

WELCOME



THE EXCHANGE

A NASSCO EDUCATIONAL EVENT

UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



Chris Macey

**Americas and Global Technical Practice
Leader, Condition Assessment and
Rehabilitation, AECOM**

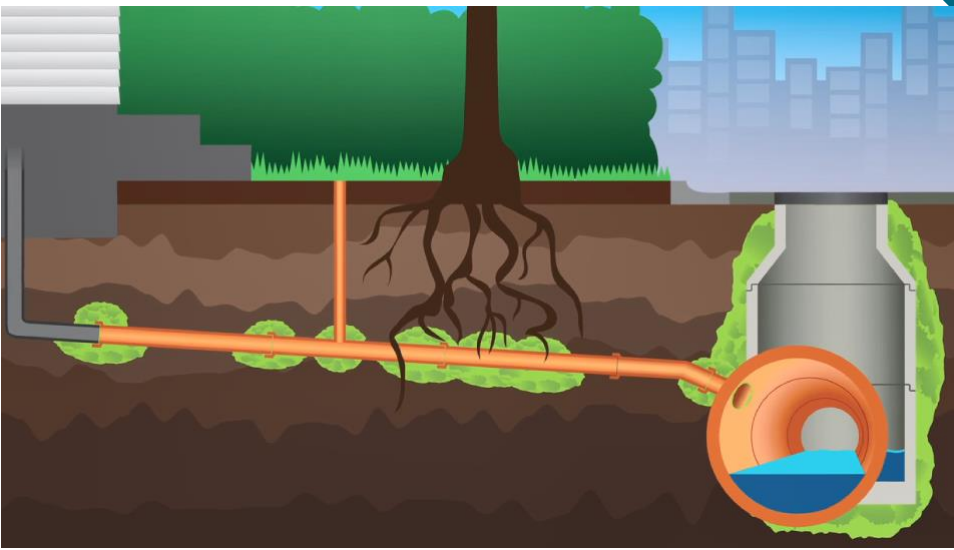
**Member of NASSCO's Technical Advisory
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Grouting Practice, Research and Safety



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Who We Are:

- Committee of Grouting Manufacturers, Contractors, and Engineers
- Discuss Advancements / Safety in Grouting
- Study Grout Materials
- Promote Grouting Industry



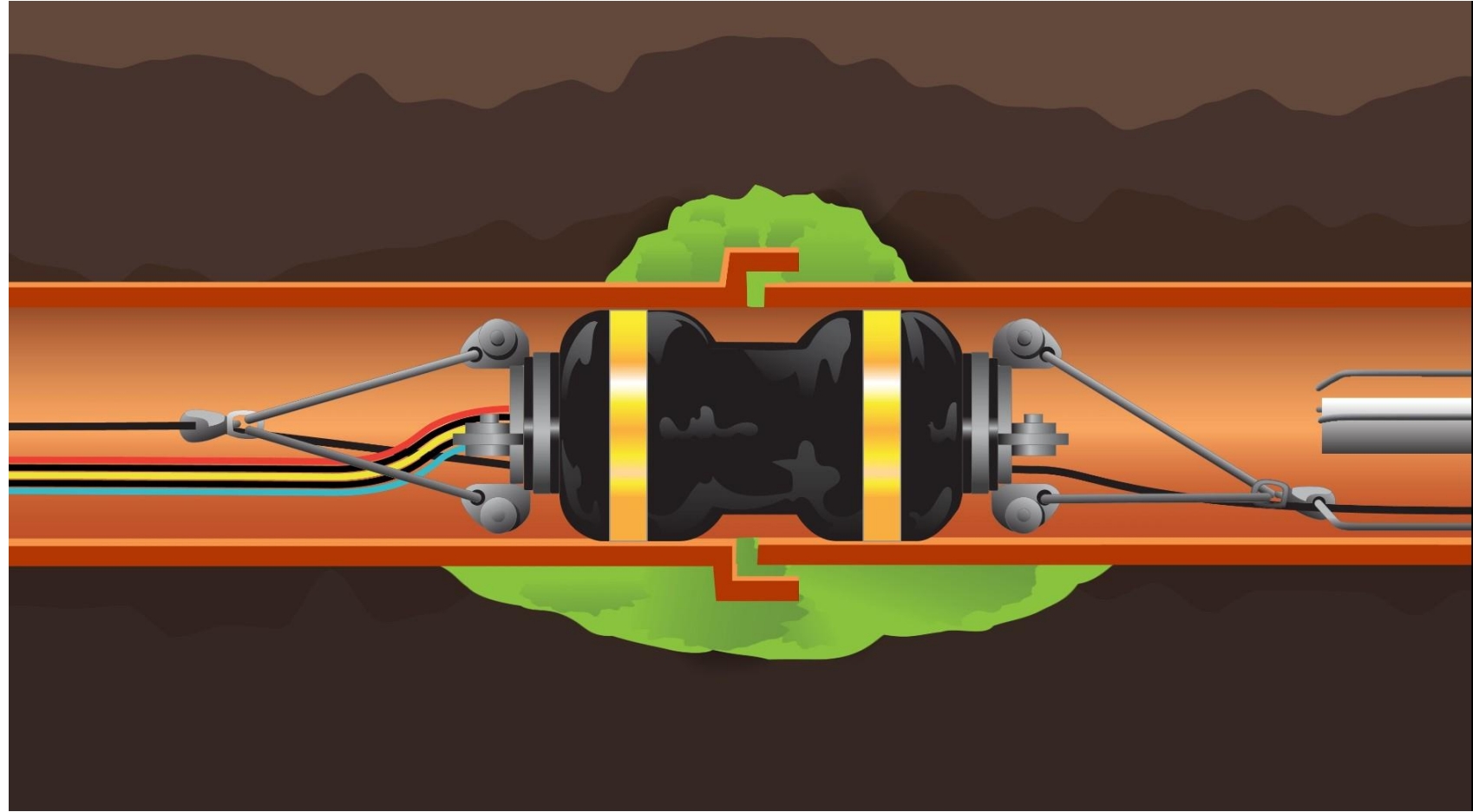
Recent Achievements:

- October 2021 - Released Two New Specifications:
 - Pipeline Packer Injection Capital Grouting
 - Pipeline Packer Injection Pre-Rehabilitation Grouting
- February 2022 - Released the Unified Grouting Safe Operating Practices Program (UGSOPP)
- September 2022 – Launched Online Grouting Safety Exam



The Purpose of Grouting

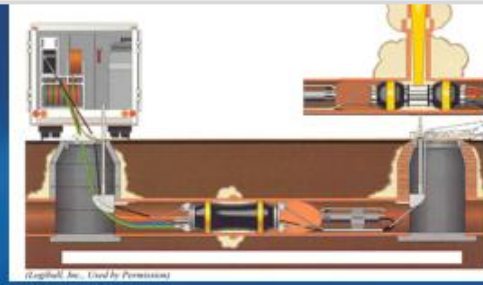
- Eliminate Infiltration
Component of I&I by Sealing
Joints and other defects in
Pipes and Structures
- Stabilization
 - Stop or reduce the rate of
ground loss around the pipe
 - Stop or reduce the flow of
water through the soil
- Grouting is another key tool in
our rehabilitation toolbox



Rehabilitation Toolbox

A key feature of almost every rehab technology is focused on arresting the progressive loss of ground.

Grouting can play a key role in this.



Grouting



Conventional Sliplining



Fold and form Liners



Segmental GRP Liners



Cured-in-place pipe (CIPP)

