec (0.6 gal).**
- b. Go to mop sink in [B103G]. There is one sink.
 - i. Flush cold water for **at least 1 min and 24 sec (0.46 gal).**
 - ii. Flush hot water for **at least 21 sec (0.114 gal).**
- c. Go to women's bathroom [B103G]. There are three sinks. Open all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 min and 7 sec (1.14 gal).**
 - ii. Flush hot water for **at least 8 sec (0.13 gal).**
- d. Go to water bubblers next to the bathroom. There are two water bubblers. Open both faucets at the same time. Fixture water flowrate is assumed as 0.68 gpm for both cold and hot.
 - i. Flush cold water for **at least 8 min and 41 sec (5.91 gal).**
- e. Go to classroom [B104]. There are 10 sinks in the room. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - For sink 1,
 - i. Flush cold water for **at least 6 min and 56 sec (2.36 gal).**
 - ii. Flush hot water for **at least 45 sec (0.25 gal).**
 - For sink 2,
 - i. Flush cold water for **at least 31 sec (0.18 gal).**
 - ii. Flush hot water for **at least 31 sec (0.18 gal).**
 - For sink 3,
 - i. Flush cold water for **at least 1 min and 12 sec (0.404 gal).**
 - ii. Flush hot water for **at least 1 min and 12 sec (0.404 gal).**
 - For sink 4,
 - i. Flush cold water for **at least 31 sec (0.177 gal).**
 - ii. Flush hot water for **at least 31 sec (0.177 gal).**

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- For sink 5,
 - i. Flush cold water for **at least 18 sec (0.101 gal).**
 - ii. Flush hot water for **at least 18 sec (0.101 gal).**
- For sink 6,
 - i. Flush cold water for **at least 18 sec (0.0996 gal).**
 - ii. Flush hot water for **at least 18 sec (0.0996 gal).**
- For sink 7,
 - i. Flush cold water for **at least 18 sec (0.0996 gal).**
 - ii. Flush hot water for **at least 18 sec (0.0996 gal).**
- For sink 8,
 - i. Flush cold water for **at least 20 sec (0.114 gal).**
 - ii. Flush hot water for **at least 20 sec (0.114 gal).**
- For sink 9,
 - i. Flush cold water for **at least 20 sec (0.114 gal).**
 - ii. Flush hot water for **at least 20 sec (0.114 gal).**
- For sink 10,
 - i. Flush cold water for **at least 11 min and 11 sec (3.8 gal).**
 - ii. Flush hot water for **at least 2 sec (0.06 gal).**
- f. Go to men's bathroom [B112M]. There is only one sink.
 - i. Flush cold water for **at least 21 min and 18 sec (7.23 gal).**
 - ii. Flush hot water for **at least 7 sec (0.04 gal).**
- g. Go to women's bathroom [B112W]. There is only one sink.
 - i. Flush cold water for **at least 20 sec (0.114 gal).**
 - ii. Flush hot water for **at least 7 sec (0.04 gal).**
- h. Go to classroom [B113]. There are 11 sinks. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - For sink 1,
 - i. Flush cold water for **at least 15 min and 19 sec (5.21 gal).**
 - ii. Flush hot water for **at least 6 sec (0.13 gal).**
 - For sink 2,
 - iii. Flush cold water for **at least 27 sec (0.15 gal).**
 - iv. Flush hot water for **at least 27 sec (0.15 gal).**
 - For sink 3,
 - iii. Flush cold water for **at least 27 sec (0.15 gal).**
 - iv. Flush hot water for **at least 27 sec (0.15 gal).**
 - For sink 4,
 - i. Flush cold water for **at least 1 min and 6 sec (1.5 gal).**
 - ii. Flush hot water for **at least 1 min and 6 sec (1.5 gal).**
 - For sink 5,
 - i. Flush cold water for **at least 23 sec (0.5 gal).**
 - ii. Flush hot water for **at least 23 sec (0.5 gal).**
 - For sink 6,
 - i. Flush cold water for **at least 32 sec (0.7 gal).**
 - ii. Flush hot water for **at least 32 sec (0.7 gal).**
 - For sink 7,
 - i. Flush cold water for **at least 33 sec (1.3 gal).**
 - ii. Flush hot water for **at least 33 sec (1.3 gal).**
 - For sink 8,
 - i. Flush cold water for **at least 20 sec (0.8 gal).**
 - ii. Flush hot water for **at least 20 sec (0.8 gal).**
 - For sink 9,
 - i. Flush cold water for **at least 20 sec (0.8 gal).**
 - ii. Flush hot water for **at least 20 sec (0.8 gal).**

