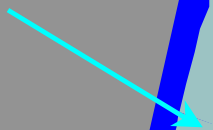


Cast Iron Replacement / Lining Methods

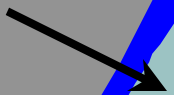
conEdison Service Territory

*Westchester
County*

Gas & Electric



Manhattan



Bronx

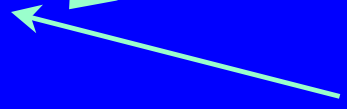
Queens

Long Island

*Staten
Island*

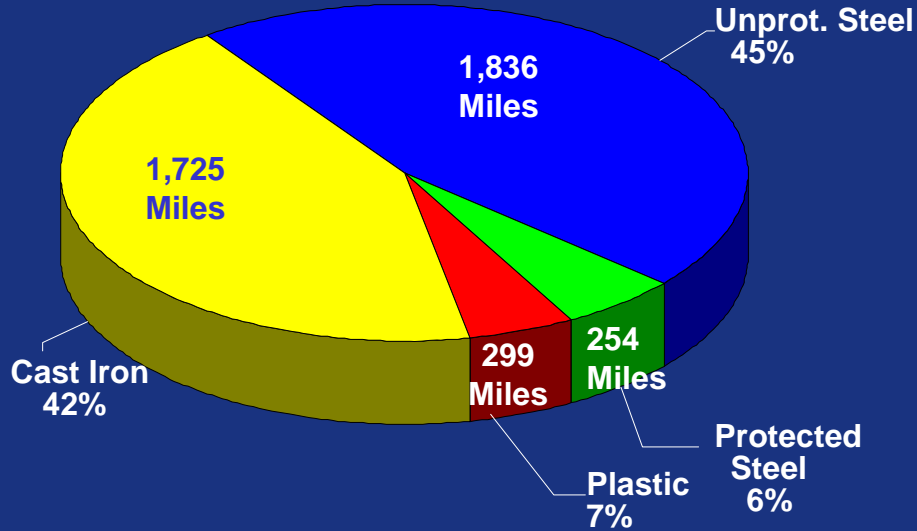
Brooklyn

Electric Only

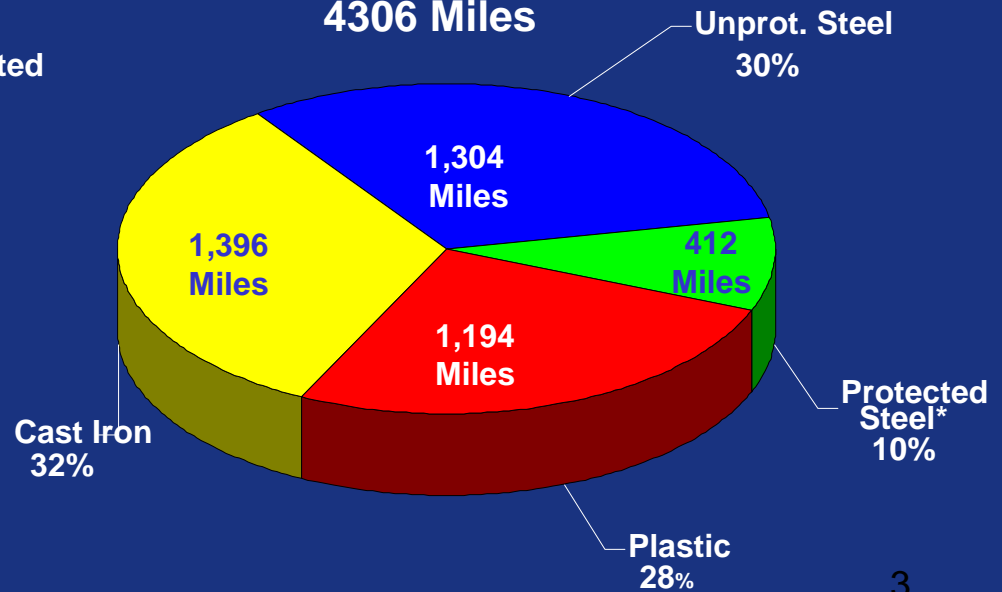


Gas System – Mains by Material

1987
4,114 Miles



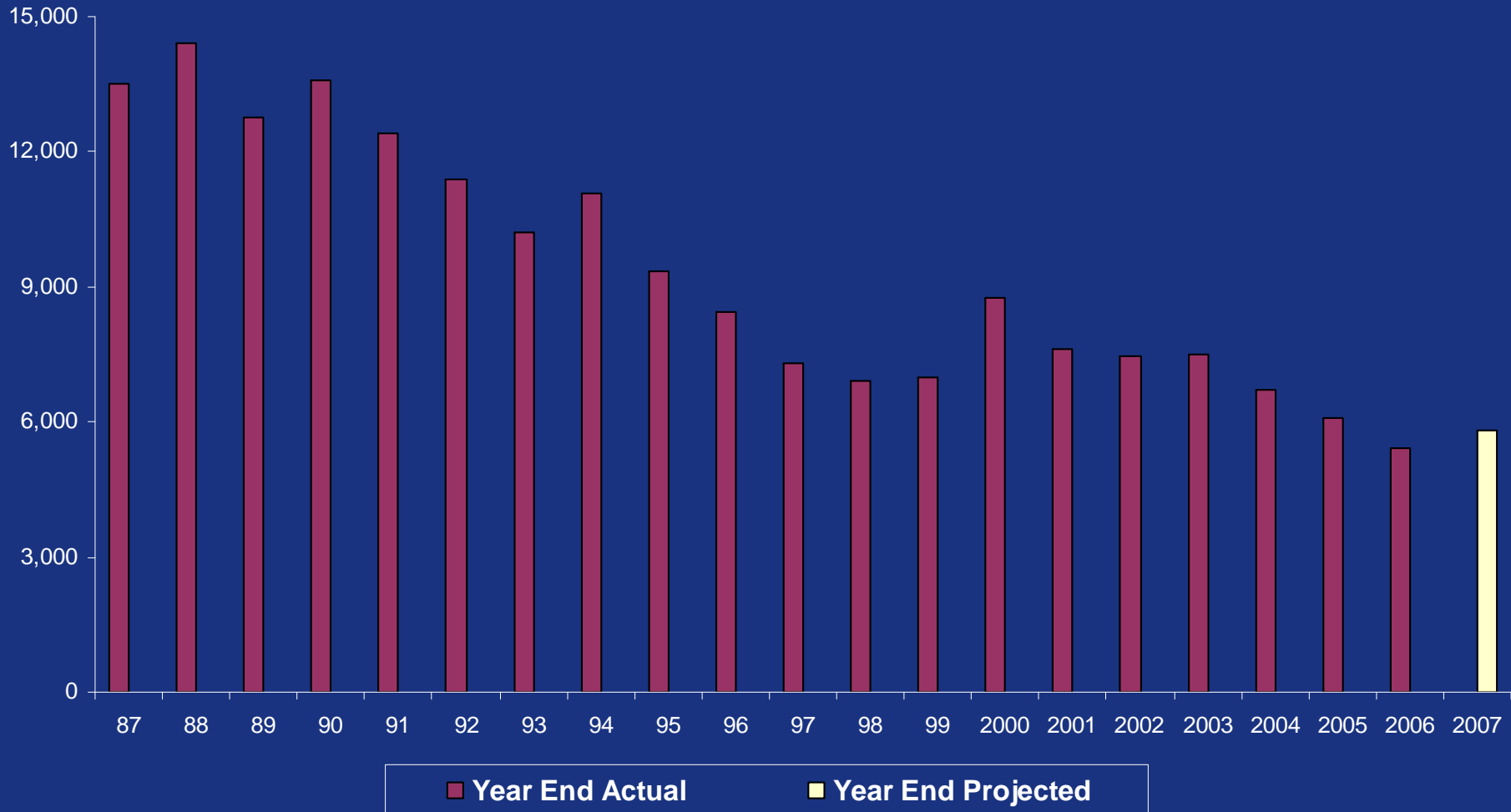
2006
4306 Miles



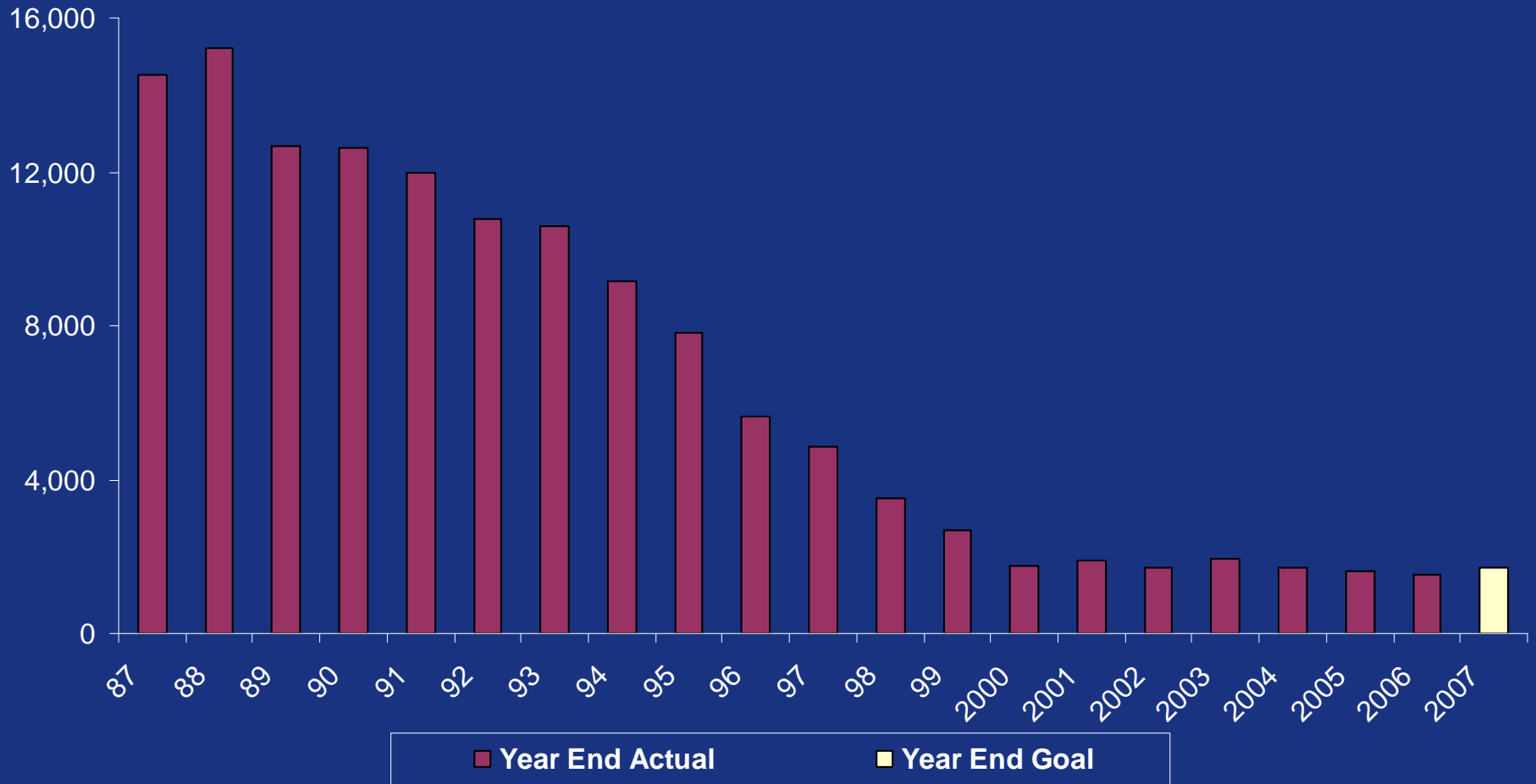
