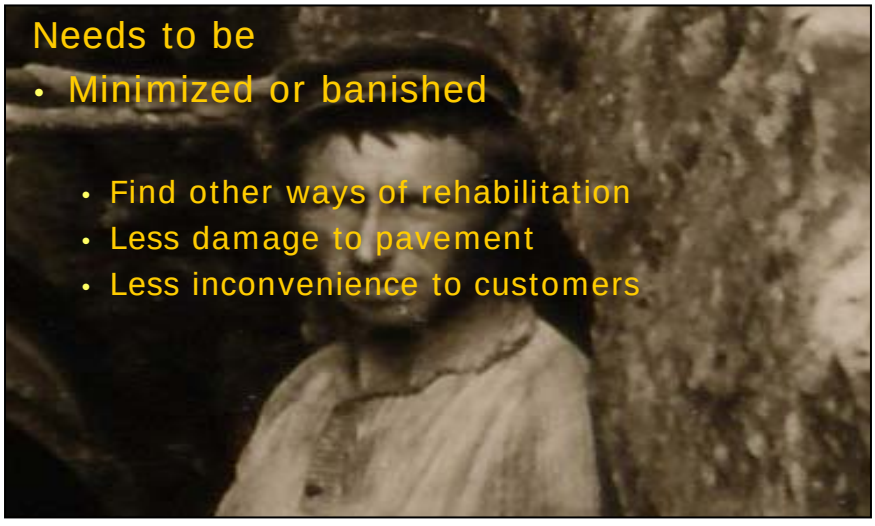
Introduction to Trenchless Technology

Continuous Trenching

New roads, old pipes?

We are not alone!

Jack's appearance



Solution to JACK

Trenchless Technologies

Trenchless Technology

Techniques for utility line installation, replacement, rehabilitation, inspection, location and leak detection,with minimum excavation from the ground surface.

North American Society of Trenchless Technology (NASTT)

Key Points

- Minimal surface excavation
  - Alternative to open cut excavation
- Can have entrance and exit surface excavations – JACK!!!!

- Pipelines usually have diameters less than 900 mm (36 inches) - non person entry

Key Points (Continued)

Typically considers only urban utilities:

- Water and wastewater systems
- Gas, petroleum and chemical pipelines
- Electrical and communications networks
- Access ways and other small diameter tunnels

Excludes: Large tunnels (< 1%)

World largest tunneling machine
(14.2 m in diameter)

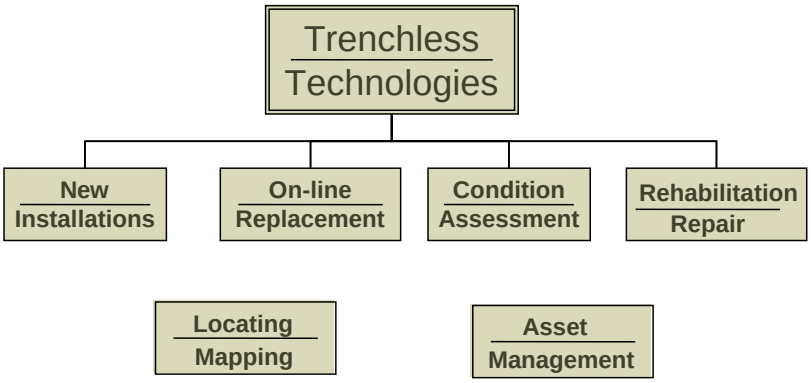
people

Chunnel

Method Classification

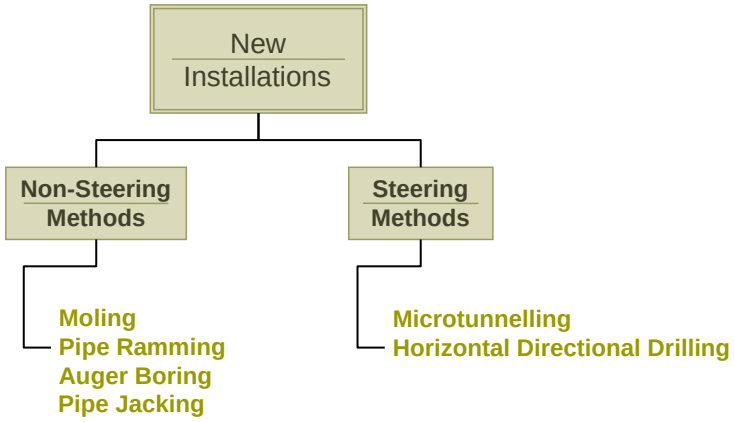
- Many classification systems proposed
- No industry standard
- Generally TT methods classified into four broad categories

