

RESEARCH REPORT
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EVALUATION OF 93-INCH CORRUGATED METAL CULVERT
ON KY 693 AND US 23, GREEN-UP COUNTY

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INTRODUCTION

In November of 1998, the Kentucky Transportation Cabinet requested that the Kentucky Transportation Center investigate a 93-inch culvert on Ky. 693 and US 23 in Green-up County. A site map is shown in Figure 1. The culvert was investigated on November 12, 1998. The 93-inch culvert (Culvert E) discharges into a large box and then cross under US 23 and discharges into a small basin.

Culvert A

The inlet and the outlet for Culvert A, crossing under US, 23 was completely under water. The top of the headwall was visible on the outlet end (Figure 2). The outlet of the culvert was probed. The distance from the debris in the bottom of the culvert to the crown of the culvert was approximately 57 inches. Information obtained from Balke Engineers indicate that Culvert A is a 5 x 8 box.

Three other culverts (B, C, and D) then take the water from the basin, under a rail yard, and on towards the Ohio River.

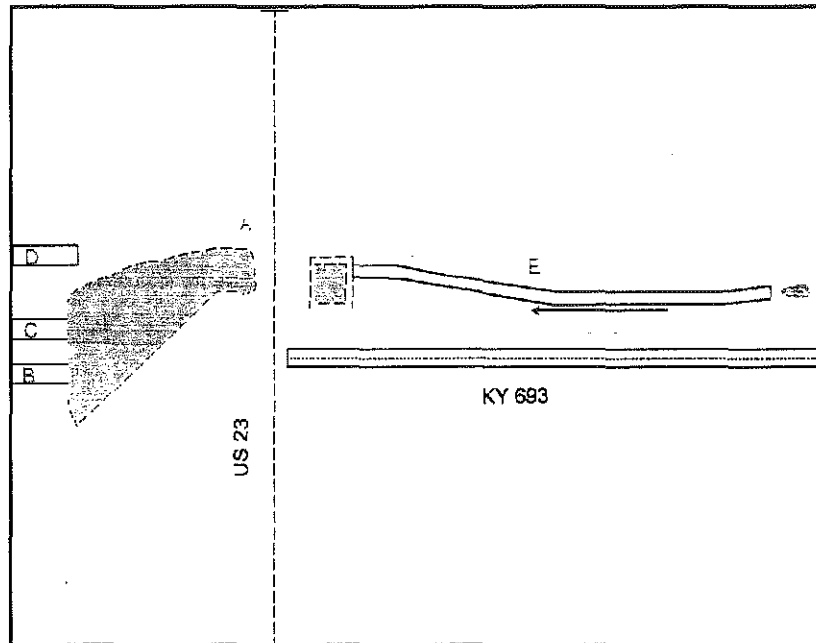


Figure 1. Site Map of the Area.

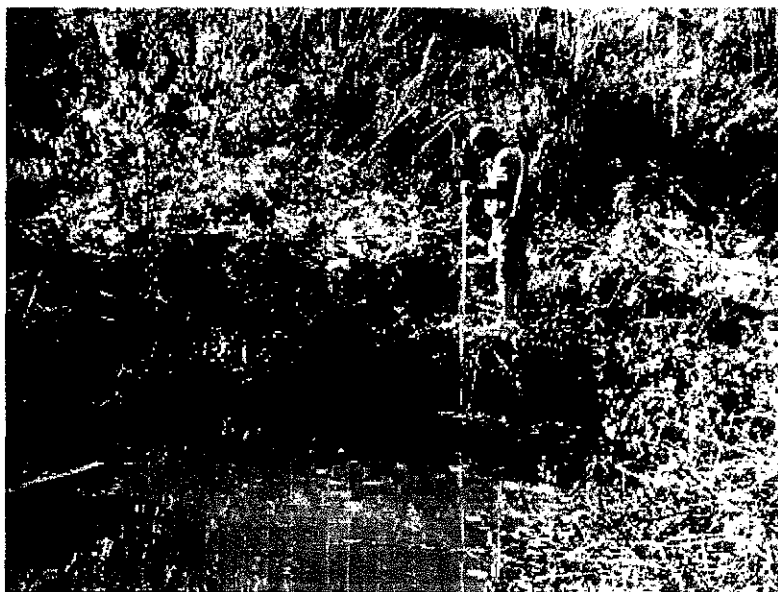


Figure 2. Outlet End of Culvert coming under US 23.

Culvert B

Culvert B was probed. From the debris line in the invert to the crown of the pipe measured approximately 86 inches (Figure 3). The culvert was open to the outlet end (Figure 4).