Estimated Emissions Reduction

- **Emissions reduction of over 135 MMscf per year**
- **Savings of almost \$1,000,000 per year**
- **Avoided maintenance costs**

Incoming Leaks



Leak Backlog

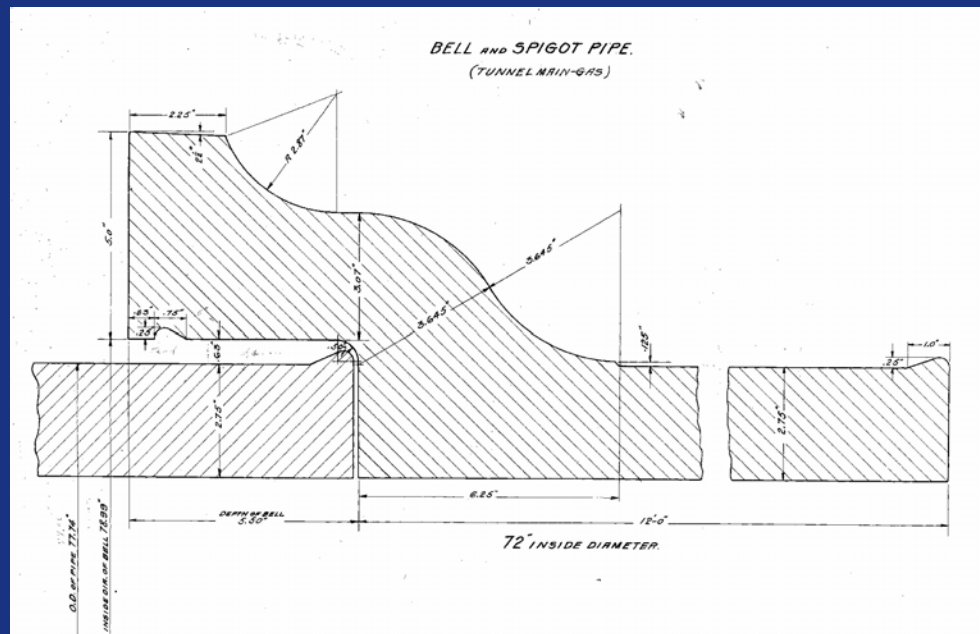
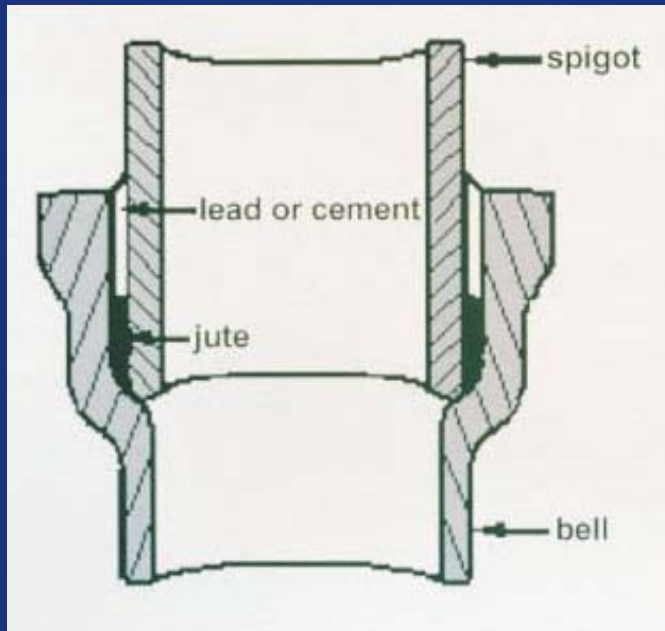