Broad Categories



New Installations

New Installations



On-line Method

On-line Method

- Pipe bursting

Gravity Pipes

- vitrified clay,
- brick,
- concrete,
- steel,
- ductile & cast iron,
- asbestos cement (transite),
- pitch fibre
- HDPE,
- PVC
- etc..

Pressure Pipes

- Prestressed Concrete Cylinder Pipes (PCCP)
  - AWWA C301 and C303, lined, embedded core, bar wrapped
- Steel
- Iron (cast and ductile)
- Asbestos cement (transite)
- Wood (solid and stave)
- HDPE
- PVC
- etc..

Pipe Materials

Metallic

- Cast iron
- Ductile iron
- Copper
- Steel
- PCCP

Non-metallic

- Wood stave pipe
- Polyethylene
  - MDPE
  - HDPE
- PVC
- Concrete
- Polymer concrete
- Asbestos cement
- Pitch fibre

Pipeline Access

GRAVITY Pipelines

- Partial pipe flow
- Interior access readily available by person, camera, and non destructive testing (NDT) tools
- Pipeline inspection performed live or off line

Pressure Pipelines

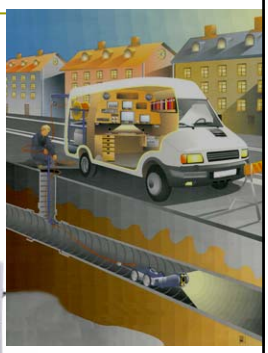
- Full pipe flow
- Typically small diameter than gravity pipelines
- Interior access limited (pressure, contamination and disinfection)
- Interior inspection usually requires pipe Sto be taken off line

Pipeline Condition Assessment

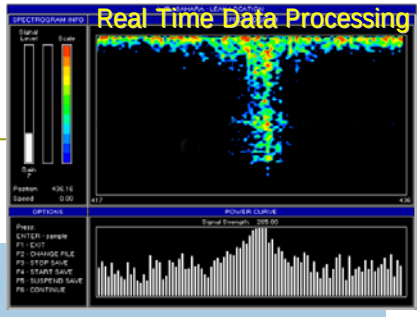
Pipe condition rating

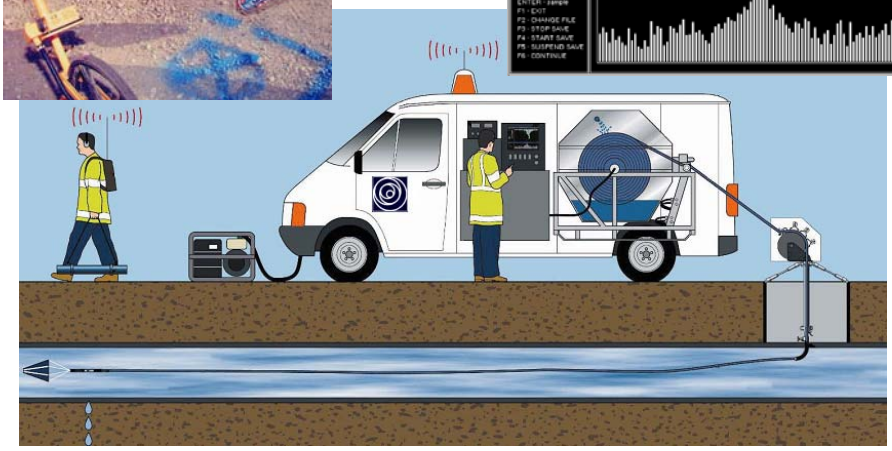
Deterioration state?

