RESEARCH PROJECT NO. 99-051
EVALUATION OF POLYETHYLENE SNAP-TITE PIPE LINER

FINAL REPORT
JULY 2006

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REPORT DOCUMENTATION PAGE	Form Approved OME No. 0704-0188

1. AGENCY USE ONLY (LEAVE BLANK)	2.REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 2007	FINAL REPORT April 2007

4. TITLE AND SUBTITLE
Evaluation of 63" SNAP-TITE PIPE LINER

5. FUNDING NUMBERS

6. AUTHORS
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8. PERFORMING ORGANIZATION REPORT NUMBER
RP 91-071

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Pennsylvania Department of Transportation
BUREAU OF PLANNING AND RESEARCH,
Harrisburg, PA 17120

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
FHWA-02-008+99-051

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

12b.DISTRIBUTION CODE

13. ABSTRACT

The objective of this research project was to evaluate the process and performance of lining an existing pipe culvert with a polyethylene pipe liner. The pipe liner used in this project is called Snap-Tite pipe liner. This process, referred to as pipe lining, was sought as an alternative to the conventional removal and replacement methods due to the fact that it is cost effective, minimizes disruptions to the traffic flow and has fewer possible impacts upon the environment. This project was located at SR 4018, Segment 50 Offset 800 in Erie County. In addition to adding the pipe liner, the liner was extended approximately 12 feet on the inlet side of the culvert so as to align the pipe with the stream and allow for flattening of the existing slope. The performance of the liner was monitored for buckling through yearly inspections for 4 years. Very little buckling was reported and a provisional special provision will be generated for Department use.

14. SUBJECT TERMS
HDPE, pipe liner, polyethylene pipe

15.NUMBER OF PAGES
19

16. PRICE CODE

17.SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	LIMITATION OF ABSTRACT
NONE	NONE	NONE	

EXECUTIVE SUMMARY

The purpose of this project was to improve the effectiveness of the drainage system at a referenced project location and to evaluate the “Snap-Tite” pipe lining process an alternative to the conventional removal and replacement methods. This rehabilitation process requires little or no excavation, is designed to improve flow of water, and can save time and cost of total reconstruction with fewer possible impacts upon the environment and little disruption of traffic.

The process involved placement of a 63” diameter polyethylene “Snap-Tite” pipe liner. Pre-molded, that would fit into an 83” diameter existing deteriorated CMP pipe. The process was implemented on approximately 90 feet plus approximately 12 feet on the inlet side of the culvert so as to align the pipe with the stream and allow for flattening of the existing slope.

After installation of the “Snap Tite” pipe lining, satisfactory performance was recorded during a three year study. The process is recommended as an alternative treatment that could be used statewide on Department reconstruction projects in pipes where infiltration prevention and improved flow is needed.

M E T R I C C O N V E R S I O N F A C T O R S

TO CONVERT FROM	TO	MULTIPLY BY
Length		
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
yard (yd)	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot (ft^2)	square meter (m^2)	0.0929
square inch (in^2)	square centimeter (cm^2)	6.451
square yard (yd^2)	square meter (m^2)	0.8361
Volume		
cubic foot (ft^3)	cubic meter (m^3)	0.02832
cubic yard (yd^3)	cubic meter (m^3)	
gallon (U.S. liquid)**	cubic meter (m^3)	0.003785
gallon (Can. liquid)**	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbm)	kilogram (kg)	907.2
Density		
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
pound- mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon(U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon(Can.)**	kilogram/cubic meter (kg/m^3)	99.78
Temperature		
deg Celsius (ºC)	kelvin (ºK)	$t^{oK}=(t^{oC}+273.15)$
deg Fahrenheit (ºF)	kelvin (ºK)	$t^{oK}=(t^{oF}+459.67)/1.8$
deg Fahrenheit (ºF)	deg Celsius (ºC)	$t^{oC}=(t^{oF}-32)/1.8$

*The reference source for information on SI units and more exact conversion factors is the "Metric Practice Guide" ASTM E 380.
**One U.S. gallon equals 0.8327 Canadian gallon.