Figure 3. Culvert B

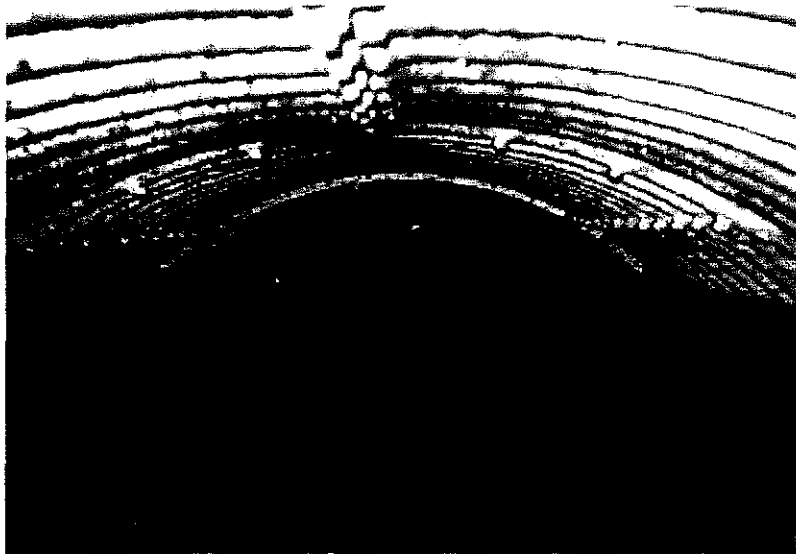


Figure 4. Inside view of Culvert B.

Culvert C

The inlet of Culvert C was probed and measured 78 inches from the debris in the invert of the culvert to the crown of the pipe. The outlet end of the structure was not visible from the inlet (Figure 6).



Figure 5. Inlet for Culvert C.

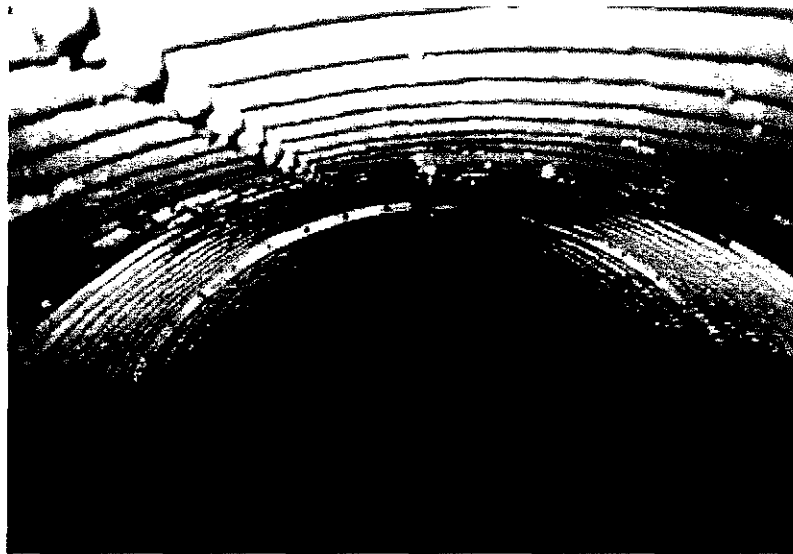


Figure 6. Inside of Culvert C taken from the inlet end.

Culvert D

Culvert D appeared to have been constructed several feet higher than Culverts B and C. The culvert had about 34 inches of open area between the debris in the invert and the crown of the pipe (Figure 7). The inside of the culvert appeared to be half full of silt and the outlet end was not visible (Figure 8).



Figure 7. Inlet End of Culvert D.



Figure 8. Inside of Culvert D taken from inlet end.

Culvert E

Culvert E was inspected from the inlet end to the large box. Significant information or distress was documented and photographed. This information is contained in Table 1 and the following photographs. The inside diameter (I.D.) of the pipe at its fullest curvature measured approximately 93 inches. The first two sections of pipe were significantly distressed. The first section had been racked to the left. The second section had been significantly deflected. The pipe appears to have been compressed vertically by approximately 20 inches. Several sections throughout the pipe had similar vertical deflections. Several storm drains had been tied into the crown of the structure and were protruding into the structure. A significant amount of corrosion has occurred between Joints 73 and 74 (approximately 1560 feet from the inlet end). The invert of the pipe appeared to be clean except for the first four to five sections of pipe (1st 100 ft). The last four sections of pipe did have approximately 1.5 to 2 feet of water backing into the structure from the box. Debris was spotted in the crown of the pipe in several areas throughout the structure indicating that the pipe appears to have been full. Past water levels are also visible in the photos from the scour marks and stains on the walls of the pipe.