- Video camera imaging (CCTV)
- Acoustic methods
- Magnetic methods



Sahara®: System





Corroded Wires & Cylinder

Common Pipe Deterioration

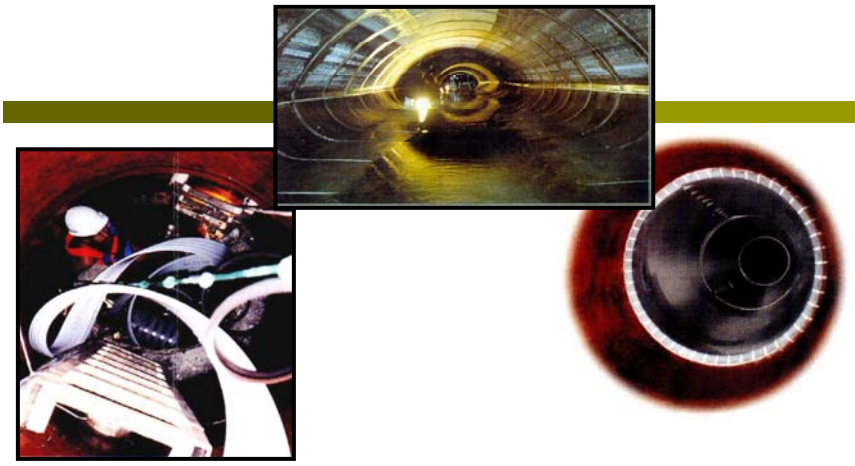
Metallic pipe

- Corrosion (reduced pipe wall thickness)
- Micro cracks in welds
- Leaking joints

Non-metallic pipe

- Cracks
- Fractures
- Deformation
- Collapse

TRENCHLESS PIPELINE REPAIR

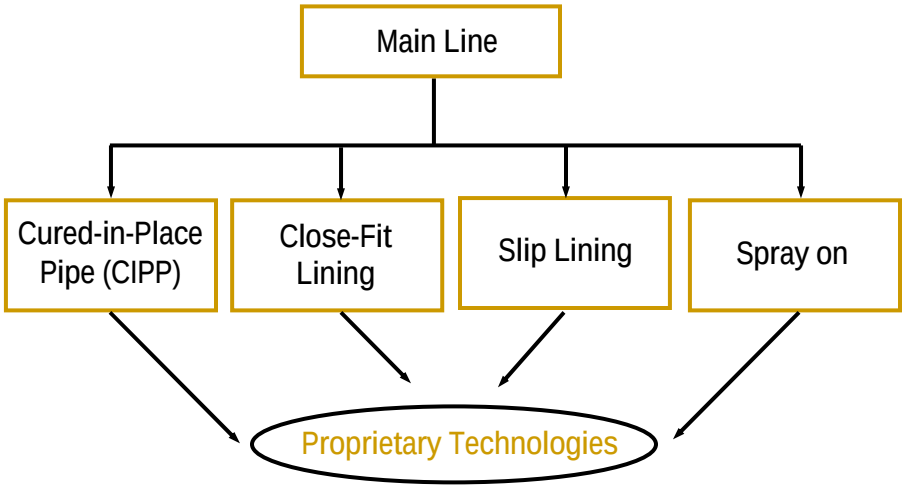


Trenchless Pipeline Repair

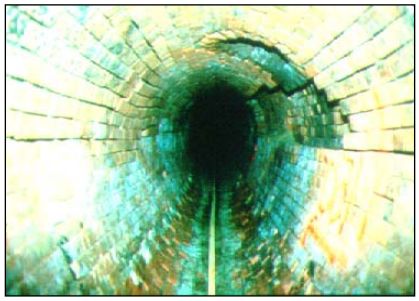
GOAL
Return a defective pipeline to
a serviceable condition without replacement

How you reach that goal is the key!

