

1 Case Study: – Prince William County Service Authority, VA

Table A Error! No text of specified style in document.-1. Project Summary

Objective	Identify a small drainage area exhibiting chronic infiltration problems to test the effectiveness of lateral sealing protocol, which would structurally rebuild the residential side sewer and eliminate ground water infiltration. Specific locations targeted for this work included both the PWCSA mainline to building lateral connection and the privately owned lateral, up to eighty (80) plus feet in length.
Method/Product	T-Liner® (LMK)
Time	Mar/Apr 2004
Location	Manassas, VA
Agency	Prince William County Service Authority – Wayne French, (703) 335-8981, french@pwcsa.org
CONTRACTOR MANUFACTURE	CONTRACTOR: Performance Pipe – Shawn Flannery (815) 433-0080, sflannery@ppi-liner.com MANUFACTURER: LMK Enterprises – Larry Kiest, (888) 433-1275, lmkliner@aol.com
Soil conditions	Two areas were targeted for the pilot project; both demonstrated seasonable high water table with permeable soils and the trench back fill.
Scope	Manufacturing and installing 20 new lateral lining composites within the existing system on both Amherst Drive and Yorkshire Lane (2 isolated cul-de-sacs) neighborhoods. A methodology review process determined and recommended by agency personnel, was a patented <i>CIPP</i> process known as T-Liner.
Procedure	a) INITIAL STEPS PRECEDING LATERAL LINING: ∇ CCTV inspection of mainlines and laterals (Aug/Sep 2003) ∇ CIP lining of mainlines ¹ (Fall 2003) ∇ CCTV inspection of remaining laterals and open cut point repair of several collapsed laterals (Aug/Sep 2003) ∇ Installation of cleanouts (4" Vac-A-Tee®) on laterals as required(March 2004) b) LATERAL LINING: ∇ Mobilization ∇ Plugging of laterals, mainlines (water meters turned off during process) ∇ Resin mixing and vacuum impregnation of liner with the resin ∇ Material installation and curing ∇ Removal of plugs and demobilization
QC testing	Resin and felt Q/A-Q/C verification was performed both at the manufacturing facility and in the field during the wetout and curing procedure. Additionally television inspection was performed to verify the effectiveness of the installation. After the lateral renewal process, monitoring of lift stations have been the predominant means of verifying success.
Financing	Fully funded by the Service Authority users, no tax dollars.
Public relations	Notice to homeowners, Agreement form
Pilot project effectiveness	Flow monitoring has been ongoing since the project was completed. In March of 2005, one year after completion of the project a documented 500,000gpd reduction. At the time of this report, only instantaneous readings are available to draw preliminary conclusions. Data collection is ongoing and a new report from PWCSA is due out in June of 2005. Restored structural integrity, especially in Orangeburg pipe.

¹ Total of 1,042 ft of mainline was CIP relined, which makes about 100% of mainline in the pilot project neighborhood. Mainlines were 8" VCP pipes

▪ Initial steps preceding lateral relining

The Prince William County Service Authority (**PWCSA**), VA, has privately owned laterals extending from the house to the sewer main, averaging about 60' in length. A large percentage of the laterals allow infiltration and many connections are HAMMER TAP-INS. (*THIS SITUATION IS NOT UNLIKE THE MAJORITY OF AGENCIES THROUGHOUT THE UNITED STATES. HAMMER TAP-INS* refer to construction practices where the contractor making the connection of the lateral to the mainline chooses to use a hammer (or similar tool) to knock an access point (opening) into the sewer main and stick the smaller size (lateral) into the sewer main. Frequently the smaller pipe will intrude into the mainline from One to four inches. This opening into the mainline also becomes a source or pathway for ground water to enter into the sewerage system.) Early construction standards did not require cleanouts for residential construction, which has since been remedied. Initial investigation on these sub-basins prior to the pilot project, revealed 12 out of 20 home owners had already installed cleanouts on their lateral systems. Some were installed near the house while others were closer to the right of way (**ROW**). The rehabilitation process chosen by PWCSA necessitated access at the homeowners side (a cleanout); therefore all properties which were part of this pilot project were brought up to current construction standards, which included outside cleanout. The remaining eight residences therefore were required to have cleanouts installed, which allowed for a maximum length of lateral to be sealed.