Conclusion

The condition of the 5 x 8 box (Culvert A) could not be fully ascertained since it was under water. Probing of the outlet end did indicate that it appears to be mostly open. Staining in Culvert E along the side walls and the crown of the pipe progressively gets higher closer to the outlet end of the structure, indicating that water is backing up into the structure. At this time it appears that the three culverts (B, C, D) running under the rail yard are backing up water into the 5 x 8 box (Culvert A) and further back through the grated retaining box into the metal pipe (Culvert E).

Several of the pipe sections observed in Culvert E had vertical deflections of approximately 20 to 22 percent. No inverse curvature and no significant wall buckling was observed during the inspection. It is likely that these sections were compressed shortly after installation and that as long as the surrounding backfill material does not weaken the pipe will not likely deflect any further.

Several storm drains were observed protruding into the crown of Culvert E. These drains should be cut flush with the crown of the pipe.

The first two sections of pipe in Culvert E are severely racked and compressed. At this time, the structure appears not to be inlet controlled. The severely racked pipe is likely causing some turbulent flow in the inlet of the structure but at this time addressing the backup at the outlet end of the pipe is more critical.

Table 1. Inspection Results of Culvert E.

JOINT NO. 1	DEFLECTION	COMMENT	PHOTO NO.
1		Severely Racked to the left	1
2	64"-72"	Invert had approximately 8" of material at 64" reading.	2
3	72"		3
4		Pipe protruding 16-inches	4, 5
5	75"		
6			
7	79"		
8	90"	Fairly Round	6
9		Racked	
10		Racked	
11	82"	Racked, Pipe coming in, no protrusion,	7
12			
13			
14		12-inch pipe protruding in 7-inches	8
15			
16			9
17	83"	Pipe racked	
18			10
19	73"		11
20			
21		Round	
22			
23			
24		12-inch storm drain, no protrusion	
25	72"		12

26			
27		Round	
28		Round	
29		Round	
30		Fairly Round	13
31		Slightly Elliptical	14
32		Fairly Round	
33		Round	
34		Round	
35		Round	
36	84"		15
37	82"	Slightly Racked	
38	80"	Elliptical	
39	77"	Elliptical	
40			
41		36-inch pipe protruding 26-inches	16, 17
42		Round	
43		Round	
44		Round	
45	86"		
46			
47			
48		12-inch pipe, no protrusion	18
49	87"	Slight flattening on crown of pipe	
50			
51		Slightly racked, 2-inch vert. offset joint	
52			
53	84"	Flattening on crown of pipe	

54	93"	Round	
55	84"	Elliptical	19
56		Slightly Elliptical	
57		12-inch pipe, no protrusion	20
58	82"		
59	80"	Flat on crown	
60		Slight deflection, mostly round	
61		Round	21
62	84"	Slight deflection	
63	84"	Slight deflection	
64	84"	Slight deflection	
65	84"	Slight deflection	
66	77"		
67	78"		
68	72"	Buckle in sidewall	
69	71"	118" horizontal	22
70	74"		
71			
72	73"	72-72 bottom slightly pushed up	
73		73-74 Wall Leaking	23
74	81"	Racked, Vert. & horiz. offset joint, debris stuck in top of joint	24, 25
75		74-75 holes in wall of pipe, 3" in diameter, total of seven holes, round	26
76		Round, Bend (Pipe turns)	27
77		Round	28
78		Round	
79		Round, End of Pipe	