Emission Reduction Methods

- **Repair**
- **System Pressure Optimization**
- **Pipe Replacement / Rehabilitation**

Cast Iron Mains (32%)

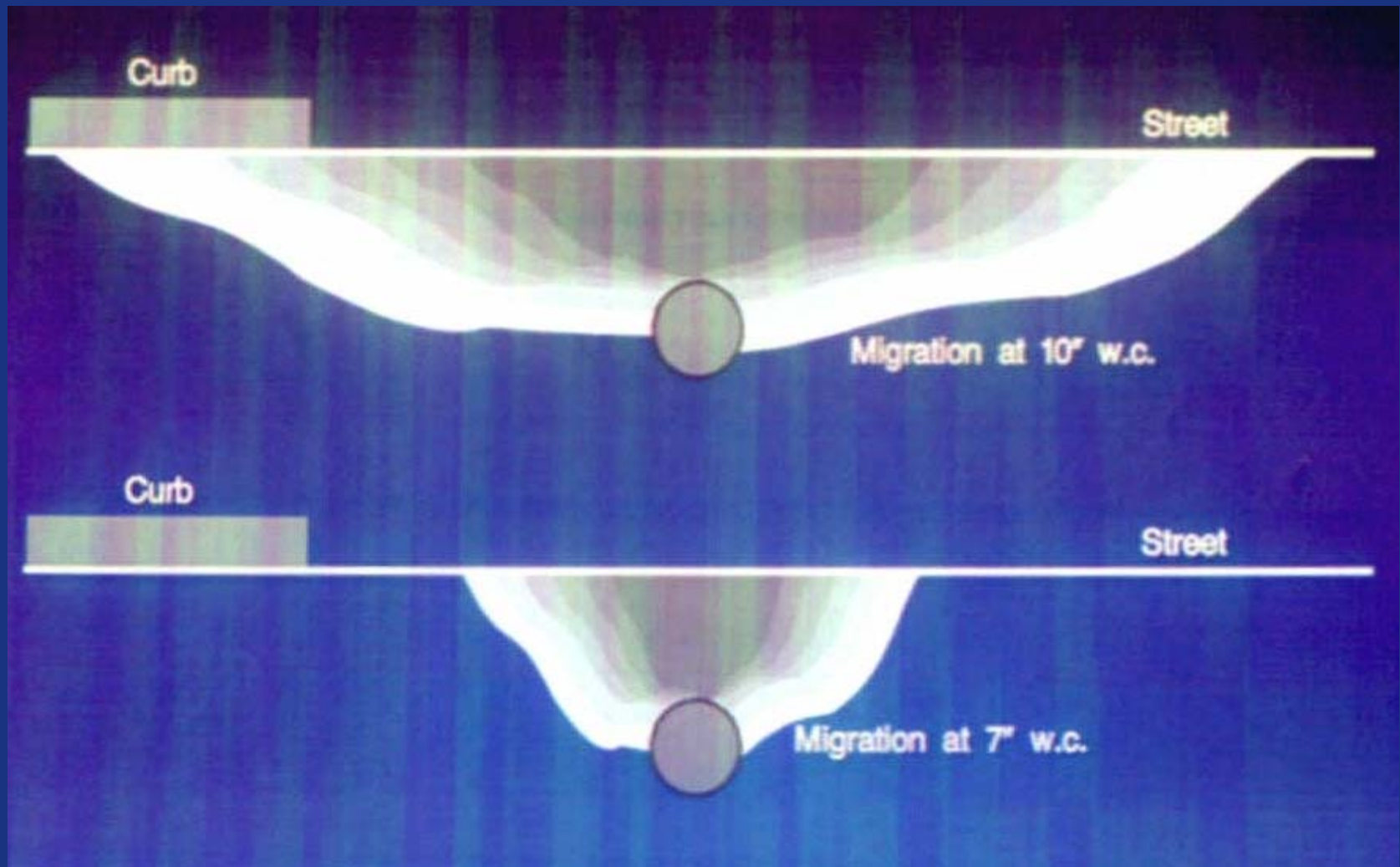
- Manufactured in 12 foot sections
- Joined using bell and spigot joints, subject to leaking
- Highly resistant to corrosion
- Extremely brittle, subject to cracking



Pressure Optimization

- **Leaks on Cast Iron Pipe**
 - 1396 miles x 5280 ft/mile = 7,370,880 ft
 - 1 joint every 12 ft = 614,240 joints on system
- **Leakage on CI joints can be reduced by 50% if pressure is lowered from 11" wc to 6" wc.**