CCTV inspection of mainlines

PWCSA performed the initial CCTV inspection of mainlines using typical, mainline video inspection equipment. This allowed for in-house documentation of the exact location of lateral connections within the mainline as well as infiltration occurring at service connections.

CCTV inspection of laterals

A lateral push camera was inserted into each lateral through cleanouts and directed towards the mainline and the house. All of the laterals made of Orangeburg materials had failed (allowed groundwater infiltration to occur) additionally all were demonstrating various levels of deformation and in seven cases the condition was so pronounced that it inhibited the cameras passage. Seven occurrences of this condition were identified. The contractor was able to re-round two of the pipes enough to allow passage of the camera as well as the CIPP materials. Five laterals were open-cut spot-repaired in ten to twelve foot long sections and replaced with sections of PVC pipe. The results of lateral CCTV inspection (Table A **Error! No text of specified style in document.**-2) clearly showed that all laterals needed rehabilitation.



Table A Error! No text of specified style in document.-2. Prince William Service Authority, VA, 2003: Condition assessment of laterals

Pipe type	Number of laterals	Condition:
Orangeburg	16	All pipes had failed with blistering and the pipe material was delaminating in layers.
Cast iron	2	Pipes had severe mineral buildup over time, which reduced their hydraulic capacity from 4" to 2" pipes. These pipes have reached the end of their life (40 years) and would continue to decay.
PVC	2	These pipes were in good condition but not the connection at the mainline.

CURED IN-PLACE PIPELINING FOR MAINLINES

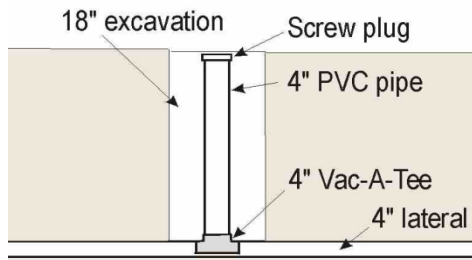
The *PERFORMANCE LINER*® CIPP system was utilized for the mainline sewers. This unique air inversion and hot air curing process also was supplied by LMK Enterprises, Inc. Service connections were re-established using typical, trenchless lateral connection procedures. Once they were opened, the system was ready and prepared for the lateral renewal process.

INSTALLATION OF CLEANOUTS WHERE NECESSARY



Vacuum excavation was utilized to create access points which would allow for the remote connection of a lateral saddle assembly product. This saddle assembly snaps onto an existing lateral pipe. The lateral saddle system significantly reduces the amount of disruption (small foot print) when compared to a typical cleanout installations. The soil was cut with a water jet and vacuumed out with a 6" tube (connected to a truck). The pit size was about 18" in diameter. It took on average 60 minutes to complete one pit.

Figure A Error! No text of specified style in document.-1 Hydro excavating of the pit



For each cleanout, a piece of 4" PVC pipe was used as a riser from the lateral. Attached to the lateral using a PVC saddle (4" VAC-A-TEE®) and coming up to grade. The water-tightness was accomplished by applying a special resin that cured in 30 minutes providing a structural seal.

new cleanouts

Figure A Error! No text of specified style in document.-2 Installation of



The new cleanout assembly was filled with water performing a hydrostatic exfiltration test verifying, a non-leaking connection.

In-Field Construction Details

Figure A Error! No text of specified style in document.-3 VAC-A-TEE® Cleanout installed in the pit



1. Cleanouts provided access to clean and inspect the lateral pipes. Once the lines were prepared and ready for insertion, a camera was inserted from the cleanout to the main pipe providing accurate robotic positioning of the main/ lateral lining. The camera inserted from the cleanout also allowed the inversion process to be documented on video recording equipment.