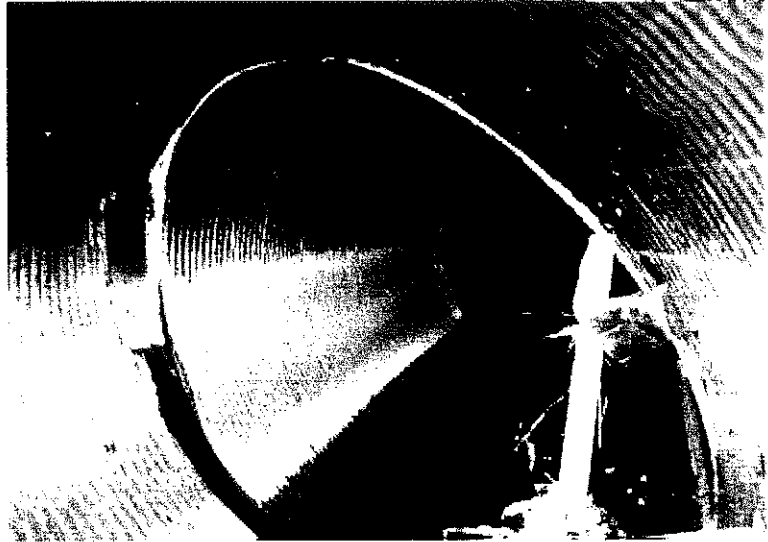


Photo 1. Joint 1, Severely Racked

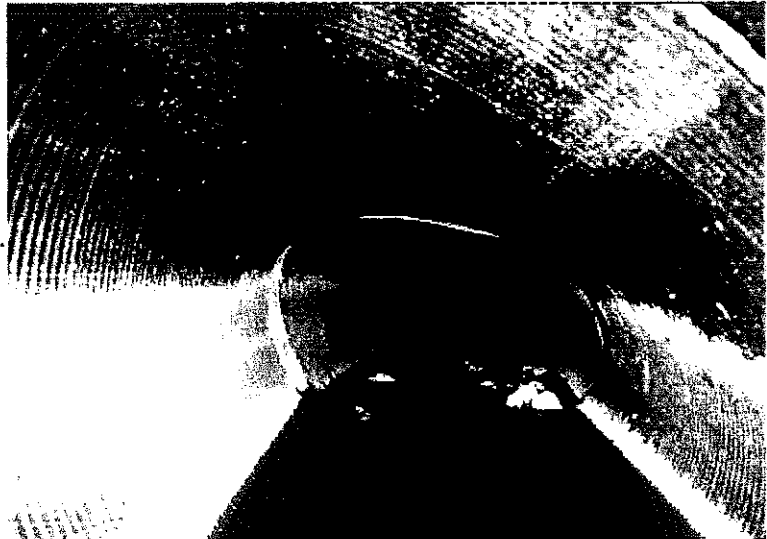


Photo 2. Joint 2, Racked, Vertical Compression



Photo 3. Joint 3-Joint 4, Pipe protruding into crown.