Leak Migration vs. Pressure



Eliminating Leaks on Cast Iron

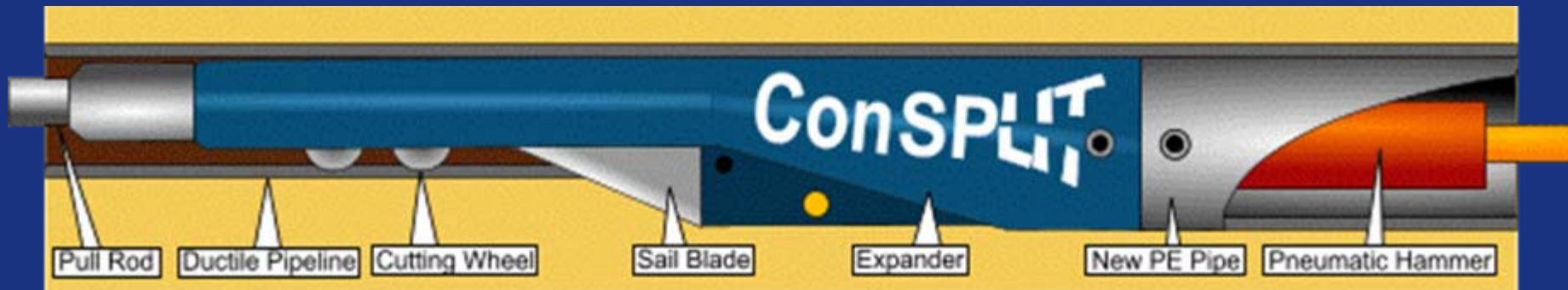
- **Replacement**
- **Joint Repair**
- **Internal Lining**

Replacement Methods

- **Direct Bury**
 - **Costly**
 - **Upsize main in areas where increased pressure / flow required**
- **Insert**
 - **Reduced capacity**
- **Con Split**

Con Split

- Minimize Excavation
- Upsize or same size installation
- Used in Cast Iron without sleeve
- Need to be away from other utilities
- Service lateral density will increase cost



Joint Repair

- **Keyhole**

- **Small Excavation**
- **Not for High Temps**



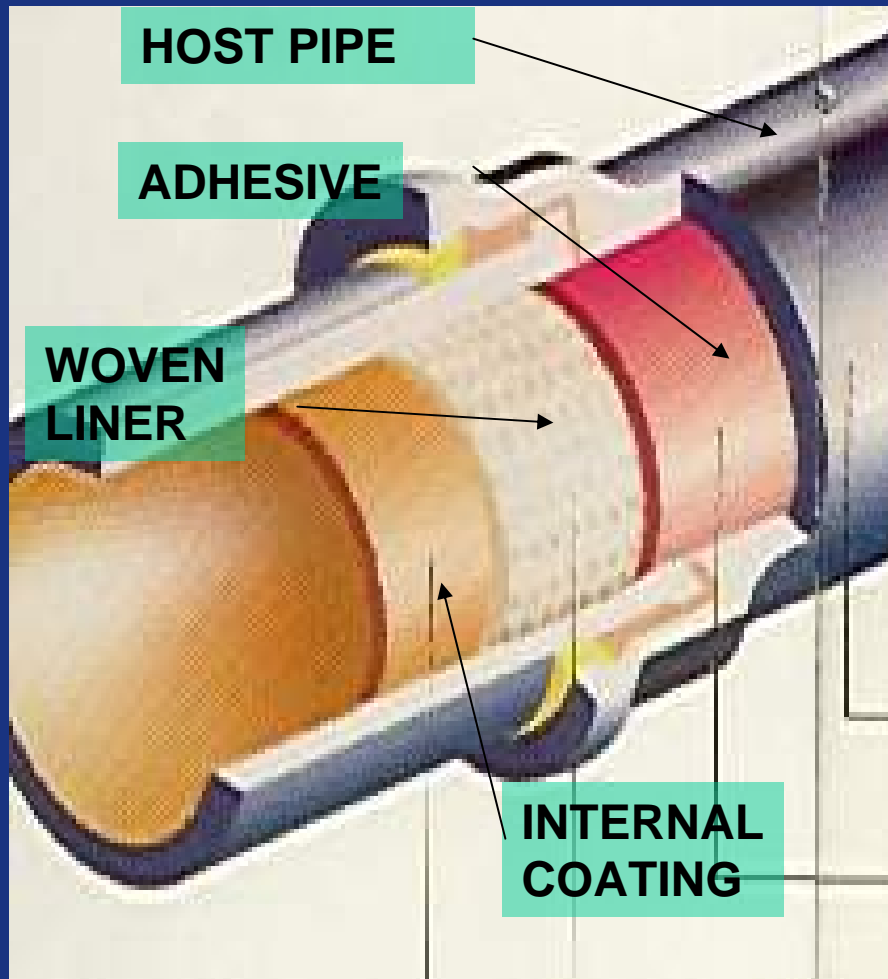
- **CISBOT**

- **Internal / Live**
- **Seal 25 Joints from one Excavation**
- **6" – 12"**

Internal Lining

- **Cured in Place Liners**
 - **Starline**
- **Tight Fit Polyethylene**
 - **Rolldown**
 - **Size for Size Insertion**
 - **Reduction of Capacity**
 - **Subline**
 - **Size for Size**
 - **Minimal Reduction of Capacity**

Starline – Cured in Place Liner



Components of Liner

- Polyester woven liner
- Polyurethane coating

Starline Process

1. Surface preparation / Pipe cleaning

- Grit-blasting method
- Required to obtain the proper bonding strength
- Abrasive is propelled through the blast hose at 100 psi
- Recovery of the grit is obtained by a high capacity vacuum system