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- For sink 10,
- i. Flush cold water for **at least 1 min and 24 sec (0.47 gal).**
 - ii. Flush hot water for **at least 33 sec (0.19 gal).**
- For sink 11,
- i. Flush cold water for **at least 29 sec (0.164 gal).**
 - ii. Flush hot water for **at least 5 sec (0.03 gal).**
- I. Go to classroom [B121]. There are 9 sinks. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
- For sink 1,
- i. Flush cold water for **at least 39 min (13.06 gal).**
 - ii. Flush hot water for **at least 45 sec (0.25 gal).**
- For sink 2,
- i. Flush cold water for **at least 32 sec (0.18 gal).**
 - iii. Flush hot water for **at least 32 sec (0.18 gal).**
- For sink 3,
- v. Flush cold water for **at least 1 min and 12 sec (0.405 gal).**
 - vi. Flush hot water for **at least 1 min and 12 sec (0.405 gal).**
- For sink 4,
- i. Flush cold water for **at least 32 sec (0.18 gal).**
 - ii. Flush hot water for **at least 32 sec (0.18 gal).**
- For sink 5,
- i. Flush cold water for **at least 14 sec (0.08 gal).**
 - ii. Flush hot water for **at least 14 sec (0.08 gal).**
- For sink 6,
- i. Flush cold water for **at least 36 sec (0.202 gal).**
 - ii. Flush hot water for **at least 36 sec (0.202 gal).**
- For sink 7,
- i. Flush cold water for **at least 36 sec (0.202 gal).**
 - ii. Flush hot water for **at least 36 sec (0.202 gal).**
- For sink 8,
- i. Flush cold water for **at least 36 sec (0.202 gal).**
 - ii. Flush hot water for **at least 36 sec (0.202 gal).**
- For sink 9,
- i. Flush cold water for **at least 36 sec (0.202 gal).**
 - ii. Flush hot water for **at least 36 sec (0.202 gal).**
- j. Go to women's bathroom [B124G]. There are 4 sinks. Open all four faucets at the same time. Fixture water flowrate is assumed as 1.36 gpm for both cold and hot.
- i. Flush cold water for **at least 8 min (2.69 gal).**
 - ii. Flush hot water for **at least 8 sec (0.18 gal).**
- k. Go to men's bathroom [B124B]. There are 3 sinks. Open all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
- i. Flush cold water for **at least 3 min and 42 sec (1.26 gal).**
 - ii. Flush hot water for **at least 11 sec (0.18 gal).**
- l. Go to water bubblers next to the bathroom. There are two water bubblers. Open both faucets at the same time. Fixture water flowrate is assumed as 0.68 gpm for both cold and hot.
- i. Flush cold water for **at least 12 min and 48 sec (8.7 gal).**

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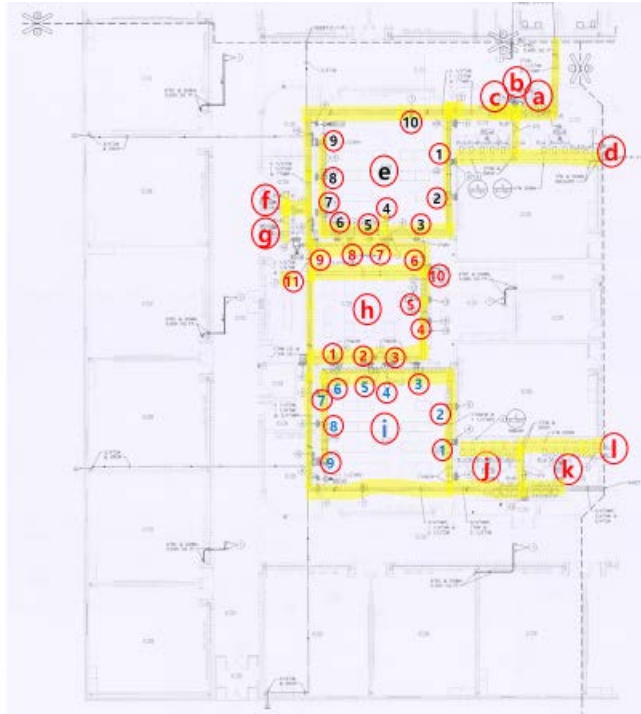
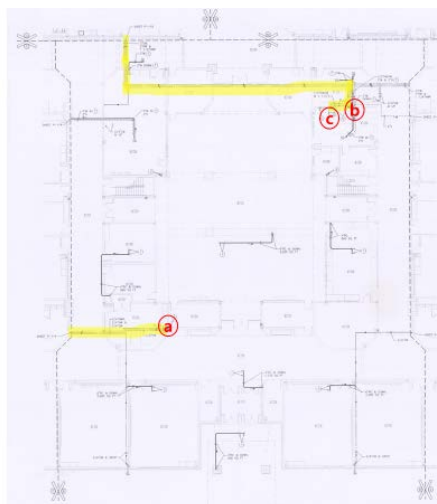