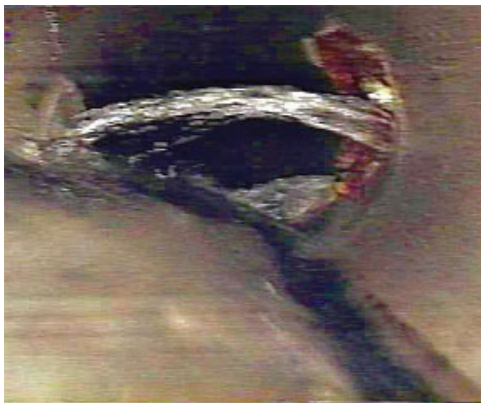
2. A mobile wet-out unit was used to vacuum impregnate the T-shaped liners with a thermo-set resin. The resin saturated materials were then loaded into a one-hundred foot long, flexible inversion launching device.



3. The installation assembly is towed through the main pipe and robotically positioned at the main to lateral connection. Air pressure was applied causing the liner and bladder to invert up into the old lateral pipe, on some laterals as far as 85 feet.



4. Once positioned, the felt tube materials were inverted with air pressure and held tight against the old lateral pipe. Hot air was mixed with the ambient air, providing a quick resin curing system. Liners in lengths of 85 feet were cured in as little as 30 minutes.



5. The finished product provided a one-piece main/ lateral composite with a full circle 16 inch long sleeve in the mainline. The materials are continuous in length from the main to the upper end of the lining which was adjacent the house foundation.



6. Once cured, the installation assembly unit (launcher) was removed and process was repeated for the next residence. Aside from some unfortunate electrical problems with the Illinois contractor's boiler, they were able to complete an installation every 2.5 hours.

▪ **Overview of performed work**

Address	Length –total	Length –relined	ID
9100 Amherst Court	82.0 ft	72.0 ft	4"
9101 Amherst Court	82.0 ft	85.0 ft	4"
9102 Amherst Court	82.0 ft	85.0 ft	4"
9103 Amherst Court	85.0 ft	81.0 ft	4"
9104 Amherst Court	78.0 ft	77.0 ft	4"
9105 Amherst Court	24.0 ft	50.4 ft	4"
9106 Amherst Court	58.0 ft	58.0 ft	4"
9107 Amherst Court	58.0 ft	57.3 ft	4"
9108 Amherst Court	54.0 ft	55.0 ft	4"
7584 Amherst Drive	79.0 ft	81.0 ft	4"
7585 Amherst Drive	80.0 ft	80.4 ft	4"
7586 Amherst Drive	49.0 ft	46.0 ft	4"
7587 Amherst Drive	84.0 ft	81.4 ft	4"
7588 Amherst Drive	58.0 ft	58.0 ft	4"
7589 Amherst Drive	70.0 ft	69.0 ft	4"
7590 Amherst Drive	56.0 ft	52.5 ft	4"
7591 Amherst Drive	50.0 ft	49.0 ft	4"
7592 Amherst Drive	58.0 ft	53.0 ft	4"
7593 Amherst Drive	56.0 ft	54.0 ft	4"
7594 Amherst Drive	54.0 ft	53.0 ft	4"

▪ **Cost analysis**

Table A Error! No text of specified style in document.-4. Prince William Service Authority, VA, 2004: Summary of costs

Item	Unit Price	Qty	AMOUNT	Average
• CCTV inspection of laterals (Done in-house by the agency's crew)	NA	20 laterals		
• Cleanout installation	\$ 1,500 /lateral	4	\$6,000.00	
• Point repair (open cut)	\$ 5,800 /ea	5	\$29,000.00	
• Rehabilitation with T-Liner Includes cleaning and post-CCTV inspection and mobilization from Illinois.	\$ 4,471.32 /lateral	20 laterals	\$89,426.40	
TOTAL		20 laterals	\$124,426.40	\$6,221.32

By mutual agreement, the agency paid for the installation of four cleanouts and the costs for remaining four cleanouts were absorbed by the contractor.