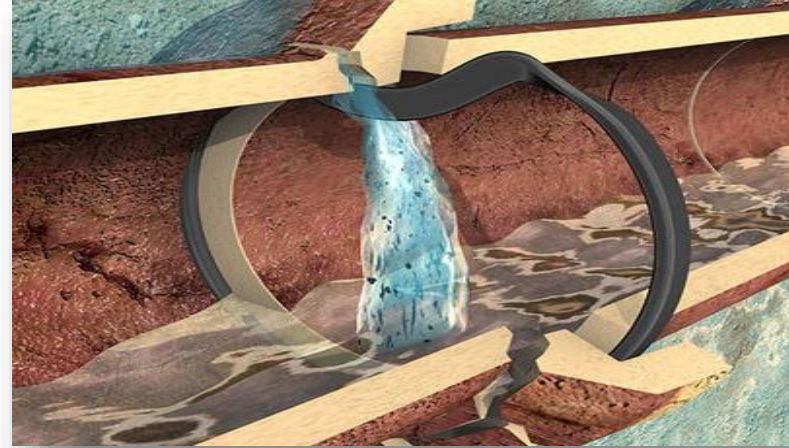


Compression Fit Liners

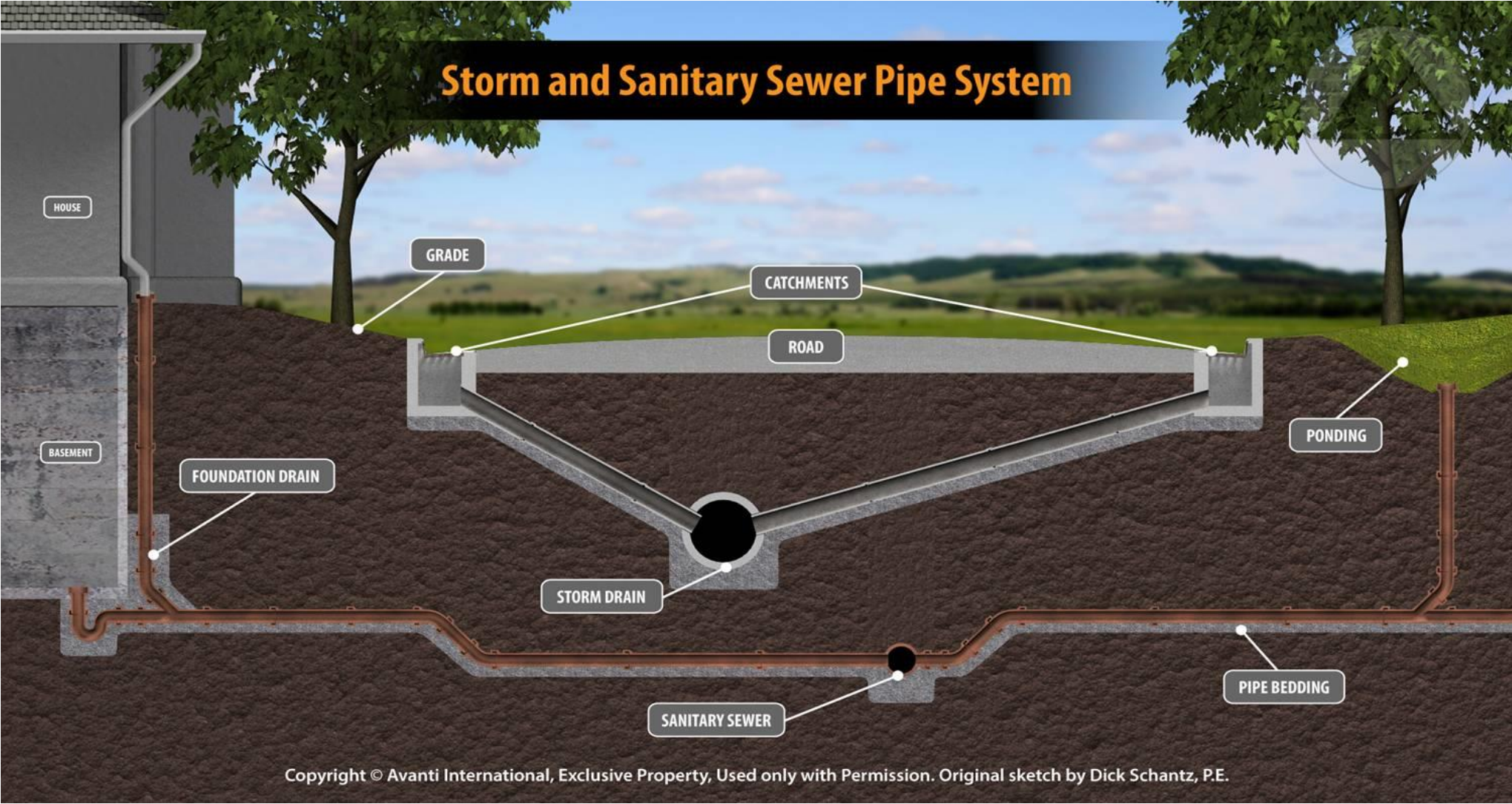


Eliminating Infiltration has many benefits

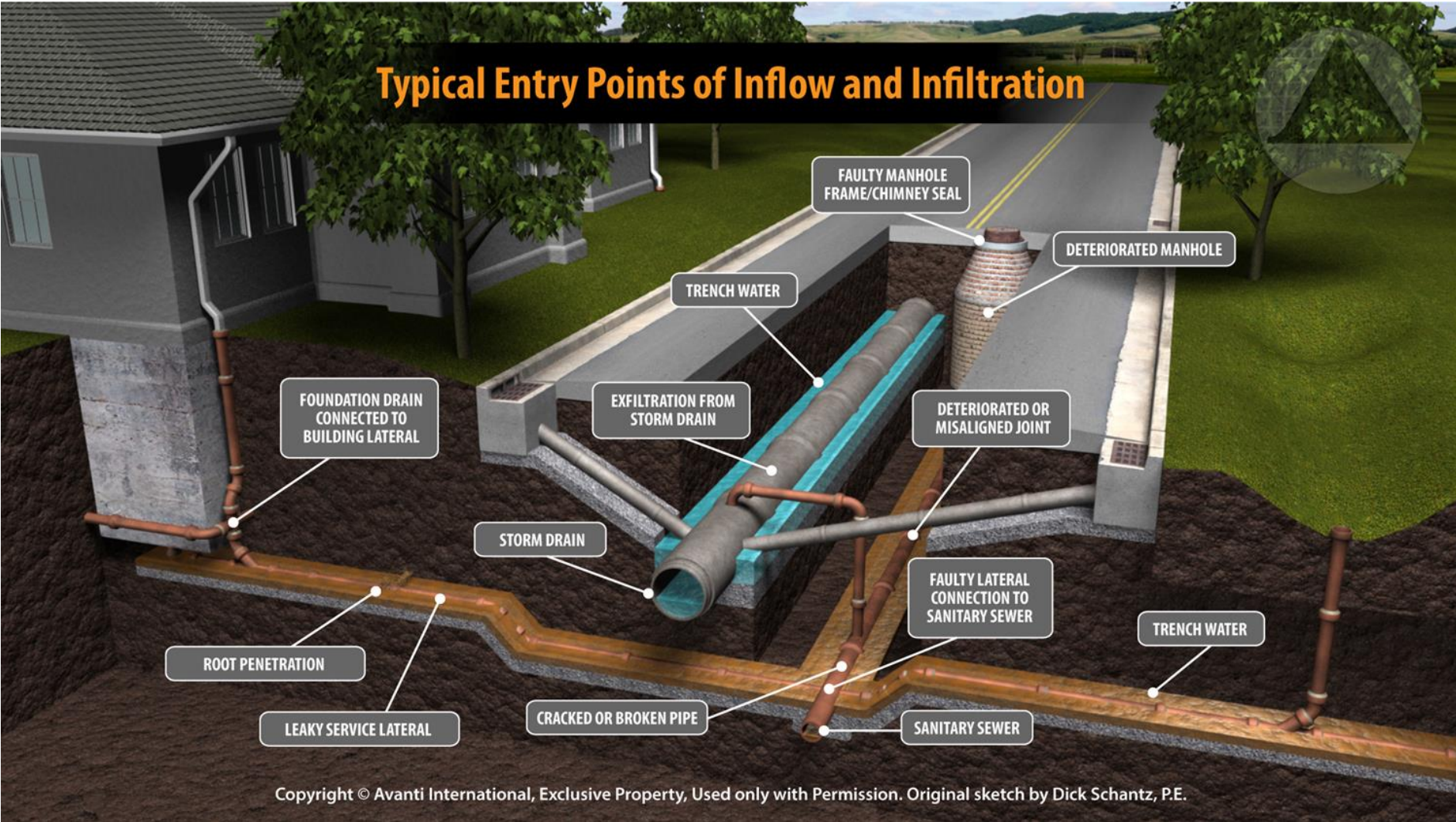
- Increase your total system capacity
- Reduce overflows
- Meet capacity regulations
- Lower treatment costs
- Increase the longevity of the sewer system as a rehab method (Capital Grouting) or as an O&M treatment



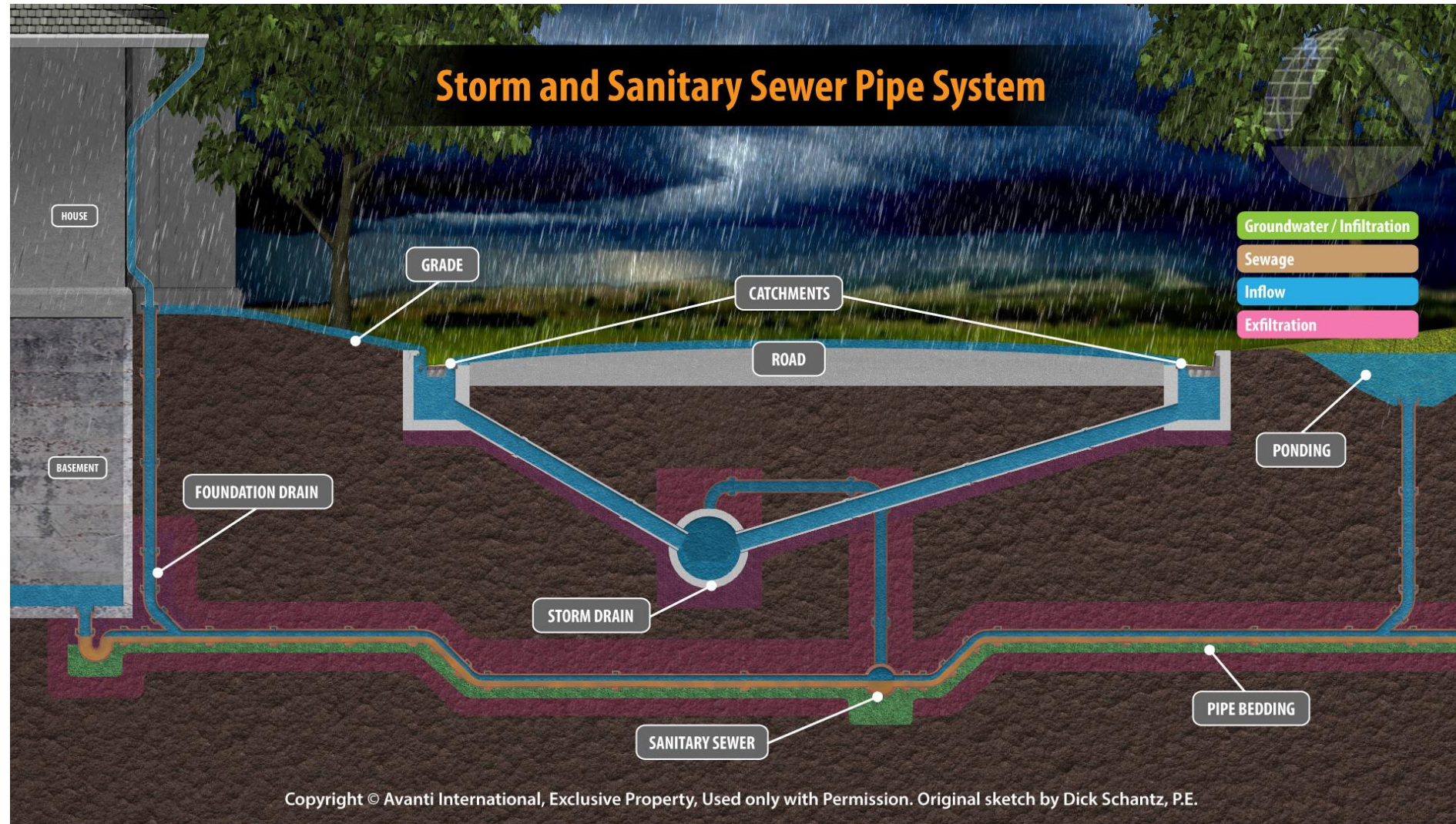
Typical Sanitary and Storm Sewer Systems



