




Wastewater Operator Certification: Collection Systems

02/08/2023

Presented by:



FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

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Collection Systems


Things to know for the Op Cert test

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Collection Topics

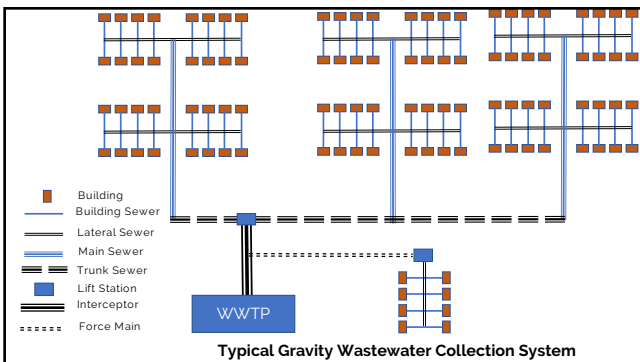
- 1) Cleaning and Maintenance
- 2) Lift Stations
- 3) Manholes
- 4) Maps
- 5) Piping and Joints
- 6) Service Connections

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Basic Design Elements

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Gravity Sewers in General

- **Slope follows the lay of the land** where possible
- Designed for **2 to 8 ft/sec flow**, 2.5 ft/sec is considered ideal
- Slope should maintain a **minimum velocity of 2 ft/sec** at average or peak flows (flow that prevents buildup in the pipe is called "scouring velocity")
- **Designed for** maximum expected flow (**peak flow**) when maximum population density has been developed
- What is the typical **per capita flow** in your jurisdiction? Volumes vary.
- **Max flow** is typically around **10am to Noon**
- **Peaking factors** are used to size the WWTPs – typically **2.5 to 3.5 times total daily flow**

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Sewer Slope

- Michigan Mobile Home & Seasonal Motor Home Park Sewer design:
 - 2 ft/sec at design flow
- Minimum slope to meet that requirement will vary by pipe diameter:

Sewer Size	Min Slope in feet/100 feet
4"	1.20
6"	0.60
8"	0.40
10"	0.28
12"	0.22
14"	0.17

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Sewer Flow

- Design requirements can vary by jurisdiction: Know yours
- In **New Mexico**, for example, **per capita flow** is typically **60 to 125 GPD**
- Michigan** mobile home park sewers require design for **minimum of 200 GPD per home site.**
- What are the design requirements in your jurisdiction?**

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Gravity Sewers

- Pipes should be sized for available cleaning equipment
- Sewer should flow half full during average daily flows (to maintain aerobic conditions and to have room for error)
- Sewers are typically 4 to 8 feet deep but may be a LOT deeper.
- Laterals, mains and trunks are typically in the center of streets
- They must be at least 2 ft vertically below and 4 ft horizontally from water distribution pipes to avoid contamination

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Some Pipe Selection Criteria

- Resistance to deterioration
- Ability to withstand surface loads
- Resistance to root intrusion
- Ability to minimize leakage
- Cost
- Service life span

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Pipe Materials



- AC – Asbestos Cement
- RC & C – Reinforced and Non-reinforced Concrete
- CI & DI – Cast Iron and Ductile Iron
- VC- Vitrified Clay
- FR – Fiberglass Reinforced Pipe
- ABS – Acrylonitrile Butadiene Styrene
- HDPE – High Density Polyethylene
- PVC – Polyvinylchloride

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AC – Asbestos Cement

- Rigid and resistant to deterioration by most wastewater
- Subject to crown rot (corrosion by hydrogen sulfide that combines with moisture to form sulfuric acid)
- Use restricted by OSHA because of asbestos content
- Joints are sleeve and rubber gasket couplings

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RC & C – Reinforced & Non-Reinforced Concrete

- Very rigid and can withstand high surface loads
- Subject to crown rot (might have coal tar epoxy or plastic lining)
- Joints - Rubber gasketed bell & spigots or mortar or bituminous filled bell and spigots



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CI & DI – Cast & Ductile Iron

- Very rigid – resists high surface loads
- Costly
- Should be used for bridge crossings and where lines are shallow
- Joints are typically rubber or caulk gasketed mechanical push on
- Joints might be leaded in old installations