Lining - Technologies

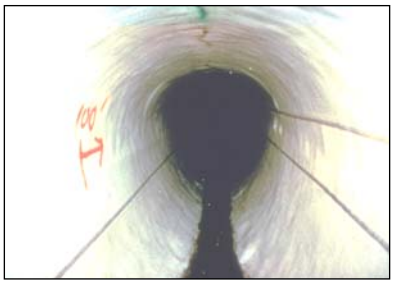


CIPP



Before

After

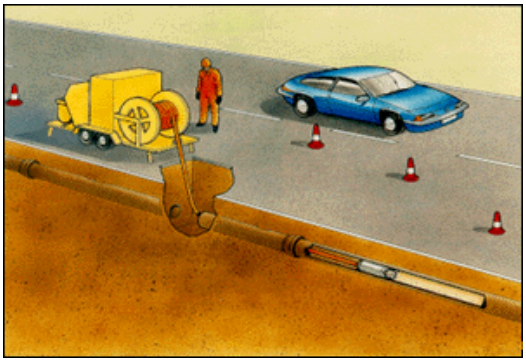


Close Fit Lining

Slip Lining

Rehabilitation

Spray on linings



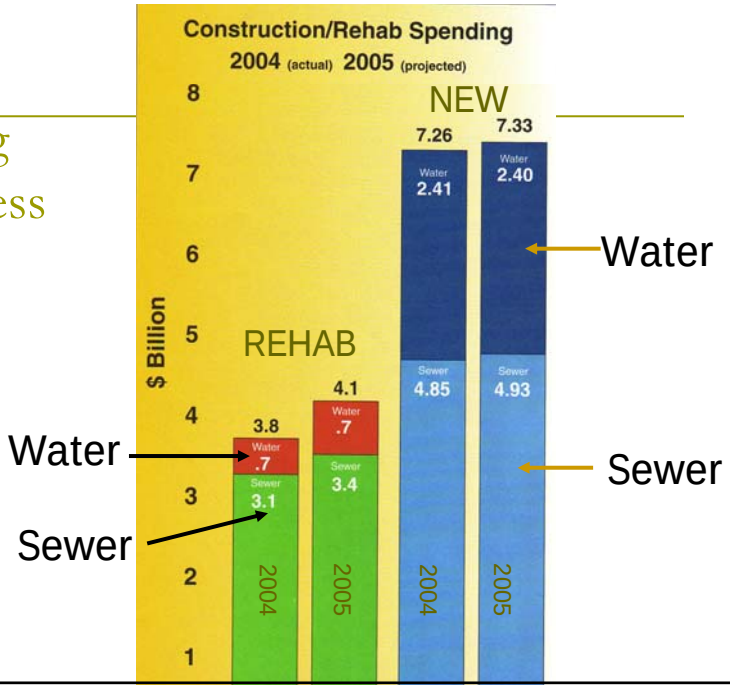
- Cement mortar
- Epoxy

Water and Sewer By-Pass

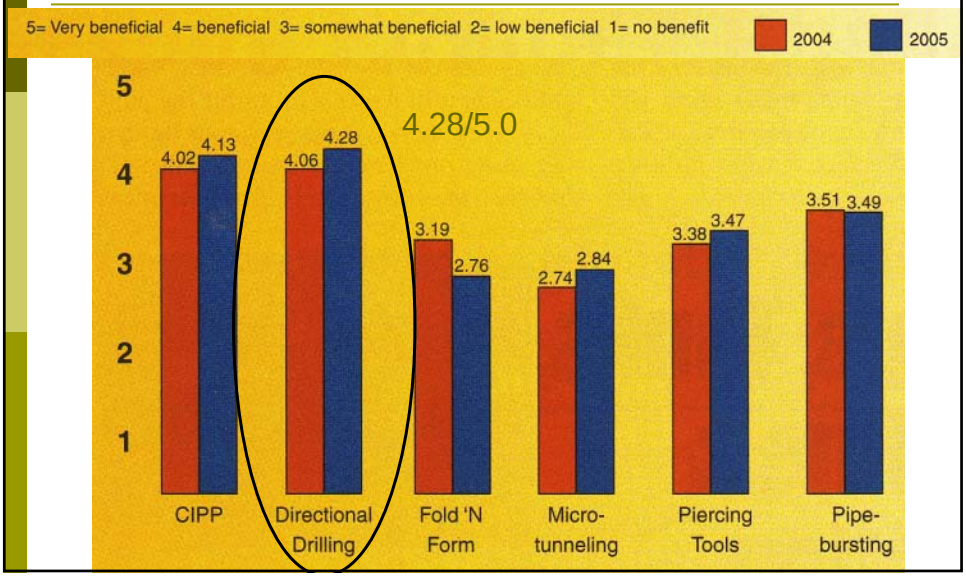
Trenchless Technologies

Tools in a Tool box

Growing Trenchless Industry



Municipal Survey Results



Where are those utilities?

Gas Main in a Sewer Lateral

Clearing a Lateral Blockage?