Starline Process

2. Adhesive Mixing

2-part Polyurethane adhesive mix

- Adhesive
- Hardener



3. Liner wet-out / Adhesive application

- Pour adhesive into liner
- Pull liner through calibrated rollers



Starline Process

4. Liner Inversion



Wound on reel of pressure drum



Bolted onto inversion cone



Attached to host pipe

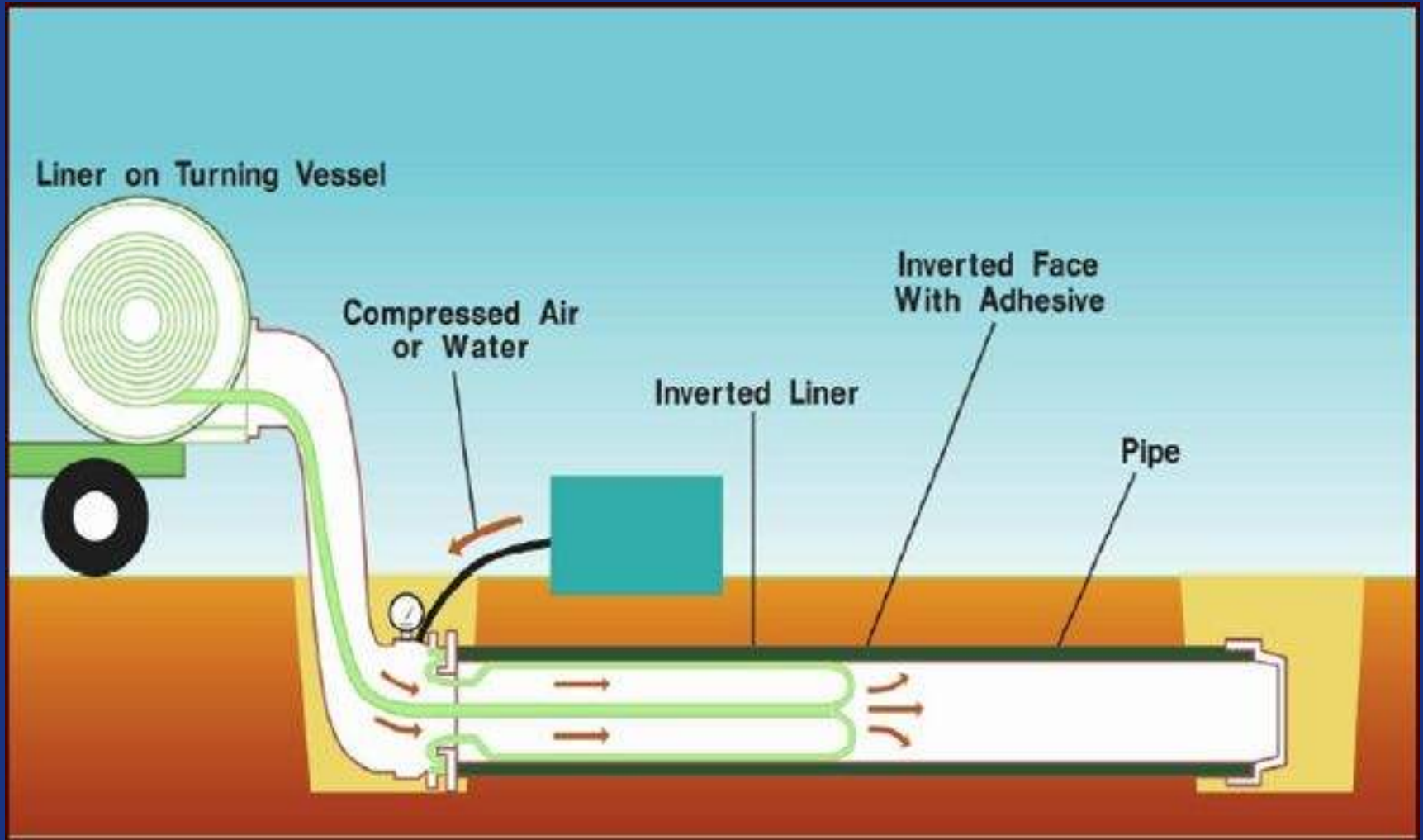


Liner forced to invert inside host pipe



Liner ends at catch basket

Starline – Cured in Place Liner



Starline Process

5. Steam curing & pressure monitoring



Steam Boiler



Air Compressor



Mixing Chamber