▪ **Project duration**

**Table A Error! No text of specified style in document.-5. Prince William Service Authority, VA, 2004:
Duration of construction work on each lateral**

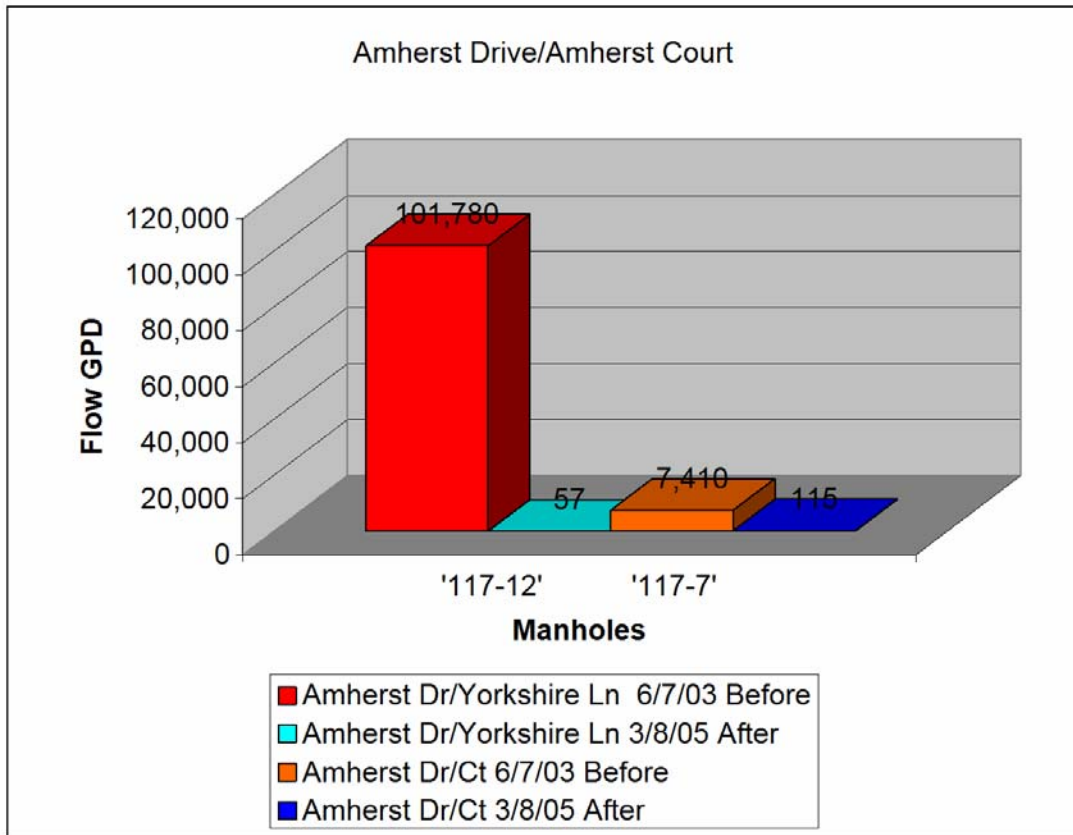
Item	Average Duration (approx.)
Preliminary inspection	
• CCTV inspection of laterals (three person crew)	45 min
Rehabilitation	
• Mobilization	15 min
• Lateral cleaning. Simultaneously: In-situ liner preparation	45 min
• Liner inversion and curing	30 min
• Post-CCTV, and demobilization	15 min
TOTAL (Rehabilitation)	2hrs 30 min

Time frame for the project, including the excavation and repairs of the failed five laterals took ten (10) working days. It took 3 hours on average to seal each connection at the mainline and to structurally renew and seal each lateral. The Illinois field crews were able to rehabilitate 2 laterals per day. There were some learning experiences during the project and overall the construction process went smoothly.

