Trenchless Technology

A 26 YEAR JOURNEY IN THE UTILITY BUSINESS

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PSEG
We make things work for you.

Today's Agenda

- Brief personal history with trenchless
- A quick review of methods
- HDD Designs for Utilities
- Engineering & Construction Considerations
- Changes and Challenges
- What are our most current issues?

Definition of Trenchless Technologies

"A family of methods, materials, and equipment capable of being used for the installation of new or replacement or rehabilitation of existing underground infrastructure with minimal disruption to surface traffic, business, and other activities."

- North American Society for Trenchless Technology

Why Trenchless? Why not?

Let's start off with a little history

- Trenchless technology had been around for many decades
- Auger or Jack and Bore in use for 40-50 years
- HDD started in the 60's with Martin Cherrington
- Impact moles were popular for street crossings and to go under rock gardens
- HDD started to gain popularity in late 80's
- Utilities started using HDD in the 90's
- Brooklyn Union/KeySpan's efforts in early 90's
- NASTT formed in 1990
- Presented paper at 1991 No-Dig in D.C

Trenchless in the 1990's

- Cultural transformation
- Learning new ways
- Sharing the risks
- Using the right tool from the tool box

The trenchless construction toolbox methods are numerous

- Pipe Ramming
- Microtunnelling
- Pilot Tube Microtunnelling
- Pipe Bursting
- Pipe Splitting
- Boring Tools (Impact Moles)
- Auger Boring/Jack and Bore
- Horizontal Directional Drilling or HDD
- Direct Pipe Method

The benefits of trenchless technology are many

- Safer for the public
- Minimal traffic impacts
- Minimal road repairs
- Deeper has little cost impact
- Can avoid many construction issues
  - Soil and debris disposal
  - Water pumping and disposal
  - Sheeting open cut trench

Types of Infrastructure

- Gas Pipelines
- Water Mains
- Sanitary and Storm Sewers
- Power lines and electric cables
- Communication cables
- Environmental wells

Horizontal Directional Drilling (HDD)

Horizontal Directional Drilling

- Installation of pipes, conduits or cables in a shallow arc using a surface-launched drilling rig
- Steerable
- Depth to avoid obstructions

Of course, it is not as easy as it looks and sounds

Proper Planning Prevents Poor Performance

- Key to review job requirements
- Walk job and see the job layout up close
- What are the constraints?
- What is the length of project?
- What construction areas do you need and what is available?
- What is the required and available pipe materials and diameters?

Carefully review the obstacles to be circumvented

- Environmentally Sensitive Areas
- Highways
- Rivers
- Railroads
- Permitting requirements

Review agency requirements and permitting applications

- Follow appropriate highway rules and regulations
- In drilling under railroads, need to follow requirements such as Conrail CE-8
- Drilling or Jacking and Boring should be continuous
- Use BMP Design requirements for HDD

Construction considerations of HDD

- Drilling can be continuous; pullback should always be continuous
- Rigs can vary in 1,000's of lbs. of pullback capacity
- Need Laydown Area for Pullback Pipe
- Depending on the size of rig, it can require up to 1 Acre of Drill Rig Lay down Area
- Mud design is a critical item
- Drilling fluids must be managed
- Good to have a Hydro fracture or IFR Plan
- Be prepared for a pipe getting stuck

Engineering Design Considerations

- Survey the site or use GIS
- Do a preliminary piping layout
- Conduct Geotechnical investigation and obtain a Geotech report
- Include soils analysis and lab tests on rock
- Pre Final Design
- Determine Pipe Stresses
- Final layout and design

Pipeline analysis tools are available to assist

- Early software included Drillpath by GRI/Maurer
- Sold to Petris in 2008; ceased selling Drillpath
- Pipeline Toolbox and Technical Toolbox HDD
- BoreAide or Vermeer Atlas Bore Planner Software

