Applied Research and Innovation Branch

EVALUATION AND PERFORMANCE OF HDPE PIPES UNDER CDOT HIGHWAYS, T-REX, AND OTHER LOCATIONS

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16. Abstract

HDPE pipes used in CDOT drainage systems are expected to have a 50-year design life. During the T-Rex project in 2003 a number of HDPE pipes were installed with shallow cover. Later, the majority of these pipes had to be removed and replaced after they were damaged by construction equipment driving over installed pipes, and excavations occurring near installed pipes. In this study, performance of HDPE pipes under CDOT highways was evaluated by: an extensive literature review; field studies utilizing manual inspection, CCTV video inspection, and laser-ring profiling technology; and, by observing a CDOT HDPE pipe installation project. Since CDOT has a limited number of such sites, a literature search was conducted to determine if cities and counties within Colorado or other state DOTs have evaluated the performance of HDPE pipes in climate zones, terrain, and construction-zone conditions similar to those found in Colorado.

In general, review of other DOTs' experiences revealed that most have encountered HDPE performance problems in the form of excess deformation (greater than 5%). That review also has shown that structural integrity of installed HDPE pipelines tested by the DOTs generally is below acceptable levels of serviceability. The review also determined that not adhering to strictly-enforced HDPE pipe-installation procedures was the cause of many of the performance problems.

Field inspections carried out for this research project were limited in scope. However, laser-ring profiling of 5 HDPE pipes in 2016 near Colorado Springs confirmed a trend for progression of pipe deformation through time under shallow-cover conditions. After 4 years of operation, 3 of the 5 pipes experienced 5% deflection. HDPE pipe segments observed by CCTV video monitoring along the T-Rex Project site had in excess of 10 feet of cover. These pipes did not show any visible deformations, but they could not be laserring profiled due to the amount of debris in the system. The study recommends that these pipes be cleaned and fully inspected.

In Colorado, due to the limited number of HDPE pipe installations which have been in operation for more than 15 years, further laser-ring profiling of pipes is needed to evaluate their long-term performance. In general, it is recommended that all previous monitoring points established on prior research projects be measured and evaluated for long-term hydraulic and structural performance. Studies by Kentucky, Ohio, Missouri, South Carolina transportation departments and others demonstrated the difficulty of achieving problem-free installations of HDPE pipes, and that the pipes do not always perform in accordance with idealized, theoretical results. Significant-to-severe deflection, corrugation "growth," crown and invert flattening, racking, sagging, and radial cracking have been observed in pipe sections in numerous test cases.

Experiences by other DOTs demonstrate that not adhering to strictly-enforced installation procedures was the cause of some performance issues. A typical installation of an HDPE pipeline observed as part of this study showed that standards for trench width, depth, and cover were not being followed. It is recommended that these standards be strictly enforced.

Implementation

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High density polyethylene pipe, HDPE, laser ring, laser profiling, CCTV video inspection, deflection, corrugation "growth," crown flattening, invert flattening, racking, sagging, radial cracking.	This document is available on CDOT's website http://www.coloradodot.info/programs/research/pdfs

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FINAL REPORT
EVALUATION AND PERFORMANCE OF HDPE PIPES UNDER CDOT HIGHWAYS, T-REX, AND OTHER LOCATIONS

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Prepared by Hydrau-Tech, Inc.

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EXECUTIVE SUMMARY

HDPE pipes used in CDOT drainage systems are expected to have a 50-year design life. Some HDPE pipes installed on CDOT projects have failed due to shallow cover, moving and static loads (from construction equipment), and disturbances in or near the pipe trenches. CDOT's experience with failed HDPE pipes has led to uncertainty regarding the cost effectiveness of using this material. During the T-Rex project in 2003, a number of HDPE pipes were installed with shallow cover. Later, the majority of these pipes had to be removed and replaced after they were damaged by construction equipment driving over installed pipes, and excavations occurring near installed pipes.

In this study, the performance of HDPE pipes under CDOT highways was investigated by: an extensive literature review; field studies utilizing manual inspection, CCTV video inspection, and laser-ring profiling technology; and, by observing a CDOT HDPE pipe-installation project. Since CDOT has a limited number of such sites, a literature search was conducted to determine if cities and counties within Colorado or other state DOTs have evaluated the performance of HDPE pipes in climate zones, terrain, and construction-zone conditions similar to those found in Colorado.

In Chapter 1 of this report, the objectives of the study and methodologies to achieve those objectives are presented. Chapter 2 presents results of an extensive literature review covering various aspects of HDPE problems. Methodology, including the equipment and procedures used in conducting field inspections, is described in Chapter 3. Field-data collection and measurement results are presented in Chapter 4, and results of data analysis are discussed in Chapter 5.