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VC – Vitrified Clay


- Rigid & Subject to cracking from root intrusion
- Resistant to acid, caustics, solvents, gasses
- Joints – bells and spigots with factory PVC or PU compression joints or rubber couplings
- Older joints may be bell and spigots with mortar



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FR – Fiberglass Reinforced

- Semi-flexible and corrosion resistant
- May be subject to crown rot
- Joints – rubber gasketed bells and spigots
- Subject to failure from unanticipated surface loading



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ABS - Acrylonitrile Butadiene Styrene

- Flexible and resistant to most things found in wastewater, BUT
- Petroleum products can soften and erode it
- Joints are solvent weld or gasketed bell and spigot
- Requires careful installation & inspection – can deflect into an oval shape

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HDPE – High Density Polyethylene

- Flexible and durable
- Resistant to most things in wastewater
- Joints – Thermally welded butt joints
- Often used in small diameter low pressure sewers and for force mains

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PVC - Polyvinylchloride

- Flexible and resistant to most things in wastewater
- Joints are typically rubber gasketed bell and spigot joints
- Solvent cement welding used for pipe up to 8" in diameter
- Subject to damage from heavy loads

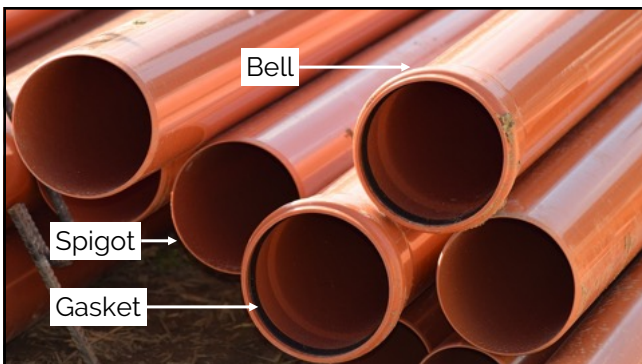


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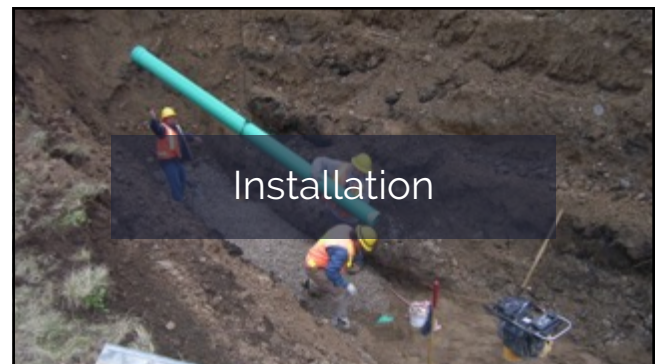
Pipe Joints

Joint #	Joint Description	Joint used with:								
		AC	CI/DI	RC	C	VC	FR	ABS	HDPE	PVC
1	Caulked Bell and Spigot		X							
2	Band Seal Coupling		X			X				X
3	Mortar or Bituminous Filled Bell and Spigot			X	X	X				
4	PVC/PU Preformed Gaskets					X				
5	Rubber Gasket Bell and Spigot		X	X		X	X			X
6	Rubber Gasketed Coupling	X								X
7	Solvent Cemented Coupling or Solvent Bell & Spigot							X		X
8	Butt Welded								X	

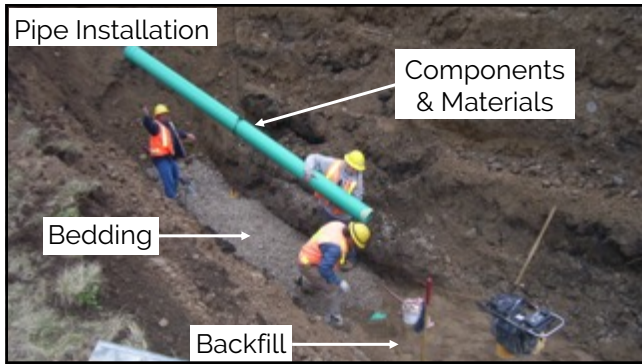
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Installation

