

GREENBOOK WORKSHOP





APWA "GREENBOOK Standard **Specifications for Public Works Construction** Sections 207, 211 & 500 Trenchless Technology

Wednesday April. 25, 2024 Zoom, CA.

Presented by: Dave Badgley Representative for:

Badgley & Assoc. &



Performance Pipeline Tech.

What we are going to cover

GREENBOOK Section 500 Pipeline & Manhole Rehabilitation

> 211-2 Chemical Resistance Test "Pickle Jar test"
 > 207 Gravity Pipe materials "Good Pipes Gone Bad"
 • Uses, History, Materials, Installation Methods
 > 500 Pipeline Rehabilitation
 > 501 Service Lateral Connection & Lateral Lining
 > 502 Maintenance Hole Rehabilitation

Section 211-2 (Pickle Jar Test Standardized Liner Material Performance Evaluation

> Based on the successful completion of the prequalification chemical resistance testing per Section 211-2 (Pickle Jar Test)

> 9 Chemical solutions & concentrations

- Sulfuric acid (H₂SO₄) 20%
 - H₂S Sewer gas
- Sodium hydroxide(NaOH) 5%
 - Drano

> 112 days = 50 Year Design Life

of Common Household Sewerage p







Acids



Bases







Physical Testing

ASTM D 790 Tensile Modulus





- Weight Change Coupons
- 1 in X 3 in X 0.125 in
- 150 bars
- Weight change +- 1.5%

ASTM D 638 Tensile Modulus





- Tensile Modulus Coupons.
- Dog Bone Shape
- 50 Dog Bone Coupons
- 80% Retention of initial strength

Installation Process Standards

Process proposed by a member agency who has successfully used the process. LA City, Co DPW, San Dist. Santa Monica OCSD San Diego City, Co. Ventura Co.

Show proof of successful completion of the chemical resistance testing

Develop a specification at monthly meetings attended by: municipal engineers, test laboratory engineers, consultants, and manufacturers reps.

> Editorial committee

> Approval by the joint committee

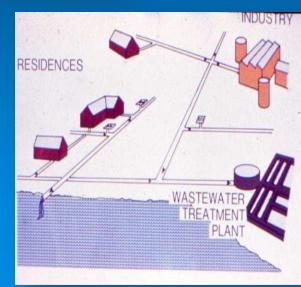
Typical Collection System Pipe



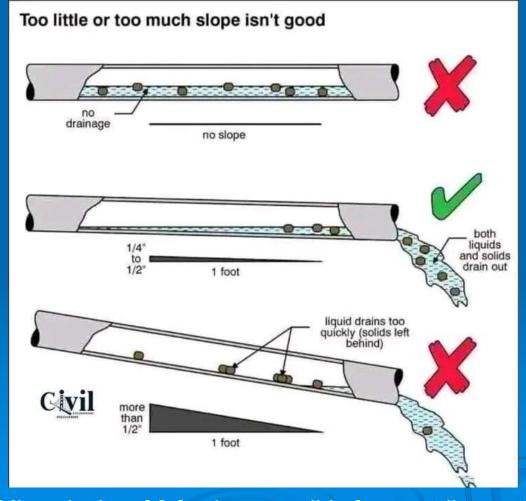
Building Sewers 2-4 inch
Lateral & Branch Sewers
4-6 inch
Main Sewers
6 12 inch
Trunk Sewers

- 15-30 inch
- Intercepting Sewers
 - 36 inch -

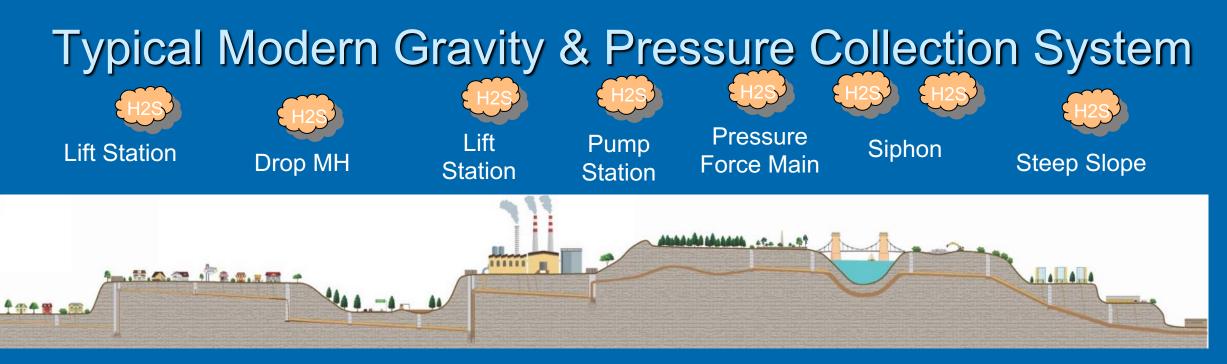




We are the beneficiaries of some really smart engineers



Min velocity of 2 fps keeps solids from settling out.



Min velocity of 2 fps keeps solids from settling out.











Pump Station





Force Main Discharge

Roots & FOG Siphon Discharge [(Grease Log)

Lift Station

Outside / Inside Drop MH How many pipelines & maintenance holes are there in the United States

- The EPA estimates that there are about
- <u>800,000 Miles of public sewers</u>
- <u>23,000 75,000 SSO happen per year</u>

Many of these assets are seriously decayed or in need of immediate rehabilitation or replacement. "EPA (October 2019)"

Major Causes of SSO Sewer System Overflows



"Grease from restraints, homes, & industrial sources are the most common cause (47%) of blockages"

•Problems that can cause SSOs include: Inappropriate materials sent to the sewers – materials such as fats, oils and grease (FOG), and some household products (including some marked 'flushable') such as baby wipes, facial wipes, sanitary pads, and tampons. All of these may create blockages,

•Tree roots entering through defects, open joints, or openings in a sewer line may cause blockages,

FOG – Fats, Oil, & Grease

Roots







Service Laterals





Main Lines

GARDEN CTTY. RV PARK 20 <- 22 Circular Binch Asbestos Cement II3.66 ft.

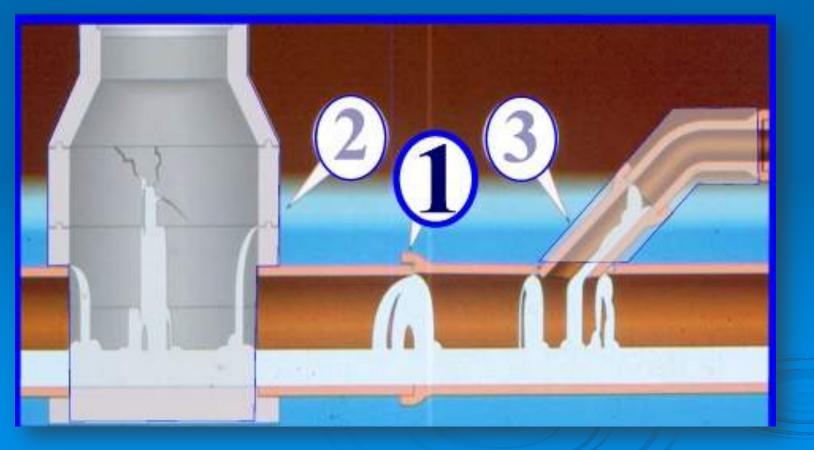
Grease attached to roots make a flow dam which causes SSO

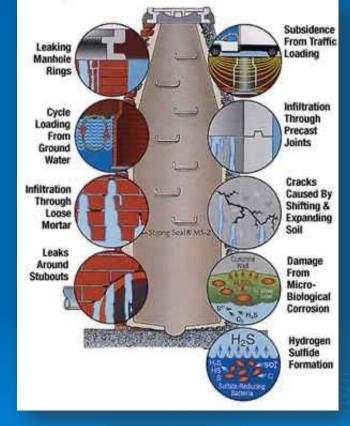
Sewer System Problem Areas

<u>1. Pipelines</u>

2. Manholes & Pump Stations

3. Service Laterals & SLC (Service Lateral Connections)





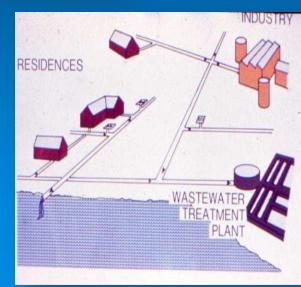
Typical Collection System Pipe



Building Sewers 2-4 inch
Lateral & Branch Sewers
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Trunk Sewers

- 15-30 inch
- Intercepting Sewers
 - 36 inch -





Classic Pipe Material Problems



Coating Failures



Concrete Failures



Metal Failures



Infiltration





Mineral Deposits



Problems



Big Problems

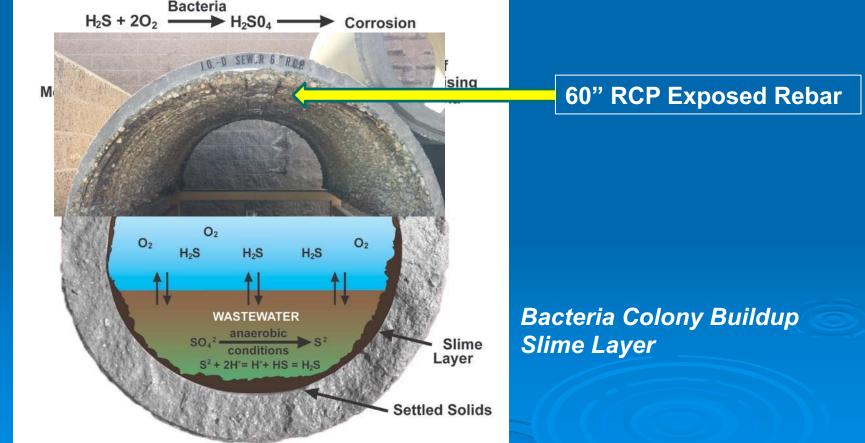
Roots

How does H₂S gas form ? Gut Bacteria Problem How tiny bacteria can destroy your sewers

3. Bacterial Corrosion Phase

2. Vapor Phase

<u>1. Liquid Phase</u>

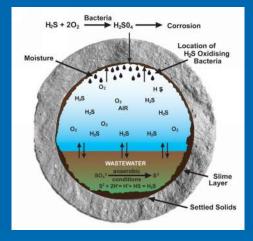


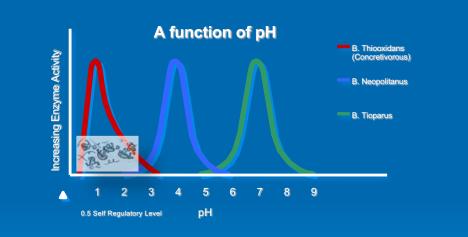
Understanding Bacterial Activity (Odor & Corrosion)

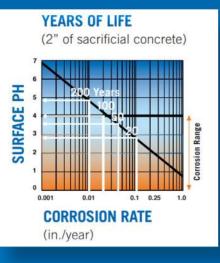
At a wall pH of 5, the MH wall corrosion rate is ~ 0.01 inch/ year

At a wall pH of 3, the MH wall corrosion rate is ~ 0.1 inch/ year

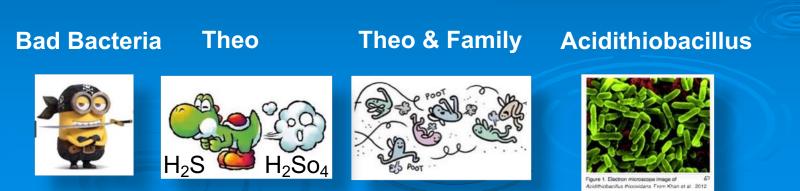
At a wall pH of 2 the MH wall corrosion rate is ~ 0.25 inch/ year







<u>"Acid i thio bacillus"</u> Thrive in and create low PH environment. They Absorb H_2S & Poop out H_2S 04 Sulfuric Acid that deteriorates concrete Structures



H₂S gas is released in the air by



Cleaning

Roots

Infiltration

Siphon Discharges



Offset Joints



Concreate & CI Corrosion

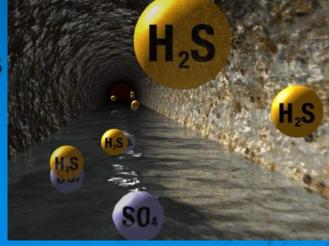


Drop Manholes



Force main Discharges

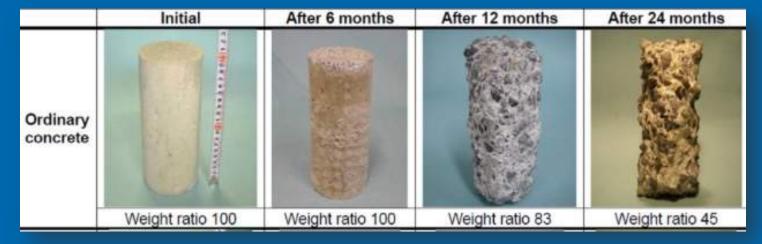
- Ineffective cleaning of pipelines
- Damaged pipes offsets
- Deteriorating Pipes
- Steep Slopes
- > Infiltration
- Poorly constructed channels through manholes
- Drop manholes
- Siphon discharges
- Force main Discharges



Debris

Roots

H₂S Corrosion of Concrete & Iron



Concrete Corrosion Testing



H₂S corrosion



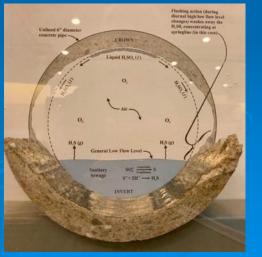
Iron MH Rusted together



Corroded Concrete MH



Corroded Concrete Behind Lining System



Corroded Concrete Pipe

FOG Grease Problems





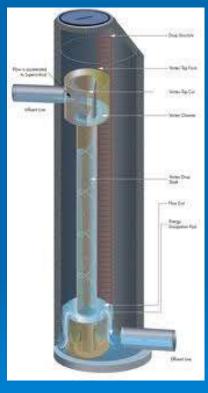


Collection System

Pump & Lift Stations

Siphons 24" 10 Feet Long Grease Log

Reducing H₂S odors & damage to a sewer collection system IPEX Vortex

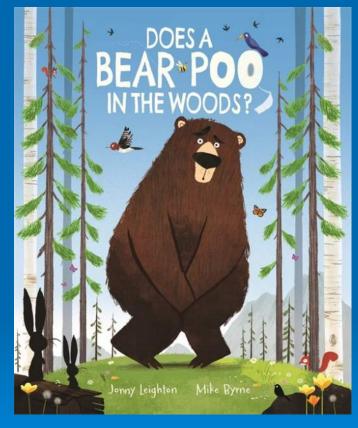






- Harnessing the power of the sewage flow and gravity.
- Like a dam's hydro electric power generator
- Install on drop structurers
- Negative pressure sucks odors down into the flow
- > Brakes up solids (FOG)
- Aerated flow at the bottom of the drop. .49

Does a Bear Poop in the woods?





l get this question all the time. Yes, I do shit in the woods

If this is true where is all of that poop now?