In general, review of other DOTs' experiences revealed that most have encountered HDPE performance problems in the form of excess deformation (greater than 5%). That review also has shown that structural integrity of the installed HDPE pipelines tested by various DOTs generally is below acceptable levels of serviceability. The review also determined that not adhering to strictly-enforced HDPE pipe installation procedures was the cause of many performance problems.

Field inspections carried out for this research project were limited in scope. However, laser-ring profiling of 5 HDPE pipes in 2016 near Colorado Springs confirmed a trend for progression of pipe deformation through time under shallow-cover conditions. After 4 years of operation, 3 of the 5 pipes experienced 5% deflection. HDPE pipe segments observed by CCTV video monitoring along the T-Rex Project site had in excess of 10 feet of cover. These pipes did not show any visible deformations, but they could not be laser-ring profiled due to the amount of debris in the system. The study recommends that these pipes be cleaned and fully inspected.

In Colorado, due to the limited number of HDPE pipe installations which have been in operation for more than 15 years, further laser-ring profiling of pipes is needed to evaluate their long-term performance. In general, it is recommended that all previous monitoring points established on prior research projects be measured and evaluated for long-term hydraulic and structural performance. Studies by Kentucky, Ohio, Missouri, South Carolina transportation departments and others demonstrated the difficulty in achieving problem-free installations of HDPE pipes, and that the pipes do not always perform in accordance with idealized, theoretical results. Significant-to-severe deflections, corrugation "growth," crown and invert flattening, racking, sagging, and radial cracking have been observed in pipe sections in numerous test cases.

Experiences by other DOTs demonstrate that not adhering to strictly-enforced installation procedures was the cause of some performance issues. A typical installation of an HDPE pipeline observed as part of this study showed that standards for trench width, depth, and cover were not being followed. It is recommended that these standards be strictly enforced.

IMPLEMENTATION RECOMMENDATIONS

Review of the experiences of other states' DOTs, conducted as part of this study, found that most DOTs have encountered HDPE performance issues in the form of excess deformation (greater than 5%). It is apparent that structural integrity of the installed HDPE pipelines which were tested by Texas DOT and other DOTs is generally below acceptable levels of serviceability.

The field inspections carried out for this research project were limited in scope. However, laser-ring profiling of 5 HDPE pipes inspected in 2016 near Colorado Springs confirmed a trend for progression of pipe deformation through time under shallow-cover conditions. After 4 years of operation, 3 of the 5 pipes experienced 5% deflection. HDPE pipe segments observed by CCTV video monitoring along the T-Rex Project site had in excess of 10 feet of cover. These pipes did not show any visible deformation, but they could not be laser-ring profiled due to the amount of debris in the system. It is recommended that the pipes be cleaned and fully inspected.

In order to assess the long-term performance of CDOT HDPE pipe installations, and to minimize excess deformation issues, application and acceptance of laser-ring technology used by Florida, Ohio, Kentucky, California and other state DOTs is recommended. This technology allows accurate measurement of deformation which in the long term results in severe deflection, corrugation "growth," crown and invert flattening, racking, sagging, and radial cracks.

For existing HDPE installations, laser-ring profiling accomplished through periodic inspections is recommended for a more accurate assessment and record keeping of pipe performance.

Experiences by other DOTs revealed that not adhering to strictly-enforced installation procedures was the cause of some performance issues. A typical installation of an HDPE pipeline observed as part of this study showed that trench width, depth, and cover standards were not being followed. It is recommended that these standards be strictly enforced.

EVALUATION AND PERFORMANCE OF HDPE PIPES UNDER CDOT HIGHWAYS, T-REX, AND OTHER LOCATIONS

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1. INTRODUCTION

1.1 BACKGROUND

Some high-density polyethylene (HDPE) pipes used on CDOT projects have failed due to shallow cover, moving and static loads (construction equipment), and disturbances in or near the pipe trenches. It is assumed that HDPE pipes used in CDOT drainage systems will have a 50-year service life. In addition to existing corrosion and abrasion guidelines, CDOT must develop new guidelines to determine how and where HDPE pipes may be safely installed. The performance of buried HDPE pipes is influenced by earth loads, vehicle (live) loads, backfill materials, trench dimensions, backfilling compaction, and in-situ soils. For corrugated HDPE pipes, the failure mechanisms are ductile failure due to high stresses, brittle cracking due to intermediate stress levels, and corrosion cracking caused by low stress levels.

In order to evaluate the performance of HDPE pipe with regard to site conditions, a research study was conducted to investigate sites where HDPE pipe has been used in Colorado. Since CDOT has a limited number of such sites, the team conducted a literature search to determine if other cities and counties within Colorado, and other state DOTs have evaluated the performance of HDPE pipes in climate zones, and terrain and construction-zone conditions similar to those found in Colorado.