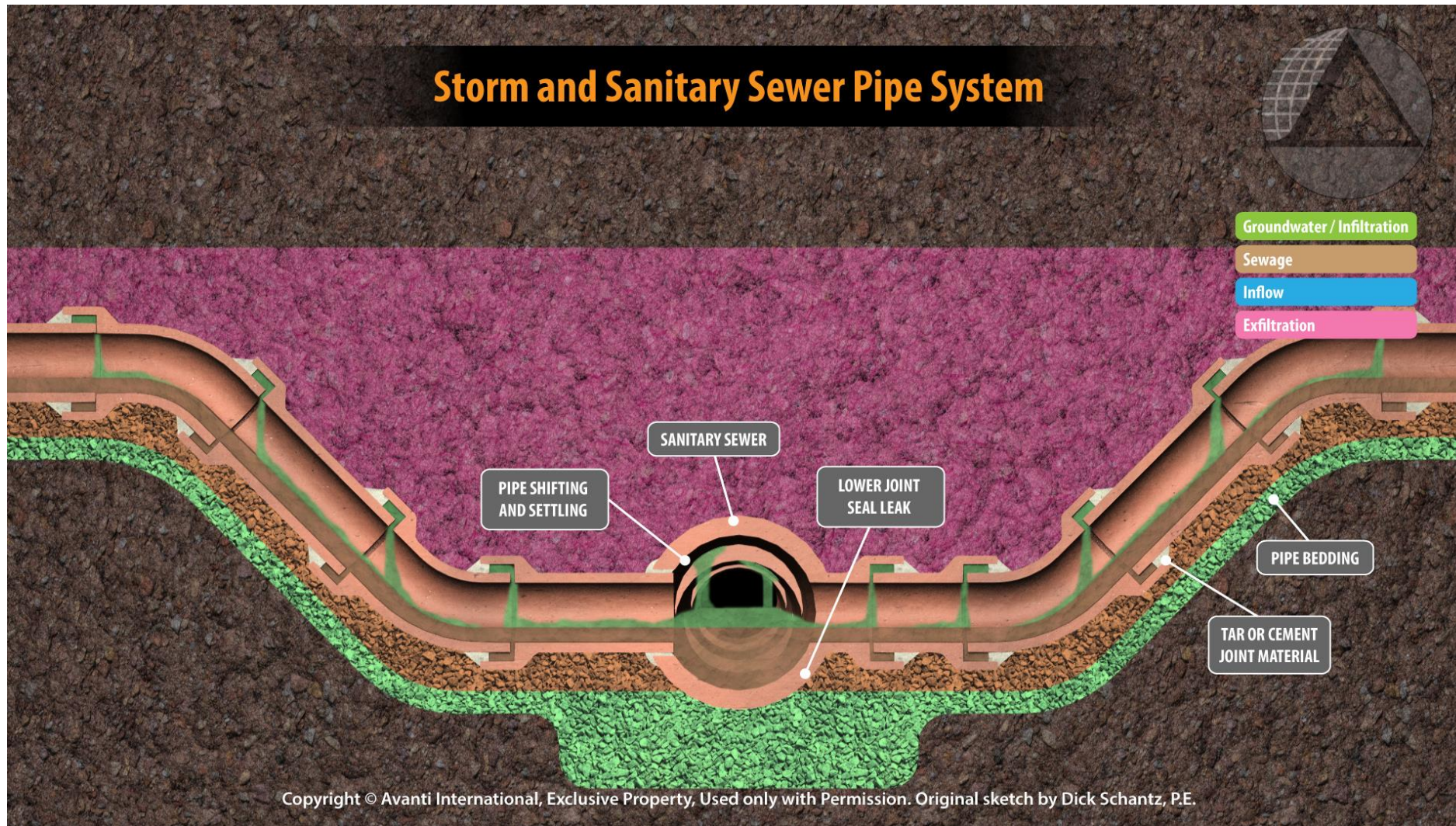
Typical Points of Entry for Inflow and Infiltration



