

**Research Report
KTC-89-54**

**PERFORMANCE OF CORRUGATED
POLYETHYLENE ENTRANCE PIPE**

by

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in cooperation with

**Kentucky Transportation Cabinet
Commonwealth of Kentucky**

and

**Federal Highway Administration
US Department of Transportation**

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October 1989



COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
FRANKFORT, KENTUCKY 40622

MILO D. BRYANT
SECRETARY
AND
COMMISSIONER OF HIGHWAYS

WALLACE G. WILKINSON
GOVERNOR

January 2, 1990

Mr. Paul E. Toussaint
Division Administrator
Federal Highway Administration
330 West Broadway
Frankfort, Kentucky 40602-0536

SUBJECT: IMPLEMENTATION STATEMENT
Research Study KYHPR-85-107-11
Performance of Polyethylene Entrance Pipe

Dear Mr. Toussaint:

Corrugated polyethylene pipe meeting the requirements of the special note for that pipe dated September 16, 1988 will be permitted for routine use as entrance pipe. The polyethylene pipe will be considered an alternate to various pipe permitted by Section 706 - Entrance Pipe of the current Standard Specifications.

Sincerely,

A handwritten signature in cursive script, appearing to read "O. G. Newman".

O. G. Newman, P. E.
State Highway Engineer

1. Report No. KTC-89-54		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Performance of Corrugated Polyethylene Entrance Pipe				5. Report Date October 1989	
				6. Performing Organization Code	
7. Author(s) R. D. Hughes				8. Performing Organization Report No.6 KTC-89-54	
9. Performing Organization Name and Address Kentucky Transportation Center College of Engineering University of Kentucky Lexington, KY 40506-0043				10. Work Unit No. (TR AIS)	
				11. Contract or Grant No. KYHPR-85-107-11	
				13. Type of Report and Period Covered Final	
12. Sponsoring Agency Name and Address Kentucky Transportation Cabinet State Office Building Frankfort, KY 40622				14. Sponsoring Agency Code	
15. Supplementary Notes Prepared in cooperation with U.S. Department of Transportation, Federal Highway Administration					
16. Abstract Observations noted during inspections of 57 entrance pipe installations are summarized. Inspections were conducted in 1986 and 1989. It is recommended that corrugated polyethylene pipe be permitted routinely as an alternate to other materials for entrance pipe.					
17. Key Words Pipe Entrances Polyethylene Corrugateds Performance			18. Distribution Statement Unlimited with approval of Kentucky Transportation Cabinet		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 37	22. Price

Introduction

Early in 1984, the State Highway Engineer requested an investigation relative to the feasibility of using corrugated polyethylene (PE) pipe for entrances and/or cross drains. FHWA officials were also interested in evaluating the performance of PE conduit installations and approval was granted for pursuit of the study as subtask number 11 under KYHPR-85-107, Long-Term Monitoring of Experimental Features.

A special Note for Corrugated Polyethylene Entrance Pipe was issued May 30, 1985. That note was revised September 16, 1988. The notes require that polyethylene materials used in manufacture of the pipe comply with certain requirements of AASHTO M 294. The notes are included in Appendix A. Bedding in accordance with Section 611 of the Standard Specifications and Standard Drawing RDI-020 (Appendix B) was also specified. Conduit installed in accordance with the designated requirements and meeting the stiffness requirements of ASTM D 2412 should be adequate for fills from one to 38 feet above the top of the conduit.

Fifty seven installations of PE conduit placed as entrance pipe were selected for long-term monitoring. Four of those installations were located in District 7 and 53 of the PE entrances were placed in District 2. Performances to date are summarized.

Installations and Performance

Thorough inspections of all installations were made during April and June 1986 and again in May 1989. Observations noted during those inspections are summarized in Appendix C.

Conditions noted during the 1989 inspections were not significantly different from those reported

for the 1986 inspections. Slight to moderate bulging near the center of the conduit was reported for approximately 25 percent of the installations. Two installations had one end crushed and both ends were crushed at one installation. The conduit having both ends crushed is located at the entrance of a garage specializing in repairs of heavy trucks. One conduit contained a dent in the center top that was the result of heavy equipment operating over the installation prior to placement of sufficient fill for protection during construction.