Utility Location and Mapping

Pipe line location

- "As built" or "As Recorded" drawings
  - Not accurate
  - Often do not know where it is (plan or depth)
- Cost of not knowing:
  - Line hits
  - Increased construction costs
- Subsurface Utility Engineering (SUE)

Pipe line location

- Cost of not knowing:
  - Line hits
  - Increased construction costs

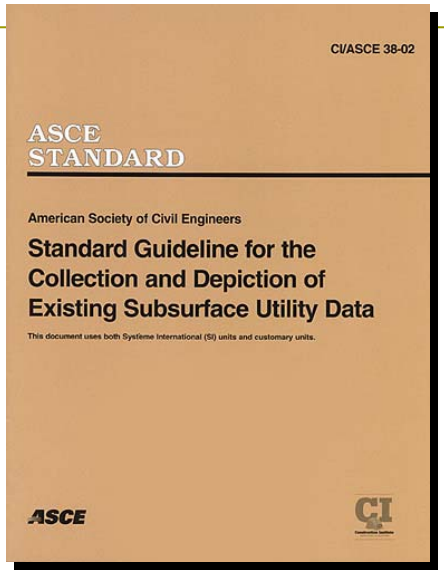
- Subsurface Utility Engineering (SUE)

Cost of Not Knowing

Basic Tenets of SUE

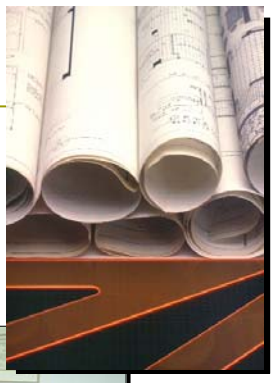
SUE Quality Levels

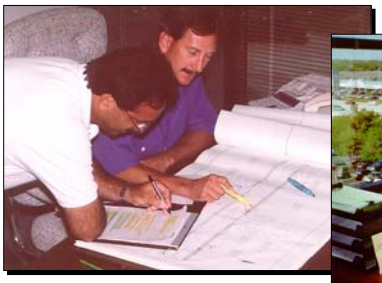
ASCE Standard Guideline



Quality Level "D"

- Utility Contact Phase
- Records Research





(Visible Features)

Quality Level "C"

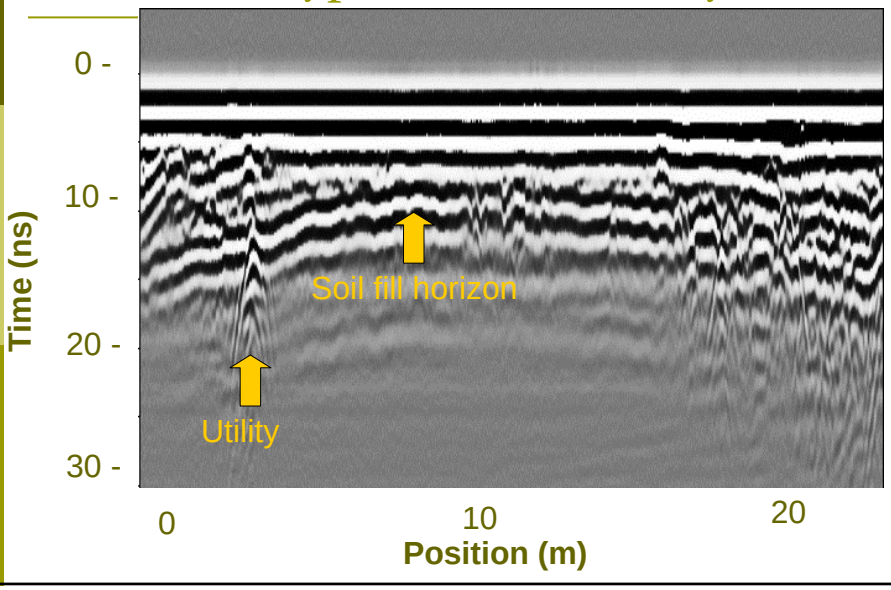
Determine Horizontal Alignment

Quality Level "B"

Typical QL-B Designating Project

- Electromagnetic
- Magnetometer
- Resonant Sonics
- Acoustical
- Pulse Induction
- Ground Penetrating Radar

Typical GPR Survey



Utility Locating

Quality Level "A"