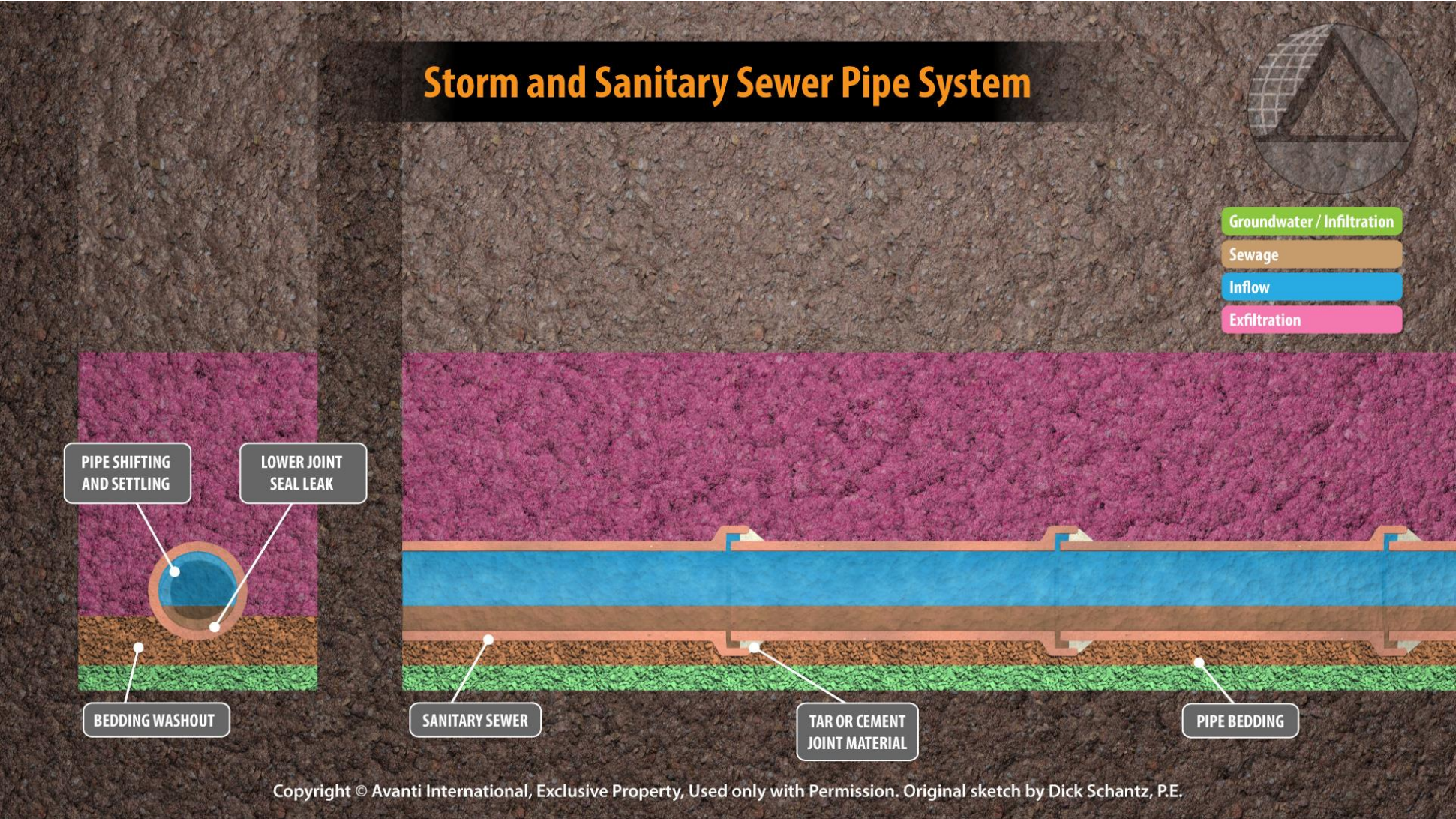
What Happens During a Rain Event



Consequences of Infiltration



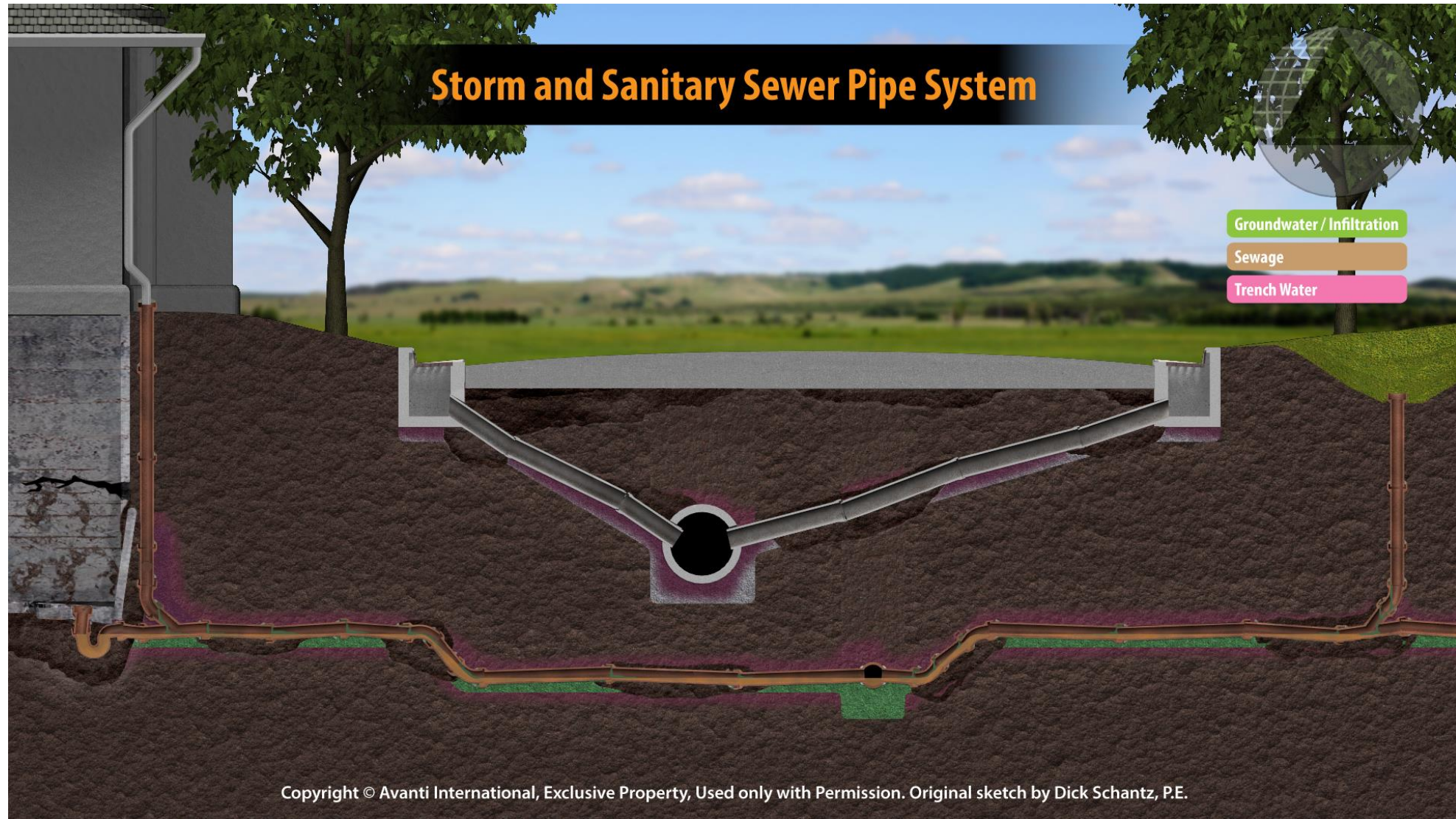
Consequences of Infiltration



Consequences of Infiltration



Longer-Term Consequences of Infiltration



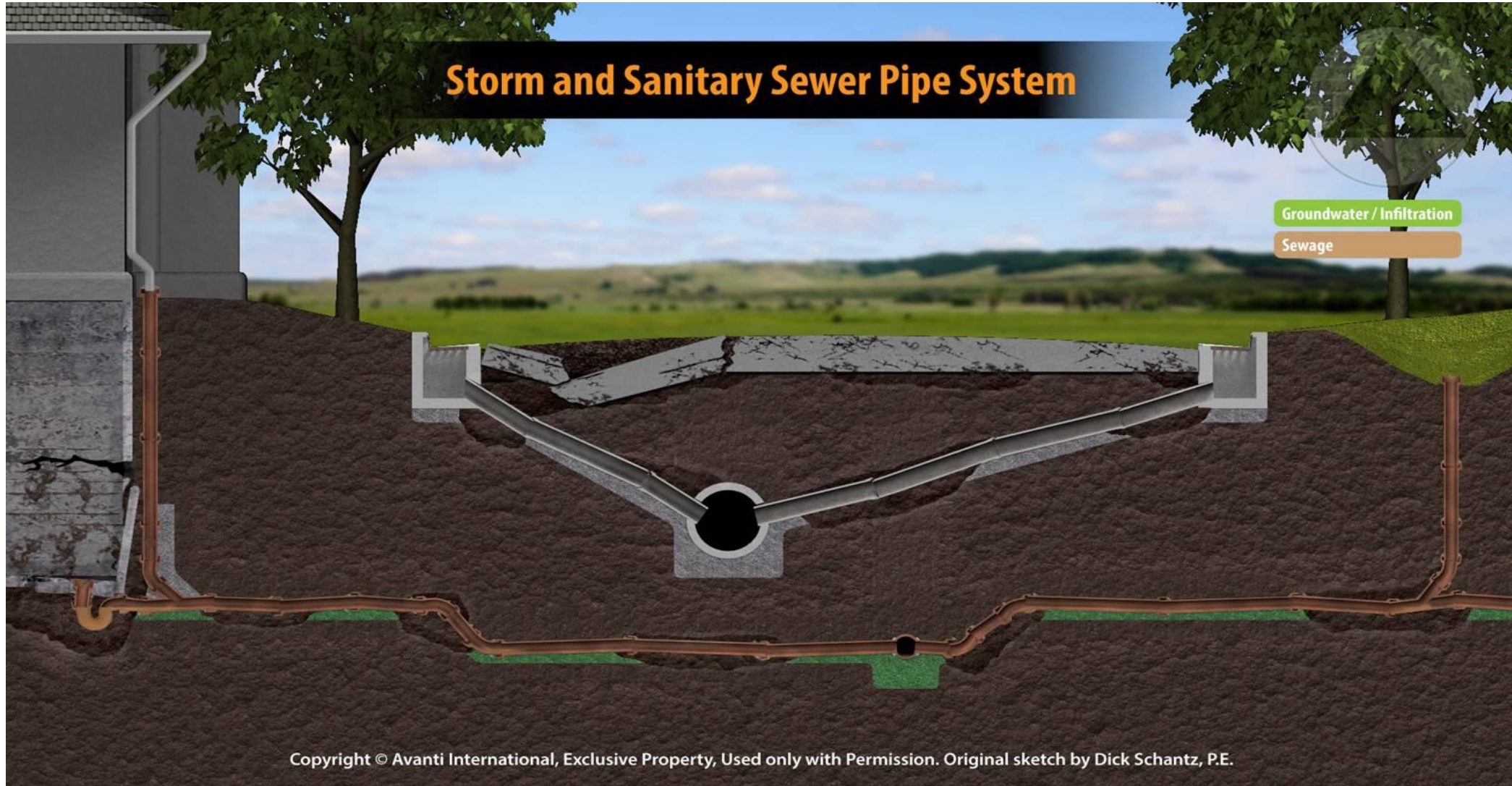
Copyright © Avanti International, Exclusive Property, Used only with Permission. Original sketch by Dick Schantz, P.E.

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Longer-Term Consequences of Infiltration





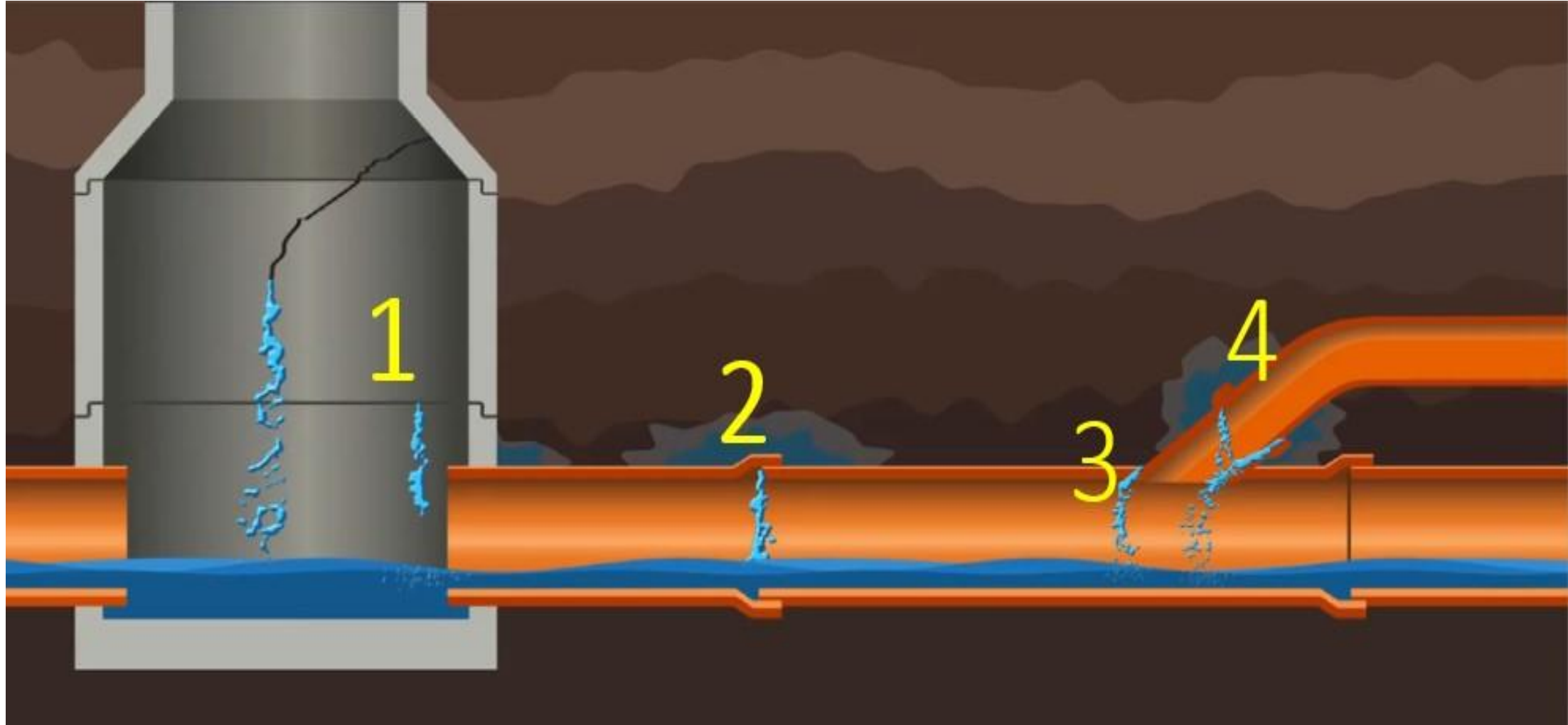
Loss of Ground Failures Always Make the News