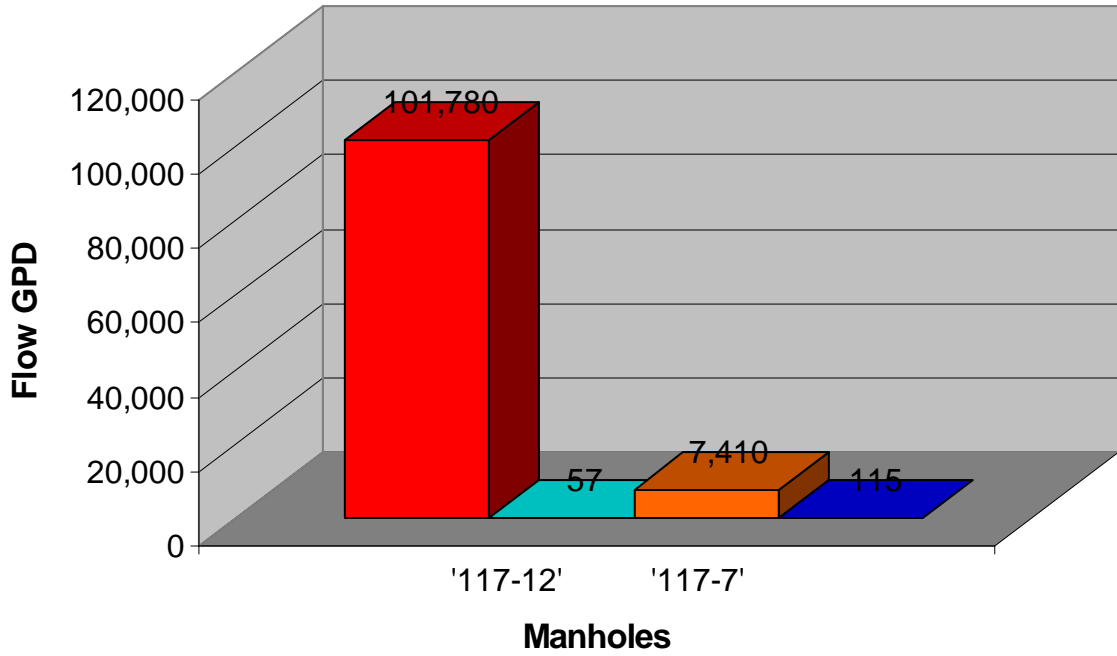
The following were the challenges:

- Orangeburg pipe material had blistered and delaminated, in some cases it had totally failed. The contractor was able to round out some of the Orangeburg material enough to allow for installation of the CIPP materials but prior to the contractor performing his work, five failed laterals required excavation and point repairs to be made
- Obtaining permission from all homeowners prior to beginning work
- Vac-a-Tee saddles did not conform to the irregularity of the outside diameter of the cast iron pipe due to exterior tuberculation. The exterior of the cast iron was very rough with heavy build-up making the outside diameter larger than normal. Today, the Standard Operating Practice for VAC-A-TEE saddles on cast iron is to sandblast the portion of pipe where the saddle will be set.
- Public relations

The Service Authority worked diligently on informing the public about the coming project. One of the things was preparing a door hanger, which explained the nature of the problem and how the lining of laterals would provide the solution.