- Utility Exposed
- Accurate X,Y, Z Locating
- Size, Material and Condition

Survey/Data Management

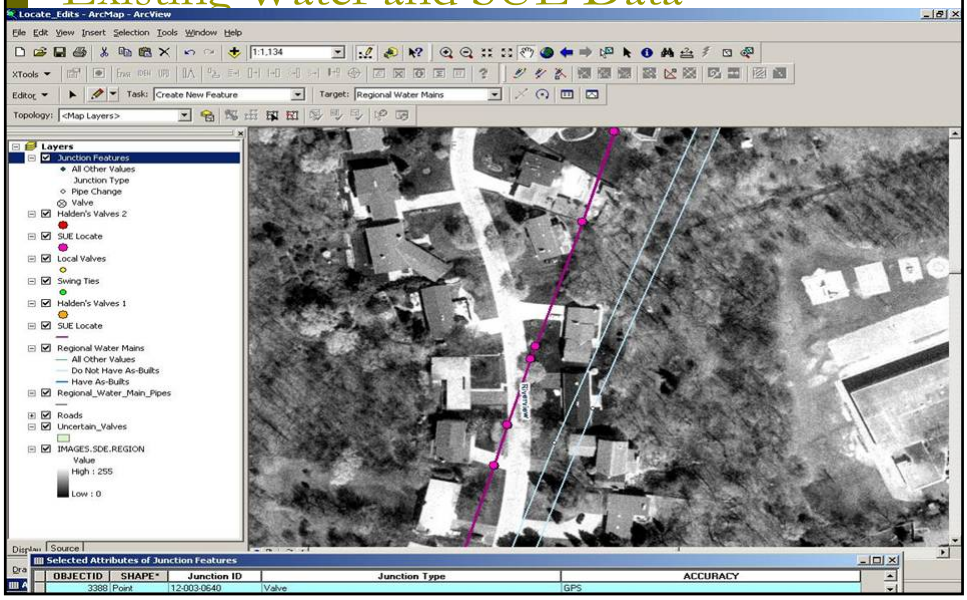
- Conventional
- GPS
- SUM
- GIS

Mobile GIS?

Utility Locating Quality Level "A"

- Non-Destructive Excavation
- Air/Water & Vacuum Units

Existing Water and SUE Data



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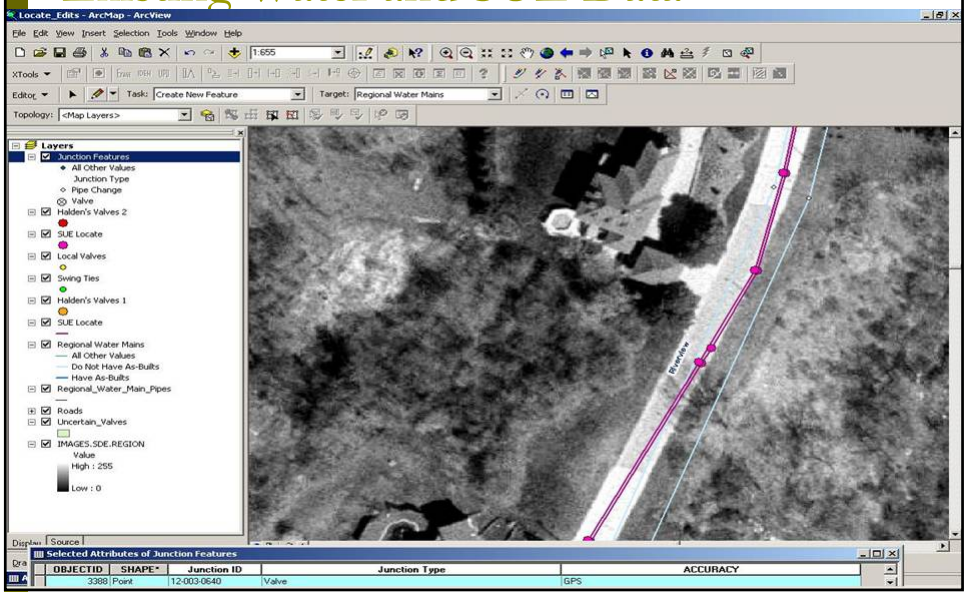