EVALUATION OF "63-inch" HIGH DENSITY POLYETHYLNE SNAP-TITE™ PIPE LINER

FINAL REPORT

BY

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INTRODUCTION

The lining of existing pipes is an economical way to improve flow characteristics and stop infiltration with only minor disruptions to the traveling public. Currently most pipe lining by PENNDOT has not been documented and no standard specification exists in the pub. 408. An 83 inch existing CMP was programmed for replacement by Erie County Department Forces on SR 4018. Erie County pipe's flow provided a small feeder tributary of Lake Erie which is considered an environmentally sensitive area. In order to avoid impact to the lake other options were considered beyond total reconstruction. . The pipe liner used in this project is called Snap-Tite pipe liner. In addition to adding the pipe liner, the liner was extended approximately 12 feet on the inlet side of the culvert so as to align the pipe with the stream and allow for flattening of the existing slope.

MATERIAL BENEFITS

The process of pipe lining with Snap-Tite pipe liner has the following characteristics which make it beneficial in the rehabilitation of pipe culverts.

- Pieces snap together to form water tight seals and the joints
- Pipe can be used in acidic soil because it is not affected by acid
- Due to the smooth inside surface, the new flow capacity often exceeds the previous capacity
- Work can be done in existing culvert eliminating the need to disrupt traffic flow and allowing workers to work off the road thus providing safer conditions
- Materials are easier to handle, therefore reducing the crew size and moreover cutting costs

- Since work can be done in existing culvert, there is no concern for repairing the road and minimal concern for restoring vegetation, therefore saving expenses

The Snaptite liner has another advantage over normal a HDPE pipe in that its unique connection is integrated into the pipe without providing a large bell end.

Engineering District 1-0 had a similar pipe lining project in Venango County with a much smaller pipe (see construction report Appendix "A".) The 63 "Outside large diameter of the Snaptitie pipe liner was not approved for HDPE pipe, which is approved up to 54 " . This process, referred to as pipe lining, was sought as an alternative to the conventional removal and replacement methods due to the fact that it is cost effective, minimizes disruptions to the traffic flow and has fewer possible impacts upon the environment. .

PROJECT DESIGN

The hydraulic engineering to insert a liner follows that for a standard pipe except allow no burial forces. The manufacturer provided pressure grouting forces. The smoothness of polyethelene pipe allow s for the smaller size of the pipe over CMP.