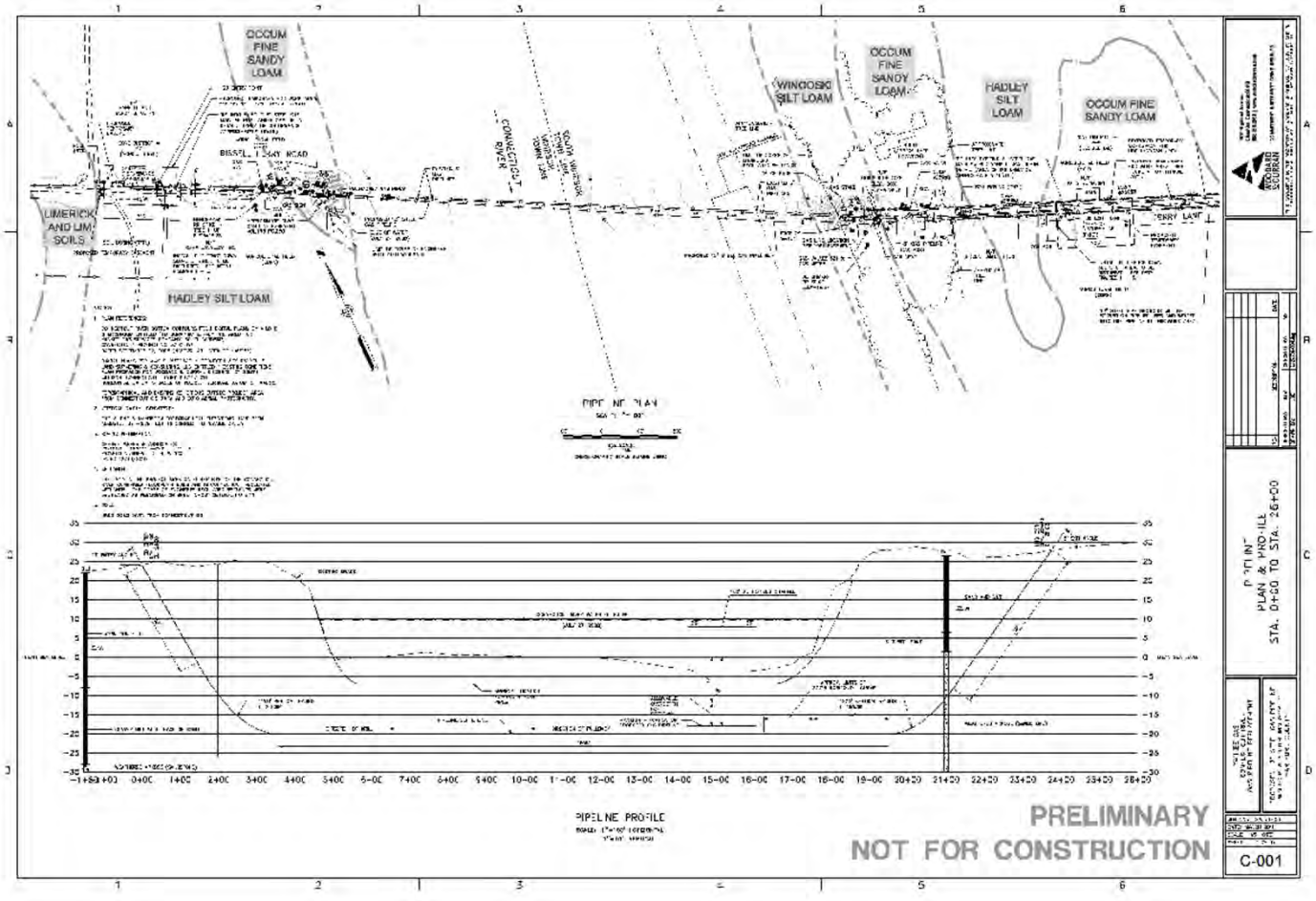
The design using HDD Toolbox includes:

- Installation of Pipelines by Horizontal Directional Drilling, A.G.A./PRCI Report PR-227-9424
- Input the key components of design curve:
  - Entry and exit angles
  - Entry and exit tangents and curves
  - Required center section length
  - Pipe diameter and strength
  - Water or Non-Water Filled
- Output Report details:
  - Pull back forces.
  - Tensile, bending and hoop stress levels at critical points on pipeline during pullback.