Various forms of debris were noted in many ditches and within several entrance pipes. Several of the structures had silted to the extent that flow was severely restricted and observations were difficult. Several entrance conduit were located in areas having grass lined channels and debris was not a problem at those sites. Ranges in conditions noted during the inspections are depicted in Figures 1 through 11.

PE conduit has been used for cross drain installations and performance surveys are continuing. Information relative to those structures will be reported at a later time.

Summary and Recommendation

No appreciable differences in the performance of corrugated polyethylene pipe and corrugated metal pipe, used for entrances, were noted during inspections. Crushed ends were no more prevalent in PE installations than in metal conduit installations. The tendency to retain silt, debris, or clog was no different for the PE conduit than for the corrugated metal structures.

Entrance pipe should be bedded in the same manner as the procedure used to bed cross drains. It is suspected that installation procedures used for entrance conduit construction may not always be in accordance with the specifications and standard drawing. Structural characteristics of the installation are

greatly enhanced by conformance to specified construction procedures because design is based upon and structural performance is related to the structure-soil interaction.

It is recommended that corrugated polyethylene pipe be permitted for use as entrance pipe.



Figure 1. Grass Lined Channel Prevents Erosion;
KY 130, Union County.



Figure 2. Large Stone Protects Outlet; US 41 A,
Henderson County.



Figure 3. Aggregate on Embankment Erodes and Obstructs Outlet.



Figure 4. Aggregate Washed from Shoulder and Blocked Outlet.



Figure 5. Heavy Vehicle Damaged Unprotected Outlet.



Figure 6. Truck Damage to Inlet.



Figure 7. Large Stone Protect Outlet.



Figure 8. Vegetation Prevents Silting.

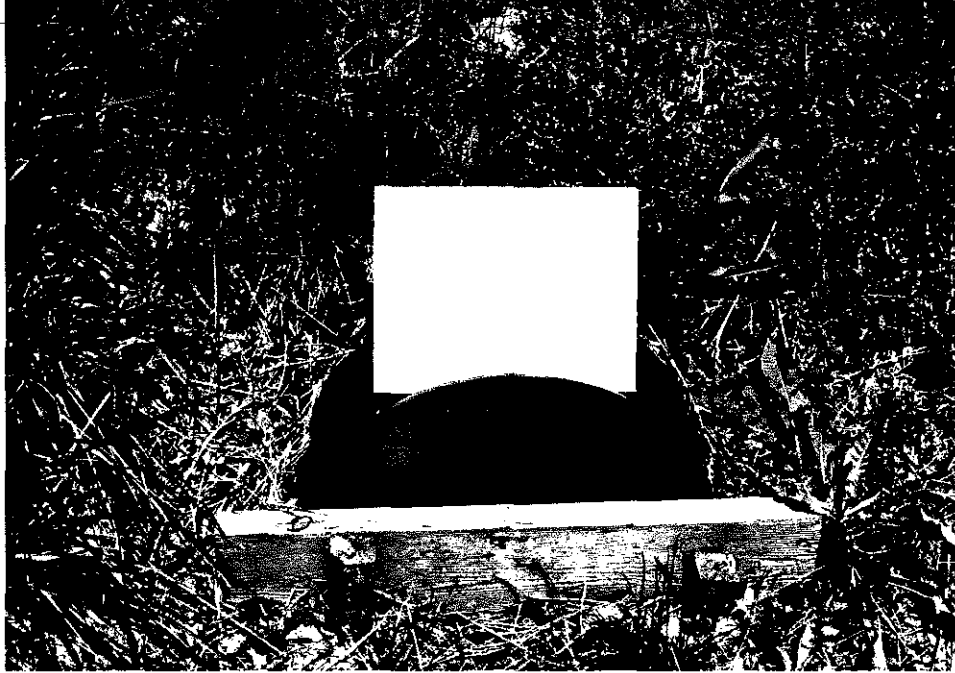


Figure 9. Timber Sill Protects Inlet.



Figure 10. Silting at Inlet.



Figure 11. Aggregate from Embankment Obstructs Flow.

APPENDIX A

SPECIAL NOTE FOR CORRUGATED POLYETHYLENE ENTRANCE PIPE

Corrugated polyethylene tubing may be furnished for 15-, 18-, or 24-inch entrance pipe on this project, at the Contractor's option.

When corrugated polyethylene tubing is furnished, all work and materials shall comply with Section 706 of the Department's Standard Specifications with the following additions and exceptions:

(1) The tubing and fittings shall meet the requirements of AASHTO M 294.