Figures 1 and 2. Typical HDPE installation project in Colorado

1.2 PROBLEM STATEMENT

In accordance with SAFETEA-LU, the CDOT Pipe-Selection Policy requires consideration of HDPE pipes for cross drains, side drains, and subsurface drains. Currently, any pipe that meets the corrosion and abrasion criteria in this policy, and is installed per the plans and specifications, is assumed to have a 50-year service life. However, there is uncertainty regarding the cost effectiveness of using HDPE pipes based on CDOT's experience with failed HDPE pipes. During the T-Rex project in 2003, a number of HDPE pipes were installed with shallow cover. Later the pipes had to be removed and replaced after they were damaged by construction equipment running over installed pipes, and excavations occurring near installed pipes.

Figure 3. CDOT's T-Rex project in Denver, Colorado

HDPE pipes have been used successfully in some states, but in Colorado designers must consider extremes of climate and terrain in addition to construction practices. There is insufficient information regarding local performance of HDPE pipes. In particular, there is a lack of information that correlates construction practices, depth of cover, and trench configuration with cracking of HDPE pipes.

1.3 OBJECTIVES

The objectives of this research study were:

- Determine performance of HDPE pipes for use under roadways and other facilities
- Inspection of existing HDPE pipes currently utilized by CDOT
- Accurate data collection and verification using various methods:
  - Information from routine past maintenance inspections
  - Physical investigation of potential damage or failure (larger pipes)
  - Physical measurements of pipe diameter (H:V:D) and potential joint separation
  - CCTV video investigation of all joints and pipe-wall lengths
  - Laser-ring and video investigation and analysis

Figure 4. Manual inspection of HDPE pipes

1.4 RESEARCH TASKS

The tasks delineated by CDOT for this research project included:

- Task 1 - perform a literature review to determine if there has been similar research that will aid CDOT;
- Task 2 - conduct a national survey of state DOTs to determine if other states have had similar problems;
- Task 3 - prepare the field-work plan;
- Task 4 - inform personnel from traffic, maintenance, residencies, and HQ about field activities and visits at least three weeks in advance;
- Task 5 - field inspection of all HDPE pipes by laser-ring method (the preferred method of inspection), and/or other applicable methodologies commonly used by CDOT and other state transportation agencies;
- Task 6 - analyze data collected in above tasks; and
- Task 7 - submit draft and final reports addressing findings of the study.

1.5 STUDY BENEFITS

Benefits of this study include:

- Improved design methodologies
- Updated materials specifications
- Improved construction techniques
- Improved maintenance and inspection practices
- Updated information to incorporate into CDOT's *Drainage Design Manual*
- Potential cost savings
- Prevention of failures of HDPE pipes

Figure 5. HDPE pipes with metal outlets across Interstate 25

2. CURRENT METHODOLOGIES REVIEW AND LITERATURE SURVEY

This report contains a bibliography from a comprehensive literature survey, including library searches and surveys of CDOT and other state DOTs, in the List of References. This survey has shown that, in general, literature on HDPE pipes can be classified under several broad categories:

- Modeling of HDPE pipes to determine structural strength and deformation under different soil and burial conditions. This information was derived from:
  - Laboratory and field experiments to determine structural properties of HDPE materials under different soil and loading conditions
  - Numerical modeling of stress fields around HDPE pipes under different soil properties
- Performance of HDPE pipes under fire conditions
- Pipe material-selection studies
- Performance of HDPE pipes in highway applications

Information from the literature review is presented in the following sections.

2.1 MODELING OF HDPE PIPES FOR STRUCTURAL PROPERTIES

Performance of HDPE pipes under deep-burial conditions has been the subject of numerous studies, both numerically and experimentally. Among the large-scale experimental studies, the Sargand et al. (2000) study was conducted to determine the performance of larger HDPE pipes under deep-soil cover using 42-in pipes. The burial depths used in the experiments were 20 ft and 40 ft. In the experiments, HDPE pipes with three different wall profiles were studied. These profiles were smooth-wall (PVC), corrugated (PVC and HDPE), and honey-comb (HDPE). After approximately 2 years of field-data collection, it was noted that all pipes were functioning satisfactorily. No pipe had more deformation than 2.5% vertically, and 1% horizontally.