Mother Nature has the answer

Mother Nature

Natural soil bacteria break down the organic waste The result is that the soil is enriched & new plants grow. It is part of the natural "Circle of Life"

EnBiorganic Equipment Set up



Inside Pump Station Set

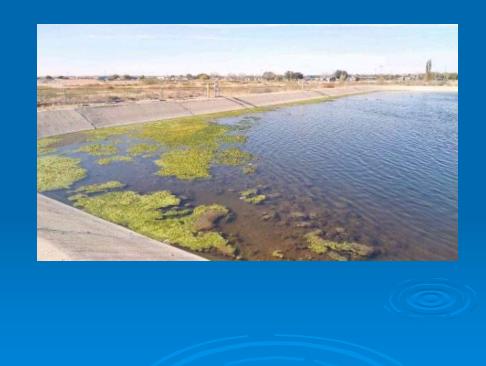


External Pump Station Set up

Sewer Pump Stations



Lakes, Ponds, Reservoirs HAB Hazardous Algae Bloom Control



Biological Augmentation EBS EnBiorganic







- Customized cultures of natural soil bacteria are developed for each location during a trial period
- The H₂S generated by odor causing gut bugs are replaced with the natural active-state bio-treatment with soil bacteria that do not make H₂S gases
- Automated biological generator w/ remote controlled monitoring.
- > The active bacteria double in volume every 1/2 hour
- Wet Well dosing reduces H₂S, FOG, neutralizes Ph, degrades wipes, & promotes WW pretreatment starting in the collection system
- Helps keep force mains & siphons fog & odor free

CMP Pipe Problems



Missing Bottom

> Deteriorated bottom
> Open joints
> Deteriorated sides
> Structural problems



Open Joints







Structural Problems

Concrete Pipe Problems



Ovaled Pipes

- > Ovaled pipe
- > Open joints
- Structural cracks
- > Exposed rebar
- > Eroded bottom channel



AC Asbestos Cement Pipe





Sheets of Asbestos pealing off



Glass Lined AC Pipe (Epoxy Coated)



AC Water Pipe Blow Out

Where is concrete used in a sewer system

Old clay pipe concrete joints



Concrete & AC pipe



Brick pipe & MH



Concrete & brick structurers











Classic Pipe Joints

Pre 1958 Top of Pipe Joint Grouted







Bottom of pipe joint No mortar



Grout in joint



Tar Joints Pre 1955



PVC Joint – mid 1958 – mid 1967

Joints are the weak link in underground piping systems



Trenchless pipe liners solve this problem in two different ways

1 Some are seamless, Jointless, corrosion resistant, solid wall pipe liners that have a tight molded fit.

2 Some are jointed, corrosion proof, with the annular space between the outside of the liners and the host pipe which is filled with a structural or non-structural cementitious grout.

Pressure Pipelines Potable Water & Sewer Force Mains



.30 - .6.4

Pipe Problems = Road Problems Build Roads on A Solid Foundation



Water Main & Sewer Breaks = Collateral Damage to Other Utilities and the Roads Above

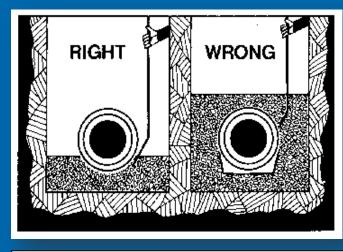


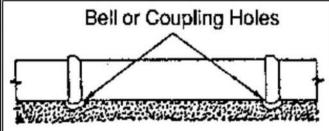
Road Culverts Fail & Wash out Roads

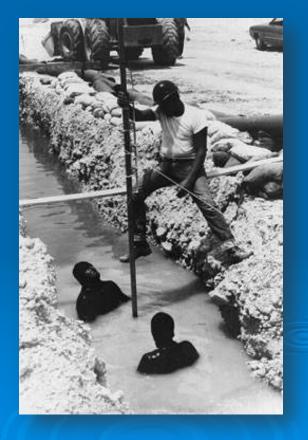


New Installations Workmanship is Important









Challenging Locations

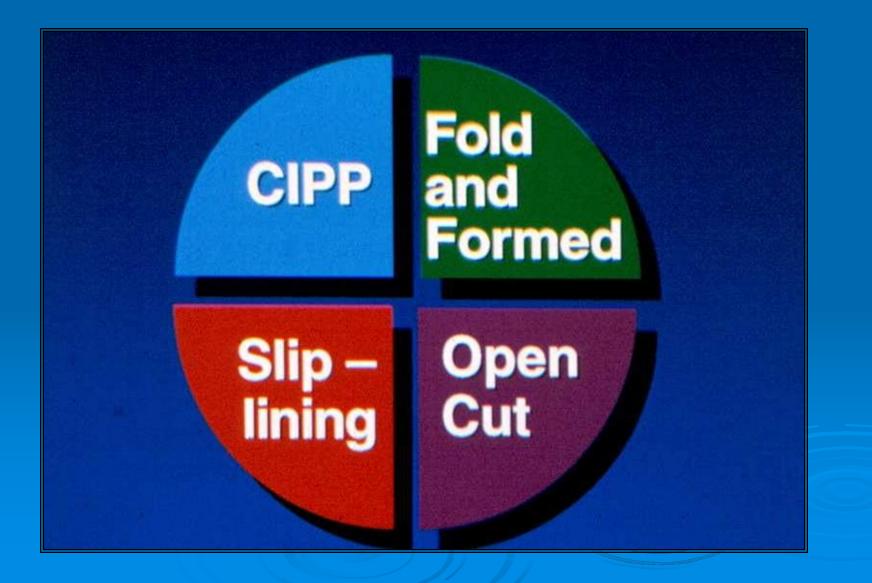
A Toolbelt of Trenchless Solutions



Tool Belt of options of Trenchless Pipe & Maintenance Hole Rehabilitation solutions

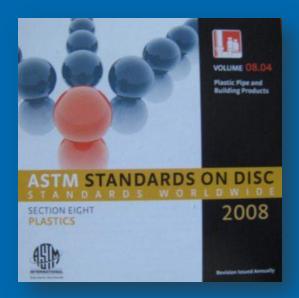
Gravity or Pressure Diameters 4" to over 200" Trenchless Rehabilitation options for most municipal sewer, storm drain, road culvert, water applications > There is no silver bullet that solves all of the problems

Four general styles of replacement

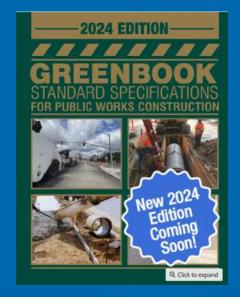


Material & Installation Standards

International



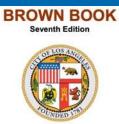
State or Regional





California "GREENBOOK" Standard Specifications for Public Works Construction

Local



CITY OF LOS ANGELES DEPARTMENT OF

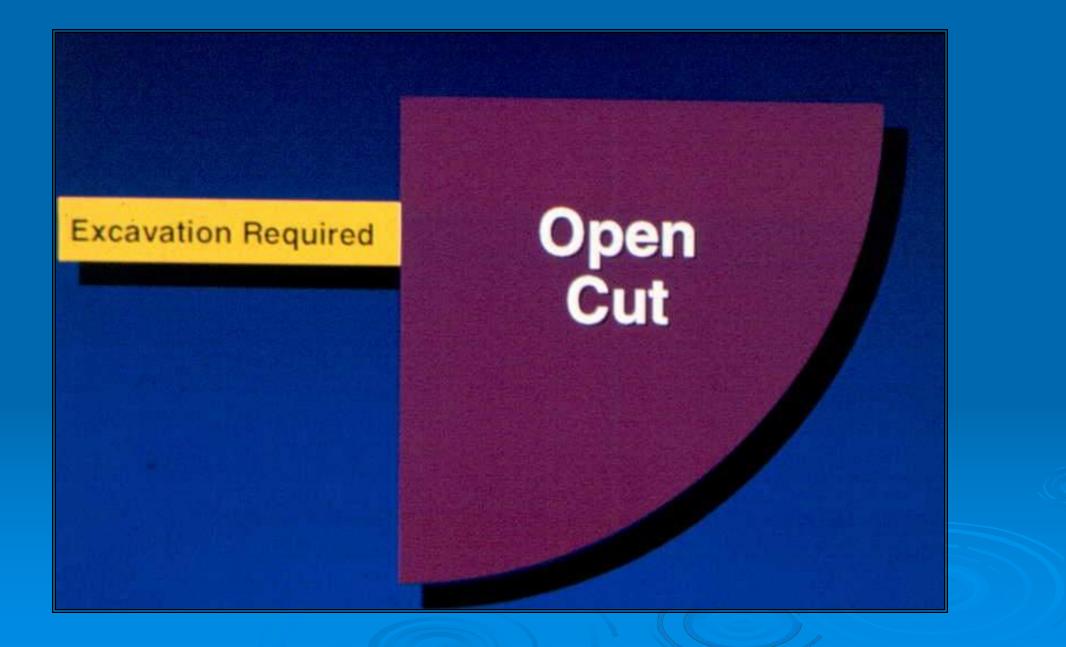
PUBLIC WORKS

ADDITIONS AND AMENDMENTS TO THE 2012 EDITION AND 2014 CUMULATIVE SUPPLEMENT TO THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

Local Standards City of Los Angeles "BROWN BOOK"

ASTM

American Society of Testing Materials



Traditional Dig and Replace Problems May take weeks or months to complete Cost overruns / Change orders



Traffic Disruption



Business Disruption



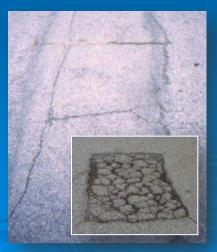
Conflicting Utilities



Broken gas lines



Broken phone cables



Shortens life of pavement



Other Utilities

Contact 811 Before You Dig may share your work area

Call other utilities early to coordinate their repairs

Other utilities may include:

- Sewer
- Water May be multiple co.
- Storm Drain
- Gas
- Cable
- Telephone
- Power
- Street lighting
- Private Easements





Shallow 5KV street lighting

Cleaning & Inspection Tools



Equipment used in tandem







Water Jet Cleaning





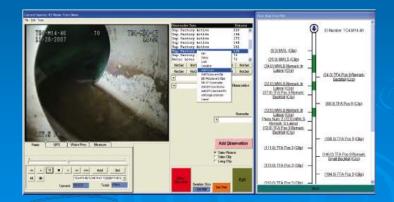








Hydraulic powered Winches Buckets, Porcupines & Scrapers



Computer Software Standardized NASSCO Coding









Styles of CCTV Equip

Specialized Cleaning Equip Water Saving, Easements, & Local Sewers Access









Smaller Combo Trucks ³/₄ hose 40 gpm 2,500 psi





Smaller European Style Jetters 5/8 hose 18 gpm 4,000 psi





Mobile Hose Reel Easement Machine

Specialized Cleaning AC Asbestos Cement Sewer Pipe



Work area covered, MH sealed around hose and vacuum. Jet hose wash down system



Debris in 100 micron tank filter were cleaned and bagged by asbestos crews



All liquids were filtered in roll off 100 micron filter



Debris tanks were hand cleaned and bagged by certified asbestos crews



Secondary filters 50 & 5 Micron Water Sampled & Tested



Bagged, Sealed, Taken to Special landfill

Specialized Cleaning Multi Function Self Propelled Robotic Cutters







CCTV Inspection – Front & Rear Facing Cameras



Grabber - Tool



Milling Machine - Tool



Chisel -Tool



High Pressure Water Jet - Tool

Specialized Cleaning Hard Deposits Self Propelled Robotic Cutters Size ranges 6 to 38 inch

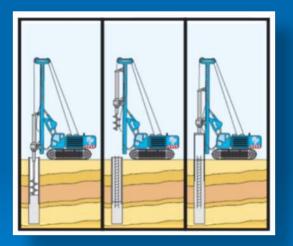






Removing Concrete from Lined Storm Drain

Lined pipe damaged by an auger drilling a hole for a casing and filling the hole with concrete













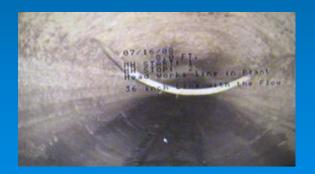
Removing Heavy Deposits



Mineral Deposits



Blacktop Paving or Rocks used in Backfill



Failing Pipe O-Ring Joints



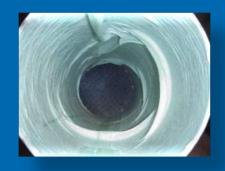
Tuberculation in CI Pipe



Concrete



Removing Trenchless Pipe Liner Problems







Wrinkles & Fins











Resin Slugs



Failed CIPP Spot Repair installations Ambient Cure Resins

Specialized Cleaning Multi Function Self Propelled Robotic Cutters







CCTV Inspection – Front & Rear Facing Cameras



Grabber - Tool



Milling Machine - Tool



Chisel -Tool



High Pressure Water Jet - Tool

Chisel Tool







Water Jet Up to 40,000 PSI





4 jet rotating nozzle – 45 Degree





Grabber





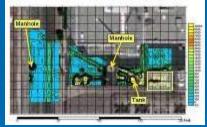
.27

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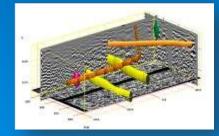
New Condition Assessment Tools

3D GPR





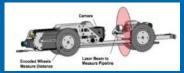
2 D View



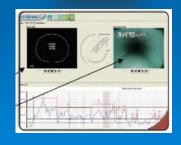
3 D View

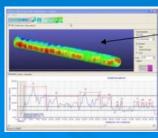
Small Dia. Laser









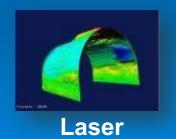


CCTV Laser Sonar











Man Entry



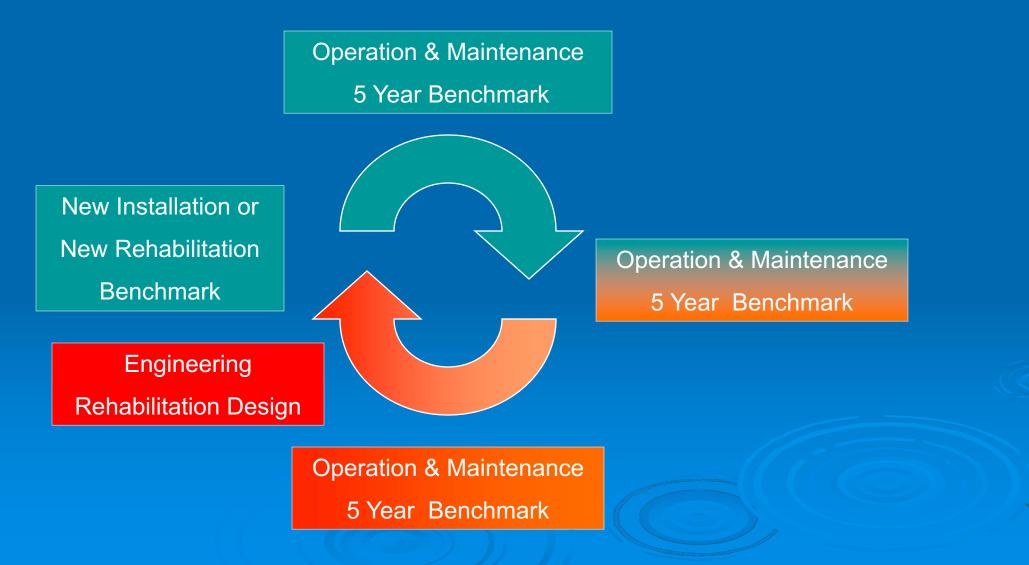


19" Access

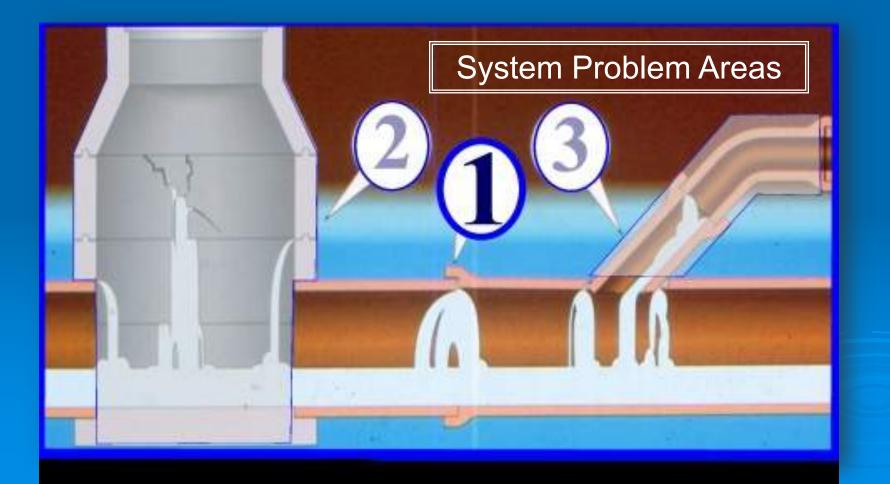


Carts Core Sampling

Pipeline Condition Assessment



Sewer System Problem Areas
 500-1 & 3 *Pipelines Gravity & Force Main* 500- Manhole & pump stations
 500-4 Service Laterals & SLC (Service Lateral Connections)



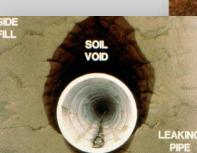
The Process of Sewer Failure

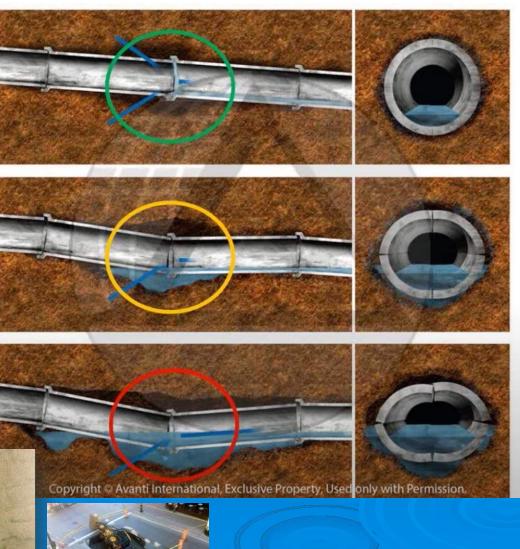
Stage 1: Initial defect, but sewer remains held in position by the surrounding soil.