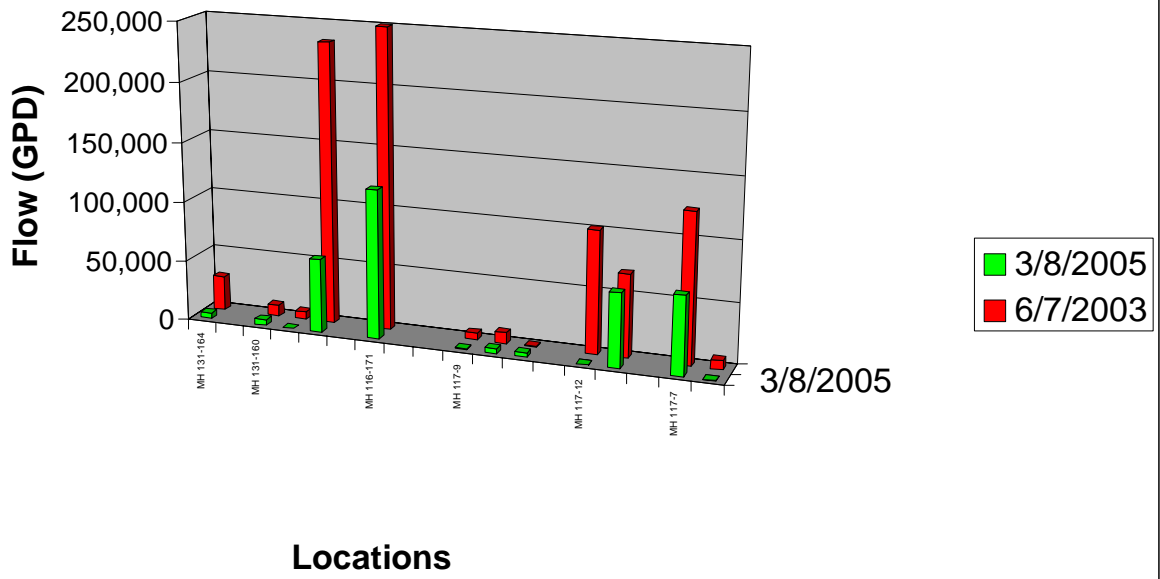


Amherst Drive/Amherst Court

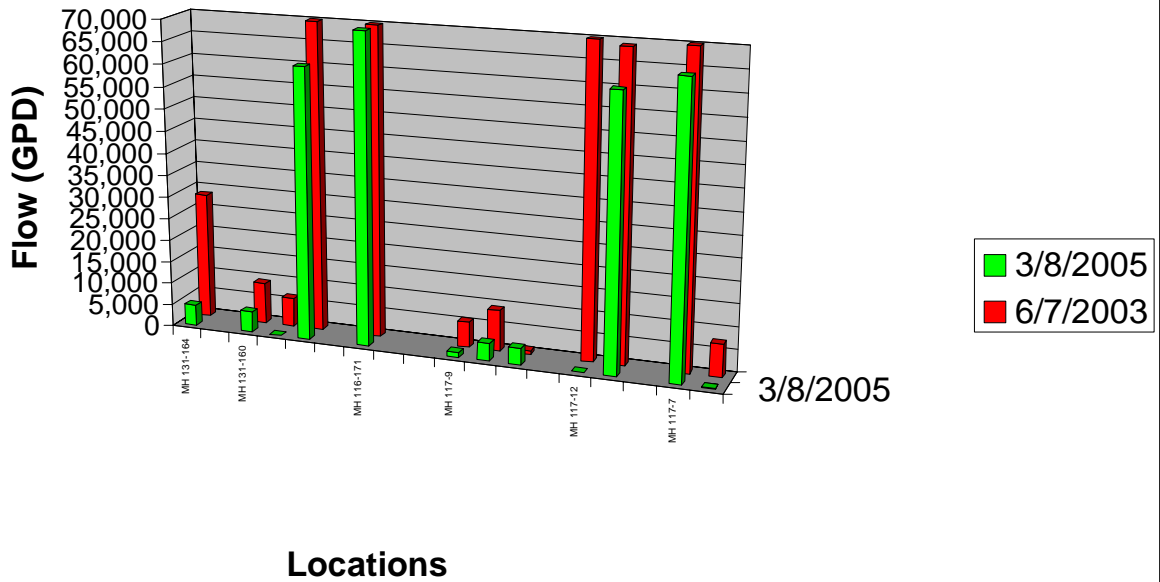


- Amherst Dr/Yorkshire Ln 6/7/03 Before
- Amherst Dr/Yorkshire Ln 3/8/05 After
- Amherst Dr/Ct 6/7/03 Before
- Amherst Dr/Ct 3/8/05 After