(2) The tubing shall be installed with a minimum cover of one foot.

(3) Bedding and backfill shall be in accordance with the requirements for culvert pipe in Section 611 of the Standard Specifications and on standard drawing RDI-020, current edition.

(4) Each manufacturer shall furnish a certification to the Division of Materials at least once each year that the polyethylene materials used in manufacture of the pipe complies with Section 5 of AASHTO M 294.

(5) Each shipment shall be accompanied by a certification from the manufacturer that the pipe complies with paragraphs 6.4 and 6.5 of AASHTO M 294.

(6) All pipe shall be approved before use. The Department will perform all sampling and testing deemed necessary, either at the plant or on the project.

(7) Payment for the accepted quantity shall be full compensation for all materials, equipment, labor, and incidentals necessary to complete the work, including the specified bedding and backfill.

May 30, 1985

SPECIAL NOTE FOR CORRUGATED POLYETHYLENE ENTRANCE PIPE

Corrugated polyethylene pipe may be furnished for 15-, 18-, or 24-inch entrance pipe on this project, at the Contractor's option.

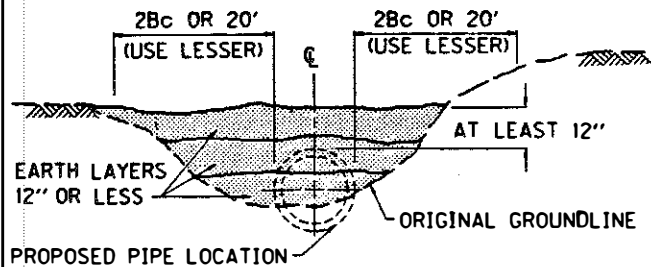
When corrugated polyethylene pipe is furnished, all work and materials shall comply with Section 706 of the Department's Standard Specifications with the following additions and exceptions:

- (1) The pipe and fittings shall meet the requirements of AASHTO M 294, and may be Type C or Type S, at the Contractor's option.
- (2) The pipe shall be installed with a minimum cover of one foot.
- (3) Bedding and backfill shall be in accordance with the requirements for culvert pipe in Section 611 of the Standard Specifications and on standard drawing RDI-020, current edition.
- (4) Each manufacturer shall furnish a certification to the Division of Materials at least once each year that the polyethylene materials used in manufacture of the pipe complies with Section 6 of AASHTO M 294.
- (5) Each shipment shall be accompanied by a certification from the manufacturer that the pipe complies with paragraphs 7.5 and 7.6 of AASHTO M 294.
- (6) All pipe shall be approved before use. The Department will perform all sampling and testing deemed necessary, either at the plant or on the project.
- (7) Payment for the accepted quantity shall be full compensation for all materials, equipment, labor, and incidentals necessary to complete the work, including the specified bedding and backfill.

September 16, 1988

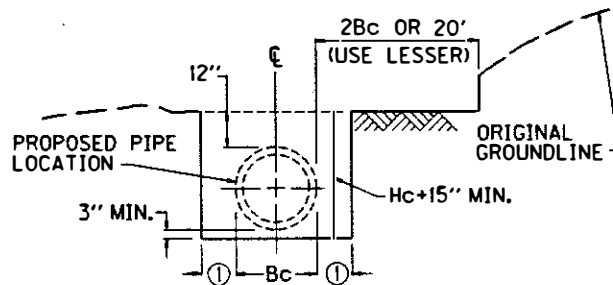
APPENDIX B

STEP 1



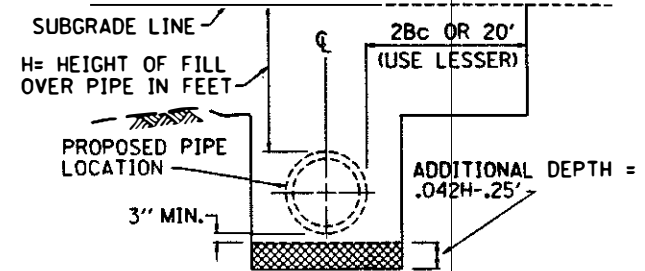
- IF THE ORIGINAL GROUNDLINE IS AT LEAST 12" ABOVE TOP OF PROPOSED PIPE FOR WIDTH OF 2Bc OR 20' (WHICHEVER IS LESS) ON EACH SIDE OF THE PIPE. GO DIRECTLY TO "STEP 2".
- IF ORIGINAL GROUNDLINE IS NOT AT LEAST 12" ABOVE TOP OF PROPOSED PIPE, COMPACT EMBANKMENT IN LAYERS 12" OR LESS TO ELEVATION AND WIDTH SHOWN. MEET DENSITY REQUIREMENTS FOR PROPOSED EMBANKMENT.