- Typically, in excavated trenches
- Lots of safety rules around excavation – read up on safety regs
- Nearby utilities have to be located before excavation (One Call)
- 48-hour notice is typically required (check your state)
- You break it, you buy it. Digger and/or employer are liable for damages

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Installation

- Most excavation done with backhoes
- Trench-less technologies becoming more common
 - Pipe Liners
 - Pipe bursting
 - Boring
 - Micro-tunneling

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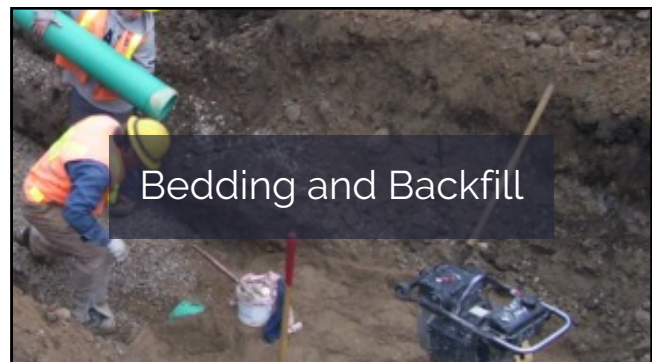
Installing Pipe

- Read the manufacturer's instructions
- Small diameter pipe (<10") can be moved by hand
- Larger pipe should be moved with machinery

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Bedding

- Pipe has to be bedded
- Compacted crushed rock aggregate is ideal
- Sand and pea gravel can be used if compacted
- If native material is used it has to be excavated to true grade with extra care

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Bedding

- Must be compacted on trench bottom and pipe sides
- Compacting directly affects load pipe can carry
- Small amounts of bedding must be removed to accommodate bells if bell and spigot joints are used.

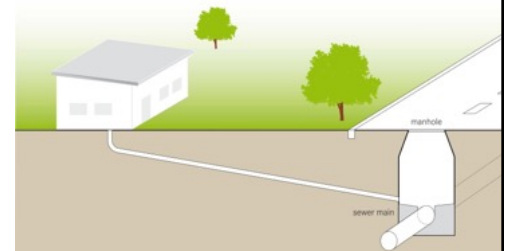
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Backfill

- Three Elements:
 - Pipe has to be protected from movement, breakage and crushing
 - Backfill should be compacted in layers until the trench is full
 - Then the ground surface gets restored.

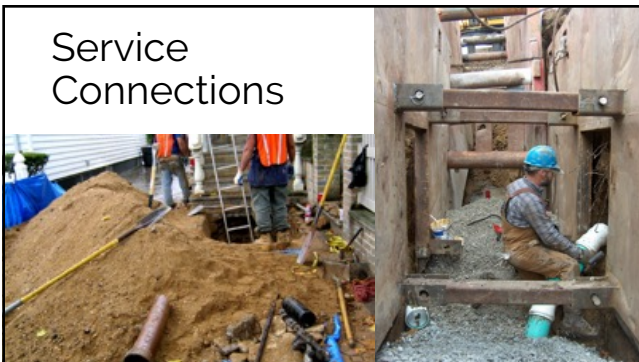
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Service Connections



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Service Connections



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Service Connections

- Aka "Taps"
 - Clamp on Saddle Ts
 - Insertion Wyes and Tees
 - Epoxy Bonded Saddle Tees
 - Synthetic Rubber Wedged inserts
- Must have a tight seal to prevent infiltration and root intrusion
- Building sewer MUST NOT protrude into main

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Manholes: What they are

- Installed in lateral, main trunk and interceptor sewers **for maintenance and cleaning access**

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Manholes: Where they are

- Can be placed where sewer **changes direction elevation (drops), pipe size and at junctions**
- Straight runs **usually no more than 300-500 feet apart** – limited by length of cleaning equipment

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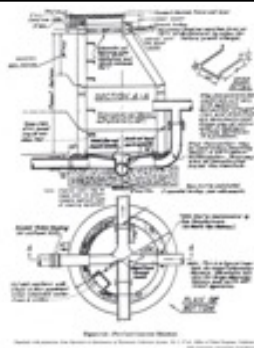
Manhole Construction:

- Can be **brick, pre-cast concrete** barrels or **fiberglass**
- **Most common** in NM: **Precast concrete** with poured in place base
- Might have **steps**, might have a **ladder**

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6 Pre-cast Concrete Manhole Parts:

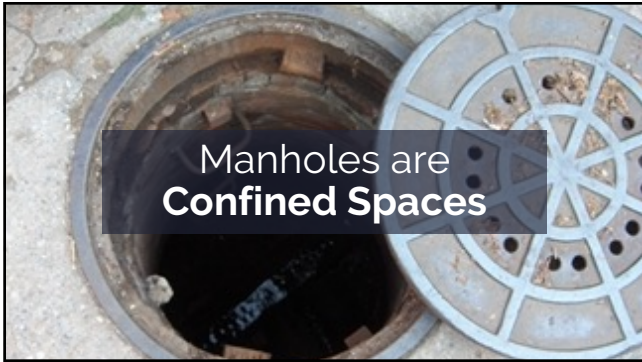
- Concrete poured in place with channels & sloped bench
- Inlet/Outlet piping sealed where it penetrates the barrel
- Precast concrete barrels fit together and sealed with mortar or bituminous material
- A concentric or eccentric cone section
- Level Adjustment Rings
- Standard tight-fitting, cast-iron ring and lid



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Manholes are Confined Spaces

- They have **limited openings** for entry and exit.
- Unfavorable natural ventilation. **Deadly gasses can accumulate** or oxygen can be displaced.
- Not designed for continuous worker occupancy.

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Manholes are Confined Spaces

- Entry is covered by OSHA Regulations
- OSHA regulations are covered under operator safety in NM Test guide



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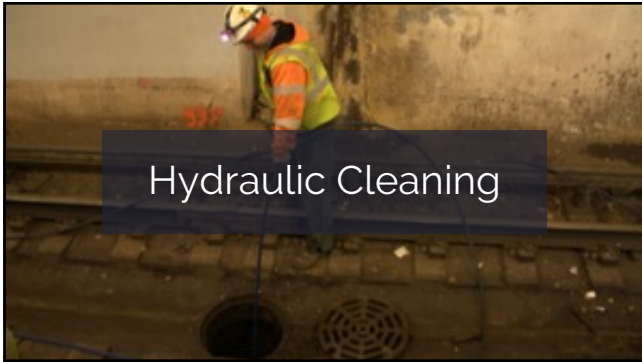


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Cleaning and Maintenance

- 1) Hydraulic Cleaning
- 2) Preventive Maintenance
- 3) Rodding
- 4) Stoppages

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Jet Rodders: High Velocity Hydraulic Cleaning Machines

- Can be truck or trailer mounted
- Typically have a
 - water supply tank
 - high pressure pump
 - an auxiliary engine for driving it
- Trucks can usually hold about 500 ft of 1-inch ID hose
- Often have different job specific attachments for the end
- Good at scouring grit, debris and grease,
- Not so good with roots though they may have root cutting attachments
- Rod from immediately downstream, rodding upstream toward the blockage

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Rodding

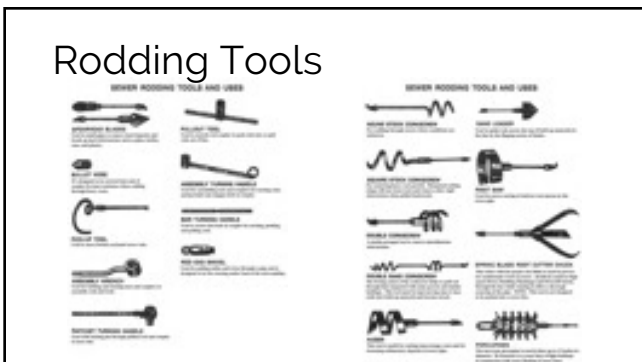
- **Hand Rodders**
 - Oldest style cleaning equipment
 - Usually, spring steel coil or detachable rods
 - Hard to use on some blockage because it's manual
 - Typically limited to 100 ft length
 - Can be used where sewer access is limited