**Temperature
and Pressure
Control**



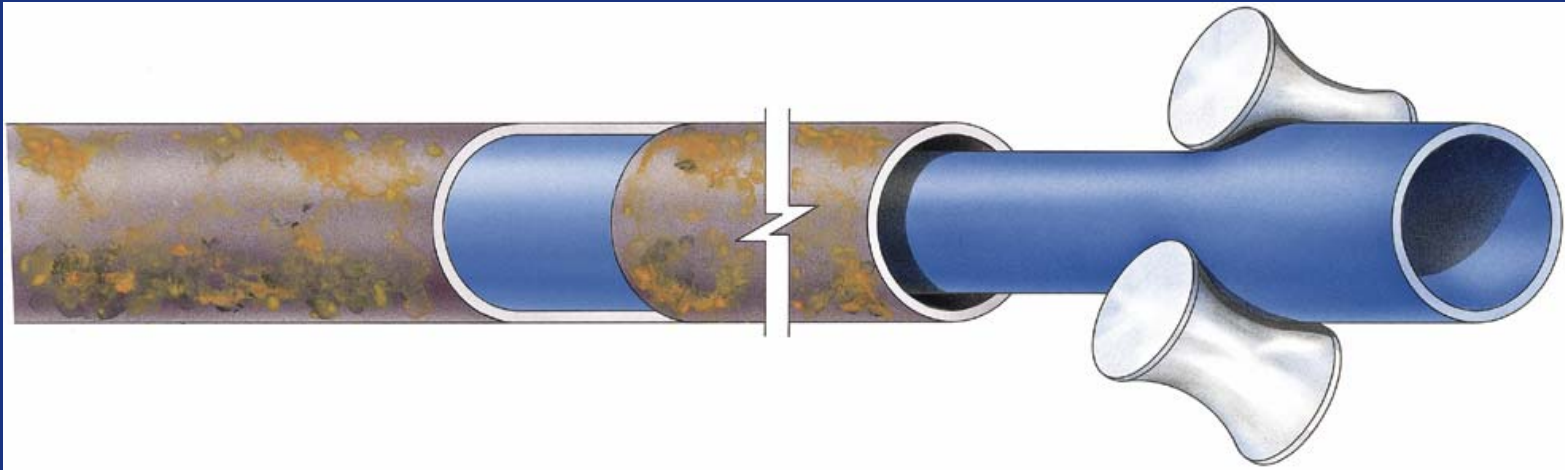
Liner

Starline Process

6. Post-lining inspection
7. Service reinstatement (if necessary)
8. Final pipe construction and restoration

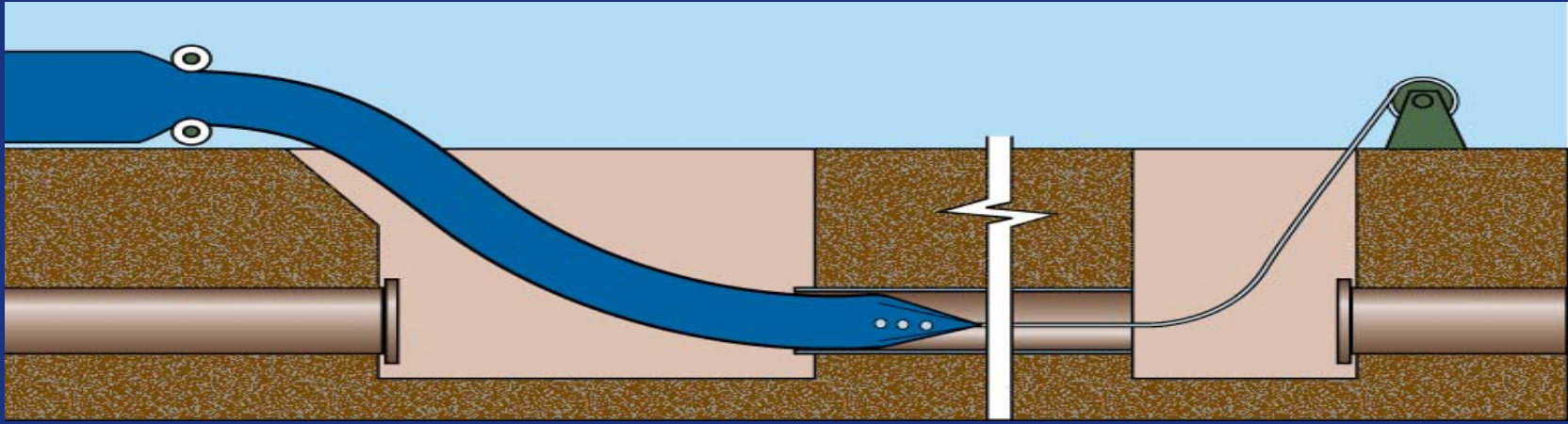


Rolldown



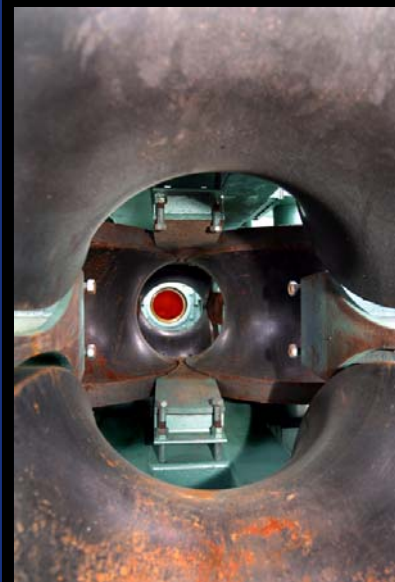
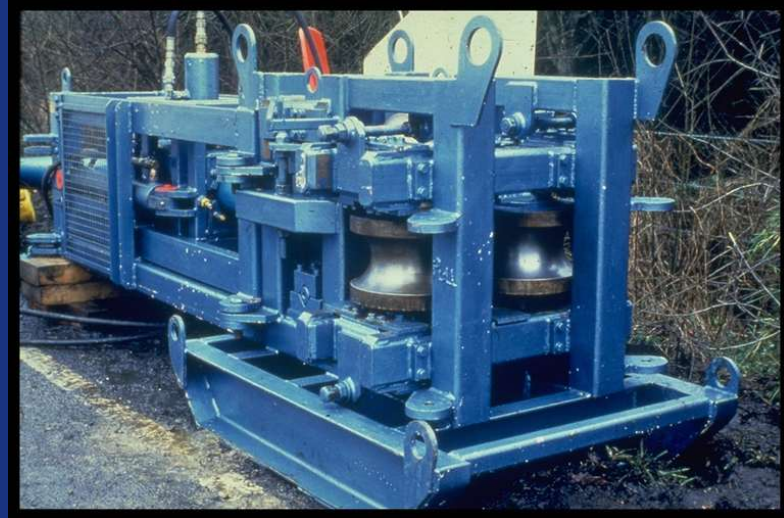
- Developed by Subterra UK.
- Concentric reduction and installation of close-fit PE pipe liners
- Uses standard PE-80/PE-100 pipe Uses thick-walled PE pipe
- Diameter reduction is typically 10%
- Reverted to a close fit by cold water pressurisation