Stage 2: Development of zones of loose ground or voids caused by the loss of ground into the sewer

Stage 3 Failure of the sewer pipe.







History of Trenchless Pipeline Rehabilitation

> 1960 Chemical Grouting > 1970 Continuous HDPE Sliplining > 1980 Cured-in-Place > 1990 Segmented Sliplining > 1990 Folded-and Reformed

Custom Designed Liner Thickness

Review Video Inspection



Job site inspection for constructability



Easements

Design

Design thickness per the Formula specified in ASTM F1216 for classic style CIPP or F2019 for UV Cured Fiberglass reinforced liners based on Marston's formula for

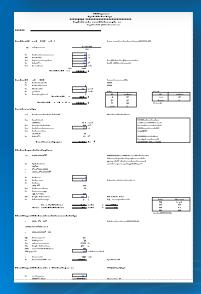
flexible pipe Required host pipe design data

- Depth
- Diameter
- Fully or partially deteriorated host pipe condition
- Oval deformation
 - Default 2%
 - Actual measured by laser profiler inspection
- Backfill Soil type
- Height of ground water above pipe
- Traffic loading
 - Truck
 - 2 truck passing
 - RR
 - Airplanes
- Safety factor (default 2)

Liner material properties

- Long term modulus of Elasticity (1/2 of short term)
- Initial modulus of elasticity





- · Calculated min wall
- thickness
- Recommended wall
 - thickness
- SDR
- Flow Calculation

Preparation Work Before Lining



Deteriorated Bottoms



Protruding Laterals



Severe Offsets



Large Voids





Gas Line Bored Trough pipe

Crushed Pipe

Trenchless Spot Repairs

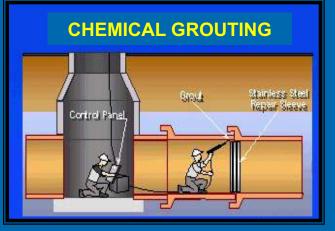
Chemical Grouting
 Mechanical Spot Repairs

 Expanded Sleeve Small Diameter
 Expanded Sleeve joint Seals Large Diameter

 Fiberglass Reinforced CIPP Spot repairs

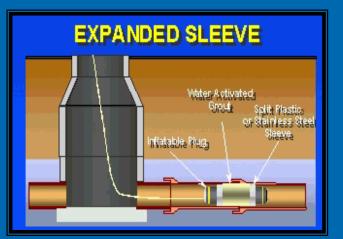
 Overlapped Expandable Wrap Style UV Light Cure

Short Length Repairs Options

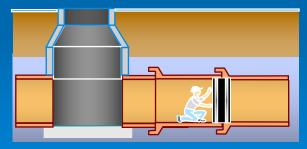


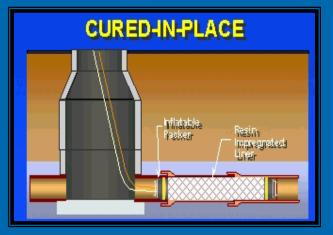


Chemical grout joint seal



Mechanical seal 2' – 3'





Cured-in-Place 2' to 50'

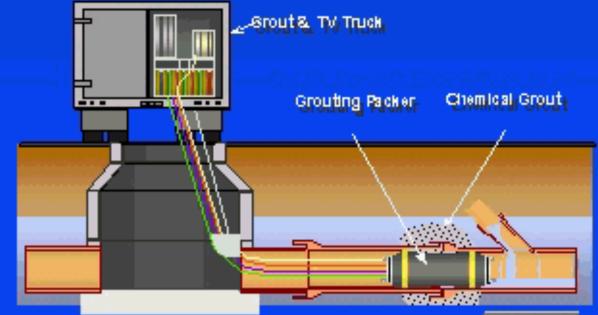
Mechanical joint seals 18" to 218" (Over 18Ft.) Diameter.

Shapes - Round, Elliptical, Box

Pipe Liner End Seal, Expansion Joint Repair

Chemical Joint Grouting NASSCO

JOINT GROUTING



Applications	Sewer	Storm Drain	Road Culverts
Size Range	Lat 4 -6	Main Line 8 4 <mark>2</mark>	Man Entry 48 <
Bypass	Low Flow		







Infiltration Aqua Seal Installation Procedure





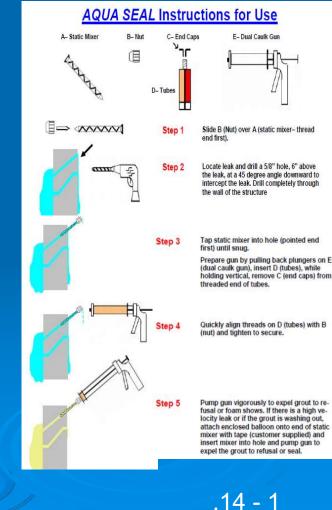




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Main Line Chemical Grouting





Infiltration Pipe backfill washing inside the pipe











Figure . NASSCO Groating Test Gell - Groat Seil Shape differences based on Gel Tin



Chemical Grouting



https://www.avantigrout.com/component/zoo/item/sewer-grouting-mainline-sewer?Itemid=101 1.09

Orange County San Chemical Joint Grouting Project 24",30",36" VCP <u>Equipment</u>







Grouting Packer Equipment Installation & Placement



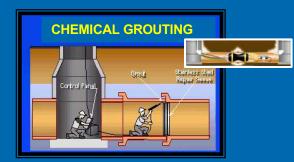




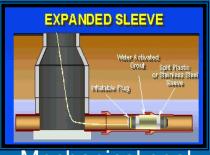




Short Length Repairs Options

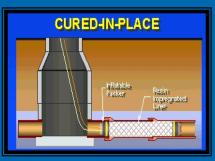


Chemical grout joint seal

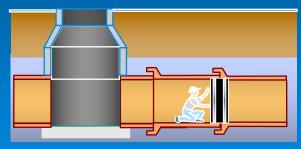


Mechanical seal

2' – 3' long



Cured-in-Place 2' to 50' long



Mechanical joint seals 18" to 218" (Over 18Ft.) Día **Shapes** - Round, Elliptical, Box

Pipe Liner End Seal, Expansion Joint Repair

Small Diameter Mechanical Spot Repairs SS Sleeve EPDM Rubber or Chemical Grout Seal



Dig & Replace **Point Repair**

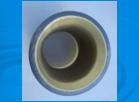


Chemical Grout Seal



Chemical Grouting Seal









EPDM Rubber Seal





EPDM Rubber Seal



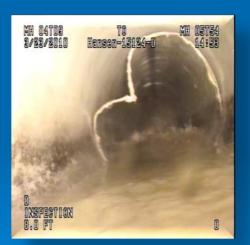


Small Diameter **CIPP Point & Spot Repairs**

Trenchless CIPP Spot Repair Small Diameter



Inversion Style CIPP Felt

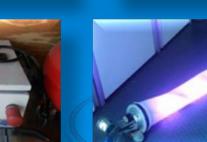




Burrito Wrap Style Felt or Fiberglass

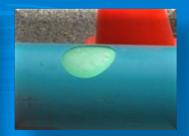
Failed CIPP Spot Repair installations Ambient Cure Resins











Cured-in-Place Spot Repair Fiberglass Reinforced UV Cured

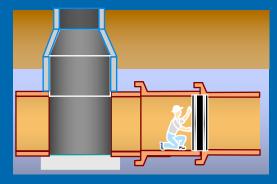
6" to 30" CIPP



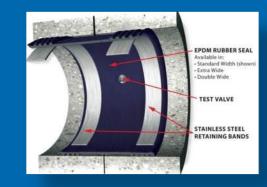


Large Diameter Man Entry Mechanical Spot Repairs HydroTit 16"-18 ft.

Man Entry Installation



Joint Seals



Rubber Seal



Installation Tool



Man Entry Pipelines







Installed Joint Seals



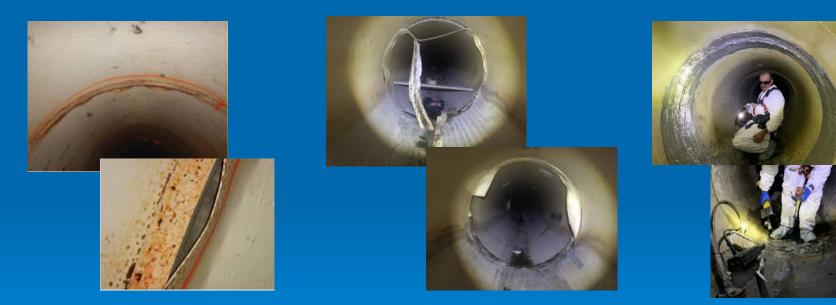


Sleeving

Installation

Individual Joint Repair

PVC Liner Joint Failure Joining dissimilar pipe materials



120" Inner Plant Pipeline Failed PVC Joint Welds 60" Trunk Pipeline Failed PVC Joint Welds Transition from 60 inch CIPP Liner to New PVC Pipe

Case History OCSD Sewer Ocean Outfall Bypass Pipe



Ocean Outfall Pipeline



Access Structure



Expansion Gauge



Chemical Grouting



Joint Seal Installation



Installed 60 & 62 inch Seals

Case History City of San Diego Rose Canyon





Failing 60 inch T-Lock Pipe Liner joints- 5 miles







Remote Environmentally Sensitive Area

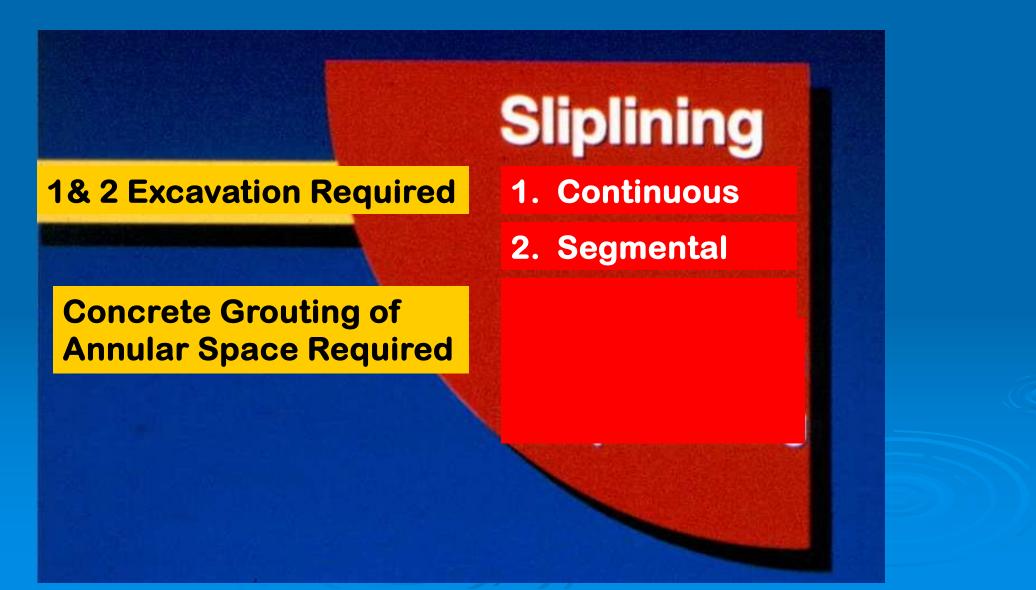


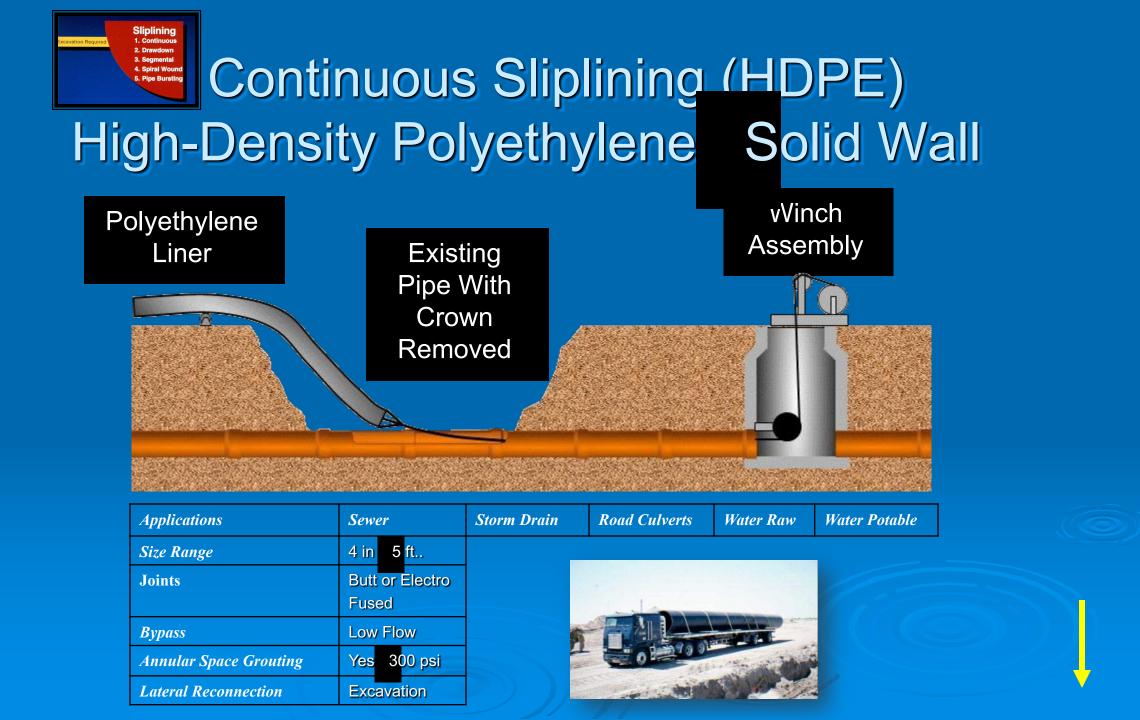
Installation



Installed Joint seals

Sliplining Options







Heat Fused









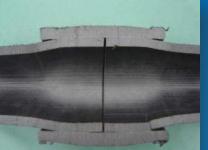


Joints

Electro Fusion







Extrusion Welding















Case History HDPE Solid Wall Continuous Sliplining

Irvine Ranch Water District, 12 inch Water line, Lined with 8 inch solid wall HDPE Pipe