General engineering design considerations and requirements can include:

- Drill entry angles of 8 to 16 degrees; exit angles of 5-10 degrees
- Maintain minimum radii for steel and plastic pipe
  - 100 feet to 1 inch for steel
  - Much tighter for plastic such as HDPE
  - Other materials such as PVC and Ductile Iron have their own requirements
  - Steel rod can be constraint
- Bore hole deformation is a concern; mud design is a critical item
- Water can control buoyancy and counteract hydraulic forces while minimizing pull forces.

A good engineering drawing will look like this:



Over the years, I have provided HDD and Jack & Bores to numerous gas and electric utilities

- 2000 foot HDD of 12 Inch Steel under a waterway in Cape May, NJ
- 1100 foot HDD of 12 Inch Steel under a canal in Sea Crest, NJ
- 1000 foot HDD of 12 Inch Steel under a major parkway in NJ.
- 1200 foot HDD of 8 inch steel under the Delaware River
- 1500 foot HDD of 12 Inch Steel under the NYS Thruway
- 2200 and 1550 foot HDD's of 24 Inch Steel under river and rail yard in GA.
- 400 foot Jack & Bore of 24 Inch Steel under a rail yard in NJ

Jobsite Safety Considerations

- Lay out a drilling plan and consider contingencies.
- Follow Call Before You Dig (811) Requirements.
- Test hole or use Ground Penetrating Radar (GPR) to locate all utilities.
- Insure safety practices for crews and public.
- Be mindful of drilling through utilities; cross bores should always be a concern.