Figure 10. Detail flushing guidance of [section C]

10. Move to building section B – media center [72.58 minutes of flushing]

- a. Go to a cabinet sink in room [D105].
 - i. Flush cold water for **at least 1 min and 30 sec (0.51 gal).**
 - ii. Flush hot water for **at least 3 sec (0.1 gal).**
- b. Go to a cabinet sink in room [D109]. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush cold water for **at least 1 hour 10 min and 35 sec (24 gal).**
 - ii. Flush hot water for **at least 9 sec (0.05 gal).**
- c. Go to a cabinet sink in room [D100E]
 - i. Flush cold water for **at least 9 sec (0.05 gal).**
 - ii. Flush hot water for **at least 9 sec (0.05 gal).**



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Figure 11. Detail flushing guidance of [section B]

11. Move to building section A – classrooms [203.32 minutes of flushing]

- a. Go to men's bathroom [C103B]. There are three sinks. Open all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - i. Flush the cold water for **at least 7 min and 48 sec (7.97 gal).**
 - ii. Flush the hot water for **at least 30 sec (0.5 gal).**
- b. Go to women's bathroom [C103G]. There are four sinks. Open all four faucets at the same time.
 - i. Flush the cold water for **at least 1 min and 42 sec (2.28 gal).**
 - ii. Flush the hot water for **at least 42 sec (0.91 gal).**
- c. Go to water bubblers near the bathroom. There are two water bubblers. Open both faucets at the same time.
 - i. Flush the cold water for **at least 11 min and 1 sec (7.49 gal).**
- d. Go to classroom [C104]. There are 10 cabinet sinks.
 - For sink 1,
 - i. Flush cold water for **at least 7 min and 36 sec (2.58 gal).**
 - ii. Flush hot water for **at least 50 sec (0.28 gal).**
 - For sink 2,
 - iii. Flush cold water for **at least 36 sec (0.202 gal).**
 - iv. Flush hot water for **at least 36 sec (0.202 gal).**
 - For sink 3,
 - vii. Flush cold water for **at least 1 min and 6 sec (0.38 gal).**
 - viii. Flush hot water for **at least 1 min and 6 sec (0.38 gal).**
 - For sink 4,
 - i. Flush cold water for **at least 27 sec (0.15 gal).**
 - ii. Flush hot water for **at least 27 sec (0.15 gal).**
 - For sink 5,
 - i. Flush cold water for **at least 14 sec (0.08 gal).**
 - ii. Flush hot water for **at least 14 sec (0.08 gal).**
 - For sink 6,
 - i. Flush cold water for **at least 36 sec (0.2 gal).**
 - ii. Flush hot water for **at least 36 sec (0.2 gal).**
 - For sink 7,
 - i. Flush cold water for **at least 36 sec (0.2 gal).**
 - ii. Flush hot water for **at least 36 sec (0.2 gal).**
 - For sink 8,
 - i. Flush cold water for **at least 36 sec (0.2 gal).**
 - ii. Flush hot water for **at least 36 sec (0.2 gal).**
 - For sink 9,
 - i. Flush cold water for **at least 36 sec (0.2 gal).**
 - ii. Flush hot water for **at least 36 sec (0.2 gal).**
 - For sink 10,
 - v. Flush cold water for **at least 6 min and 42 sec (2.28 gal).**
 - vi. Flush hot water for **at least 5 sec (0.02 gal).**
- e. Go to women's bathroom [C117W]. There is only one sink. Fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
 - i. Flush the cold water for **at least 30 min and 54 sec (10.5 gal).**
 - ii. Flush the hot water for **at least 6 sec (0.03 gal).**
- f. Go to men's bathroom [C117M]. There is only one sink.
 - i. Flush the cold water for **at least 50 sec (0.28 gal).**
 - ii. Flush the hot water for **at least 10 sec (0.057 gal).**