STEP 2



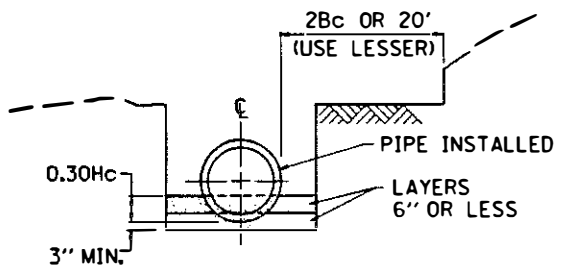
- EXCAVATE TO WITHIN 12" ABOVE TOP OF PROPOSED PIPE A WIDTH OF 2 Bc OR 20' (USE LESSER) ON EACH SIDE OF PIPE.
 - EXCAVATE TRENCH TO WIDTH AND DEPTH SHOWN.
- ① AT LEAST 12", BUT NOT MORE THAN 15".

ROCK FOUNDATION DETAILS STEP 3



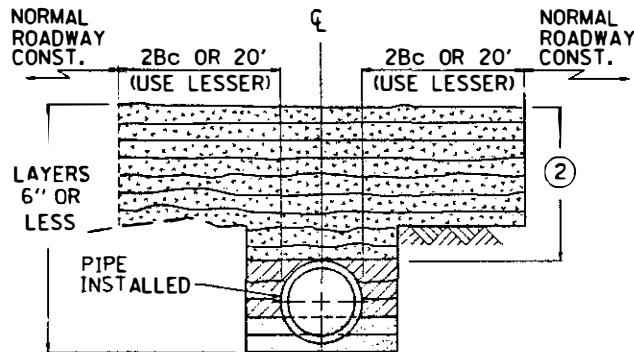
- IF ROCK FOUNDATION IS NOT ENCOUNTERED, GO DIRECTLY TO "STEP 4".
- IF ROCK FOUNDATION IS ENCOUNTERED, EXCAVATE TRENCH ADDITIONAL DEPTH USING FORMULA GIVEN. THIS ADDITIONAL DEPTH SHALL ALWAYS BE AT LEAST 0.75' AND WILL NOT BE REQUIRED TO BE MORE THAN 0.75Hc-.25', REGARDLESS OF ABOVE FORMULA RESULTS.
- BACKFILL ADDITIONAL EXCAVATION AREA WITH EARTH CUSHION OF FIRMLY COMPACTED FINE SOILS IN LAYERS 6" OR LESS.

STEP 4



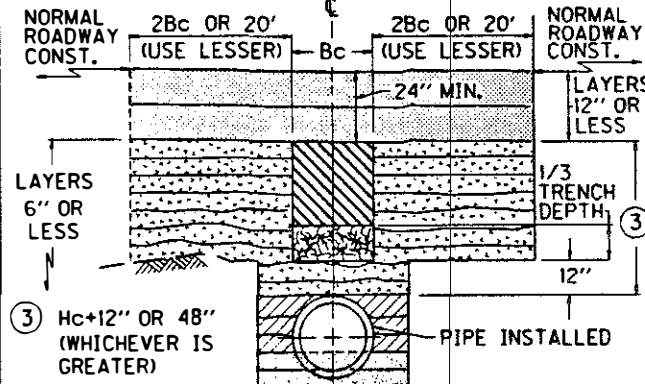
- COMPACT SAND IN TRENCH IN LAYERS 6" OR LESS TO WIDTH AND ELEVATION SHOWN.
- EXCAVATE A GROOVE IN THE COMPACTED SAND TO CONFORM TO THE OUTSIDE OF THE PIPE. AFTER EXCAVATION OF THE GROOVE, APPROXIMATELY 3" OF SAND SHOULD REMAIN BELOW THE OUTSIDE INVERT OF THE PIPE. THE CRADLE SHALL BE GAGED FOR SHAPE AND SLOPE BY STRIKING OR DRAWING A TEMPLATE THROUGH THE GROOVE IMMEDIATELY BEFORE PLACING EACH SECTION OF PIPE.
- INSTALL PIPE AT CORRECT ALIGNMENT AND ELEVATION. RECOMPACT ANY LOOSE SAND DISTURBED DURING INSTALLATION.