Pipe Problems





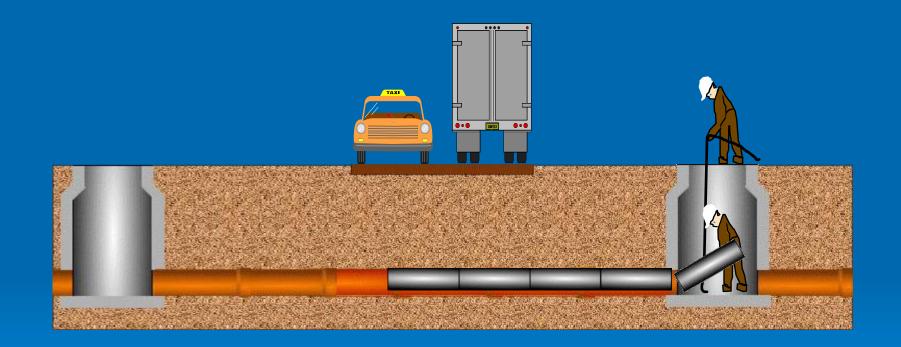








Segmental Sliplining



Applications	Sewer	Storm Drain
Size Range	12 " to 12 ft.	
Bypass	No	
Annular Space Grouting	Yes 300 psi	
Lateral Reconnection	Excavation	



Snap Joint



Thread Joint

Threaded Joints

How to Join Threaded Weholite Pipe for Culvert Sliplining Applications

https://www.youtube.com/watch?v=64bq7aB7rrU&t=10s



Case History Section Slipliner





















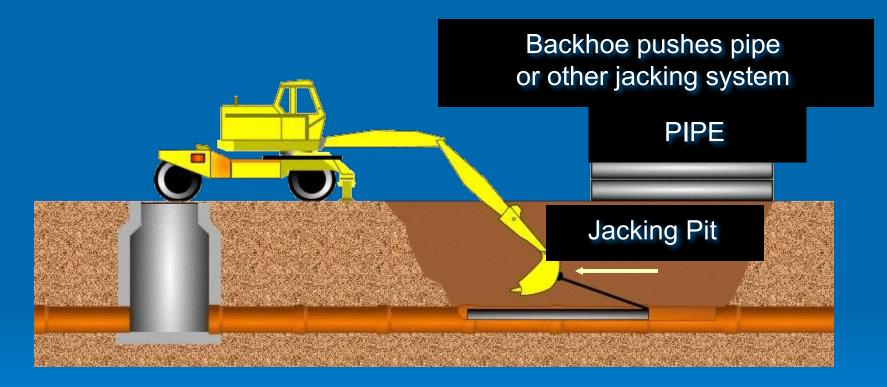








Sectional Sliplining



Applications	Sewer	Storm Drain	Road Culverts	Water Raw	Water Potable	
Size Range	18 inch to 12 ft.					
Bypass	No					
Annular Space Grouting	Yes 300 psi					
Lateral Reconnection	Excavation					



Sectional Sliplining Options

> 500-5-4 HDPE Solid-Wall Pipe Liner

> 500-5.8 Centrifugally Cast Fiberglass Reinforced Plastic Mortar (CCFRPM) Pipe. (Hobas & FlowTite)

> 500-5.11 HDPE Spirally-Wound Profile Wall Liner Pipe (Spirolite & Weholite)

> 500-5.12 Polyvinyl Chloride (PVC) Pipe Lining System. (Vylon)



Sectional Liner Pipes



Large Diameter Pipes "12 ft."



Long lengths up to 40 lf









Flush Style Joints

Custom Shapes



Installation Pits & Cleaning



Concrete Lined Pit



Cleaning Mandrel

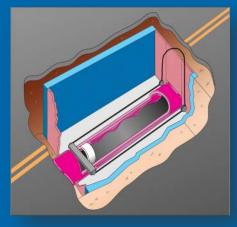


Lining Without Mandrel Cleaning

Installation Methods



Excavator With Plate



Cable style Pusher



Hydraulic Pusher









Installation Video





2 inch wall loss in 40 Years

Cleaning Mandrel 30 inch X 15 ft. Proofing Mandrel 37 X 15 ft.









Case History Davis Ca. 4,757 ft. Single Pit 36" in 42"





1,750 ft





Flow

3,000 ft

Staging the Pipe 318 sections of 36 X 15ft.

Pit



Restraining Cable











Case History Davis Ca. 4,767 ft. Single Pit 36" in 42"

1,767 ft



3,000 ft

Flow

















Manhole lining

Case History IEUD Line under major Hy & RR tracks





















Case History Sectional Slipliner Road Culvert















Annular Space Grouting GREENBOOK Section 500-7

Annular space grouting between the host pipe and the outside of the continuous HDPE or sectional slipliner systems with light weight 300 psi non-structural concrete.

Max allowable weight per cubic foot 3 lb.



Annular Space Grouting Light Weight Grout Mix 300 psi



Foam generator



Foam / Concrete Grout



Down stream burp tube



Grout applied from upstream side











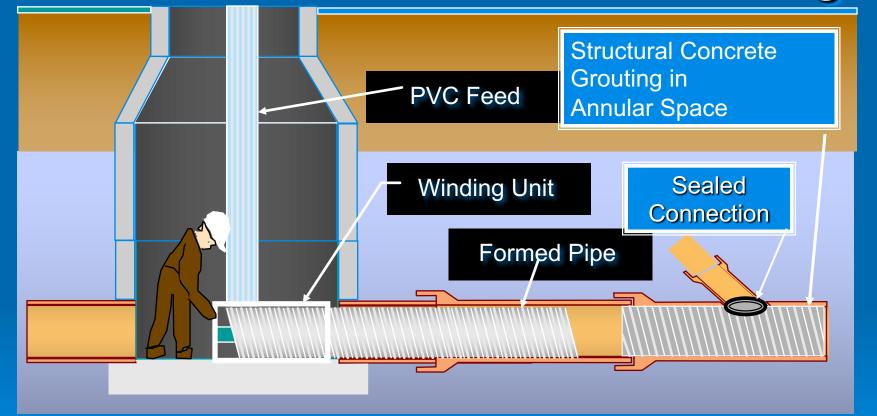
Sliplining Machine Spiral Wound Small Diameter Lining

> 500-6.6 Polyvinyl Chloride (PVC) Pipe Lining Systems (Danby Panel-Lok & Twin-Lok)

> 500-5.13 Machine Spiral Wound Polyvinyl Chloride (PVC) Pipe Liner (Danby Twin-Lok) (Rib-Loc)

Sliplining Machine Spiral Wound Small Diameter Lining

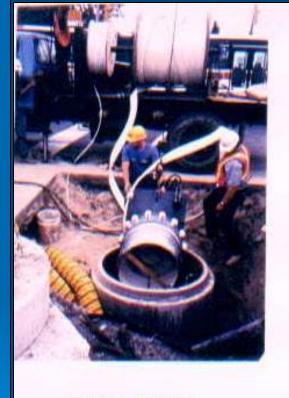
Sliplining 1. Continuous 2. Drawdown 3. Segmental 4. Spiral Wour 5. Pipe Burstin



Applications	Sewer	Storm Drain	Road Culverts
Size Range	6 <mark>30</mark>		
Bypass	Low flow		
Annular Space Grouting	Yes 5,000 psi		
Lateral Reconnection	Excavation		

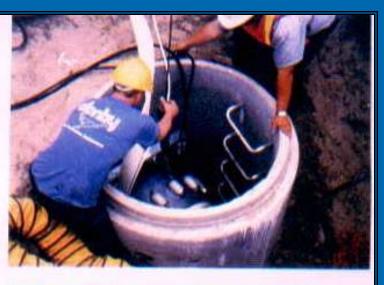


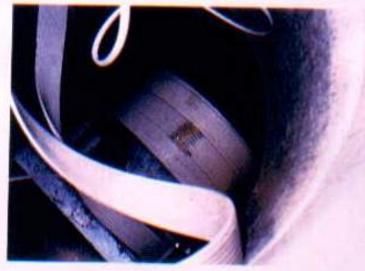
Machine Wound 8-30 Inch



Ottawa Ontario 30° RCP Sewer Danby Twin Lok June 1992











Annular Space Structural Grouting GREENBOOK Section 500-7





- Gap at lateral connection
- Lateral connection after grouting per ASTM F 1741
- > 5,000 psi structural concrete
- Concrete grout is used to fill irregularities between the back of the liner and the host pipe
- > Grout covers T-locks & joints
- Exposed concrete grout needs corrosion barrier
- Grouted liner provides a tight molded fit



Sliplining Spiral Wound Large Diameter Lining

> 500-5.6 Polyvinyl Chloride (PVC) Pipe Lining Systems (Danby Panel-Lok)





Panel-Lok 36-Inch & Larger



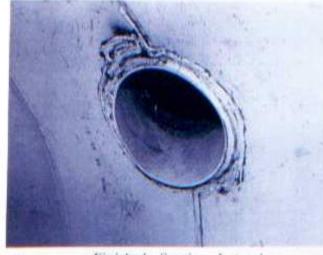
Preparing the coil for use



Feeding the strip down the manhole



(Unfinished)



Finished Service Lateral (Cut Flush and Welded)





PVC Liner Installation



Spiral Wound Style Installation





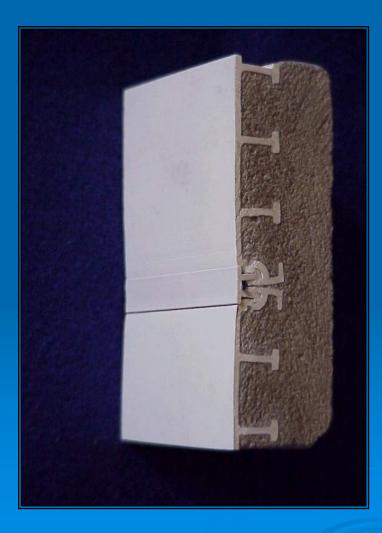
Panel Style Installation







Grouted Sample



- Grouting per ASTM F 1698
- > 5,000 psi structural concrete
- Exposed concrete grout needs corrosion barrier
- Concrete grout is used to fill irregularities between the back of the liner and the host pipe
- > Grout covers T-locks & joints
- Grouted liner provides a tight molded fit





5. Pipe Bu

Stand Offs



Mixing Grout



Mixing & Testing



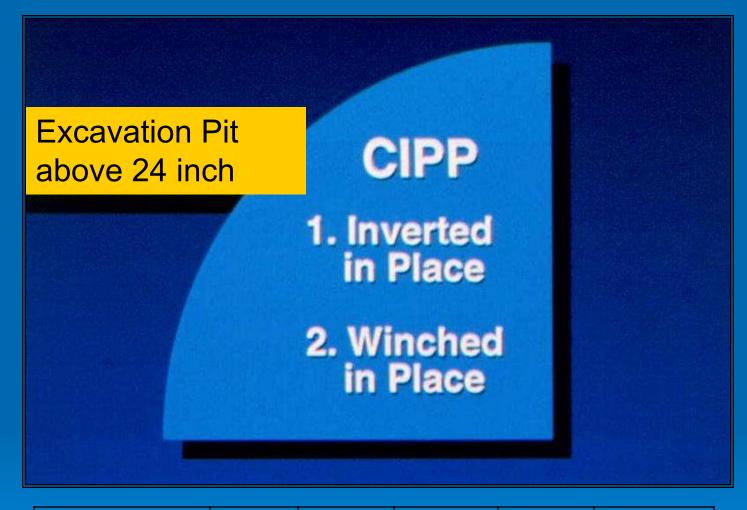
Grout Application



Grout Lifts



Grouted Sample



Applications	Sewer	Storm Drain	Road Culverts	Water Raw	Water Potable
Size Range	4 & Larger				
Joints	No				
Bypass	Yes				
Annular Space Grouting	No				
Lateral Reconnection	Robotic				

Cured-in-Place Pipe Liner

500-5.5 Cured-in-Place Pipe (CIPP) Liner Polyester Felt Hot water or Steam Cured

> 500-5.14 Ultraviolet (UV) Light-Cured Cured-in-Place (CIPP) Fiberglass Reinforced Liner

Custom Designed Liner Thickness

Review Video Inspection



Job site inspection for constructability



Easements

Design

Design thickness per the Formula specified in ASTM F1216 based on Marston's formula for flexible pipe

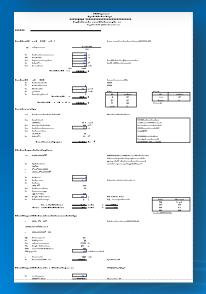
Required host pipe design data

- Depth
- Diameter
- Fully or partially deteriorated host pipe condition
- Oval deformation
 - Default 2%
 - Actual measured by laser profiler inspection
- Backfill Soil type
- Height of ground water above pipe
- Traffic loading
 - Truck
 - 2 truck passing
 - RR
 - Airplanes
- Safety factor (default 2)

Liner material properties

- Long term modulus of Elasticity (1/2 of short term)
- Initial modulus of elasticity





- · Calculated min wall thickness
- Recommended wall thickness
- SDR
- Flow Calculation

CIPP Cured-in-Place Materials



Polyester felt liner tube



Felt layers added to increase liner thickness



Shipped Liner tube



Base Resin



Powered Catalyst -Liquid Styrene - Die



Mixing Resin



Vacuum Impregnation



Wet out Resin Slug



Calibrated Rollers



Installation Methods

Water Inversion



CCTV Refrigerated Truck

Air Inversion



Liner in Refrigerated Truck

Winched-in-Place





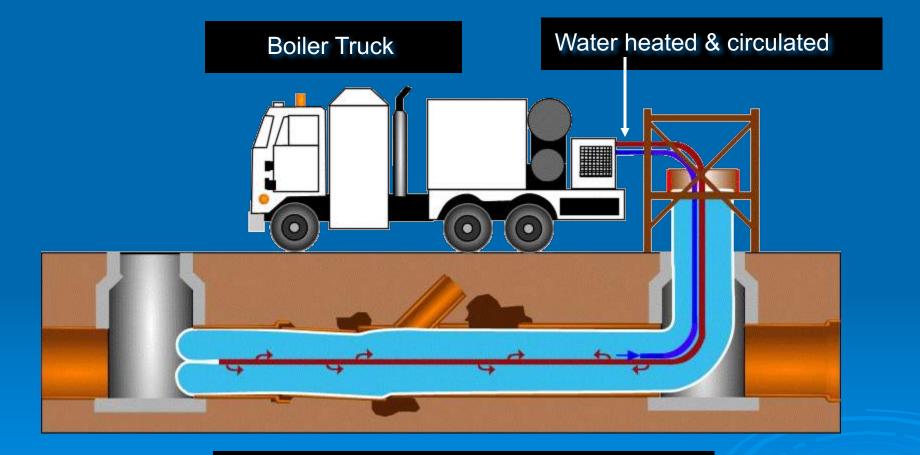








HOT WATER / STEAM CURE



Heated Water or Steam Curing 180^o



Quality Control Monitoring for CIPP liner Installations

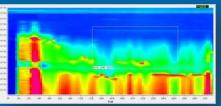


Controllers available Rent or Purchase

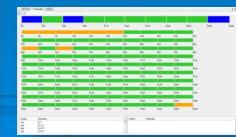




Cloud Internet-based real time remote monitoring Real time data for Contractor, Eng., & Inspector



Color coded graphic view of the curing process

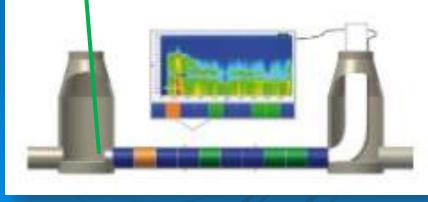


Computer generated curing log sheets



Fiber optic Cable W/internal strength member





Case History Classic CIPP Felt City of LA

Upstream MH

Installation Video

Downstream MH













.31

Case History 24 Inch Shooter Newport Beach Back Bay











.17 - 10

Case History 36 Inch & Larger Cal Trans Road Culvert



Built in large diameter pipe liner material handling system.