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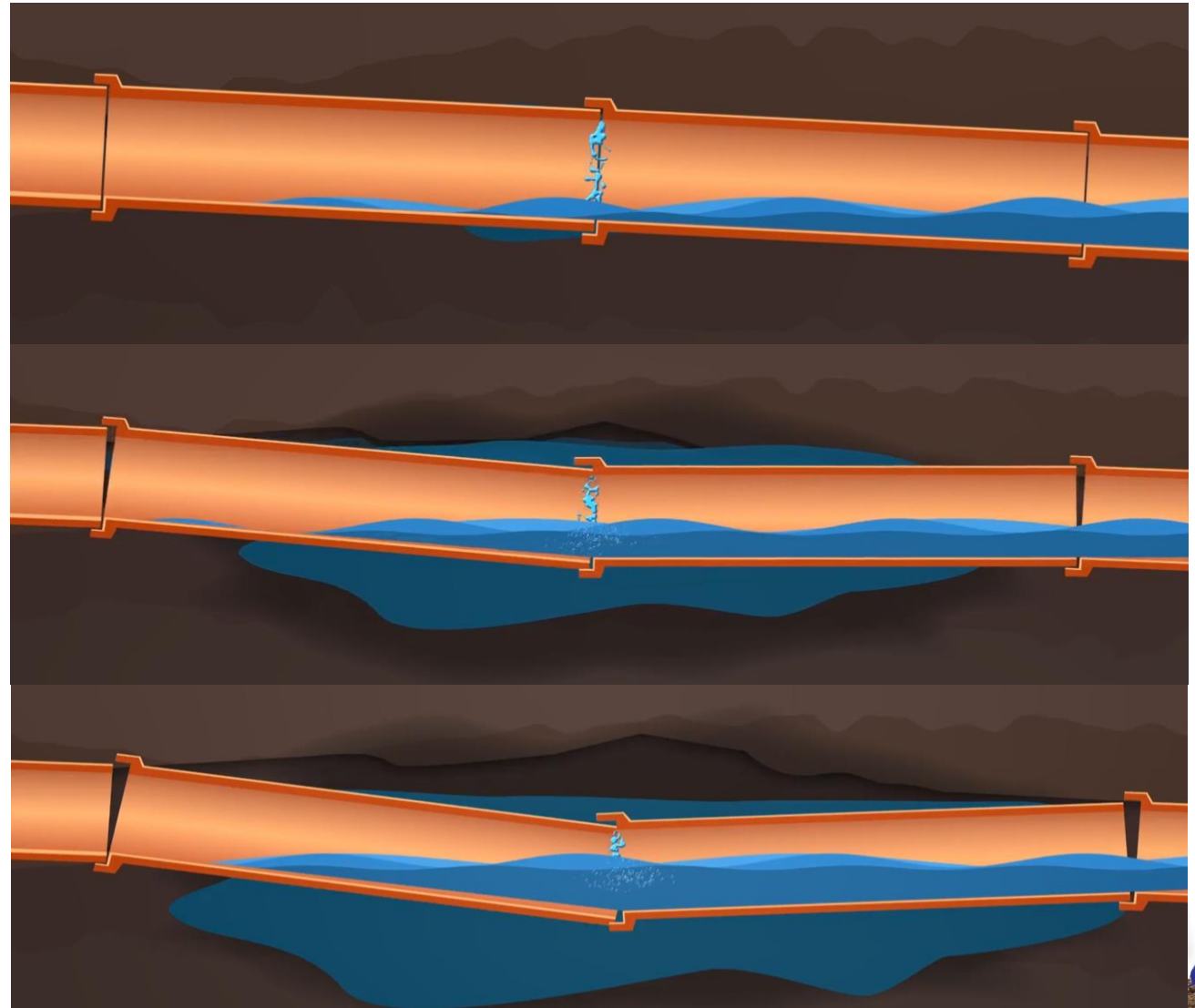


Typical Points Of Infiltration



Three Stages Of Pipe Failure Due to Loss of Ground

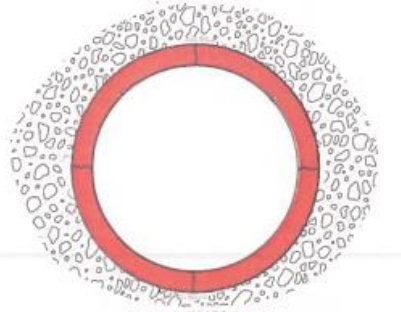
- Stage 1:
 - Failing Joint Compounds Allow for Infiltration
- Stage 2:
 - Voids Formed Around Pipe Allow for Movement
- Stage 3:
 - Pipe Failure Due to Loss of Ground



Water Research Council (WRc) Collapse Studies ~ 1970s/1980s

Stage 1, 2, and 3 of pipe failure due to loss of ground

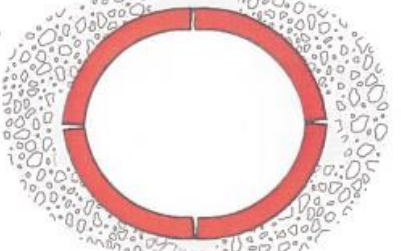
- We've known about this type of failure for a long time
- Not just leaking, but infiltration through pipe fractures as well



STAGE 1

Pipe cracking is caused by bad laying or subsequent overloading or disturbance. The sewer remains supported and held in position by the surrounding soil.

Visible defects: Cracks at soffit, invert and springing. Infiltration may also be visible.

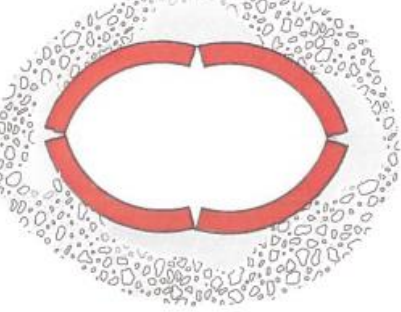


STAGE 2

Infiltration of groundwater or infiltration / exfiltration caused by surcharging of the sewer washes in soil particles. Side support is lost allowing further deformation so that cracks develop into fractures.

Side support may also be insufficient to prevent deformation if the original backfill was either poorly compacted or of an unsuitable material.

Visible defects: Fractures, slight deformation. Infiltration may or may not be visible.



STAGE 3

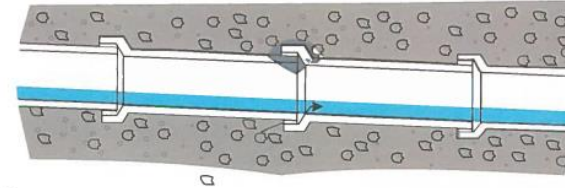
Loss of side support allows side of pipe to move further outwards and the soffit to drop. Once deformation exceeds 10%, the pipe becomes increasingly likely to collapse.

Visible defects: Fractures and deformation, possibly broken.

STAGE 1:

Gap in sewer at joint or a poor lateral connection.

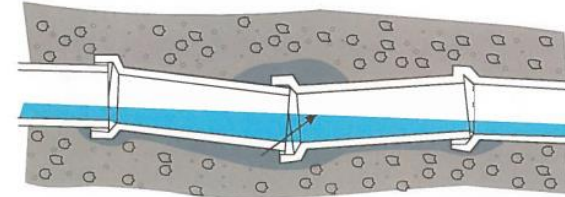
Visible defects: Offset joint, badly made connection. Infiltration.



STAGE 2:

Infiltration of groundwater or infiltration / exfiltration caused by surcharging of the sewer washes in soil particles. Loss of soil support around the sewer allows pipe to move, opening joints and increasing the in wash of soil.

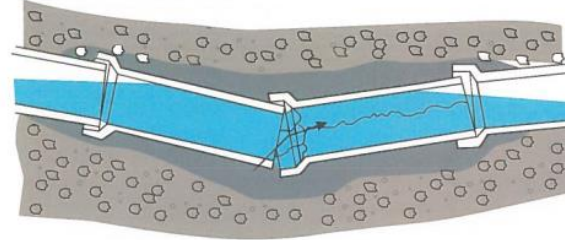
Visible defects: Open and displaced joints, loss of line and level. Infiltration. NOTE: Care must be exercised when viewing video tape recordings as displaced or slightly displaced joints can be overcompensated by the camera's lighting system.



STAGE 3:

Uneven loading of pipes due to joint displacement causes cracking of pipes. Process then accelerates and cracked pipes may also deform.

Visible Defects: Open and displaced joints, cracked and fractured pipes, loss of line and level. NOTE: The camera may be submerged due to loss of gradient.



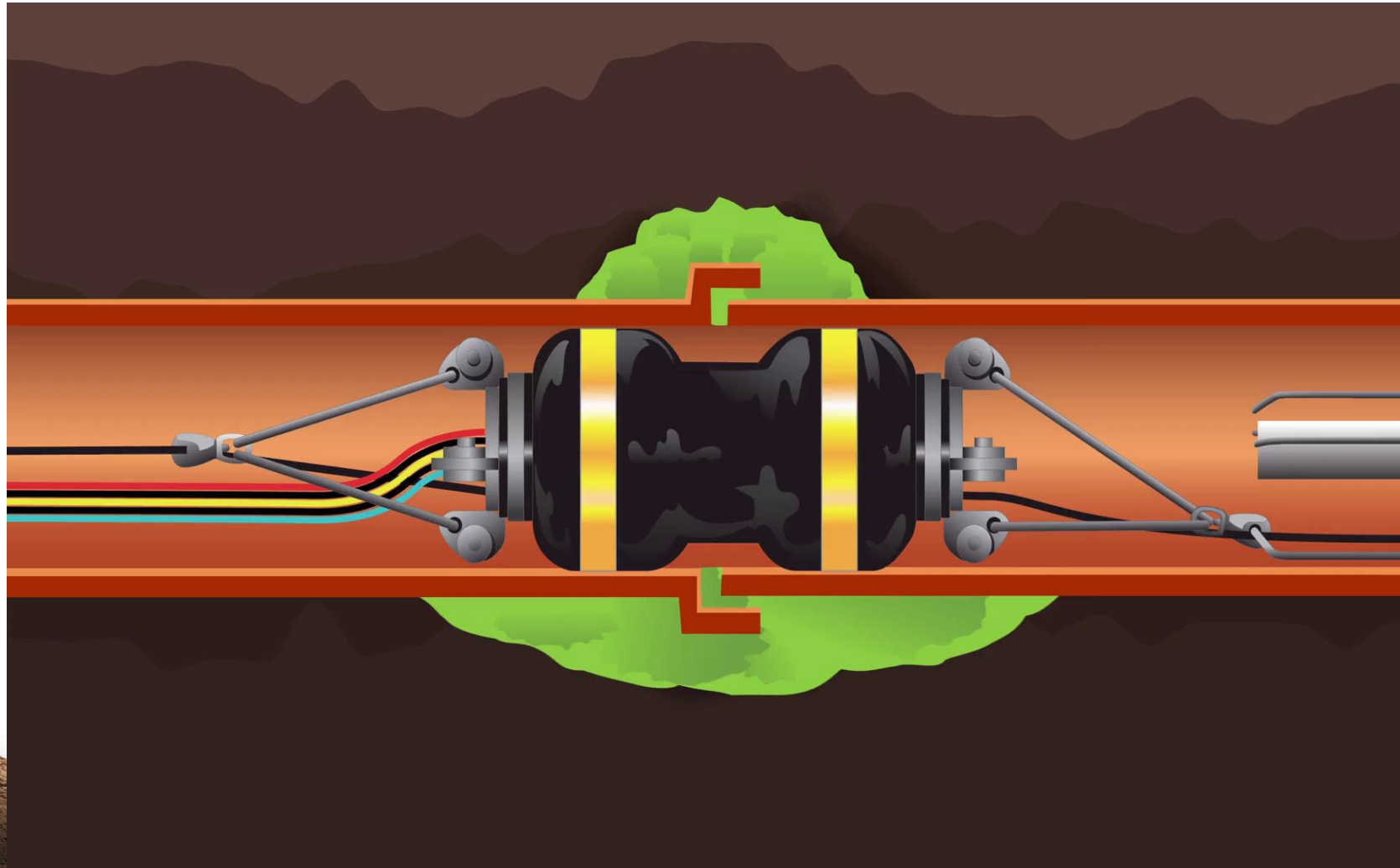
From WRc Sewerage
Rehabilitation Manual (SRM)
V4 - App F