STEP 5



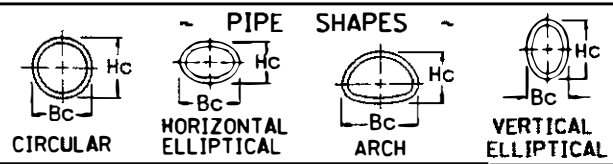
- COMPACT SELECTED FINE SOIL, SAND OR NO. 10 COARSE AGGREGATE IN LAYERS 6" OR LESS TO TOP OF THE PIPE.
 - IF BI-BEDDING IS SPECIFIED, GO DIRECTLY TO "STEP 6".
 - IF BI-BEDDING IS NOT SPECIFIED THEN COMPACT SELECTED FINE SOIL TO ELEVATION ② ABOVE TOP OF PIPE. MEET DENSITY REQUIREMENTS FOR ADJACENT EMBANKMENTS.
 - PROCEED WITH NORMAL ROADWAY CONSTRUCTION.
- ② 48" REQUIRED IF FILL HEIGHT PERMITS.

BI-BEDDING - FILLS OVER 36' STEP 6



- COMPACT SELECTED FINE SOIL TO ELEVATION ③ ABOVE TOP OF PIPE. MEET DENSITY REQUIREMENTS FOR ADJACENT EMBANKMENT.
 - EXCAVATE A TRENCH Bc WIDE DOWN TO 12" ABOVE TOP OF PIPE.
 - FILL BOTTOM 1/3 OF TRENCH WITH LOOSE STRAW OR HAY.
 - FILL TOP 2/3 OF TRENCH WITH LIGHTLY COMPACTED SOIL.
 - PLACE EMBANKMENT IN LAYERS 12" OR LESS TO 24" MIN. ABOVE TOP OF TRENCH TO WIDTH SHOWN. MEET DENSITY REQUIREMENTS FOR ADJACENT EMBANKMENT.
 - PROCEED WITH NORMAL ROADWAY CONSTRUCTION
- ③ Hc+12" OR 48" (WHICHEVER IS GREATER)

NOTE:
A. BI-BEDDING (STEP 6) IS APPLICABLE ONLY TO REINFORCED CONCRETE PIPE TO BE CONSTRUCTED ACCORDING TO CURRENT STANDARD DRAWING RDI-001.



KENTUCKY
DEPARTMENT OF HIGHWAYS

PIPE BEDDING FOR
CULVERTS, SEWERS,
STORM DRAINS, AND
THEIR COMBINATIONS

STANDARD DRAWING NO. RDI-020-04

SUBMITTED: *James S. Schuman* 8-31-87
DIRECTOR, DEPARTMENT OF HIGHWAYS DATE

APPROVED: *P. J. Turner* 9-11-87
STATE HIGHWAY ENGINEER DATE

APPENDIX C

1986 INSPECTIONS

District 7

BOURBON COUNTY

4/3/86 KY 1939, Pipe #1, MP 3-4

Small entrance to house and paddocks appears to be rarely used. Sighted through pipe and noted slight bulge in top middle. Otherwise in good condition. 15" dia.

4/3/86 KY 1939, Pipe #4, MP 0-1

Entrance to yard and paddocks. End crushed by tractor or truck. Slight bulge in center. Fair condition. 18" dia.

CLARK COUNTY

4/4/86 US 60, Pipe #3, MP 0-1

Entrance to house. Slight bulge in center, mower cut at one end. Fair condition.

4/4/86 US 60, Pipe #5, MP 2-3

Pipe under entrance to house/farm. Slight bulge in center. Owner stated that heavily loaded trucks had traveled over it during construction. Good condition.

District 2

HANCOCK COUNTY

6/3/86 US 60, MP 14-15

18" pipe in front of Willamette Industries. Pipe appears to be in good condition. Was able to sight through pipe to other end. Cover was eroded, exposing nylon fabric.

KY 144, MP 0-1

18" pipe under farm entrance. Excellent shape. 20" cover in good condition.

KY 1700, MP 0-1

18" pipe under entrance to house. Semi-clogged with mud at inlet. Small bulge at left end. Fair condition.