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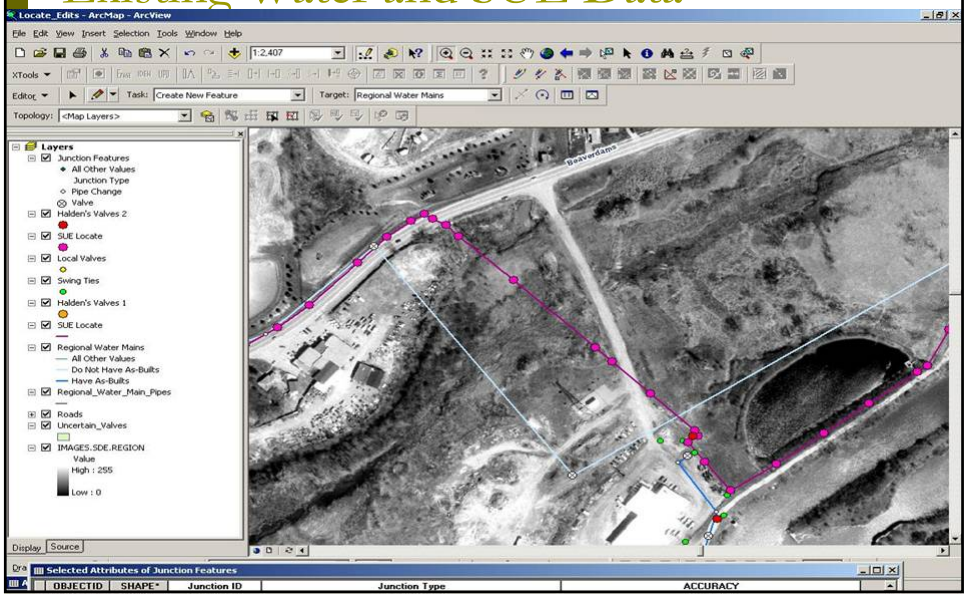


What is Cost of Not Knowing?

Studies show that there is a payback of at least $4.00 for every $1 spent on SUE.

- Reduced construction delays
- Improved asset operation maintenance and planning
- Effective spending of rehabilitation $$:
  - One Ontario relined cement mortar pipe beside it was labeled on GIS system as unlined DI.
  - Liner wrinkled and had to be removed

Trenchless Technology

vs.

Open cut excavation

Social Costs

Economic:

- Traffic disruption
- Pedestrian disruption
- Commercial and business disruption

Environmental:

- Noise and vibration

Social Costs (con't)

Safety

- Worker safety
- Emergency service access

Indirect costs

- Loss of residual life of adjacent utilities and pavement structures

Social Costs

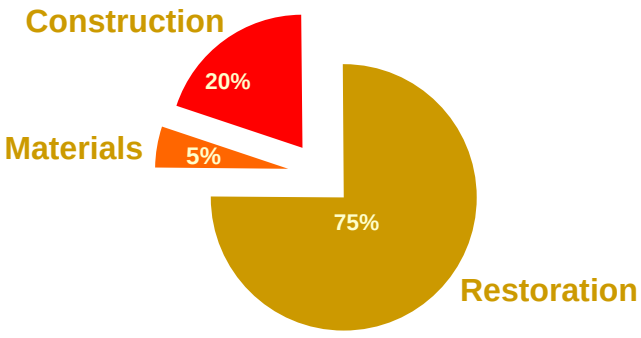
- Not traditionally included in construction costs
- Sometimes difficult to quantify or specify
- Becoming more relevant for rehabilitation and construction in urban areas

Social Costs

Social Costs

Environmental Costs

Typical Urban Project Costs



Typical Urban Project

- Social costs savings
  - Traffic delays (cars & people)
  - Economic loses (business)
- Environmental
  - Noise
  - Greenhouse gases
- Public perception

Advantages of TT

New installations

- Faster pipe installation
- Environmentally friendly???
- Lower social costs
- Less labour intensive
- Lower green house gas emissions?
- Deeper services

Rehabilitation

- Limited excavation
- Fast
- Low social costs
- Line remains in service
- Lower construction cost???

TT Limitations

New construction

- Limited contract specifications available
- Installation impact on pipe or other buried structures??
- Contractor experience
  - Who takes the risk?

Rehabilitation

- Quality assurance
  - Materials, construction
- Industry marketing
- Installation cost?
- Inspection techniques
- Design techniques
- Failures - cost of not knowing