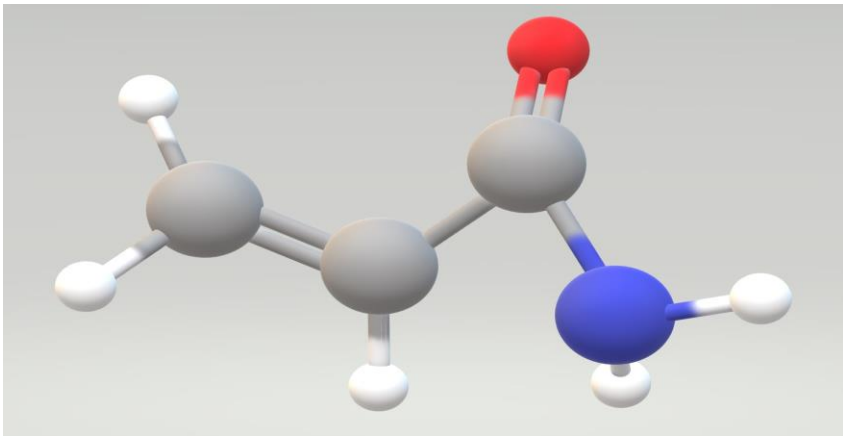
The Stabilization Process



The Process of Sewer Packer Grouting

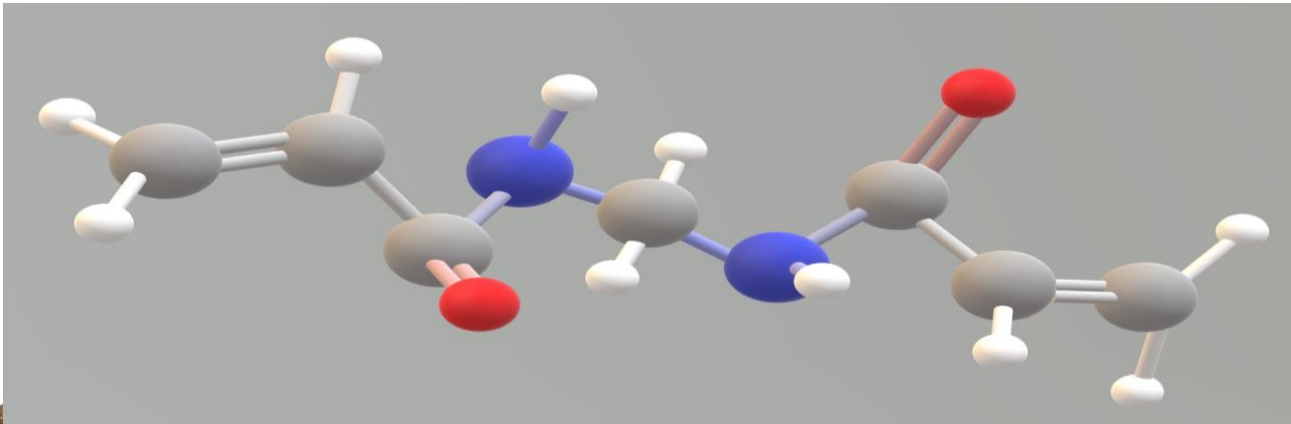
- Center Packer Upon Joint
- Perform Air Test
- Predominately Injection of Acrylamide Grout to Exterior of Pipe
- Re-test Joint



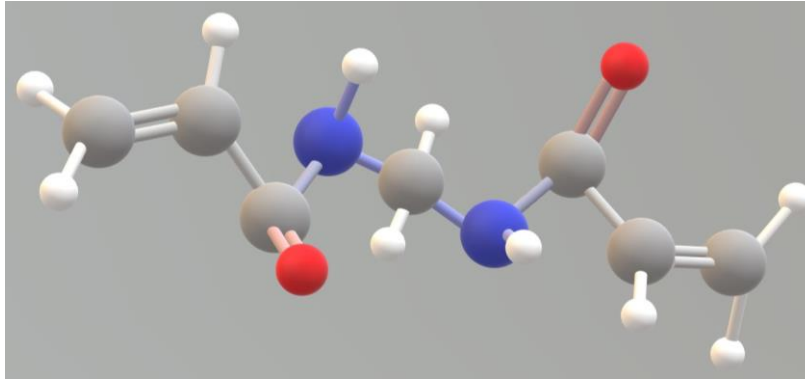
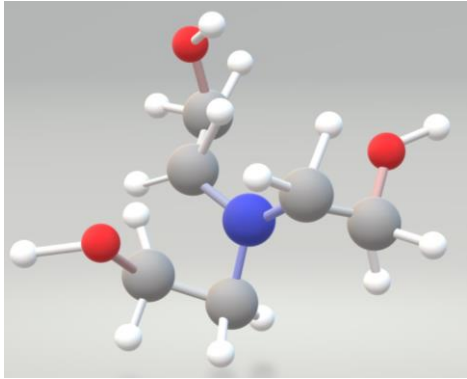


What is Acrylamide?

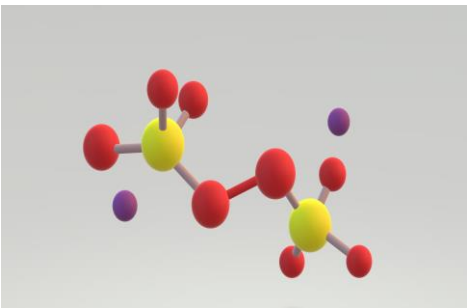
- Acrylamide is a readily polymerized amide, derived from acrylic acid.
- Most Acrylamides are found as water soluble thickeners used in wastewater treatment and also in the manufacture of permanent-press fibers.
- It can also be formed when foods are cooked at high temperatures.



3 Components of Acrylamide Chemical Grout



- Acrylamide Monomer (AM) & Methylene Bis Acrylamide
- Triethanolamine (TEA)
- Sodium Persulfate



When combined these three chemical compounds diluted in water create a chain reaction that results in a controlled gelation and the final product is inert.

The United Grouting Safe Operating Practices Program (USOPPP)

- December 6th, 1978 – F. David Magill, Jr. President of Avanti International announces the availability of AV-100 Chemical Grout along with Avanti's Safe Operating Practices Program.
- All buyers of AV-100 must certify their compliance with this program on an annual basis.
- David also encouraged companies to earnestly enforce the Safe Operating Practices.



The United Grouting Safe Operating Practices Program (USOPP)

- 1987 - US EPA begins Acrylamide exposure testing on manhole sealing projects.
- October 2nd, 1991- The US EPA proposed to prohibit the manufacture, distribution and use of acrylamide and N-methylolacrylamide (NMA) grouts after measuring exposure levels to acrylamide grout. The primary concern was worker safety.
- The EPA determined that it was necessary to protect grouters from the neurotoxic and carcinogenic risks arising from significant exposures even while wearing personal protective equipment (PPE).
- The need to protect workers was understood by industry but not practiced in a consistent manner by all Practitioners

The United Grouting Safe Operating Practices Program (USOPPP)

- On January 24th, 2002, the US EPA met with the National Association of Sewer Service Companies (NASSCO) and Avanti International, the sole supplier of acrylamide grouts in the US at the time.
- The EPA informed them of their findings concerning the inadequacies of the PPE currently in use in the industry and the existence of more suitable PPE.
- At the meeting NASSCO and Avanti expressed general agreement with EPA's findings, pledged to, and took measures to incorporate the new information into their product stewardship and worker safety programs.



The United Grouting Safe Operating Practices Program (USOPP)

- While Safety Measures continued to be addressed post-2002, there was not a unified approach across industry. Many good practices evolved but there was not a consistent approach across an increasing supplier and installer base.
- To amalgamate the best of the best in Good Safety Practices into a single consensus driven resource:
 - September 2021 - ICGC began working on a Universal Safe Operating Practices document with several manufacturers, distributors, equipment manufacturers, and contractors.
 - March 2022 - The United Grouting Safe Operating Practices Program (USOPP) was released.

GROUTING UNIFIED SAFE OPERATING PRACTICES PROGRAM



Version: 1.0
March 2022



Special thanks to NASSCO's Infiltration Control Grouting Committee (ICGC) and the following individuals for the development of this document:

John Manjak – Michels Corporation
Ray Bahr PE – American Chemical Grout Company
Marc Ancill – Logiball
Britt Babcock, PE – Avanti International
Jessica Williams – Avanti International
Paul Harris – Pipeline Products
Stewart Rome – Cues
Donald Rigby – Madewell
Dennis Pivin – Aegion
Tad Powell PE – Hazen & Sawyer

Additional thanks to NASSCO's Health and Safety Committee

USOPP Topics Covered

Free Download from [NASSCO.org](https://www.nassco.org)

Recommended For:

- Grouters
- Inspectors
- Municipalities
- Personal Safety:
 - PPE
 - Respirators / Cartridges
 - Chemical Protective Clothing
 - OSHA Requirements



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USOPP Topics Covered

- Transportation:
 - DOT Placards
 - Proper Storage and Transportation
 - OSHA Hazard Warning Systems
- Grouting Best Practices
- Additives

Online Testing Now Available on the NASSCO Training Source



Advance your career by becoming a certified professional.