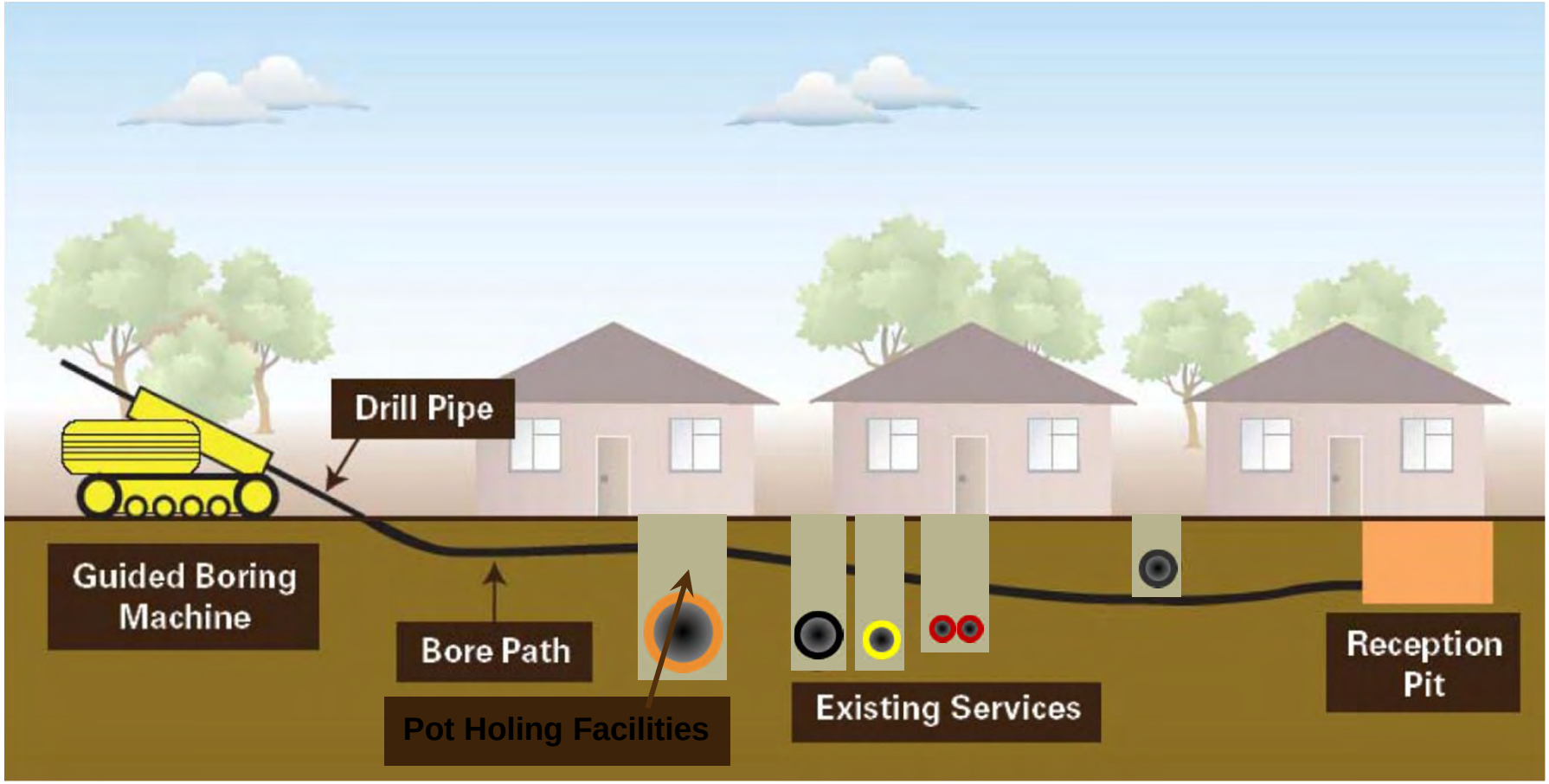
Trenchless Technology

Dig Test Holes and verify facility locations when using trenchless technology