Amherst/Lomond Area



Amherst/Lomond Area



See appendix 1

Figure A Error! No text of specified style in document.-4 Educating the Homeowners

Manassas, VA 20111
8 August 2003

Re: Lateral replacement

Dear Mr. & Mrs. _____:

As you know, this spring has been one of the wettest in recent history. As such, there have been issues that were always present but were greatly magnified due to this high groundwater condition. We have been dealing with Inflow and Infiltration (I & I) for quite some time. However, the rains this spring inundated the system and helped us pinpoint the areas that require our focused attention. One of those areas is Amherst Court and that portion of Amherst Drive from the cul-de-sac to Yorkshire Lane. We have performed investigative work in this area, and determined that a good deal of the I & I present is coming from the laterals (the pipe that connects the sewer in your house to our main line in the street). We have recently learned of a new procedure for repairing these laterals that does not involve digging up the whole yard.

The process involves the relining of the lateral from inside the main line pipe. This is the same technology that the industry has been using for some time now, but only recently has it been adapted to apply to the small house laterals. The process involves inserting a machine in the main line which has the flexible liner attached to it. The liner is impregnated with a resin and then inserted up the lateral to within five feet (or to the stub-out from the house). Once inserted, the resin cures and you now have a new service lateral, which will give you many years of service and will eliminate most, if not all, of the I & I from the laterals. By eliminating this groundwater, we are able to save money, as this water goes to the treatment plant and must be treated, even though it is clear groundwater. This costs everyone money, since this water is not metered, (i.e. doesn't come from a building, where the sewer rate is based on the amount of water used), there is no way to recover the cost of treating this water at the treatment plant.

In order to perform this process, your lateral must have a cleanout installed at the property line or at the house. The cleanout is a pipe with a cap on it that allows access to the lateral for cleaning and inspection purposes. This cleanout, if not already present, is necessary for this process. If one is not present, we will have one installed, which will entail digging up a portion of your lawn and installing the cleanout. Also, if there is only a cleanout at the street and not one at the house, we will have to dig up the one at the street and replace it with a "straight" tee. This is necessary due to the fact that the tees installed in a typical sanitary cleanout are "swept" with the direction of flow from your house. We need to have a "straight" tee for not only the relining process, but also to facilitate our ability to insert a camera in the line and TV the lateral. This will reveal any problems that may be present, and also tell us where any cleaning must be performed. This should be the extent of the digging in your lawn, unless of course there is a complication.

However, there is one exception to this rule. If the lateral to your home is Orangeburg, the situation changes. Orangeburg is a pipe material that was used for many years, even as late as the 1970's. The pipe is made of cellulose fibers that are injected with hot coal tar pitch. If Orangeburg is present in the lateral to your home and it is in fairly good condition (i.e. it is still mostly round), the process can still be performed. However, if the pipe is severely out-of-round or collapsed, then we would not be able to perform the relining. At that point, we will have to contact you to discuss other options for repair. This will involve, most likely, digging up the lateral from the street to the house and replacing it.

The relining project will be conducted at no cost to you, the homeowner. However, if the condition described above (collapsed or severely out-of-round Orangeburg pipe) exists, we will have to contact you to discuss the replacement options, as well as any cost. By doing this, it will benefit you, as well as everyone else on our system. We want to make this area a demonstration project for this new process and we would greatly appreciate your assistance in that effort.

You will find a permit included with this letter, which we need you to sign, if you are the owner. If you are a tenant, please sign in the appropriate section and then pass it along to the owner for his/her signature. We would like to have all of these permits returned as quickly as possible, so that we may schedule the contractor to come in and perform the work.

If I you have any questions or concerns, please feel free to contact me at 703-335-7980. You may also contact John Scott or Wayne French at the above number.

Sincerely,

Figure A Error! No text of specified style in document.-5 Educating the Homeowners

PERMIT

THIS PERMIT is made and entered this ____ day of _____, 2003, by and between _____ and _____, owners (the UNDERSIGNED), and the PRINCE WILLIAM COUNTY SERVICE AUTHORITY, 4 County Complex Court, Prince William, Virginia ("the Authority").