Powered liner handling rollers mounted in refrigerated trucks

> Wide portable shooters



Case History Cured-in-Place CIPP Pipeline Liner

Los Angeles County Department of Public Works Sewer Rehabilitation of 1150 15" VCP using CIPP to prevent landslides



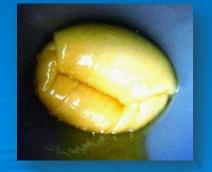
18th hole of golf course slid into Pacific Ocean



Installation Set up



Cracks formed over sewer in Palos Verdes Dr.



Installation



Job Site



CIPP Post Lining



Laboratory Quality Control Testing After Installation



Restrained Sample Down Tube Restrained Sample Middle MH Flat Plate Sample Large Liners

Marked Sample



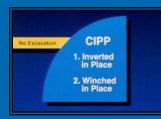
Dimensions







Tensile Prop



Lined Pipe



Tight Molded Fit

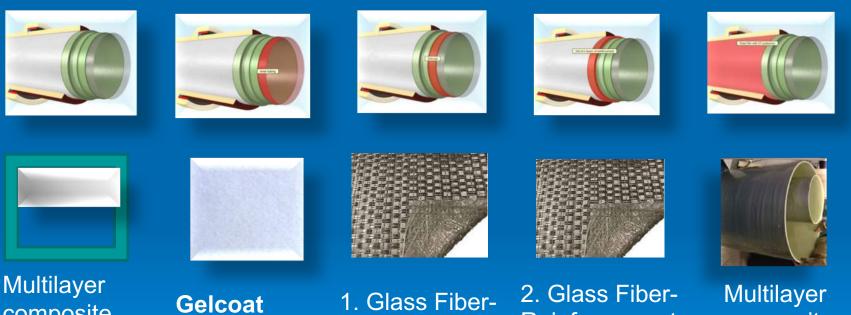
Seamless
Jointless
Solid wall
Structurally Sound
Tight molded fit
Robotic lateral reinstatement
Diameters 6-12 inch & larger

Styrene odorWrinkles, blisters, or fins

UV Cure Installation Video



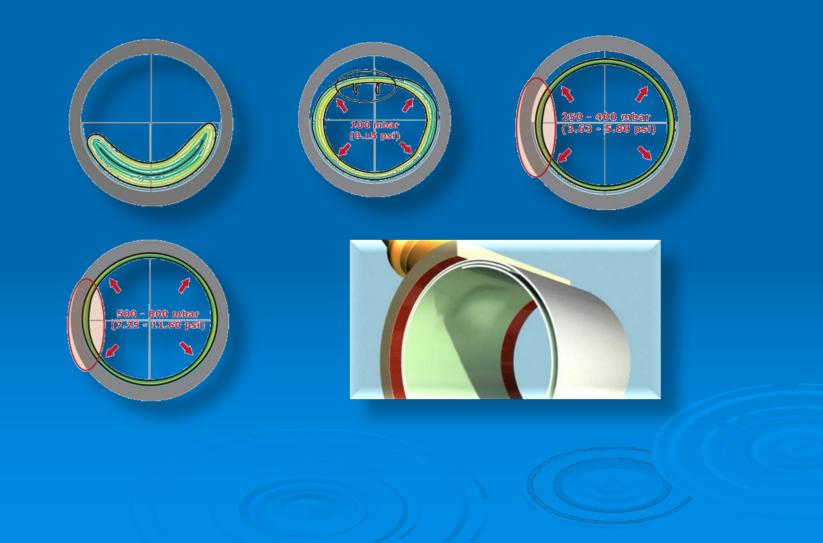
Fiberglass Reinforced UV Cure Pipe Liner Material Design



composite Clear plastic inflation tube w/Styrene Blocker (Removed after Curing) Gelcoat Resin impregnated Fleece

1. Glass Fiber-Reinforcement Chopped & strand woven Fiberglass 2. Glass Fiber-Reinforcement Chopped & strand woven Fiberglass Multilayer composite Styrene & UV light shielding

Pipe Liner Expansion



6 inch to 80 inch Pipe Liners Up to 1,929,000 psi













Case History UV Cure CIPP Huntington Beach

Upstream Setup



Downstream Setup



Downstream Equip.







UV Cure Unit Light Train



Case History 4 miles of 21 & 24 inch AC pipe North Trunk Line Rehabilitation \$2-\$5 Million

COUNTY OF SANTA BARBARA DEPARTMENT OF PUBLIC WORKS LAGUNA COUNTY SANITATION DISTRICT











<u>Challenges</u>

- Main line to WWTP
- Deteriorating AC pipe
- All cleaning done under the asbestos remediation contractor
 - Heavy debris Rock, Logs
- Environmentally sensitive Area
 Full time biologists
- Bypass ½ mile & 1 mile long
- Cattle grazing & Strawberry Fields
- > WWII Aircraft gun range

21 INCH AC (ASBESTOS CEMENT) TRUNK SEWER, DETERIORATION



PROTECTED SPECIAL STATUS SPECIES

- CA Red-Legged Frog, Vulnerable (Rana Draytonii)
- CA Tiger Salamander, Vulnerable (Ambystoma Californiense)
- Pacific Pond Turtle, Vulnerable (Actinemys Pallida)
- Western Spadefoot Toad, Near Threatened (Spea Hammondii)
- Two-Striped Garter Snake, Least Concern (Thamnophis Hammondii)











Salamanders hide in ground squiral holes





Bypassing 1/2 & 1 mile long bypassing Redundant bypass pumps maned 24 Hr. per Day













Asbestos **Is**olation While Cleaning

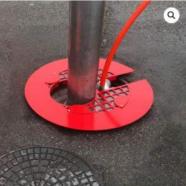
First Generation

Second Generation









Spray Guard









Hose Washer

INSPECTION: CCTV CREWS Observed Cleaning







Main Line Cleaning & Chemical Grouting

Self Propelled Robotic Cutters



CCTV Inspection – Front & Rear Facing Cameras



Grabber - Tool



Chisel -Tool



Milling Machine - Tool



High Pressure Water Jet - Tool

Chemical Grouting

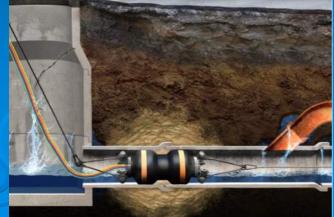






Infiltration Pipe backfill washing inside the pipe





Specialized Cleaning & Disposal AC Asbestos Cement Sewer Pipe (15,000 Lb. of debris removed & disposed of)



Work area covered, MH sealed around hose and vacuum. Jet hose wash down system



Debris in 100 micron tank filter were cleaned and bagged by asbestos crews



All liquids were filtered in roll off 100 micron filter



Debris tanks were hand cleaned and bagged by certified asbestos crews



Secondary filters 50 & 5 Micron Water Sampled & Tested





Bagged, Sealed, Taken to Special landfill

The liners were delivered on site before the lining started to reduce delays, costs & risks of bypassing





- Lighter weight liners reduce shipping costs & fuel greenhouse gas.
- Liner does not require refrigeration & ice to keep the liner from prematurely curing & reducing shipping costs and greenhouse gas.
- liner is good for a minimum of 6 months without refrigeration
- > All boxes are custom sized to reduce waste
- Trees are planted to replace wood used. Partnered with onetreeplanted.org plants a tree per crate in the country where liner is installed



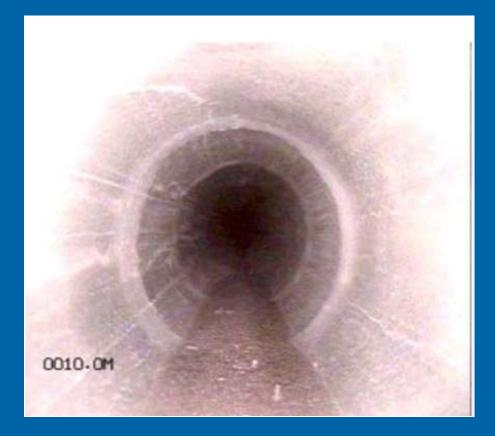






UV Cured Fiberglass Reinforced CIPP Liner

Lined Pipe Joint



Dimple at Lateral Connection





LAGUNA COUNTY SANITATION PROJECT

Client: Santa Barbara County Public Works

The Project consisted of the Trenchless Rehabilitation of more than 20,000 feet of 21- and 24-inch diameter asbestos lined sewer line with UV cured in-place pipe (CIPP).

The project also included pre- and post-rehabilitation cleaning and video inspection, sewage bypassing, chemical grouting joints prior to lining due to ground water intrusion, and asbestos abatement through environmentally sensitive and protected central coast regions and private businesses (cow pastures, produce and vegetable farms) in Santa Maria, California.

Laguna County Sanitary District was in need of a by-pass using 12" HDPE piping with 4-6 silent pumps that were monitored 24 hours a day through the completion of the project. The by-pass was set up, broken down, and moved 5 times to sustain the project through the ~4 miles lined.

"This project required the Performance Pipeline Technology team to perform to the highest standards and navigate many restrictions, challenges and to coordinate many moving pieces with communication across all channels, and it's been impressive to see them not only succeed, but also to do so in a capacity thought impossible in the industry even a few years ago." -Christoph Lindner, IMPREG VP Contractor: Performance Pipeline Technology

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0-

Liner Manufacturing: IMPREG

NOTABLE CHALLENGES

 Asbestos Abatement in Every Phase of the Project

 Severe Deterioration of the Host Pipe

Minimal Jobsite Footprint
 Approval and Extremely Limited
 Project Access Points

 Protection of Environmentally Sensitive Ecosystems & Endangered Species Along Jobsite Footprint





4 miles of 21 & 24 inch AC pipe North Trunk Line Rehabilitation \$2-\$5 Million Challenges

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UCT Awards







APWA Awards





Dave Badgley, Brittany Glassburner, Carol Glassburner – Performance Pipeline Technologies & Kevin Thompson Engineer Santa Barbara Co

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Access & Dust Control



Bypassing 1/2 & 1 mile long bypassing Redundant bypass pumps maned 24 Hr. per Day













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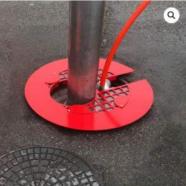
First Generation

Second Generation









Spray Guard









Hose Washer

SPECIAL SITE PREPERATION

Manhole Set Up And Area Protection After Clearance By The Biologist Team, full time air testing



Main Line Cleaning & Chemical Grouting

Self Propelled Robotic Cutters



CCTV Inspection – Front & Rear Facing Cameras



Grabber - Tool



Chisel -Tool



Milling Machine - Tool



High Pressure Water Jet - Tool

Chemical Grouting

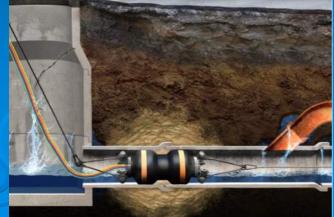






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Installing Sliding foil





Largest and Longest UV Cured Duel Siphons Lined in the US

Specifying Agency: LA City

Lining Contractor: Performance Pipeline Technologies

Longest and largest Diameter siphon lined with UV Cured pipe liner in the US

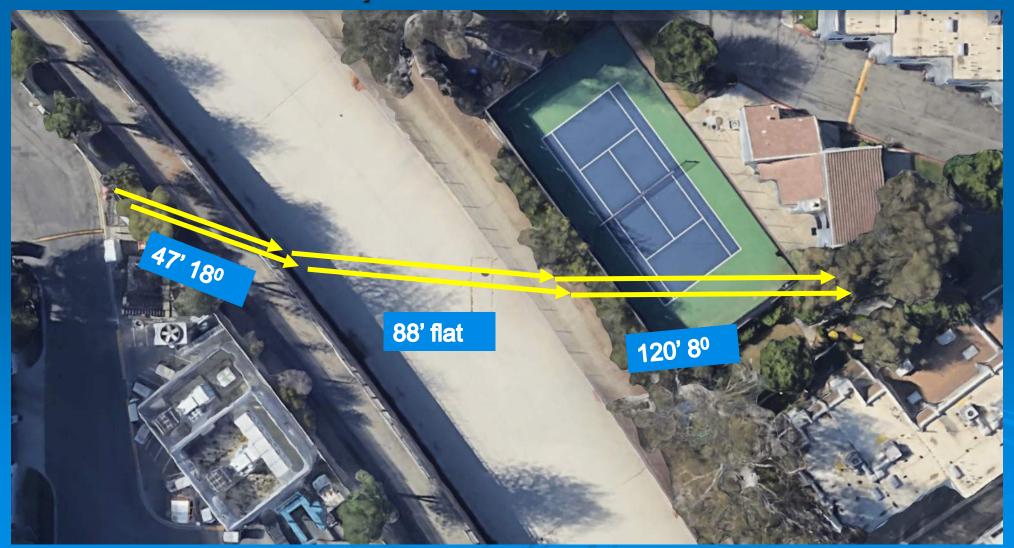
2 42 inch pipes, each 255 ft long

> Angle points 18^{0 &} 8⁰

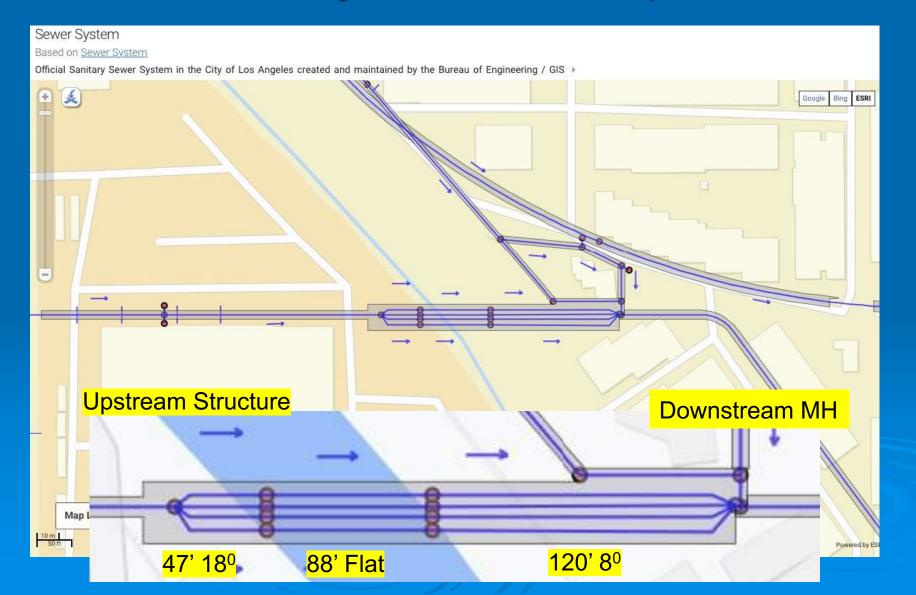
Designed for up to 14 foot head of water

> Abandon MH in storm Channel

CASE History LA City NOS No. Outfall Sewer Duel 42 inch Siphons Under the LA River