Rolldown - Process

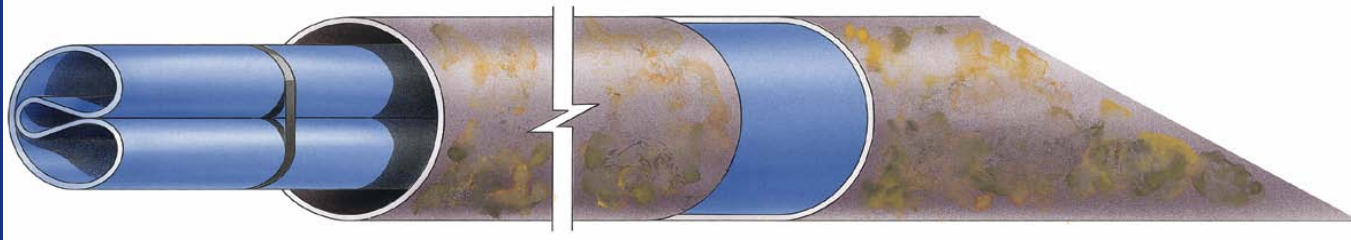


- Diameter range 4" - 20" SDR 11 - 33
- Bends up to $11\frac{1}{4}^\circ$ can be negotiated
- Typical lining lengths 1000 feet
- Long insertion trench required
- Excavations required to reconnect service connections/laterals etc

Rolldown - *Process*

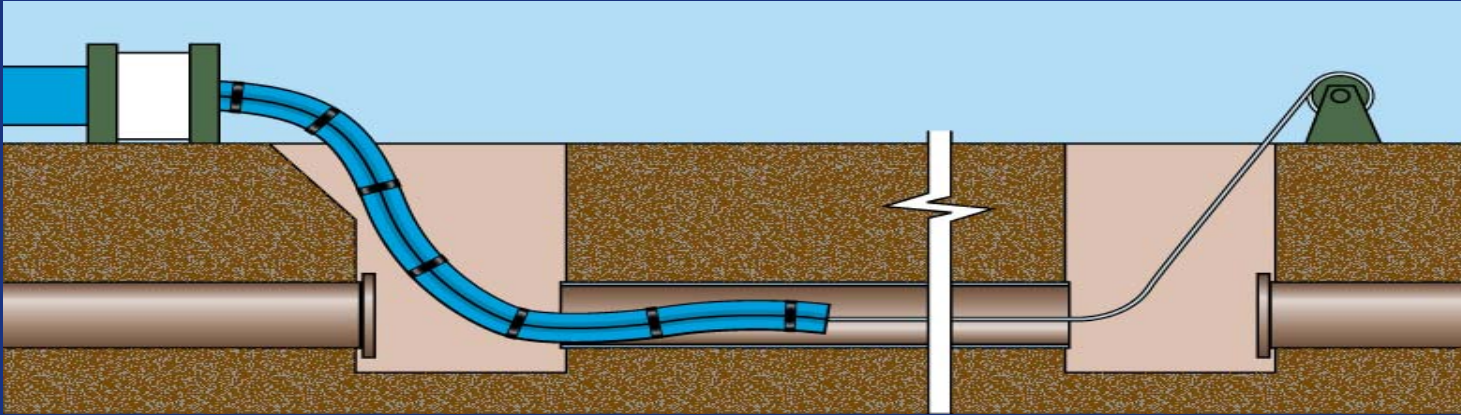


Subline



- **Subline is a process for the cold folding and installation of close-fit, thin-wall PE pipe liners**
- **Uses standard PE-80/PE-100 pipe**
- **Subline was developed to allow lining of large diameter pipes & improve ability to negotiate bends**
- **Liner insertion process is simple slip lining**
- **Reverted to a close fit by cold water pressurisation**

Subline



- Available for PE diameters 3" – 59"
- SDR 26 - 80, depending on diameter
- Folded shape helps insertion, bends up to $22\frac{1}{2}^{\circ}$ can be negotiated
- Lengths up to 1000 ft
- Long lead-in trenches for welded PE strings
- Local excavations to reconnect service connections/laterals etc

Subline - *Process*