NASSCO's Grouting Unified Safe Operating Practices Program (USOPP)
ID: E-E046P1
Language: English

CHEMICAL GROUT SAFETY EXAM

Price

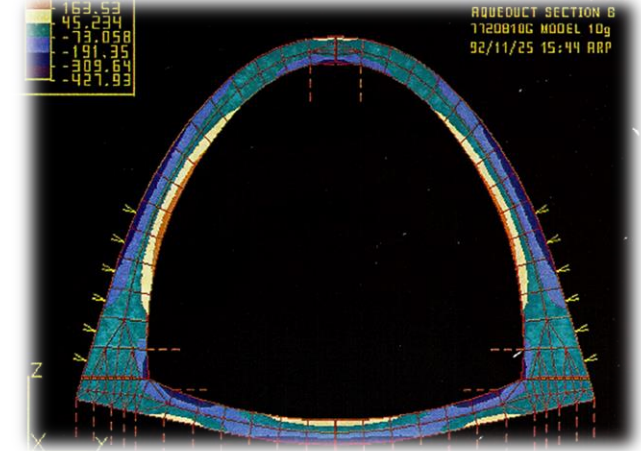
\$ 50.00

ADD TO CART

ABOUT THIS COURSE CONTENT

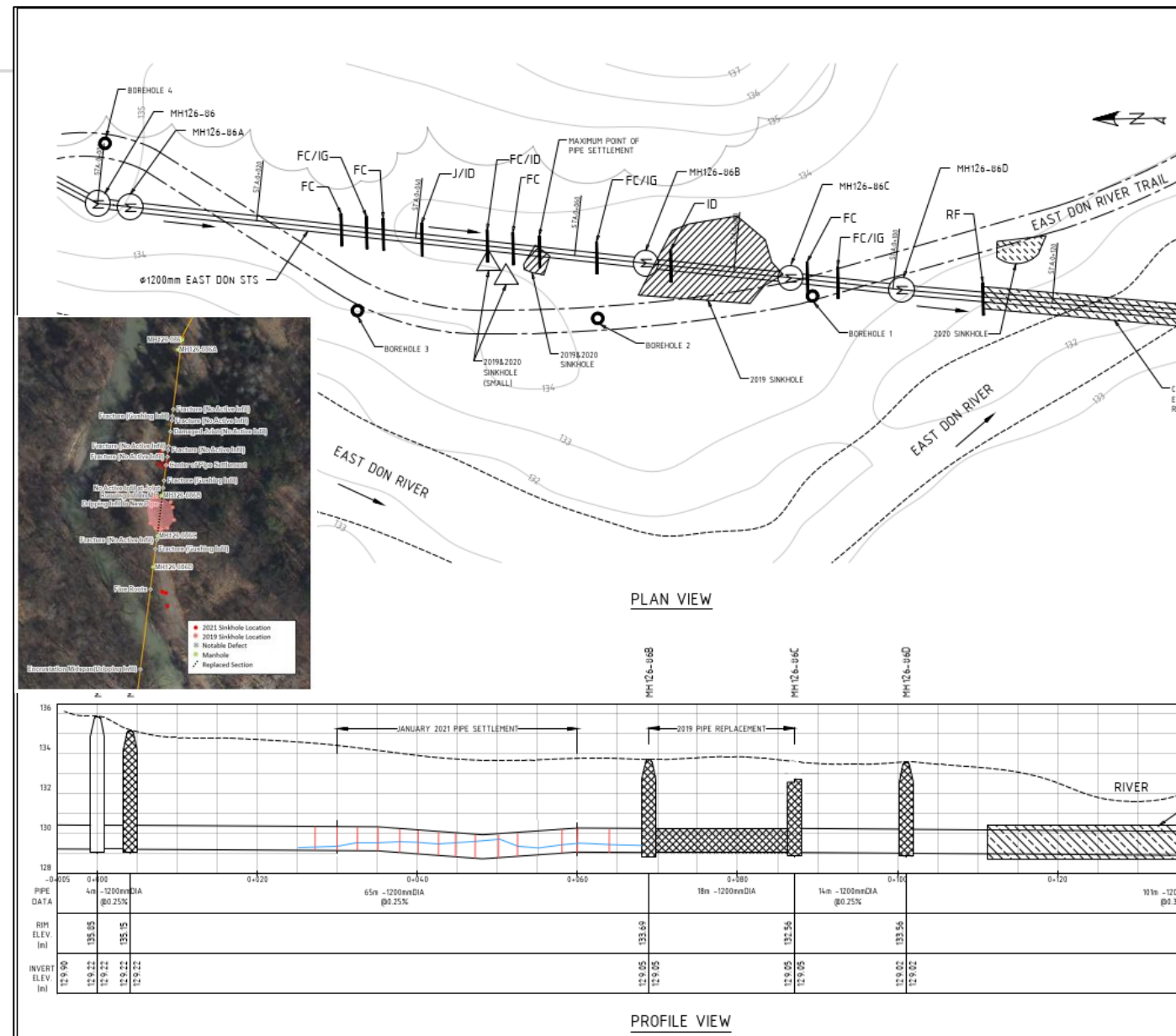
This course is a critical step to ensure the safe handling of chemical grout used in the rehabilitation of underground infrastructure. Successful completion of NASSCO's Grouting Unified Safe Operating Practices Program (USOPP) Exam demonstrates that a student has a basic understanding of knowledge to help protect employees and the environment from potential hazards associated with the use of chemical grouts. The student will read and understand the USOPP Specification developed by NASSCO's Infiltration Control Grouting Committee (ICGC) prior to taking the Exam. An 85% pass rate is required for successful completion and recognition of knowledge.

Stabilization Grouting – Goes beyond pipe joints alone, and grout mixtures can be very innovatively matched to the application

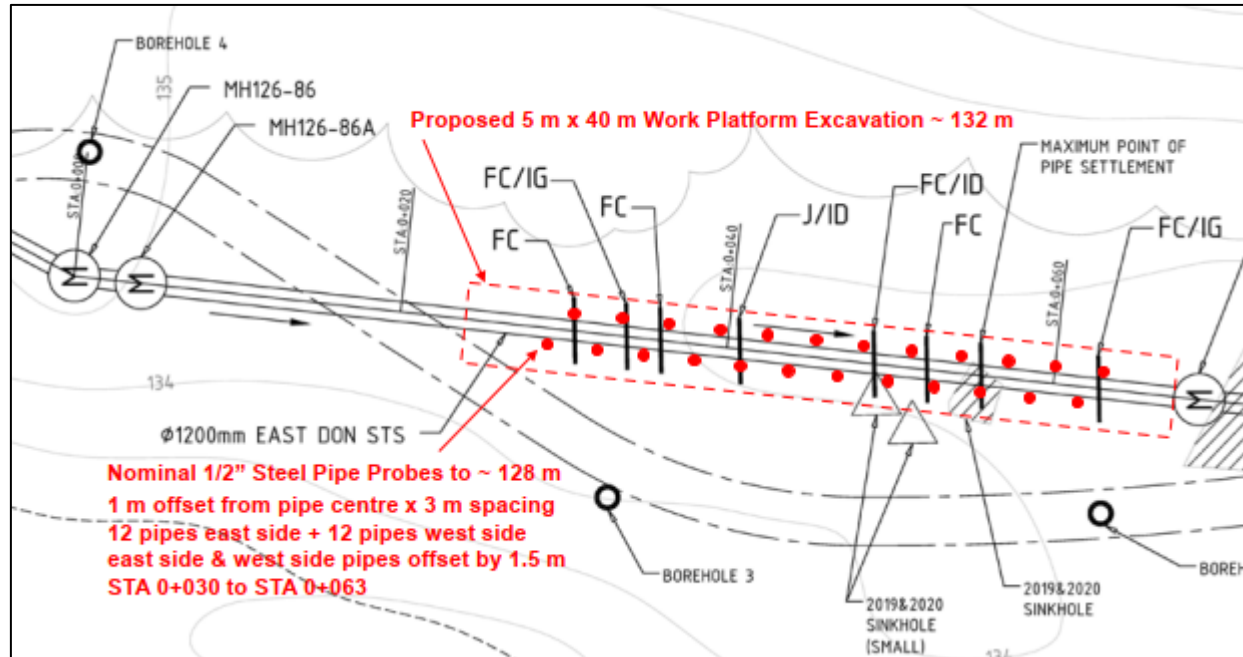


Emergency Repairs – Toronto, ON

1. External grouting for stabilization on a 48" Interceptor
 - a. Could not stop infiltration by conventional internal grouting
 - b. Soft soils and active loss of ground was creating a large sinkhole; 10-12 pipes involved and over 2 feet of settlement
 - c. Stabilized externally with cementitious grouts to strengthen soil and allow prep for a CIPP liner