PERFORMANCE SUMMARY

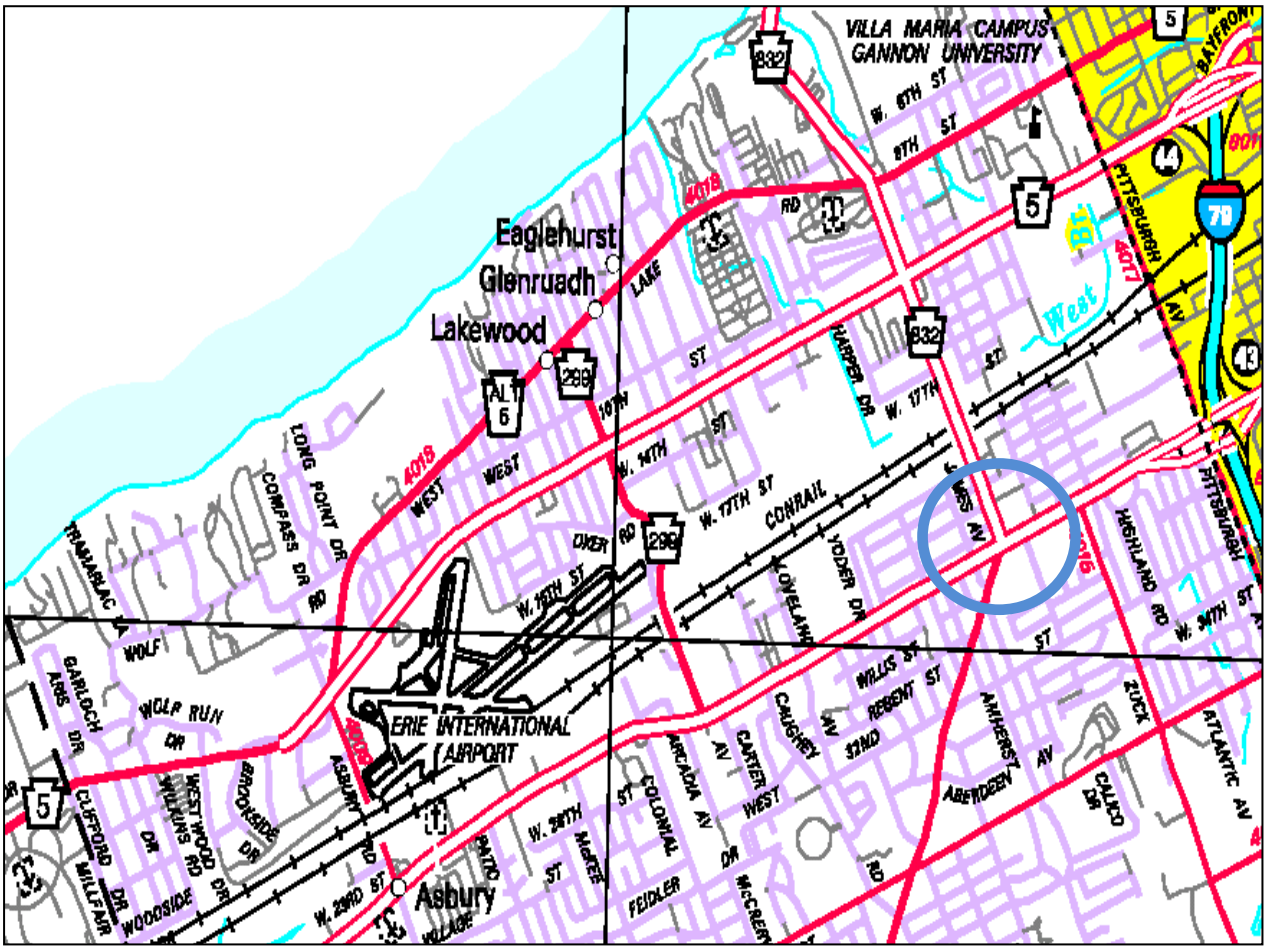
Inspection of this liner was close to inspecting a took place at least annually over a 4-year period**.** The inspection was conducted by the project manager and an assistant who would walk through the pipe with a hand held light and tape measure to determine distortion of the inside diameter. Multiple inside diameter measurements were difficult to attain under high flow environment. No change was determined in the diameters over the four year period. Pictures were also difficult to obtain in the pipe because of the amount of darkness within the pipe liner.

MATERIAL DESCRIPTION

The pipe liner that was used in this project was called Snap-Tite and was produced by ISCO in Louisville, Kentucky. The Snap-Tite pipe liner can be purchased in lengths ranging from 2 to 50 feet. The pipe liner is made from a high density polyethylene resin. The inside of the pipe is made to be smooth so that the flow capacity can be returned to or exceed the previous conditions.

PROJECT LOCATION

The Snap-Tite polyethylene pipe liner was used in the rehabilitation of a pipe culvert at SR 4018, Segment 50 Offset 800, Erie County.