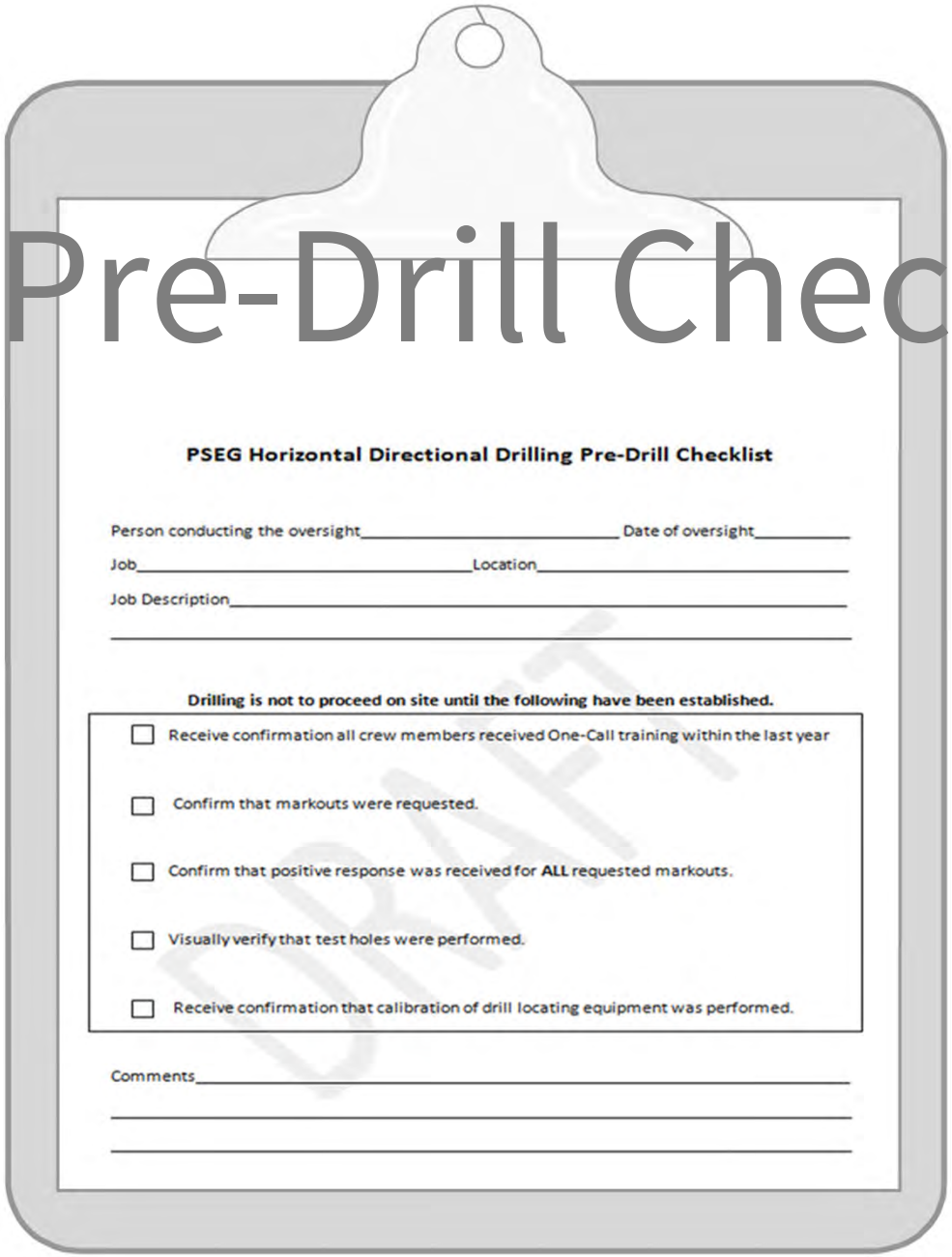
Utilities which are being crossed should be exposed during drilling and pullback operations