KY 271, MP 0-1

18" pipe under entrance to house. Semi-clogged with mud at inlet. Small bulge at left end. Fair condition.

MCLEAN COUNTY

6/3/86

KY 1080, MP 3-4

18" pipe under heavily traveled driveway. One end badly clogged; could not sight through pipe. Possibly crushed in middle. Fair condition.

KY 1080, MP 4-5

18" pipe under driveway is almost completely clogged. Concrete driveway above pipe. Clogged totally one side. Bad condition.

6/6/86

KY 1233, MP 2-3

15" pipe under home driveway. Clogged right side. Bulged in center. Fair condition.

KY 136, MP 11-12

18" pipe under driveway to farm and house. Draining well, good condition.

KY 1046, MP 5-6 (A)

15" pipe under field entrance. Some silt clogging. Draining fair, good condition.

KY 1046, MP 5-6 (B & C)

18" and 15" pipes side by side (field entrances). 18" pipe is nearly buried at one end; bad condition. 15" pipe is partially clogged but still draining. Both covers eroding.

KY 798, MP 0-1

15" pipe under field entrance. Slightly clogged one end. Heavy undergrowth. Good condition.

US 431, MP 6-7

18" pipe under driveway to woods. Cover eroding slightly. Pipe in good condition.

KY 254, MP 2-4

18" pipe under field entrance. Clogged on right side, but still draining. Fair condition.

KY 81, MP 14-15

15" pipe in front of house. Bulge in center, still draining. Fair condition.

KY 85, MP 1-2

18" field entrance. Bulged in top, draining well. Fair condition.

OHIO COUNTY

6/3/86

KY 54, MP 6-7

Entrance to mobile home. 18" pipe in excellent condition. Owner dug and cleared inlet and outlet channels recently. Cover 20"-30".

KY 54, MP 7-8

18" pipe east of Fordville. Small entrance to yard and barn. Cover eroding. Both ends clogged with silt. May be bulged in center. Little or no traffic on entrance. Fair condition.

KY 695, MP 16-17

18" pipe slightly crushed on one end. Otherwise, good condition. Entrance to field.

KY 136, MP 8-9

18" pipe across from road having stop sign. Pipe is bulged on top. Fair condition. Cover in good condition.

KY 136, MP 0-1

24" pipe near McLean and Ohio County line under driveway to farm and house. Heavy brush at each end. Pipe dented in center, but still draining. Fair condition.

KY 764, MP 2-3

18" pipe under driveway to home. Slight bulge in top, unclogged. Good condition.

KY 762, MP 0-1

18" pipe in home driveway. Pipe in good condition, but erosion has caused it to clog with silt and gravel almost 70 percent.

DAVIESS COUNTY

6/3/86

US 43, MP 1-2

18" pipe under entrance to Utica Truck garage. Ends are severely crushed; could not sight through pipe. Bad condition due to heavy truck traffic.

CALDWELL COUNTY

6/4/86

KY 91, MP 5-6

18" pipe under driveway to field. Pipe free of debris. Small bulges on top; otherwise good condition.

KY 139, MP 12-13

18" pipe under entrance to wooded area. Cover is slightly eroded. Excellent condition due to little or no traffic.

KY 293, MP 14

18" pipe under driveway to home. Right end badly clogged with silt. Small bulges on top.

Fair condition.

WEBSTER COUNTY

KY 132, MP 4-5

24" pipe along right-of-way ditch leading into creek. Leaves and debris clogged inlet.

Good condition.

US 41-A, MP 19-20

15" pipe and 18" pipe coming out of underground box. Both in good condition.

UNION COUNTY

6/4/86

US 60, MP 3-4

15" pipe in front of grain elevator. Pipe has gravel in it, but draining well and in good condition.

KY 270, MP 4-5

15" pipe leading to field. Curved in middle, otherwise good condition.

US 60, MP 12-13

15" pipe under driveway to home. Left side almost completely clogged by silt. Right end clogged also, was not able to sight through pipe. Bad condition.

6/5/86

KY 56, MP 13-14

15" pipe under driveway to home. Pipe unobstructed. Small bulges in top with cuts in polyethylene. Bad condition.

KY 141, MP 20-21

15" pipe under cemetery drive. Clogged with silt on right side. Pipe in good condition.