CONSTRUCTION PROCEDURE

This project took place at SR 4018, Segment 50 Offset 800 in Erie County (SEE LOCATION Map Figure 2 pae 3). . The objective of this research project was to evaluate the process and performance of lining an existing pipe culvert with a polyethylene pipe liner

As a result of steep terrain a tracked excavator was used during the pipe liner installation. A minimal amount of excavation and tree removal occurred adjacent to the stream on the inlet side of the culvert in order to create a staging area for installation. The Snap-Tite pipe liner was installed according to the manufacturer's installation procedures which can be referenced in the Manufacturer's Installation Procedure section. This project occurred during a low flow period of the stream so the minimum amount of disturbance took place. Subsequent to the installation of the pipe liner the water flow was diverted back into it and the construction of a new D-W endwall was completed. Before the backfilling of the pipe extension a silt barrier fence was placed at the base of the slope in order to encompass the backfill area. While the embankment was being placed, R-4


CONTRAIL


SERV-ALL


HITACHI
EX150

rock-lined ditches were constructed down to the stream. In order to correct any of the minor disruptions to the environment, the disturbed areas were seeded and mulched after the completion of the embankment. After the permanent erosion and sediment controls were established the temporary controls were removed. Photos, with captions, of the actual pipe liner installation can be referenced in Construction Photos section of this report.

MANUFACTURER'S INSTALLATION PROCEDURE

- **Step One-Select and prepare the existing culvert.**

  Inspect the culvert to ensure the liner can be inserted without obstruction. Flush and/or clean the existing culvert.

- **Step Two-Insert one end of Snap-Tite Liner into existing culvert.**

  This can be done by pulling or pushing the pipe using a variety of techniques. Leave about five feet exposed prior to this step. It may be necessary to create a "nose cone" by cutting the ends of the pipe.

- **Step Three- Position the next section of Snap-Tite Liner with the proper alignment.** Place the opposing end of a second section against the exposed end of the first section. The two sections must be in alignment and have the same slope.

- **Step Four- Install a Gasket.** Install a gasket on the male end to ensure a water-tight seal. The gasket should be installed in the groove furthest from the end.

- **Step Five- Attach the chains and couplings.** Double-wrap the chains approximately two feet from the coupling or tighten with the chain binders. Attach one chain hoist on each side of the coupling.

- **Step Six- Snap liner together.** Align the ends with the male bevel inside of the female bevel. Pull the couplings together, forcing the female end to expand and allow the male end to move into the female end. When lands and grooves are aligned the couplings will "snap" and lock together.

- **Step Seven- Push joined liners into the culvert and repeat until completely lined.** Remove chains, push joined liners into the culvert and repeat steps 1-5.

Each new piece of pipe is snapped onto the preceding pipe and pushed or pulled into the culvert, leaving enough pipe protruding from the culvert to join with the next length of pipe.

- **Step Eight- Seal the culvert ends.** Seal the annular space between the Snap-Tite liner and the existing pipe with an appropriate grout.
- **Step Nine- Grout the annular space.**

  It is recommended that the annular space between the existing culvert and the liner pipe be grouted. This will help fill the voids created by previous washouts, provide additional structural support, and prevent point loading

Figure 1 Inspection photo September 2003

CONCLUSIONS AND RECOMMENDATIONS

The performance of the Polyethylene Snap-Tite pipe liner has been satisfactory with the lining of the 83" deteriorated CMP pipe. The liner had no buckling during the approximately three years it has been evaluated at this project site.

It is recommended that the Polyethylene Snap-Tite pipe liner be approved as an alternative for statewide use a pipe rehabilitation process on Departments projects. The potential for use of the Polyethylene Snap-Tite pipe rehabilitation may be limited to restoration of flow and infiltration prevention.

The Department's Engineering District 1-0 indicated that the Polyethylene pipe rehabilitation process, significant savings were realized on this project and they received a quality product which will serve the public well. Preliminary indicator s are favorable for the performance of the HDPE pipe liner.

ACKNOWLEDGMENTS

The authors would like to thank the following people who helped during construction filed views and writing of this paper. Without their help this research would not have been completed. Thank you.

Eelman Associated : Albert Eelman

Engineering District 1-0: Jeff Karr, Paul Miller, and Jeff Oswalt