When drilling parallel to a facility, test holes should be made every 25 feet or so to verify location

Trenchless Technology



HDD Pre-Drill Checklist



PSEG Horizontal Directional Drilling Pre-Drill Checklist

Person conducting the oversight_____ Date of oversight_____

Job_____Location_____

Job Description_____

_____

Drilling is not to proceed on site until the following have been established.

- ☐ Receive confirmation all crew members received One-Call training within the last year
- ☐ Confirm that markouts were requested.
- ☐ Confirm that positive response was received for **ALL** requested markouts.
- ☐ Visually verify that test holes were performed.
- ☐ Receive confirmation that calibration of drill locating equipment was performed.

Comments_____

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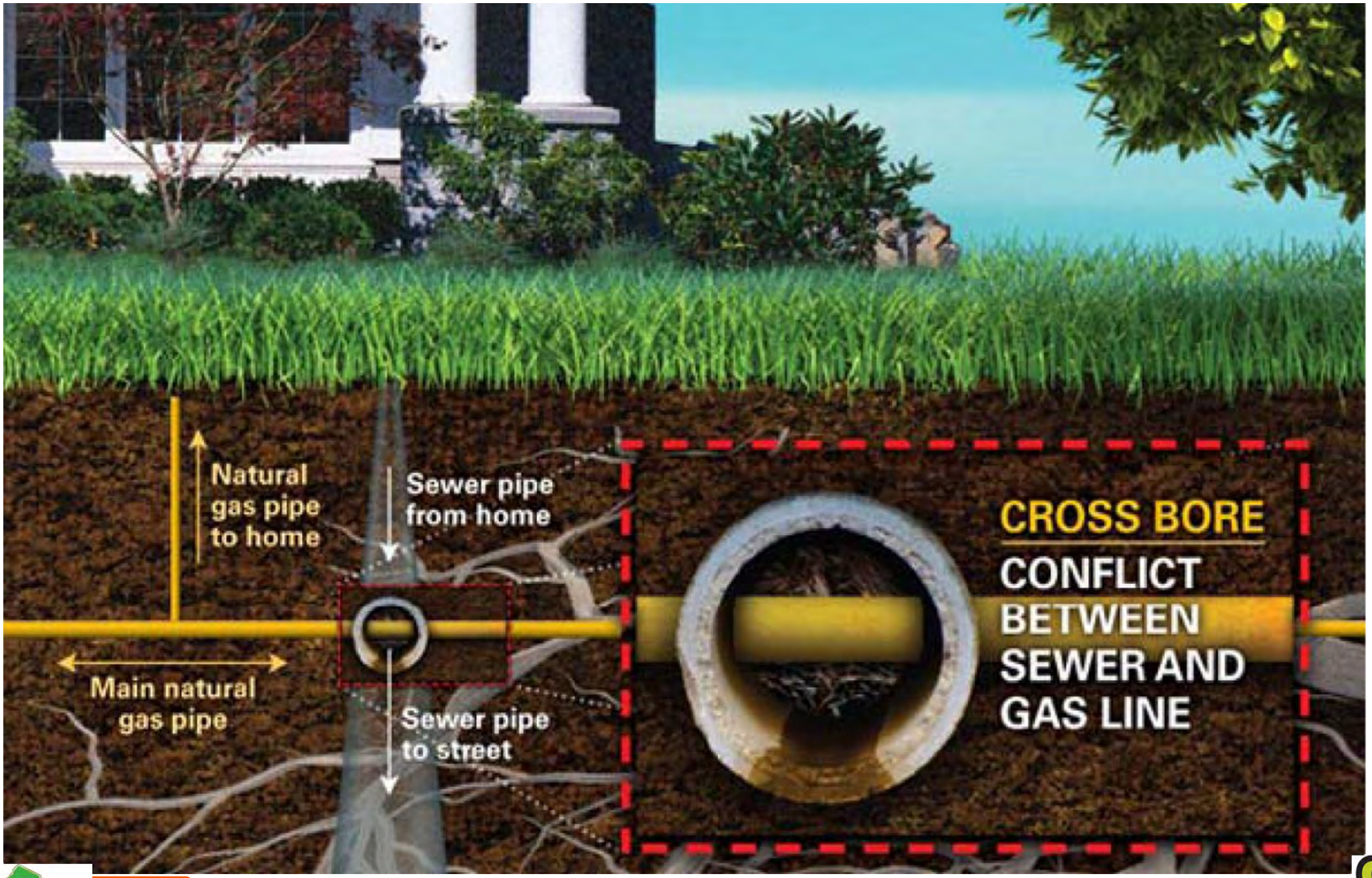
What is a Cross Bore?

The unintended installation of a utility line by trenchless construction methods which damages an existing utility.