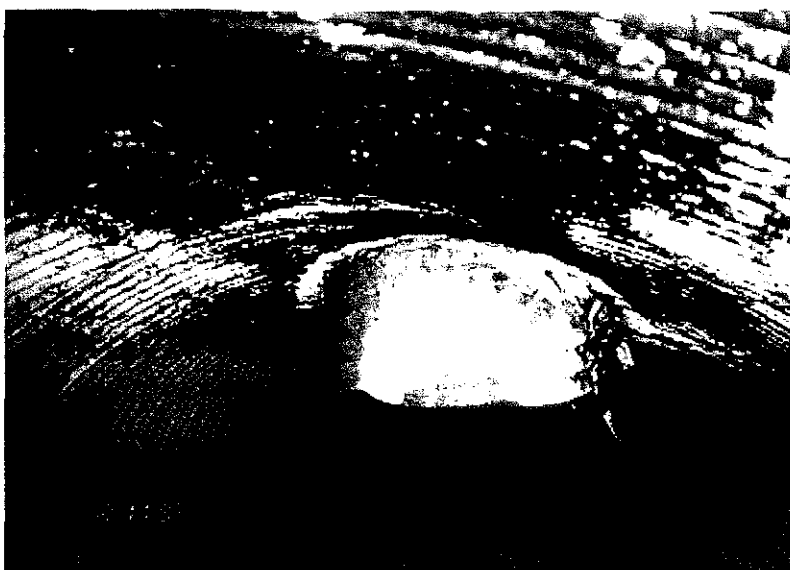


Photo 4. Joint 4, pipe protruding into crown

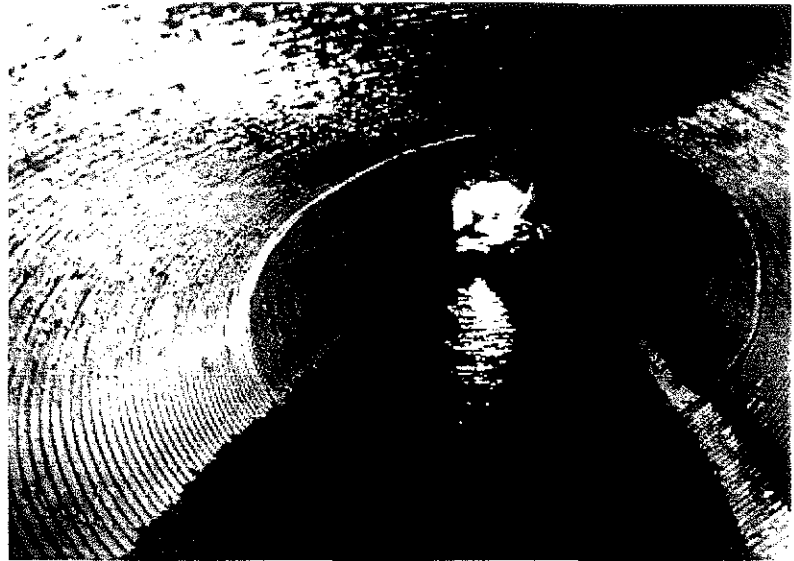


Photo 5. Joint 6, looking up grade



Photo 6. Joint 8, looking up grade

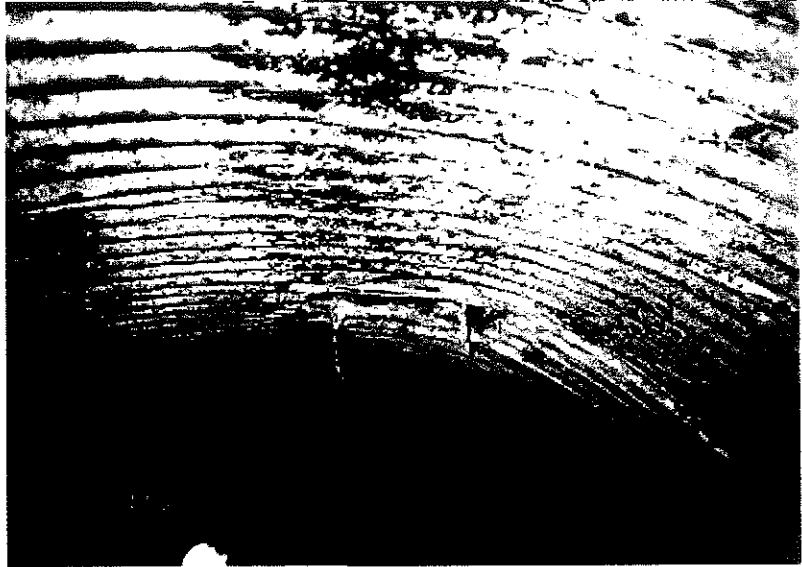


Photo 7. Joint 11, 12-inch pipe tied into crown



Photo 8. Joint 14, pipe protruding from crown