LA City Sewer Map



Abandon MH Access in Bottom of River







Downstream Side Access



Cleaning by Hand and Vactor Suction



Bypass **D**iversion Structure Stop Log





Upstream Access Inside CBS Studios Radford Studio Center





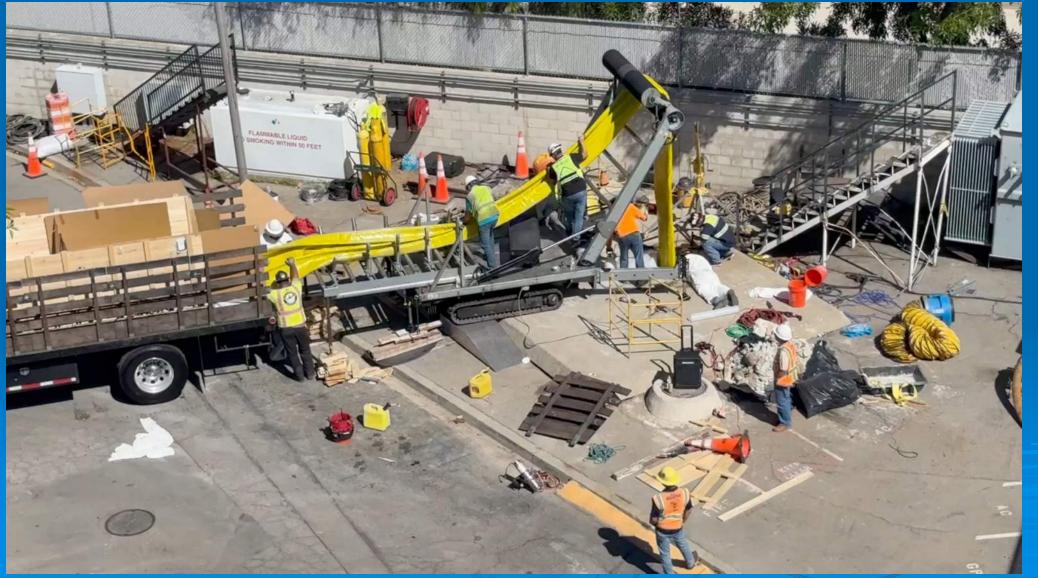


Liner Installation



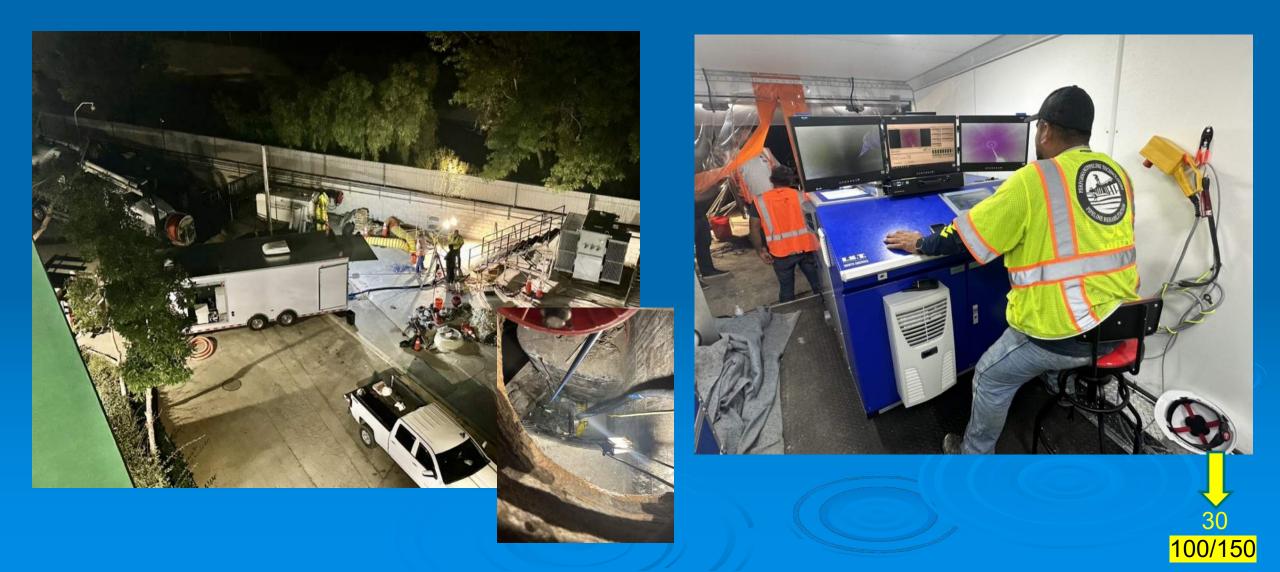


Video of Installation





UV Curing Control Center



Operators Control Council



2.90 pt

0.82 R/m 188.4

Down Hole UV Curing Equipment









Largest and Longest UV Cured Triple Storm Drain Lined in the US

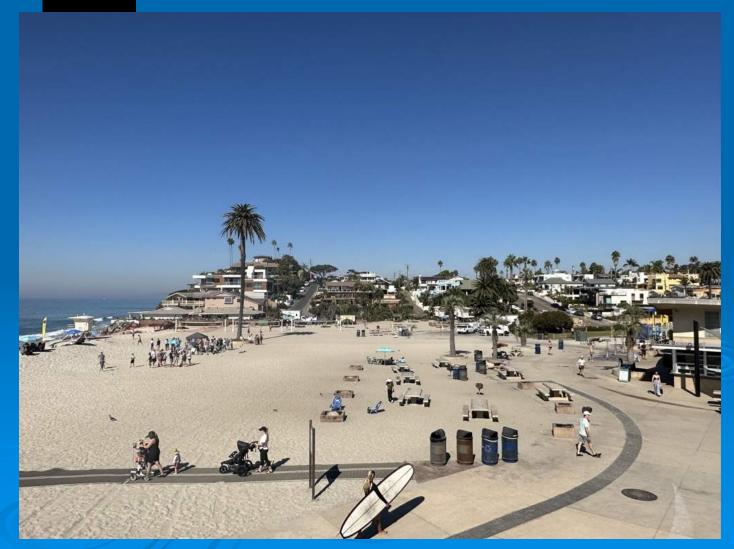
Longest and largest Diameter storm drain CMP pipes lined with UV Cured pipe liner in the US

- 3 72 inch CMP parallel arch shaped pipes each 285 ft long
 > Remove protruding Lateral
- Storm damaged pipelines funded by a grant from the California State parks department

Case History Moonlight Beach Project Site Overview

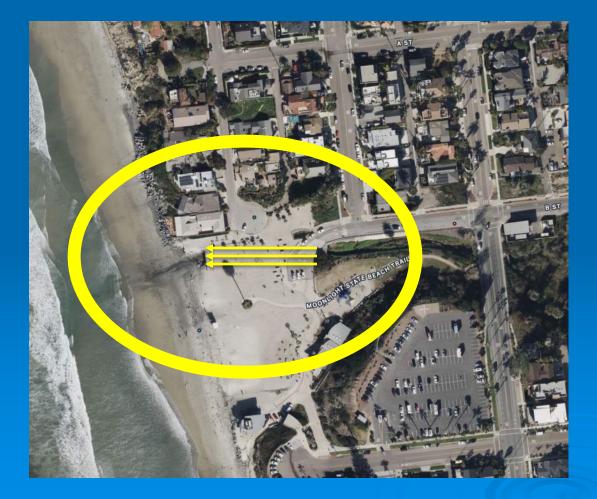








City of Encinitas Moonlight Beach





Details

> General Contractor: Beador Construction Co.

> Pipe Lining Sub: Performance Pipeline Technologies

Problem Three Failing CMP Arch pipe storm drains

- Diameter: 72" Arch pipe
- Length: 285 ft each
- Solution Trenchless Pipe Lining
 - Fiberglass Reinforced UV Cured CIPP
 - Thickness: 13.7 mm / 0.539 inches
 - Liner Weight: 32,000 lb. each / 16 tons

Note Worthy: Longest 72' UV cure liners installed in the US

Anyone that would like to view the installation contact Dave Badgley

Pre Lining Site Photos Inlet Outlet side on the beach



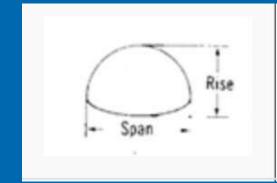








CMP Pipe Arch Problem Areas



72 inch Round









Bypass & Dewatering

















Sliding Foil Installation



















Unloading the crated pipe liners Liner Weight : 32,000 lb. each / 16 tons



Installing the Pulling Harness













Outer Ware Layer untapped before installation



Pipe Lining Installation







Liner Installed









Installing End Cans













UV Pipe liner Curing Equipment proCASTRO Mechatonik GmbH













3 Jumbo Light Trains 36,000 Wats of Power Ability to cure 1800mm / 72 inch Diameter 13.7mm 0.539 inches thick at 3 ft per min

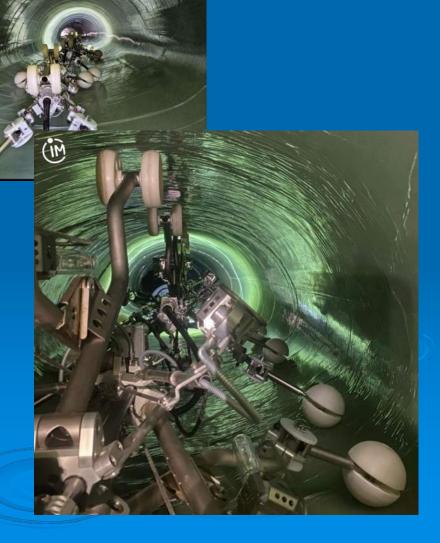




Installing the light train







Calibrating / Expanding the Liner



Inspecting while calibrating the pipe liner





Curing 1800mm / 72 inch Dia. 13.7mm 0.539" thick Cured at 3 ft per min = 95 min per line





Sealing the ends of the installed pipe liner with Epoxy



Installed pipe liner





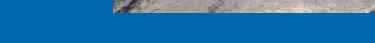




Up Stream







Up Stream



Down Stream







Lined under the volleyball courts Without Disruption



Outlet to the Ocean



Damaged slope repaired and 145 feet of new 18 inch CMP pipe was lined with CIPP







Finished Slope Repair

Finished Early Saturday Dec 16 2023 Before Next Rain Storm



	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
	Dec 17	Dec 18	Dec 19	Dec 20	Dec 21	Dec 22
		2222	2222	00000	00000	00000
	Partly cloudy	Patchy rain	Patchy rain	Moderate rain	Heavy rain	Moderate rain
High	21°c	20°c	possible 18°C	19°c	17°c	16°c
Low	16°c	16°c	16°c	15°c	14°c	13°c
Wind	15 km/h 🔺	14 km/h 📐	14 km/h 🔫	20 km/h 🔺	17 km/h 🍌	18 km/h 🚄
Cloud	41%	46%	86%	75%	76%	83%
Rain	0.0 mm	0.3 mm	5.0 mm	5.3 mm	20.9 mm	12.0 mm
ressure	1015 mb	1015 mb	1014 mb	1013 mb	1013 mb	1012 mb
lumidity	38%	54%	83%	81%	82%	86%
Sunrise	06:46 AM	06:46 AM	06:47 AM	06:48 AM	06:48 AM	06:49 AM
Sunset	04:44 PM	04:45 PM	04:45 PM	04:46 PM	04:46 PM	04:47 PM

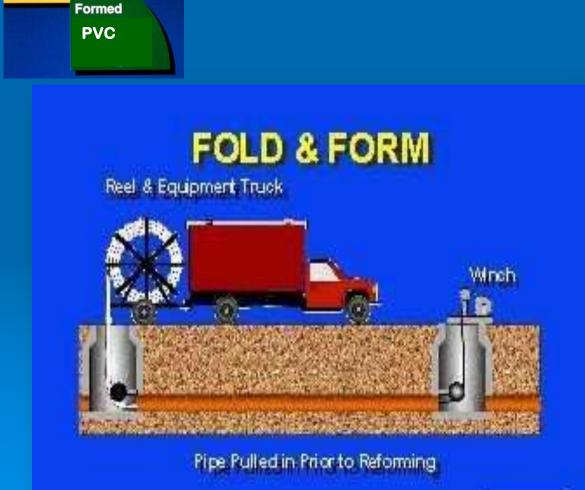
Encinitas, United States of America Weather Calendar



Real Life Testing Feb 1 2024

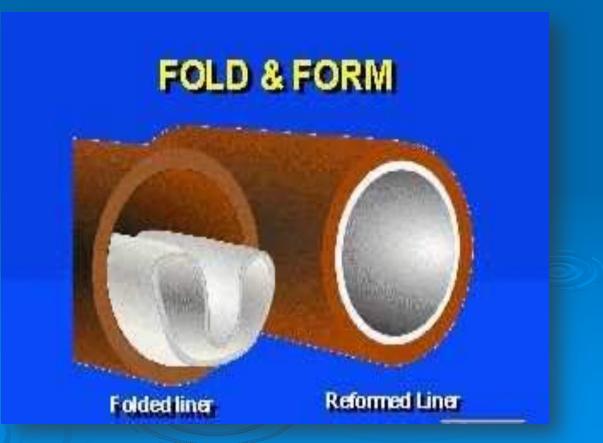


Folded & Reformed Expanded-in-Place PVC Liners



Fold and

No Excavation





Folded & Reformed

> 500-1.7 Deformed/Re-formed HDPE Pipe Liner. (U-Liner)

500-1.10 Type "A Folded and Reformed PVC Pipe Liner (NuPipe, EX, Nova Form)

> 500-1.10 Type "B Folded and Reformed PVC Pipe Line (AM-Line)



Benefits

Factory manufactured Factory quality control Long continuous lengths > Variety of pipe wall thicknesses > Virtually no annular space > PVC or HDPE > 6 – 30 inch



Factory Quality Control







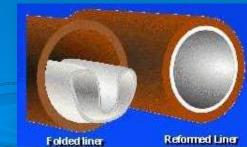


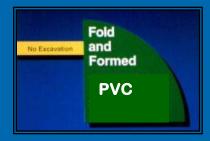






- Heated flattened pipe pulled in by wench
- Internally heated and pressured to reform
- Like plastic blow molding





Liner Pipe installation

Installing Liner



Liner on Shipping Reel





Pulling Yoke



Heating Liner in Reel Trailer







Downstream MH

Processing Liner



Steam Heated & air pressurized

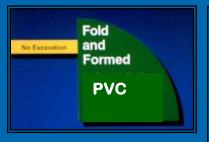


Folded & Reformed Expanded-in-Place PVC



https://www.youtube.com/watch?v=2kYuK_XFfyA

Benefits Folded & Reformed Expanded-in-Place PVC Liners





- Seamless
- Jointless
- Solid wall
- Structurally Sound
- Tight molded fit
- Diameters 6 30 inch



- Materials pre-tested before installation
- > Odorless Styrene Free
- Can be re processe before laterals are cut

Post-Installation Inspection Active service lateral reinstatement





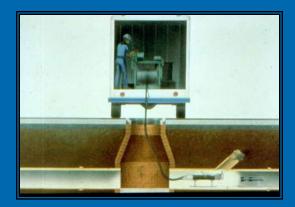
•Capped Laterals are the source of many maintenance problems.