What a Cross Bore Looks Like



Gas Pipe Bored Through a Sewer

Can go undetected for decades

Resulting blockages can be easily mistaken for roots

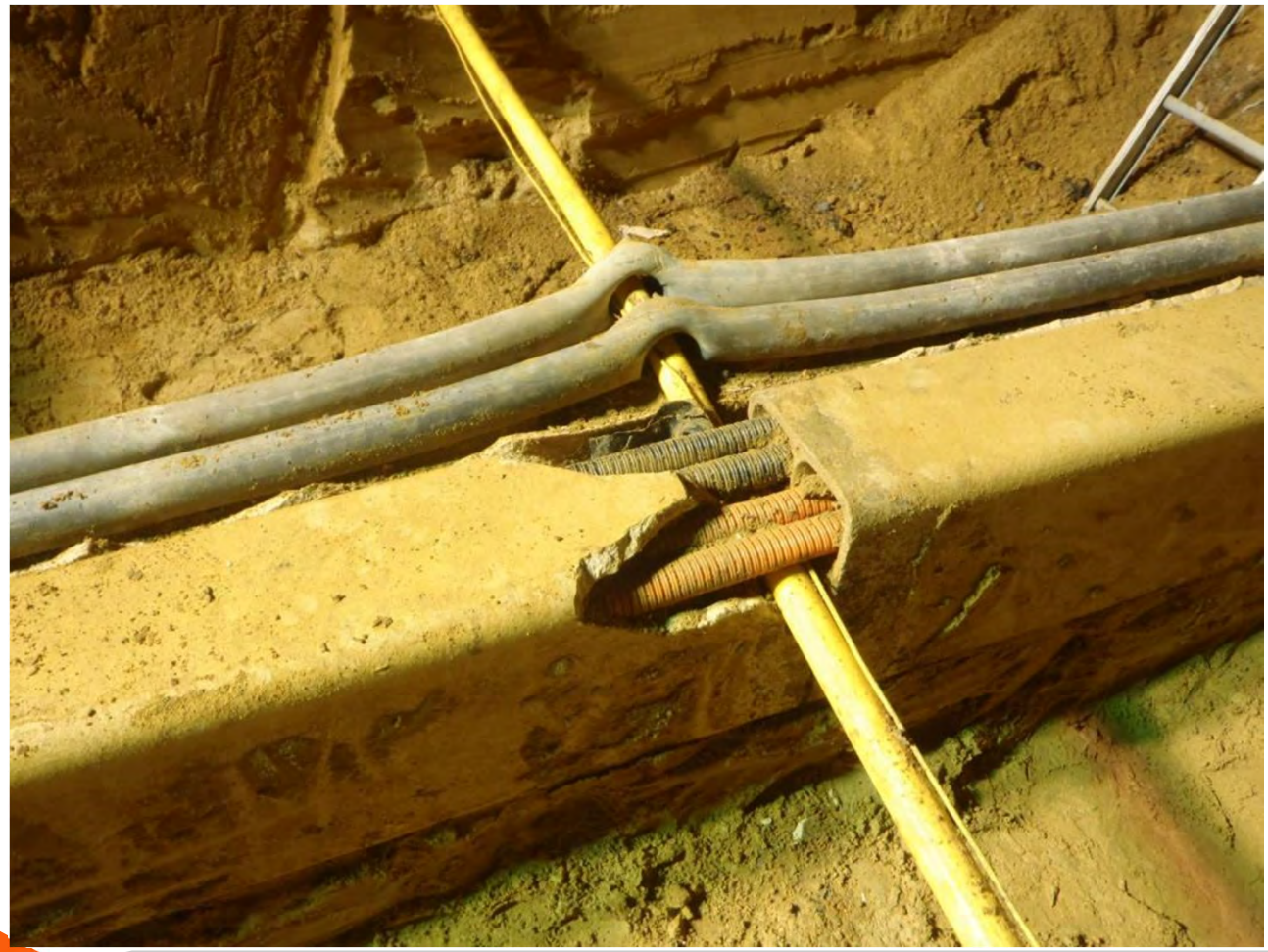
Gas cross bore breach can quickly fill a house with gas (minutes)

The Blockage

The Common Fix

The Possible Result

Gas Pipe Bored Through Communication Lines



Construction Considerations

- Bore Tracking Technology
- What are construction requirements of agency?
- Be prepared to deal with an HDD Pipe that is stuck
- Create a Frac Out Plan for HDD

So what has changed in last 26 years?

- Better locating technology for drilling
- Use of GPR
- More powerful drilling rigs
- New technology such as Intersect Drilling, Pilot Tube Micotunnelling, and Direct Pipe Method
- Other HDD applications being developed such as environmental and geothermal

What are our challenges?

- Safety and Quality
- Continuing the technology development
- Training the next generation
- Finding qualified resources
- Lowering the costs
- Education and communication
- Preventing bad news but if it happens, recovering quickly from the issues; put corrective action in.

North American Society for Trenchless Technology (NASTT) Mission

- Founded in 1990, to advance the science and practice of trenchless technology for the public benefit through education, training and research
- Membership, Training, Publications
- Online Resources at www.nastt.org
- NASTT's No-Dig Show &
  ISTT's 35th International No-Dig
  April 9-13, 2017 • Gaylord National in Washington, D.C

- Thanks and Q&A’s