Photo 9, Joint 16. Pipe Elliptical

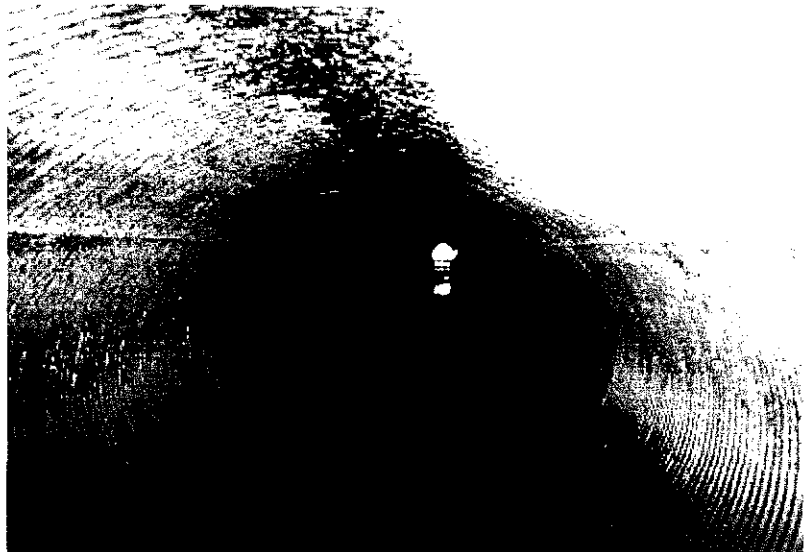


Photo 10. Joint 18, looking up grade



Photo 11. Joint 19, down grade



Photo 12. Joint 25, up grade



Photo 13. Joint 30, up grade

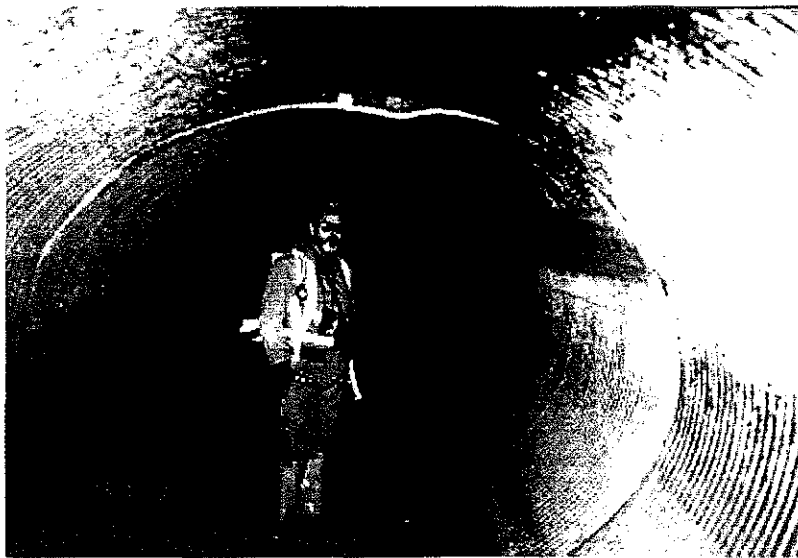


Photo 14. Joint 31, down grade

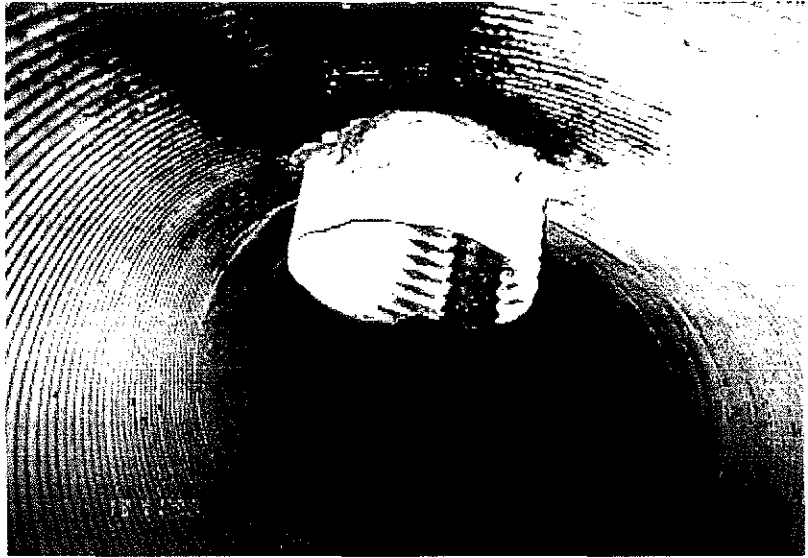


Photo 17. Joint 41, up grade