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- g. Go to classroom [C113]. There are 9 cabinet sinks.
- For sink 1,
- i. Flush cold water for at least 10 min and 36 sec (3.58 gal).
 - ii. Flush hot water for at least 30 sec (0.17 gal).
- For sink 2,
- v. Flush cold water for at least 46 sec (0.256 gal).
 - vi. Flush hot water for at least 46 sec (0.256 gal).
- For sink 3,
- ix. Flush cold water for at least 21 sec (0.114 gal).
 - x. Flush hot water for at least 21 sec (0.114 gal).
- For sink 4,
- i. Flush cold water for at least 21 sec (0.114 gal).
 - ii. Flush hot water for at least 21 sec (0.114 gal).
- For sink 5,
- i. Flush cold water for at least 17 min and 56 sec (6.1 gal).
 - ii. Flush hot water for at least 2 min (0.68 gal).
- For sink 6,
- i. Flush cold water for at least 32 sec (0.18 gal).
 - ii. Flush hot water for at least 32 sec (0.18 gal).
- For sink 7,
- i. Flush cold water for at least 32 sec (0.18 gal).
 - ii. Flush hot water for at least 32 sec (0.18 gal).
- For sink 8,
- i. Flush cold water for at least 1 min and 6 sec (0.38 gal).
 - ii. Flush hot water for at least 1 min and 6 sec (0.38 gal).
- For sink 9,
- i. Flush cold water for at least 23 sec (0.13 gal).
 - ii. Flush hot water for at least 23 sec (0.13 gal).
- h. Go to classroom [C121]. There are 9 cabinet sinks. All fixture water flowrate is assumed as 0.34 gpm for both cold and hot.
- For sink 1,
- i. Flush cold water for at least 1 hour and 24 sec (20.6 gal).
 - ii. Flush hot water for at least 45 sec (0.25 gal).
- For sink 2,
- vii. Flush cold water for at least 36 sec (0.20 gal).
 - viii. Flush hot water for at least 36 sec (0.20 gal).
- For sink 3,
- xi. Flush cold water for at least 1 min and 16 sec (0.43 gal).
 - xii. Flush hot water for at least 1 min and 16 sec (0.43 gal).
- For sink 4,
- i. Flush cold water for at least 27 sec (0.15 gal).
 - ii. Flush hot water for at least 27 sec (0.15 gal).
- For sink 5,
- i. Flush cold water for at least 15 sec (0.08 gal).
 - ii. Flush hot water for at least 15 sec (0.08 gal).
- For sink 6,
- i. Flush cold water for at least 36 sec (0.2 gal).
 - ii. Flush hot water for at least 36 sec (0.2 gal).
- For sink 7,
- i. Flush cold water for at least 36 sec (0.2 gal).
 - ii. Flush hot water for at least 36 sec (0.2 gal).
- For sink 8,
- i. Flush cold water for at least 36 sec (0.2 gal).

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- ii. Flush hot water for **at least 36 sec (0.2 gal)**.
- For sink 9,
- i. Flush cold water for **at least 36 sec (0.2 gal)**.
 - ii. Flush hot water for **at least 36 sec (0.2 gal)**.
- i. Go to women's bathroom [C124G]. There are 4 sinks. Flush all four faucets at the same time. Fixture water flowrate is assumed as 1.36 gpm for both cold and hot.
 - i. Flush the cold water for **at least 2 min and 18 sec (3.19 gal)**.
 - ii. Flush the hot water for **at least 6 sec (0.13 gal)**.
 - j. Go to a mop sink in room [C124C].
 - i. Flush the cold water for **at least 8 sec (0.05 gal)**.
 - ii. Flush the hot water for **at least 8 sec (0.05 gal)**.
 - k. Go to men's bathroom [C124B]. There are 3 sinks. Flush all three faucets at the same time. Fixture water flowrate is assumed as 1.02 gpm for both cold and hot.
 - i. Flush the cold water for **at least 18 sec (0.304 gal)**.
 - ii. Flush the hot water for **at least 18 sec (0.304 gal)**.
 - l. Go to water bubblers near the bathroom. There are two bubblers. Open both faucets at the same time. Fixture water flowrate is assumed as 0.68 gpm for both cold and hot.
 - i. Flush the cold water for **at least 13 min and 24 sec (9.11 gal)**.