Capped Laterals can remain un-opened to reduce infiltration & maintenance costs Dimple at Lateral Connection





Dimple at Lateral Connection











Router bit or wire cup brush – Brush smooth - Remove all coupons

Pipe Liner End Seals Tight Fitting CIPP & FF Pipe Liners



Expanded Lip in MH



Sikadur -32 Hi-Mod Epoxy





Poor Quality Workmanship



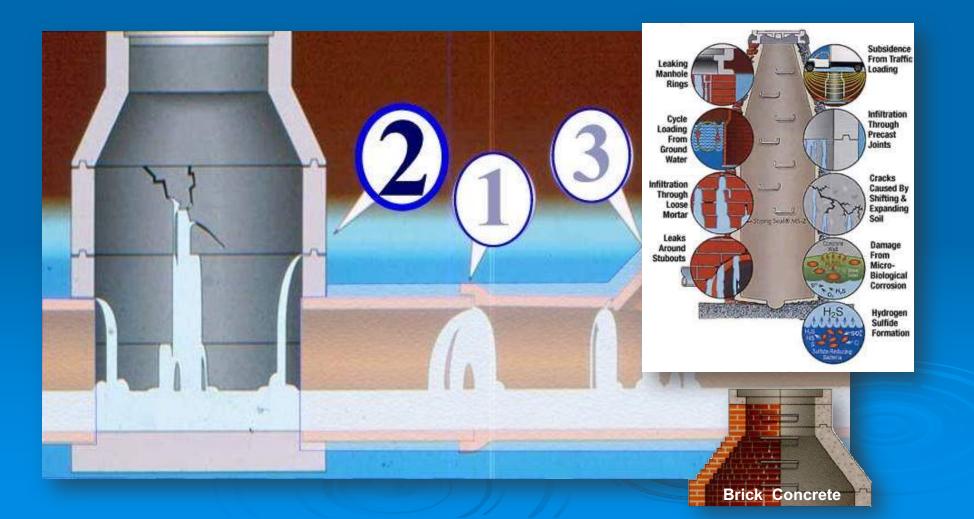


Hydrophilic Rubber Seal – Insignia (Expands up to 800% By Volume) Gravity - 6" & Larger

Pipe Liner End Seals – HydraTite Gravity & Pressure - 8" and larger

Sewer System Problem Areas Pipelines Manholes & Pump Station Service Laterals & SLO (Service Lateral Connections)

3. Service Laterals & SLC (Service Lateral Connections)

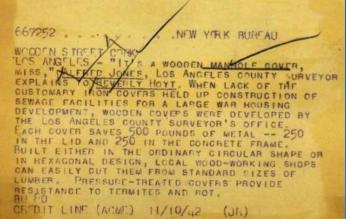


How many maintenance holes are there in the United States

- The EPA estimates that there are about <u>20 million manholes</u> in the United States — one manhole for every 400 feet of pavement.
- Many of these manholes are seriously decayed or in need of immediate rehabilitation or replacement. (October 2019)

Advancements in Maintenance Hole Rings & Covers Materials





1942 LA Co. developed a wooden MH cover

Cast & Ductal Iron Problems



Rusted Shut



Broken

Composite

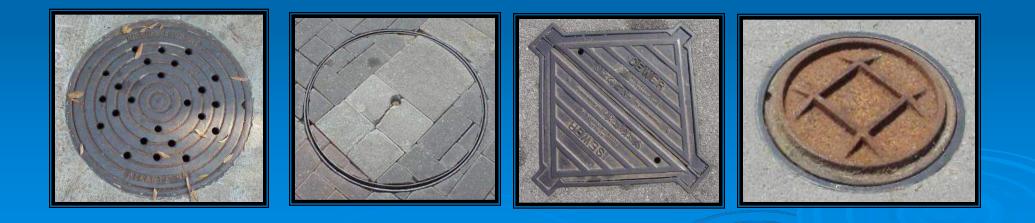
- Non-Corrosive
- leak proof
- lighter weight
- No scrap value
- Smart cover sensor compatible





Maintenance Hole Covers





Opening Rusting & Stuck Manholes

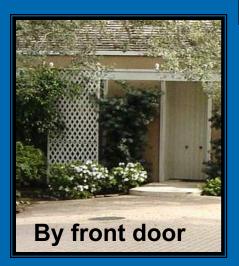






CORROSION CAUSES SAFETY HAZARDS

NIMBY Not in My Back Yard



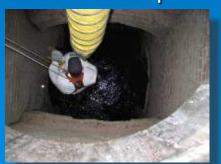




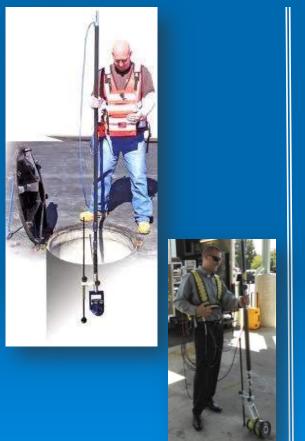


Maintenance Hole Inspections





Over 6 ft.. diameter sewer

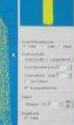


Pole Cameras



Panoramo or Cues Spider Inspection System





High resolution digital photography & Laser measurements

Tree Roots Problems



Tree roots can break or clog sewers and cause:

- Structural damage
- Sewer stoppages
- Sewer System
 Overflows (SSO)





Deteriorated Concrete Brick Mortar Maintenance Hole



- Missing grout
- Deteriorated shelf
- Poor quality bricks



Deteriorated Concrete Maintenance Hole



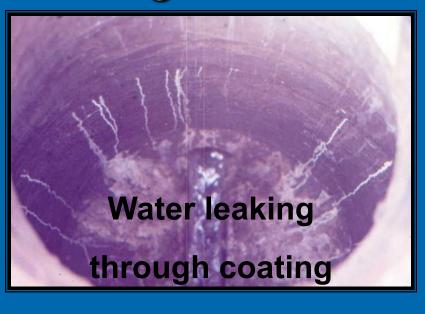






First Generation Coating Failures







Deteriorating coating near channel

Mineral Deposits Problems

Tree Roots



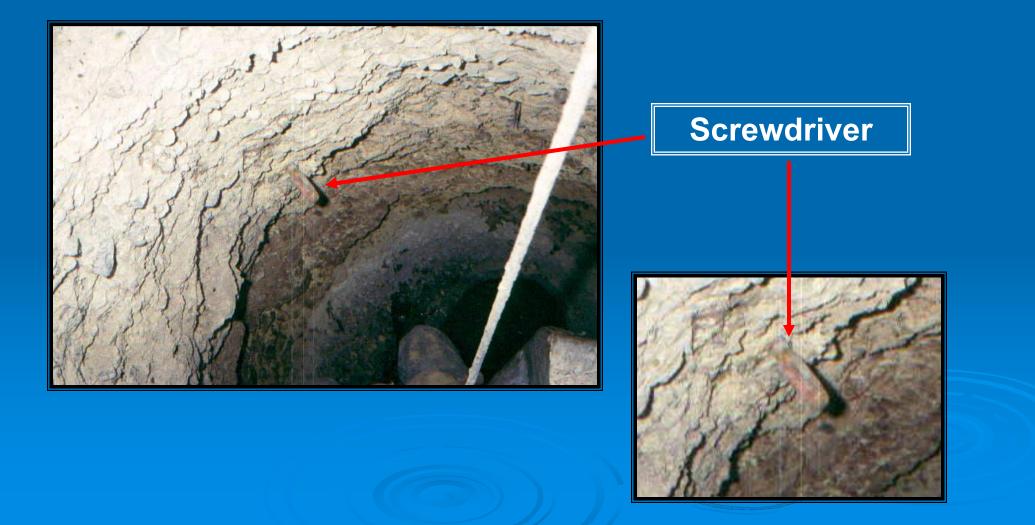


- Like underground caverns, dissolved minerals in infiltrating water can build up in underground structures and form stalactites.
- This is the tip of a six foot long stalactite found in a 50 foot deep MH in the City of LA.

Calcium Stalactite

This buildup formed around tree roots.

Screwdriver Test to Quantify Extent of H2S Corrosion



Maintenance Hole Channels Problems



90° Turn



Debris Buildup

- Creates odors
- > Releases gases that deteriorate concrete
- Solids settle out



Narrow Channel

Manhole Problems = Road Problems Build Roads on A Solid Foundation













Brick MH Problems Exfiltration & Collapse









Manhole Coatings Damaged During Repaving



Manhole raised using concrete risers will deteriorate



Lowering Manholes can damage coatings



Score existing liners before lowering & removing grade rings

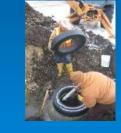


Install reusable adjustable chimney seals











Light weight rubber riser rings





Recoat exposed concrete with compatible flexible liner

Section 500-2 Manhole Rehabilitation

- > 500-2.5 Internal Locking PVC Manhole and Structure Lining System (Permaform / Ameron T-Lock)
- > 500-2.6 Segmented PVC lining System (Danby)
- 500-2.7 Polyurethane and Epoxy Protective Lining Syster (Spray Roq Sancon 100 Zebron)
- > 500-2.8 Epoxy Lining System (Raven Saueresen)
- > 500-2.9 Epoxy Mastic and Flexible PVC Liner System (Ameron Arrow-lock)

Manhole Rehabilitation Surface Preparation



Grinding off old steps



Chipping off deposits



Sand blasting



High pressure water blasting



Prepared Surface



Chemical Grouting

Internal Form Styles Concrete Grouted Annular Space

- Removable Form w/ PVC protective liner System
 - 500-2.5 Internal Locking PVC Manhole and Structure Lining System (Permaform/ PVC T-Lock & Ridged PVC Danby)
- > Permanent Cast-in-Place PVC form & Liner System
 - 500-2.6 Segmented PVC lining System (Danby)

Removable Forms Assembled Inside MH W/ T-Lock PVC Sleeve

Assembling Forms

PVC T-Lock **Material**

Installed PVC Liner Grout Installation on forms

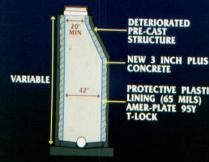
5,000 PSI Concrete

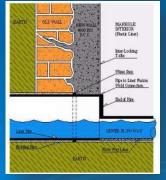














Cast-in-Place Ridged PVC form / Liner system Danby



PVC Standoffs Bolted to walls



Installed Liner



Grout Installation 5,000 PSI Concrete

PVC Material

Ridged PVC Pipe & MH liners













500-2.3.3 Resurfacing Air-Placed or Hand Applied Concrete Rebuild back to original strength & dimensions

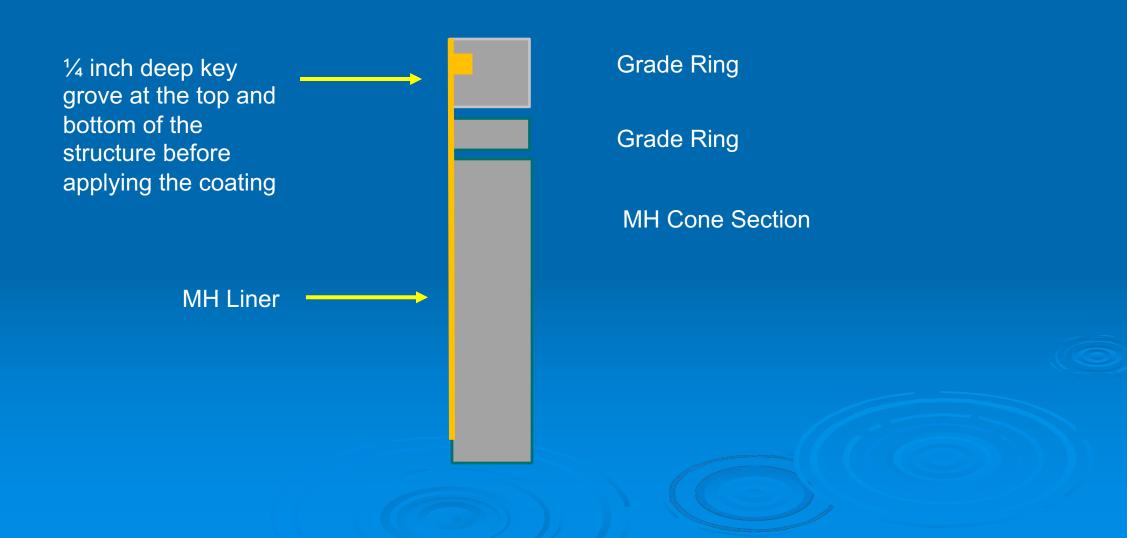




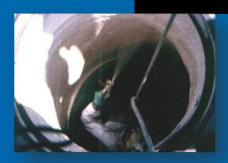




Key Grove



Trowel or Spray Apply Ridged or Semi Ridged Epoxy Protective Lining







Coating Min. 125 mils 1/8" thick



Spray applied epoxy w/ flexible polyurethane coating

 • 500-2.7 Polyurethane and Epoxy Protective Lining System (Spray-Roq - Sancon -Zebron)

Spray or troweled applied epoxy w/ ridged epoxy coating

•500-2.8 Epoxy Lining System (Sauereisen - Raven)

Finished Maintenance Hole all exposed concrete is protected

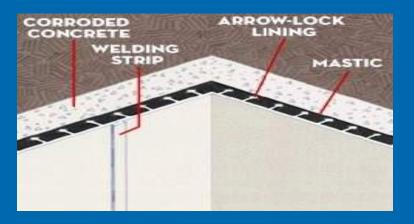


All exposed concrete must be protested



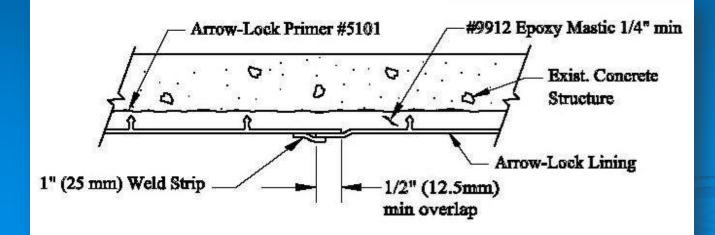
Spray materials specified must be compatible with the other lining and pipe materials.

Epoxy Mastic & Flexible Liner System Arrow Lock PVC



Epoxy Mastic application





Material



PVC Liner & Epoxy Mastic



Verification of Quality Spark Testing



Spark Testing Equipment

Spark Testing 15,000 Volts Min



Finishing Touches Composite Rings & Covers

Iron MH Problems

Composite MH Covers Second Generation – CAP





Rusted Shut









Broken





More Robust & Water Tight



RF ID Built in -





24" – 36" Clear Opening – Colors options



Locatable



ransmitter and Antenn over No holes an as the signal passe

hart Cover Sensor

Smart Cover & CAP Alert Compatible



Custom Logos



Locatable with Standard Metal Locators















Fiberglass Reinforced Composite Maintenance Hole Ring & Covers







Non Corrosive

> Watertight

Lockable Bolt or Paddle Lock

 $> \frac{1}{2}$ the weight of Cast or Ductal

Bolt on ready for sensors (Cap Alert or Smart cover)

Burping style covers available
 RF ID encapsulated sensor
 Metal detector locatable

Custom Colors

City of Oxnard Trunk Line Upgraded old Metal MH to CAP Composite MH

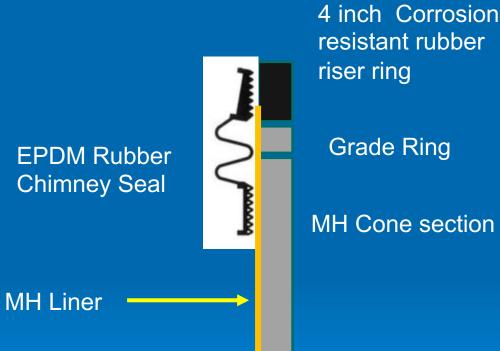








Finishing Touches Chimney Seal







Internal Uni-Band & Flex Seal Chimney Seals S.S.I

Expandable Rubber Seal W/ SS Bands

Brush on Polyurethane Flexible Seal







Install With Standard Wrench No custom tools required







FLEX SEAL Utility Sealant

...15 Years Later

...22 Years Later





Cross over Applications

Manhole rehabilitation methods and materials used for large diameter road culvert rehabilitation

500-2. Spray on and trowel applied Manhole lining used for bottom lining of large diameter culverts Pipeline rehabilitation methods and materials used for manhole rehabilitation