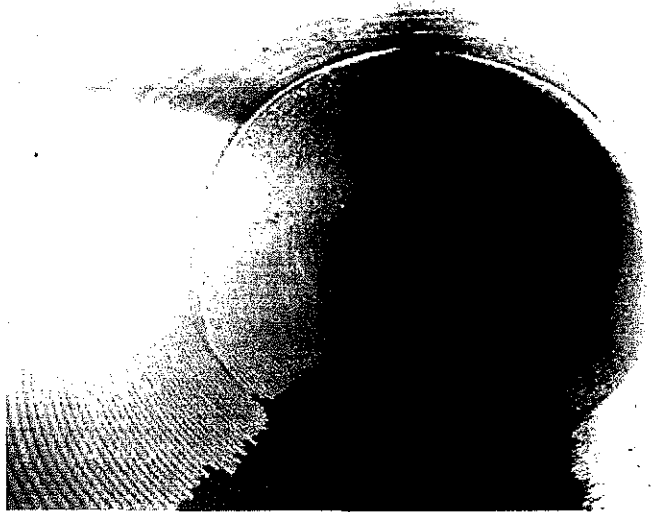


Photo 18. Joint 48, up grade

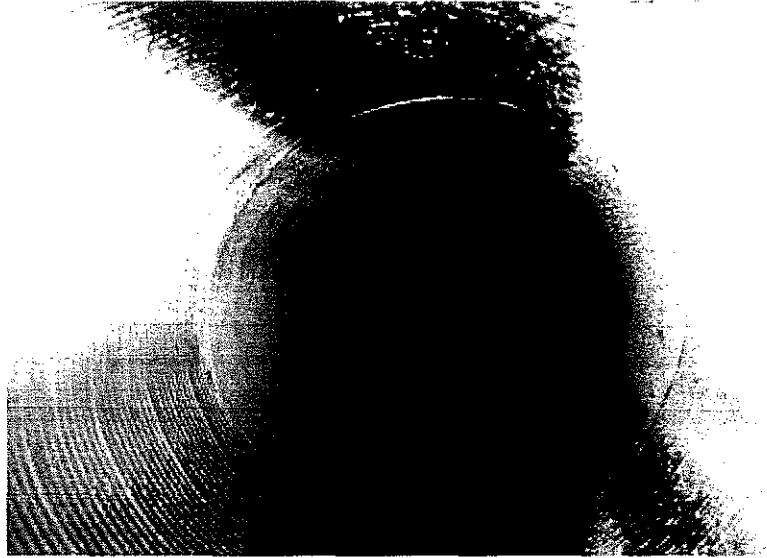


Photo 19. Joint 55, up grade



Photo 20. Joint 57, up grade

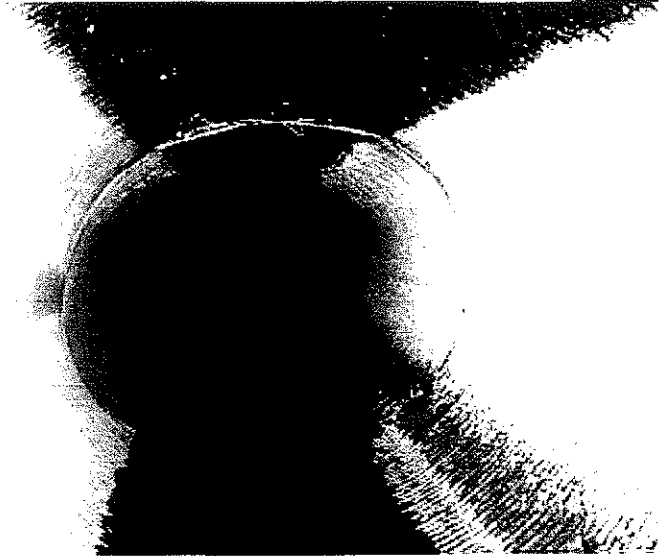


Photo 21. Joint 61, up grade



Photo 22. Joint 69, up grade, pipe elliptical



Photo 23. Joint 73, hole in wall of pipe.