KY 130, MP 7-8 (A)

15" pipe under driveway to mobile home. Slightly clogged with leaves at both ends. Pipe in good condition.

KY 130, MP 7-8 (B)

15" pipe under driveway to oil pump. Heavy undergrowth at both ends. Pipe in good condition.

KY 950, MP 1

18" pipe under driveway to home. Good condition.

KY 1594, MP 0-1

15" pipe under driveway to home. Clogged throughout, but still able to sight through. Gouged by mower on left side. Bad condition.

KY 130, MP 10-11

18" pipe under driveway to home. Good condition.

KY 130, MP 0-1 (A)

15" pipe under farm driveway. Heavy undergrowth, pipe nearly buried. Possibly crushed in center. Fair condition.

KY 130, MP 0-1 (B)

15" pipe under entrance to field. Pipe almost completely clogged by silt. Bad condition.

KY 109, MP 2-4

15" pipe under driveway to house. Good condition.

KY 130, MP 8-9

15" pipe under driveway to field and oil tanks. Heavy undergrowth. Fair condition.

CHRISTIAN COUNTY

6/5/86

KY 91, MP 1-2

15" pipe under driveway to home. Small bulge in top center. Good condition.

MUHLENBERG COUNTY

6/6/86

KY 277, MP 0-1

15" entrance pipe to homes. Draining well, good condition.

HENDERSON COUNTY

6/5/86

US 41-A, MP 4-5

15" pipe under home driveway. Crushed slightly on left side. Free of debris. Fair condition.

US 41-A, MP 6-7

18" pipe under home driveway. Bulged in center. Good condition.

US 41-A, MP 10-11

18" pipe under home driveway. Excellent condition.

KY 1078, MP 3-4

15" pipe under field entrance. Bulged in center. Good condition.

KY 351, MP 11-12

15" pipe under home driveway. Appears in good condition.

KY 136, MP 11-12

15" pipe under driveway to home. Owner cleaned ditches at both ends. Good condition.

HOPKINS COUNTY

6/5/86

KY 1294, MP 3-4

18" pipe under home driveway. Left side eroded and half clogged with silt and gravel. Otherwise good condition.

1989 INSPECTIONS

District 7

BOURBON COUNTY

5/25/89 KY 1939, Pipe #1, MP 3-4
Pipe full of stagnated water. Overgrown on West end.

KY 1939, Pipe #4, MP 0-1
Same condition as inspected on 4/3/86.

CLARK COUNTY

5/24/89 US 60, Pipe #3, MP 0-1
Some silt accumulation in pipe.

US 60, Pipe #5, MP 2-3
Some gravel at both ends.

District 2

HANCOCK COUNTY

5/15/89 US 60, MP 14-15
Bulge in pipe 20' from north end. Curvature in pipe, difficult to sight through. South side of pipe exposed (nylon fabric and pipe); North side to some extent. Good flow of water

through pipe.

KY 144, MP 0-1

Inlet and outlet are clear. Good condition.

KY 1700, MP 0-1

Bulge (or puncture) at 20' from inlet. Pipe slightly deformed. Heavy brush around pipe ends.

KY 271, MP 0-1

Partially clogged at outlet. Small bulge at outlet.

MCLEAN COUNTY

5/17/89

KY 1080, MP 3-4

West side clogged; not draining. Poor condition.

KY 1080, MP 4-5

Unable to locate pipe.

KY 1233, MP 2-3 Correction: MP 1-2

Some gravel and silt accumulation in pipe. 1/4 full on South end.

KY 136, MP 11-12 Correction: MP 12-13

Some undergrowth. Small amount of silt on West end.

KY 1046, MP 5-6 (A)

Completely clogged on North end. South end fixed to keep silt, leaves out using rip-rap.

KY 1045, MP 5-6 (B & C)

18" pipe buried. 15" pipe is in same condition.

KY 798, MP 0-1

Pipe fairly clear; good shape.

US 431, MP 6-7

Undergrowth at both ends. Good condition.

KY 254, MP 2-3

Pipe is half full of silt.

KY 81, MP 14-15

North end silted with underbrush.

KY 85, MP 1-2

Pipe condition unchanged.

OHIO COUNTY

5/18/89

KY 54, MP 6-7

Pipe in good condition.

KY 54, MP 7-8

Pipe condition unchanged.

5/17/89

KY 69, MP 16-17

Partially filled at both ends with silt. Pipe in same condition as inspected on 6/3/86.