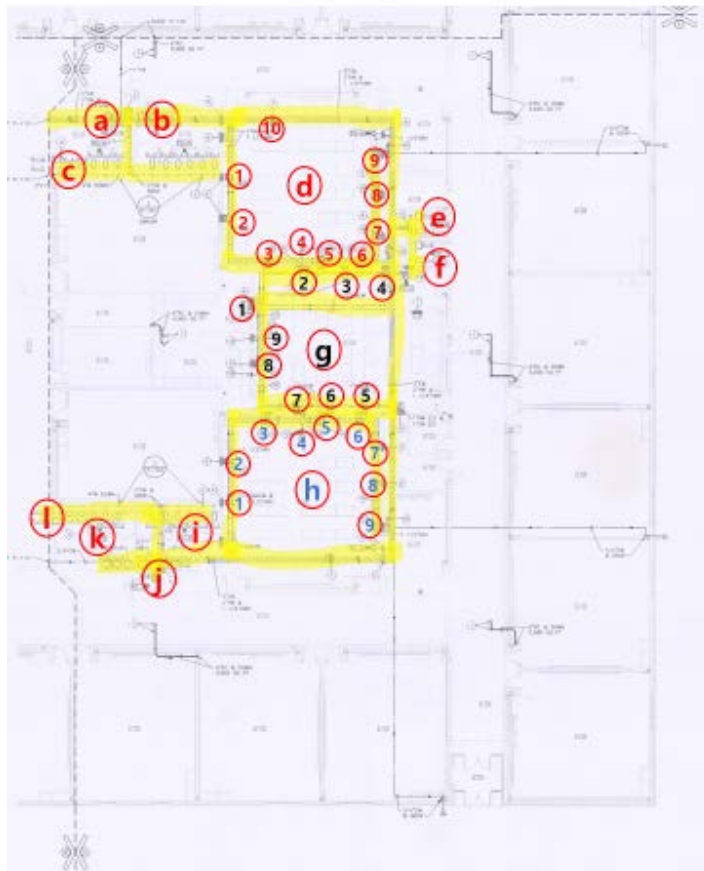


Figure 12. Detail flushing guidance of [section A]

12. Move to building section M – cafeteria, classrooms [3.2 minutes of flushing]

- a. Go to a cabinet sink in a room [A301B]. Only cold water line exist at this location.
 - i. Flush the cold water for **at least 3 min and 12 sec (1.08 gal)**.

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Figure 13. Detail flushing guidance of [section M]

Total estimated theoretical and idealistic flushing time

** Once flushing in the utility room [section K] is complete, three teams can likely work at the same time to flush three sections together: Team 1 [sections L, H, J], Team 2 [section E, F,G], and Team 3 [sections D, C, B, A, M].*

1. Building Section K (utility room)	10 hours and 50 minutes
2. Building Section L	1 hour 7 minutes and 27 seconds
3. Building Section H	1 hour 22 minutes and 38 seconds
4. Building Section J	1.5 minutes
5. Building Section E	3 hours 48 minutes and 58 seconds
6. Building Section F, G	2 hours 30 minutes and 14 seconds
7. Building Section D	3 hours 16 minutes and 57 seconds
8. Building Section C	2 hours 32 seconds
9. Building Section B	1 hour 12 minutes and 35 seconds
10. Building Section A	3 hours 23 minutes and 19 seconds
11. Building Section M	3 minutes and 12 seconds

28 hours 35 minutes and 35 seconds of OVERALL flushing time for the building
Total time can be reduced by having multiple teams flush multiple sections as described above.

This time does not include the time necessary to bring fresh water from the water meter to the building in coordination with the utility, empty, flush, and refill the hot water tanks, recirculation loops, softener tanks, and maintenance point-of-use filters installed throughout the school. This also does not include time needed for the final steps (see below).

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13. Final steps

- a. Flush all toilets once at the end of all faucets have been flushed.
- b. Make sure open all the spigots up at the end of the flushing.
- c. Run and waste several cups of water through the refrigerator water dispenser.
- d. Run dishwashers through a washing and rinsing cycle.
- e. Consider replacing and installing new filter cartridges on the water coolers, bubblers, refrigerator, and sinks.