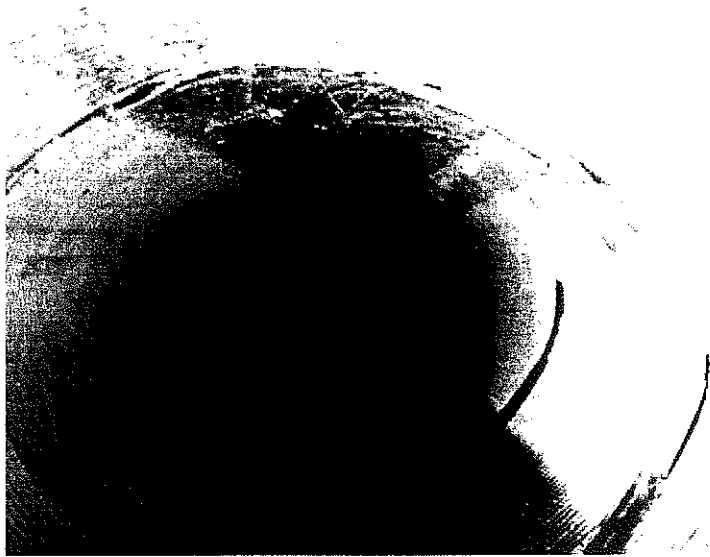


Photo 24. Joint 74, up stream

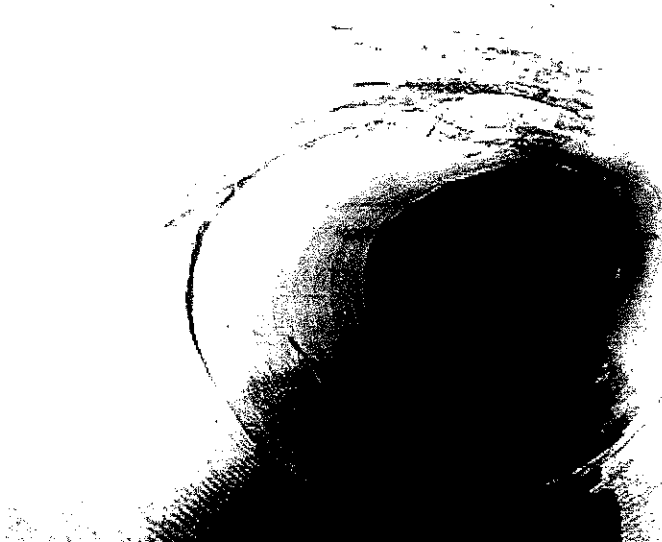


Photo 25. Joint 74, down grade

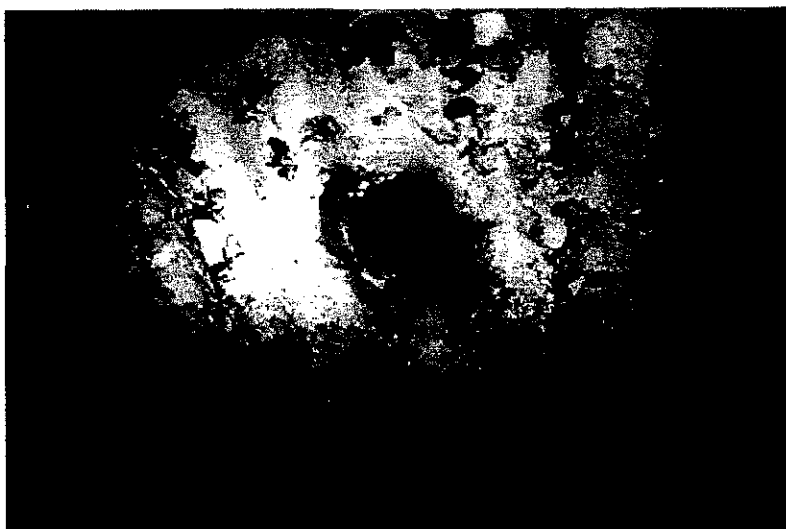


Photo 26. Joint 74-75, hole in wall of pipe.

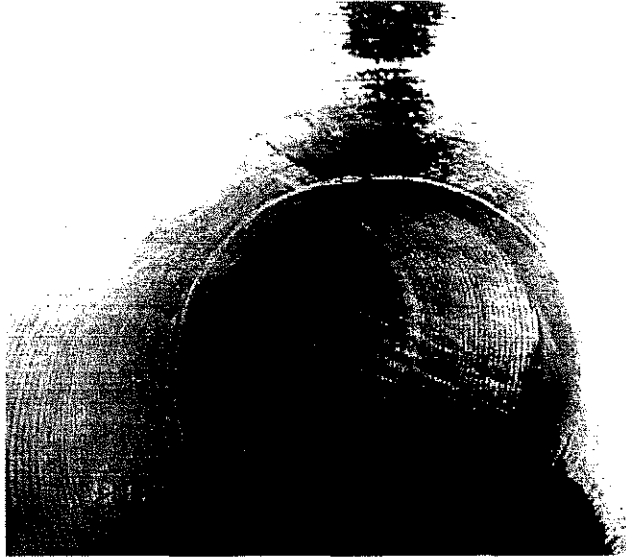


Photo 27. Joint 76, down grade

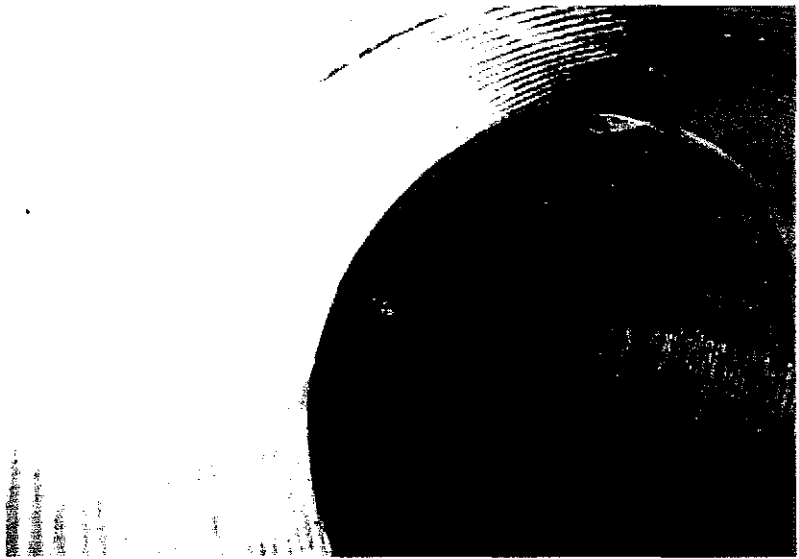


Photo 28. Joint 77 to end of pipe.