KY 136, MP 8-9

No cover over pipe. Some gravel inside; some undergrowth.

KY 136, MP 0-1

Pipe in same condition as inspected on 6/3/86.

KY 764, MP 2-3

Pipe is heavily clogged on both ends. Pipe crushed on West end.

KY 762, MP 0-1

Pipe in same condition as inspected on 6/3/86.

DAVIESS COUNTY

5/17/89

US 431, MP 1-2

South end of pipe crushed and filled with gravel and dirt. North end of pipe covered;

unable to see.

CALDWELL COUNTY

5/16/89

KY 91, MP 5-6

Slight depression in center of pipe. Pipe is holding water; able to sight through pipe clearly.

KY 139, MP 12-13

North end of pipe has some silt accumulation. Able to sight through pipe clearly.

KY 293, MP 13-14 (13.9)

Ends of pipe have been concreted over; bulge on top of pipe near the center. Outlet of pipe deformed. Fair to poor condition.

WEBSTER COUNTY

5/16/89

KY 132, MP 4-5

Unable to locate pipe.

US 41-A, MP 19-20

Pipe is in good condition.

UNION COUNTY

5/16/89

US 60, MP 3-4

Pipe is one-quarter full of dirt and gravel. Pipe is in fair condition.

KY 270, MP 4-5

Pipe is in same condition.

US 60, MP 12-13

Unable to locate pipe.

KY 56, MP 13-14

Pipe is in same condition as inspected on 6/5/86.

KY 141, MP 20-21

North end clogged with silt. South end of pipe is in good condition.

KY 130, MP 7-8 (A)

Pipe is clogged with leaves and silt at both ends. Pool of water in middle of pipe.

KY 130, MP 7-8 (B)

Pipe is in same condition as inspected on 6/5/86.

KY 950, MP 1

Slight silt accumulation in pipe. Good condition. Owner of property explained that pipe was to be replaced by 36" pipe by 5/89.

KY 1954, MP 0-1

Pipe in same condition as inspected on 6/5/86. Pipe is still heavily clogged.

KY 130, MP 10-11

Pipe is in same condition as inspected on 6/5/86.

KY 130, MP 0-1 (A)

Pipe is in same condition as inspected on 6/5/86.

KY 130, MP 0-1 (B)

Pipe is completely clogged. Very bad condition.

KY 109, MP 2-4

Pipe is in same condition as inspected on 6/5/86. Good condition.

KY 130, MP 8-9

Pipe has very heavy undergrowth. Fair condition.

CHRISTIAN COUNTY

5/16/89 KY 91, MP 1-2

Pipe is in same condition as inspected on 6/5/86.

MUHLENBERG COUNTY

5/18/89

KY 277, MP 0-1

Ends of pipe are slightly clogged. Pipe clear and in good condition.

HENDERSON COUNTY

5/16/89

US 41-A, MP 4-5

Pipe ends are filled with rip-rap. south end has some debris.

US 41-A, MP 6-7

Pipe is in same condition as inspected on 6/5/86.

KY 1078, MP 3-4

Pipe ends are covered with under growth. Pipe is in same condition as inspected on 6/5/86.

KY 351, MP 11-12

Pipe is half filled with silt. Pipe is covered, but able to see light through other end.

KY 136, MP 11-12

Rip-rap has been placed over pipe ends. Rip-rap is covered by leaves and debris. Pipe appears to be in good condition.

HOPKINS COUNTY

5/18/89

KY 1294, MP 3-4

Pipe is caved in middle. Gravel, silt in West end. Heavily silted on East end, with pipe being 3/4 full. Covered over top on East end.

- Figure 1. Grass Lined Channel Prevents Erosion;
KY 130, Union County.
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- Figure 2. Large Stone Protects Outlets; US 41A,
Henderson County.
- Figure 3. Aggregate on Embankment Erodes and
Obstructs Outlet.
- Figure 4. Aggregate Washed from Shoulder and
Blocked Outlet.
- Figure 5. Heavy Vehicle Damaged Unprotected Outlet.
- Figure 6. Truck Damage to Inlet.
- Figure 7. Large Stone Protect Outlet.
- Figure 8. Vegetation Prevents Silting.
- Figure 9. Timber Sill Protects Inlet.
- Figure 10. Silting at Inlet.
- Figure 11. Aggregate from Embankment Obstructs Flow.