500-1.4 CIPP pipelining used for manhole rehabilitation









New Construction External Chimney Seals

Infi-Shield Gator Wrap Infi-Shield External Rubber Seal





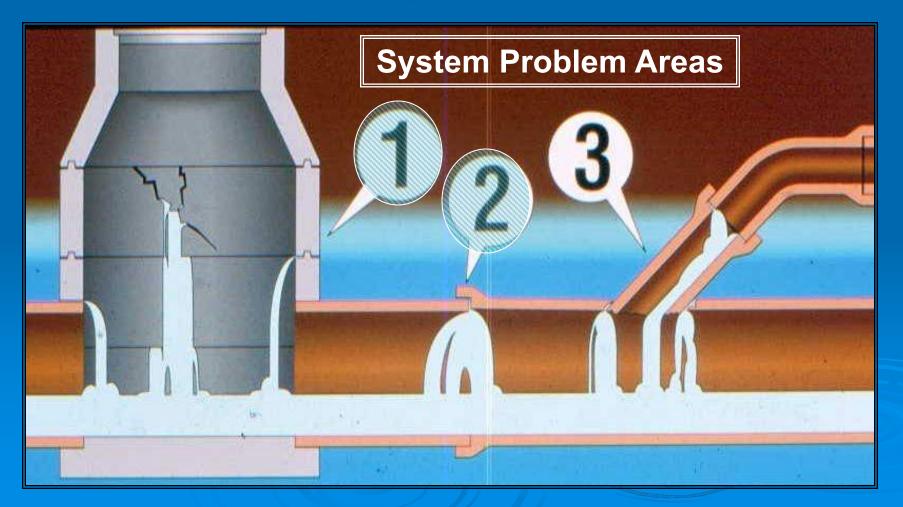


Sewer System Problem Areas

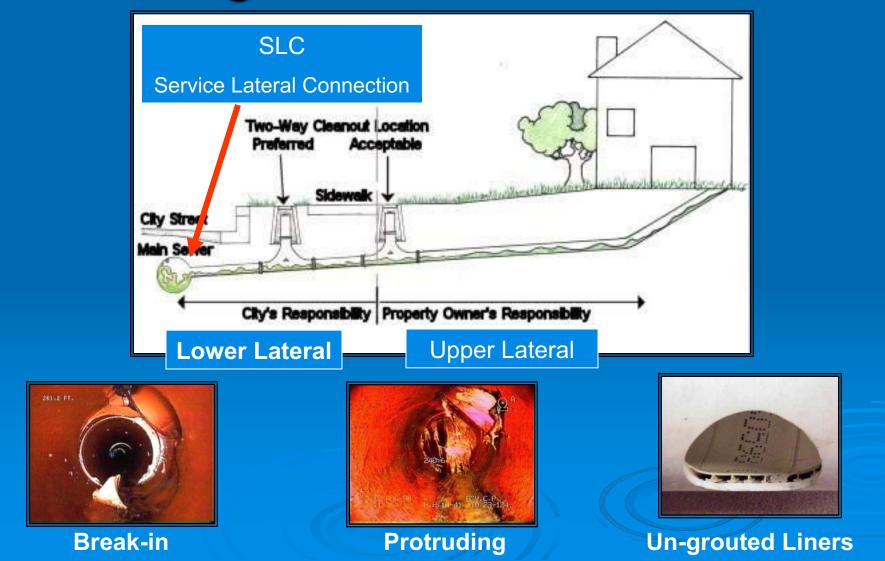
1. Manholes

2. Pipelines

3. Service Laterals & SLC (Service Lateral Connections)

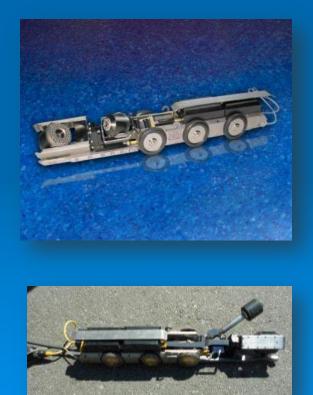


500-4 Service Laterals SLC Segments & Problems



Lateral Inspections

CCTV Inspection Cleanout to the Main CCTV Inspection Main to Clean out



Electroscaning Joint Leak inspection Cleanout to the Main





Lateral Connection on CIPP lined pipe First joint Infiltration -14 feet deep







Lateral Cleaning





Prep Work Before Inst Or final Solution Chemical Grouting





Computer controlled testing & grouting Panel



Chemical Grout to stop infiltration and stabilize the surrounding soil on the outside of the pipe

Steps for Lateral Sealing

> Clean > Inspect Pre Test > Grout or Line Post Test > Clean > Inspect

CIPP Service Lateral Connection Sealing

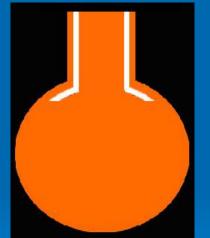








Brim Style







What's new in 2025 supplement

19.4	line Rehabilitation Systems	
7,1		
-	7.1.1 Heat Cured	
	7.1.2 Ultraviolet (UV) Cured	
7.2	Folded and Reformed Pipe Liners	
2.0	7.2.1 Polyvinyl Chloride (PVC)	
7.3	Fusible Solid-Wall Pipe Slipliners, Annulus Grouting	
-	7.3.1 High Density Polyethylene (HDPE)	
7.4	Segmented Pipe Slipliners, Annulus Grouting	
	7.4.1 Fiberglass Reinforced Polymer Mortar (FRPM)	
-	7.4.2 High Density Polyethylene (HDPE), Profile Wall	
-	7.4.3 Polyvinyl Chloride (PVC), Closed Profile Wall	
7.5	Spiral-Wound Slipliners, Structural Annulus Grouting	
	7.5.1 Man Entry Polyvinyl Chloride (PVC), Open Profile Wall	
100	7.5.2 Machine-Wound Polyvinyl Chloride (PVC), Open Profile Wall	
7.6	External Pipe Wraps, Cappped	
-	7.6.1 In-Place Plastic Wraps	
	7.5.1. General	
	7.6.1.2 Submittals	
	7.6.3.4 Installation	
-	26.2.5 Historium	
	The back for the second s	
-	7.6.3.6 Acceptance	
-	7.5.1.8 Measurement	

In Closing



Summary

- Many pipelines and maintenance holes are reaching the end of their useful life.
- Some older pipeline or joint materials did not stand the test of time.
- Infrastructure is built over the existing pipelines
- The condition of buried pipelines need to be evaluated and repaired before streets are repaved

Conclusion

- The useful life of old pipelines & maintenance holes can be extended 50+ years by rehabilitation.
- Pipeline defects can be replaced without damaging existing streets
- > Rehabilitation is faster, cheaper, and uses better materials than dig and replace
- The GREENBOOK Standards offer a well proven foundation for trenchless rehabilitation project specifications.



Questions or Comments



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Gene Glassburner

Performance Pipeline Technologies 5292 System Drive Huntington Beach, CA 92649 Office: 714 536-7386 Cell: 714) 350-2131 Email: Gene@pptsocal.com

Question #1

> Are any of the trenchless liners NSF rated for pressure water service applications?



Answer to #1

Yes The Continuous HDPE slipliner in the Greenbook section 500-5.4 HDPE Solid Wall Pipe Liner

- One other lining that is not yet in the Greenbook, Primus Liner is for 6-20 inch pipelines for pressure applications only
- > This can also be used for Sewer force main lining
- > Able to negotiate angle fittings
- Long continuous lengths up to 8,500 ft
- Watch Installation Video at pptsocal.com
- > Additional info

Pressure Sewer & Water System Solutions Sewer Force Mains & Potable Water

Kevlar Reinforced Pressure Pipeline Rehab. Potable Water & Sewer Force Mains

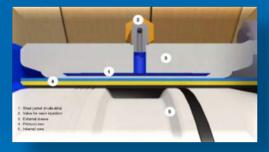
6"-20", Lengths up to 8,500', Pressure 1,000 psi



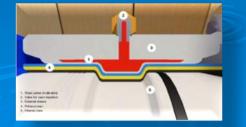
Low Pressure 6"-12" 400 psi



Medium Pressure 6" – 20" 1180 psi (shorter)

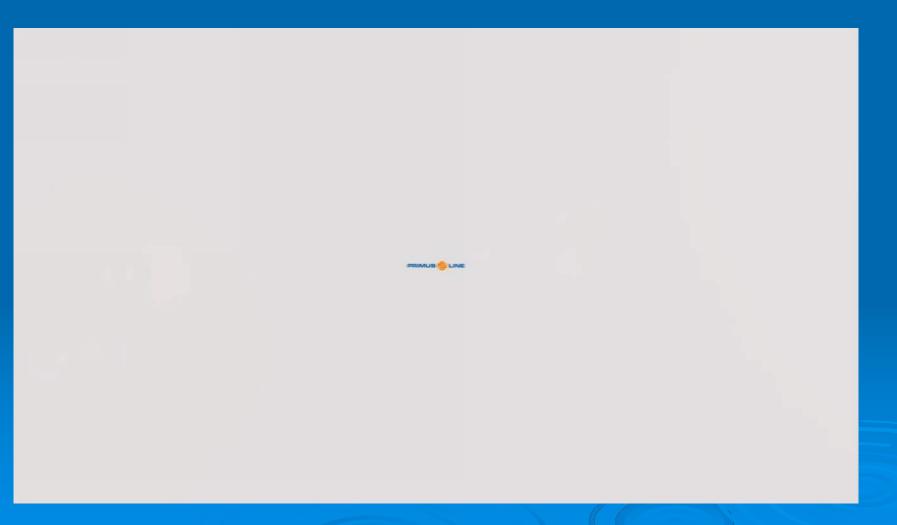






Video Link: https://www.youtube.com/results?search_query=primus+liner

Primus Pressure Pipe Liner System



https://www.youtube.com/watch?v=I68YTQ4AZHY



City of Oneonta





Case History - 2,400' - 20" Primus Liner

with minimal invasive dig and replace at valve area





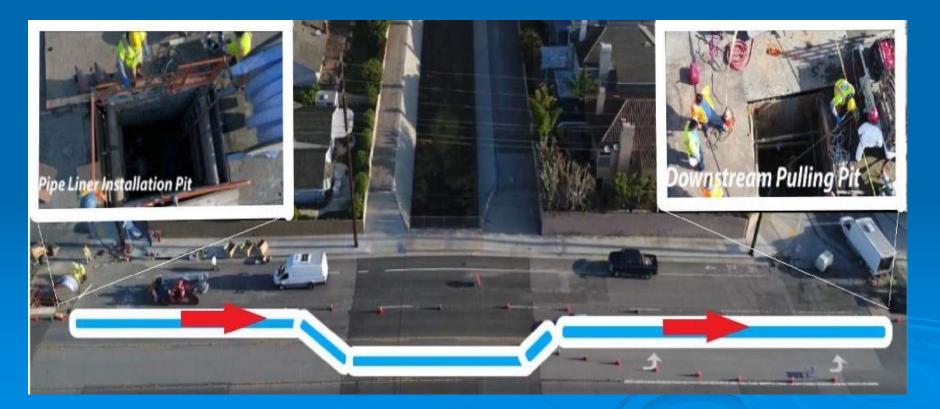


Case History Fountain Valley

Garfield Ave. Between Persimmon St. and Mount Castile Cir. Pipe Diameter 12 inch - Total Length 355 - 1962 CMLC Cement lined Steel Pipe

Pipe Liner Installation Pit

Downstream Pulling Pit

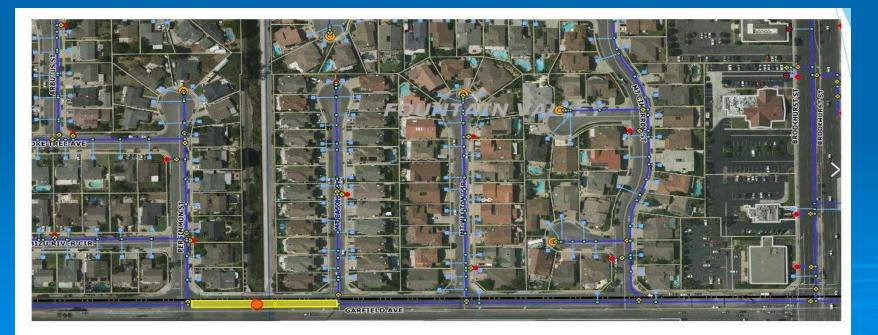


Potable Water Siphon

City of Fountain Valley CA. Project Location

Garfield Ave. Between Persimmon St. and Mount Castile Cir.
 Pipe Diameter: 12 Inch
 Length: 355 feet

Potable Water with Siphon under Storm channel



Installation Processus



Repair Options and Costs Re-route water line over channel Estimated cost \$240,000 \$300,000 (Design, construction, county permits) Replace siphon under channel using jack and bore method Estimated cost \$260,000 \$300,00 (Design and) construction) Line existing siphon with Cured in Place Pipe (CIPP) • Estimated cost **\$200,000** (Construction) Line existing siphon with Primus Line Estimated cost \$130,000 (Construction)



For lateral connections can pipe bursting be used as well as CIPP liners

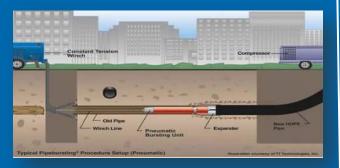


Answer #2

- Yes but it will require 2 pits to be dug one of them in the street down to the depth of the sewer.
- May not be cost effective compared to CIPP liners
- > Will not work in bends without additional pits
- For main lines that need upsizing it is the best tool, less costly than dig and replace.

Sliplining 1. Continu **Pipe Bursting** 2. Drawdown 3. Segmenta 4. Spiral Wor 5. Pipe Bur **Upsizing Small Diameter Pipes** Pre lining Lateral

Upstream Incursion Pit



Aila hile hile hile hile hile







Downstream Pulling Pit











Expose Lateral Connections













Preparation

Reconnection of

slipliner laterals





Questions #3

CIPP Liners wrinkle when going around bends in the pipe will the fiberglass reinforced liners also have wrinkles in a bend ?

Answer # 3

- It is unusual to have 45 or 90 degree fittings in a gravity sewer.
- Generally changes in flow directions are in manholes.
- Long sweeps made by gently off setting joints are generally not a problem with either style liner.
- Wrinkles will occur in CIPP liners on the inside curve where the material bunches up on the inside curve and stretch thinner on the outside curve.
- Fiberglass reinforced liners are thinner and would have fewer wrinkles.

Question #4

We have been replacing our spray on MH liners about every 8-10 years. Are there other structural liners that will last longer and will not fail with high ground water pressure

Answer # 4 Yes There are two styles of structural liners that have been used for many years that not in the GREENBOOK yet:

CIPM Fiberglass reinforced Cured-in-Place Manhole liners with an internal PVC moisture and gas barrio r (Triplex)

Calsiur Aluminate Mortar that changes the PH in the manhole to prevent the acid producing bacteria from colonizing (Sewpercoat)

Both are 20 year plus lifetime without failure
 Used by LA Co San, OR Co San, San Diego

Case History San Bernardino Co. Convert Dry Well with lead paint into Wet Well



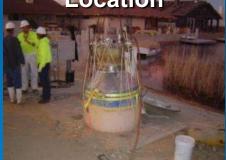
Silver Lake Hellendale



Installation



Pump Station



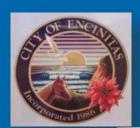


10 ft.

10 ft.

30 ft.





Case History Wetlands Easement Access















Easement Installation











Fiberglass Reinforced 60 inch Wet well Liner 20 Years old Mammoth Mt. Ca. 29 year old MH liner Plano Texas





2002 Wet Well 20 years old

1993 MH - 29 years old

Structural Manhole Rehabilitation 100% Calcium Aluminate (6,000-7,000 PSI p 5 Min 1/2 inch thick)



Concrete MH Before



After Lining



Brick MH Before



After Lining



Pump Station Before



After Lining





Quality Control Core Testing