WHEREAS, the Authority owns and operates a sanitary sewer collection system in Prince William County, Virginia, serving the Property situated at _____; and

WHEREAS, it has been determined that the sanitary sewer lateral located on or as a part of the Property may be leaking and therefore creating a source of groundwater inflow and infiltration; and

WHEREAS, the Undersigned, for good and valuable consideration, the receipt whereof is hereby acknowledged, wishes for the Authority to rehabilitate the lateral, and hereby grants permission for same, all upon the following terms and conditions:

1. Install a new cleanout at the property line or modify the existing cleanout at the property line by installing a "straight" tee and replacing the cleanout stack.
2. The Authority shall be permitted to reline the lateral using the T-Liner™ process.
3. The relining shall be performed by the Authority at no cost to the Undersigned.

However, upon completion of the work, the lateral shall at all times be maintained and kept functioning by the Undersigned and shall be the property of the Undersigned. The Authority shall warrant the work performed for a period of one (1) year from the date of completion.

4. The Service Authority will restore the area disturbed by the work described above to as near original condition (condition of the area before work began) as possible.

IN WITNESS THEREOF, the parties have caused this Permit to be executed the day and year first written.

THE UNDERSIGNED: PRINCE WILLIAM COUNTY SERVICE AUTHORITY

(OWNER)

By: _____ (OWNER)
Title: _____

ALSO ACKNOWLEDGED BY:

(TENANT)

(TENANT)

Dear Prince William Service Authority Customer:

We, (*PERFORMANCE PIPELINING, INC.*) have been contracted by Prince William Service Authority to perform maintenance or to renew your sewer service line. The technique we use requires very little excavation to renew the underground sewer pipe. The disruption our efforts will cause is minimal when compared to replacing the entire pipe by conventional excavation. Our method of repair is referred to as a “Trenchless Technology”.

The main purpose of this renewal process is to reduce groundwater and heavy rainfall entry, called Infiltration and Inflow (I&I), into the sanitary sewer system causing sanitary sewer backups and expensive wastewater treatment plant expansions. The process also is resistant to root blockages and restores structural integrity of the pipeline.

To achieve the objective the following is to take place:

1. Install outside sanitary sewer cleanouts predominantly by using a non-dig process achieved by vacuum to create a small bore hole. The patented no-dig cleanout installation method (called VAC-A-TEE™).
2. Line the sanitary service line from the sanitary sewer main (located in the parkway or street) using a remote controlled launcher that launches a special liner (like a sock) that is impregnated with an epoxy like resin, expanded to the full diameter of the service line, and becomes hard like PVC pipe after being steamed for approximately 30 minutes. The lining is seamless eliminating broken sections, root intrusion, and I&I.
3. The new rehabilitated service line is to be structurally sound with a 50-100 year life expectancy.
4. Performance Pipelining, Inc. warrants the product and workmanship for 10 years. Other contractors only warrant their work for 1 year.

Our goal is to provide you a long lasting, non-leaking, trouble free sanitary service line that will assist the Prince William Service Authority in their program to upgrade the sanitary sewer collection system and their goal to reduce sanitary sewer overflows.

During the repair, your service will be temporarily blocked for a short period of time. We respectfully request that you refrain from using any water during the installation time. This is a short period of time that typically is less than two hours. Our crew is tentatively scheduled to begin work on your sewer service line on the following date. We will make every attempt to contact you immediately prior to inserting the new pipe lining.

Scheduled Date for Lining

From: am pm

To: am pm

Thank you for your cooperation during our construction project.

If you should have any questions or concerns, please do not hesitate to contact us at 888.847.6664
Attention: Shaun M. Flanery, President

- **Effectiveness of rehabilitation**

Based on our preliminary, instantaneous measurements, it appears as though the project was 98% successful in removing inflow and infiltration. This data has to be verified with follow-up measurements, but it is apparent that the system is quite effective.