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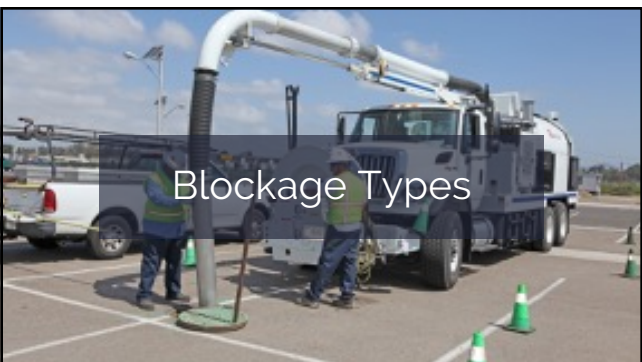
Rodding

- **Power Rodders**
 - Rotating steel rods or flexible cable
 - Stored on reel cage
 - May be powered by motor, small engine or power take off
 - Typically truck mounted
 - Flush or clean hydraulically after rodding to restore flow

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Cleaning & Maintenance

- **Three Categories:**
 - Preventive Maintenance
 - Emergency Clearing
 - Emergency Repairs

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Preventive Maintenance

- Cleaning to **avoid** blockages
 - Line cleaning
 - Chemical treatments for roots
 - Sediment removal
- Done regularly, it **minimizes problems** like backups, odors and lift station callouts

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Emergency Clearing & Repairs

- Getting the system **back into operation**
- As **soon** as possible
- Step one is **finding the best method** to fix the problem
- **Always keep records** of maintenance and repairs

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Emergency Clearing & Repairs

- **Factors to consider**
 - Prior history
 - Nearby trees
 - New connections
 - Other utility repairs
 - Surface indications like sinkholes, settlement or indentation

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Emergency Clearing & Repairs

- **Always keep records** of repairs and maintenance
- **Record everything important** including:
 - **Where & When** it occurred
 - **Cause** of blockage
 - **Line size**
 - **Manhole ID**
 - Amount and type of **material removed**

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Cleaning takes place
from downstream of
the blockage

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Don't let blockage
debris move further
down stream

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Large blockages
may require the
WWTP notification

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Lift Stations

- 1) Components
- 2) Preventive Maintenance
- 3) Operation
- 4) Typical Layout

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Lift Stations – Purpose

- Raising wastewater from lower to higher elevation
- Use pumps to move water into force mains
- After the force main gravity takes over

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Lift Stations – Reasons for

- Cost of excavation to maintain slope for scouring velocity
- Soil instability
- High ground water tables
- Might be an economical solution for current flow levels

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Lift Stations – Design Goals

- Goal is moving wastewater with maximum efficiency
- Pumps have to be selected to minimize surges and provide as constant a flow as possible to minimize surges
- Should blend in, with surrounding area and odor, noise and rubbish should be dealt with immediately

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Lift Station Types

- **Dry Well** - Two chambers
 - one to collect wastewater, and
 - another for pumps, motors, valves, controls and other equipment
- **Wet Well** – Single chamber
 - Pumps might be above wastewater
- Benefits and drawbacks to each design

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Lift Station Components

- Pumps
- Wet Well
- Hardware
- Bar Racks
- Dry Well
- Valves
- Electrical Systems
- Alarms
- Motor Control Center
- Hours Recorder
- Pump Controls
- Force Mains

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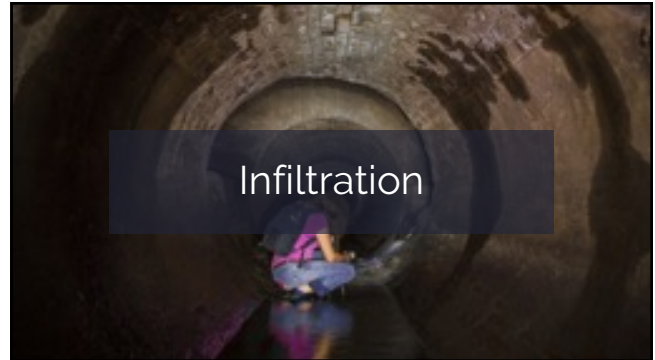
Maps

- 1) Two sets of construction project plans
 - Working plan that guides construction
 - As-built plans that reflect deviations from the working plan
- 2) As-builts become the true record of where everything is actually located and should be made into revised final drawings
- 3) As-builts are your friends. Not having them leads to headaches