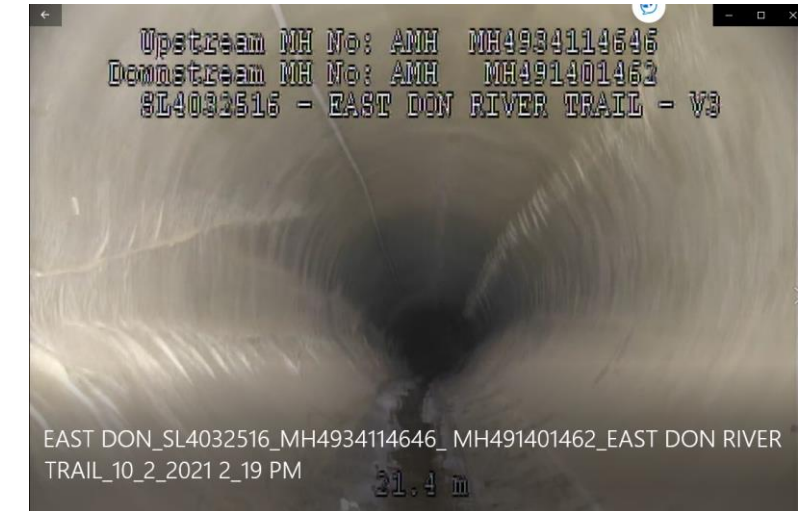


External Stabilization Facilitated a Permanent Trenchless Repair



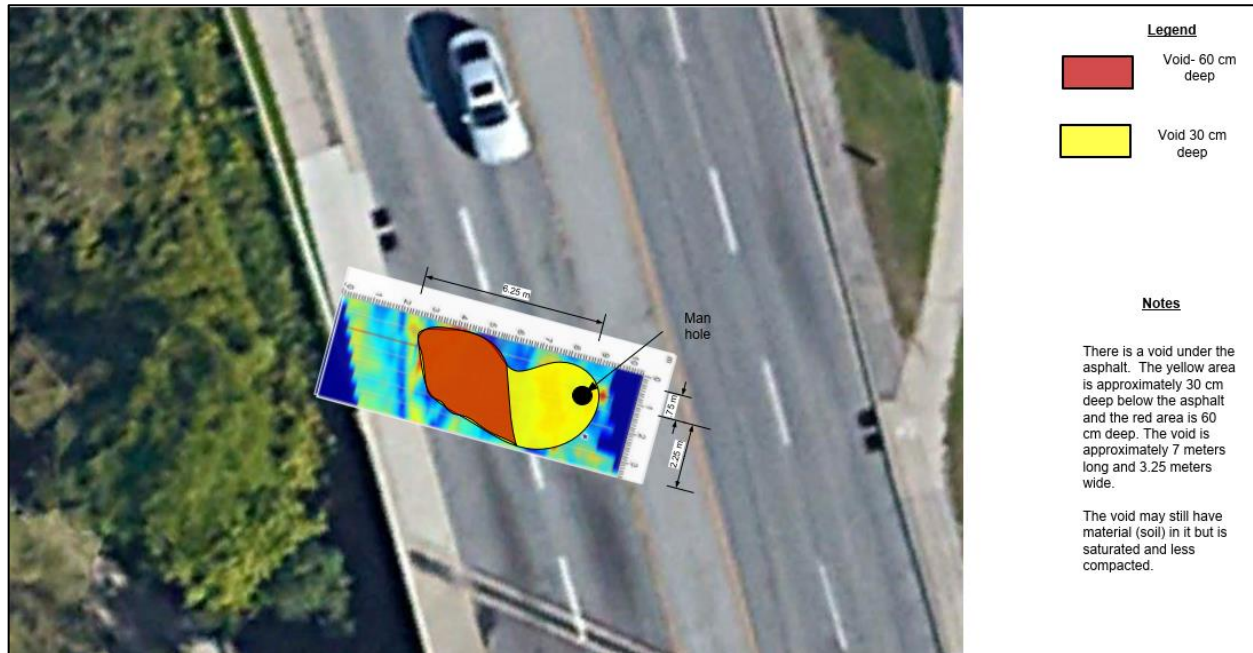
Grouting bought time and stability to:

- Avert a collapse
- Allow a relatively straightforward CIPP liner install
- Increase the strength of the soil structure around the pipe (for the long term)

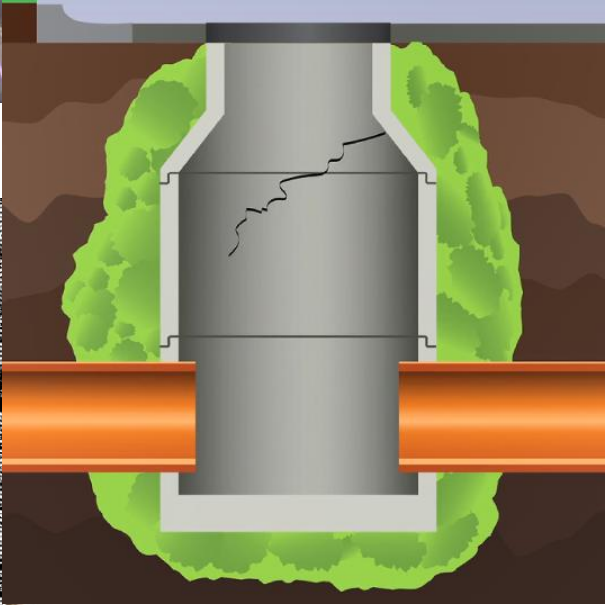
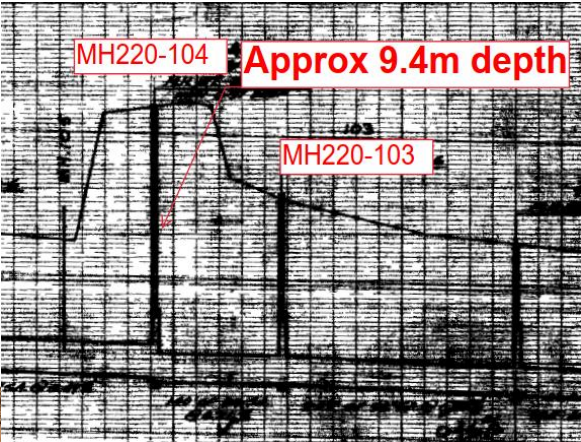
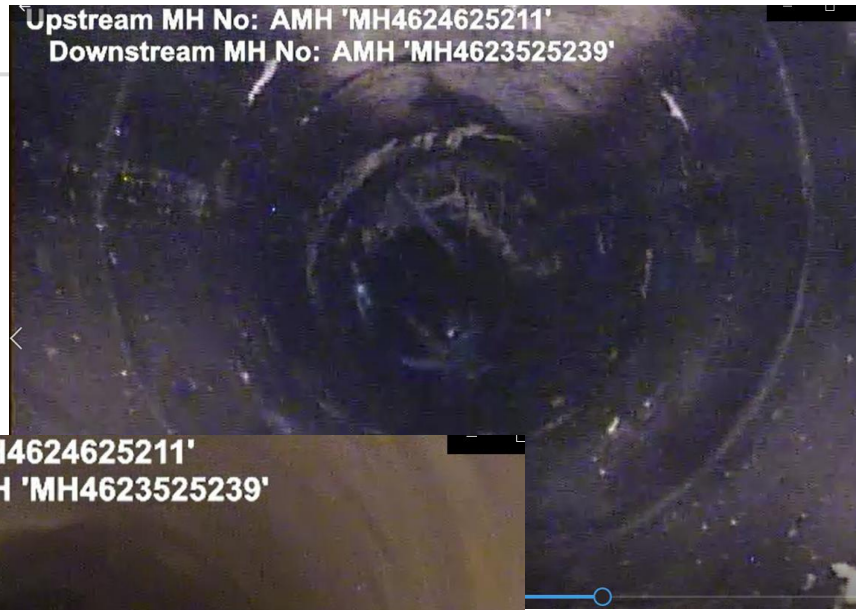
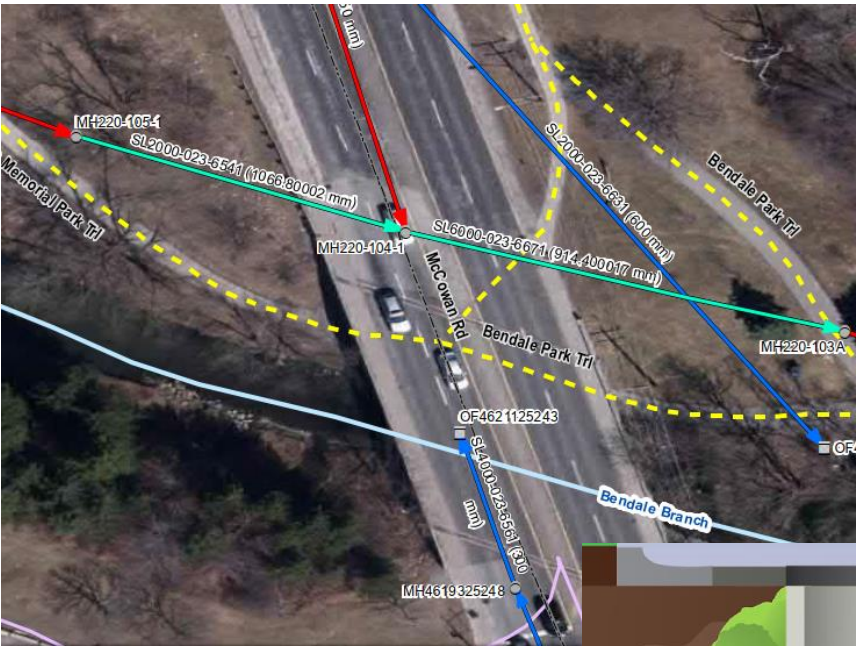


Another Emergency Repair – Toronto, ON

- Surficial depression appeared in June 2021
- MH Sunk ~ 1-2 feet and took 42" diameter pipe with it
- Engaged a slope failure that was going to take out a bridge



Polyurethane Stabilization



Grouting Test Cell Research

Origin of the Research:

- 2016 Development of Technical Specifications
- Need to document and understand the formation of gel masses within trench during packer injection grouting
- Various smaller tests were performed
- Decision reached to construct a full-scale model of an 8" pipe installation with defects which allowed for trench reconstruction and various bedding materials



Gel Injection Trials



Vary:

- Native and embedment soils
- Grouting formulations
- Grouting gel times

Formations Observed



Observe:

- Effect on different defect types
- Grout path relative to voids in various soil types
- Nature and effectiveness of stabilization

Conclusions:

- Grout Descends Below the Structure Providing a Stabilizing Cradle in Haunch Area
- Defects are Sealed with Neat Grout
- Longer Gel Times Allow for Larger Gel / Soil Matrix
- Voided Areas in Pipe Trench are Filled with Neat Grout
- Trench Dams are Created to Mitigate the Free Flow of Groundwater



Upcoming Releases

- Test Cell Whitepaper
- Sewergrouting.com Updated Website
- Webinar: Test Cell Findings - Grout Formations
- ITCP - Grout Inspector Certification Program





Q & A

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