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I & I – What it is

- **Inflow** – Water entering through manholes and illegal connections
- **Infiltration** – Groundwater entering sewer through breaks or joints or broken manhole barrels
- Can cause **hydraulic overload** at the WWTP and **should be limited whenever possible**

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I & I - Identification

- **Identification** can be **complex** and **costly**
- Methods used include:
 - **Late Night Surveys** (checking manholes for clear water flow 2-4 am)
 - **CCTV inspection** (prior line cleaning important)
 - **Smoke Testing** – through manhole covers
 - **Flow Record Analysis**

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I & I – Controlling it

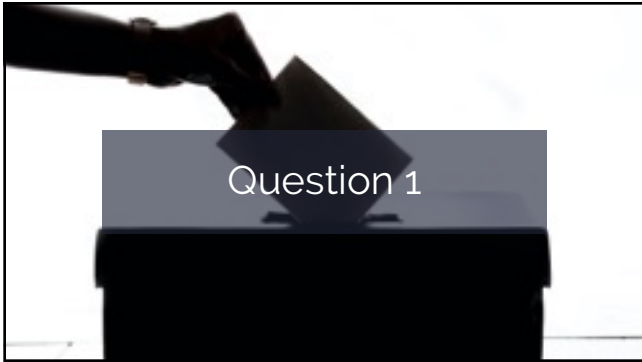
- **Many methods**
 - Pipe replacement
 - Slip lining
 - Pipe bursting
 - Chemical grouting
 - Storm sewer improvement
- **Often requires outside contractors**
- Collection crews can often deal with manholes by fixing deterioration, raising rings, repairing joints, etc.

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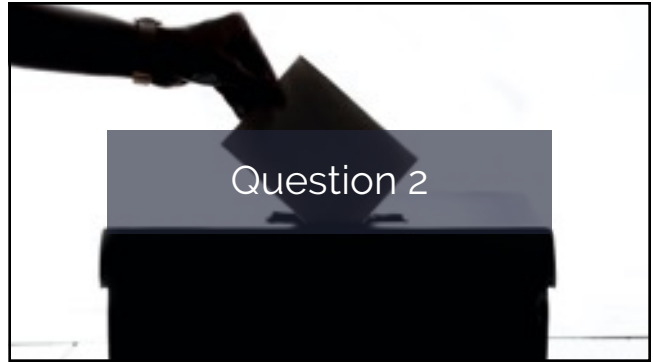
Sample Questions

Let's try a few...

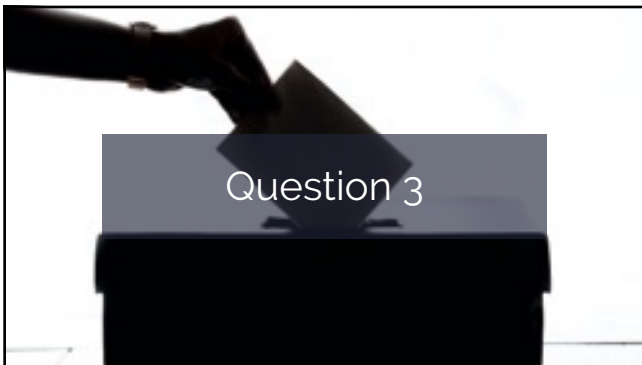
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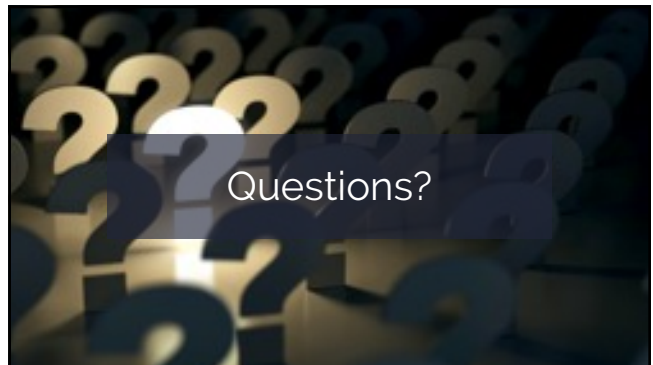
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