In a different study, Sargand et al. (2009) examined the performance of HDPE pipes under deep-burial conditions after 20 years of operation. In the study entitled "Pennsylvania Thermoplastic Pipe Deep-Burial Project: 20th-Year Investigations," 24-in diameter corrugated HDPE pipe under 100-ft burial were examined. The pipe under study was located on I 279 near Pittsburgh, on the 20-year anniversary of the research project. Visual inspections along with an in-situ pipe-drilling experiment found that the pipe-drilling-induced strains in the pipe wall completely dissipated within 5 seconds. During a 2002 inspection, cracking was observed on one of the joints. However, these cracks did not seem to have increased substantially during the 2007 inspection (buried under 70 ft). Measurements showed that the horizontal deflection changed only by 0.3% over a period of 17 years, and the vertical deflection changed only by 0.2% over a period of 18 years.

Tafreshi and Khalaj (2007) studied structural properties of HDPE pipes in a controlled, laboratory environment. In the study entitled "Laboratory Test of Small-Diameter HDPE Pipes Buried in Reinforced Sand Under Repeated Load," Tafreshi and Khalaj applied loads to simulate the axle load of a 18,000 kg truck over two pairs of twin wheels. This load translates to 8.5 kg/cm^2. Without 5 cm of rigid asphalt, the maximum applied load was reduced to 5.5 kg/cm^2. Their conclusions were:

- For all tests, the larger portion of deformation of the pipe and settlement of soil surface happened at the end of the first pulse, compared with its total deformation due to a number of load cycles. The ratio of deformation of the pipe from the first to the last cycle changed from 0.5 to 0.9 in different tests.
- The rate of pipe deformation decreases significantly as the number of loading cycles increases. Consequently, a steady-response condition is achieved as the number of further cycles of loading reaches approximatley 140 cycles.
- The optimum length of geogrid is approximately 4-5 times the pipe diameter. The optimum embedded depth of the first reinforced layer is approximately 0.35 times the loading-surface width.
- Both the percent vertical-diameter change and settlement of soil surface of the pipe decrease with increased relative density of soil.
- The geogrid-reinforced sand decreased the pipe deformation and settlement of the soil surface significantly. Also, the performance of geogrid-reinforced loose soil is greater than unreinforced medium or dense soil.
- The vertical-diameter change of a pipe decreases, and settlement of the soil surface increases as the embedment depth of the pipe increases.
- The maximum deformation of the buried pipe is reduced approximately 54% by using 3 layers of reinforcement and an embedment depth of 3 times the external pipe diameter. This is based on a pipe-strain reduction factor, *PDRF*, of 0.46 for loose sand. The deformation is reduced by approximately 40% for dense sand using a PRDF of 0.6.
- The maximum settlement reduction due to five layers of reinforcement and the embedment depth of 3*D* reached approximately 58% for loose sand, and 51% for dense sand.
- In all tests performed on embedded pipes in weakly-compacted sand (relative loose state), and for embedment depth of the pipe below 2.5 times the external pipe diameter, the value of vertical diameter change was greater than 5%, regardless of the number of reinforced layers. Based on the accepted limit of 5% for vertical-diameter change, in this case the failure of the pipe occurred due to large deformation of the pipe, together with excessive settlement of the ground surface. For this relative density, the safety of the pipe is provided by embedment depth, and using the number of reinforced layers equal to 3 times the external pipe diameter. Leaving the surrounding soil uncompacted may result in serious damages to pipes during repeated loads.
- The pipe in medium-dense and dense sand with sufficient embedment depth of the pipe and a number of reinforced layers remained mostly undamaged at the time of the failure, which happened due to excessive settlement of the soil surface.

In a separate study, Kang et al. (2009) investigated short-term and long-term behavior of buried, corrugated, high-density polyethylene (HDPE) pipes using the finite-element method and soil models. Equations for deflections, wall stresses, arching factors, etc., were derived using soil-structure models and externally introduced into the numerical finite-element-method model. The main objective of the study was to investigate the considerable differences in the mechanics of short-term and long-term performance of buried HDPE pipes. The study found that while earth loads were significantly affected by time-dependent material properties and interface conditions, the deflections were not significantly affected by these factors.

2.2 HDPE FIRE HAZARD

It is documented in numerous field observations that HDPE pipes are subject to a fire hazard during ditch-burning operations. In a study by the Florida DOT, Kessler and Powers (1994) investigated HDPE fire risks. In their "High Density Polyethylene Pipe-Fire Risk Evaluation" study, Kessler and Powers examined recent concerns related to flammability of HDPE pipes. Under FDOT standards, it was shown that there was no significant risk from fire to HDPE pipes, and that the heat gain in pipes was not sufficient to cause softening or weakening of the pipe. The expected burn rate was found to be very low (1.7 ft/hr). The pipe manufacturer's claim that there is insufficient oxygen within a pipe to support a fire was not confirmed.

2.3 PIPE MATERIAL-SELECTION STUDIES

Numerous studies in the extended literature are devoted to pipe-material-selection guidelines developed by various DOTs. As part of these studies, HDPE pipe was investigated for appropriate applications. An extensive review of these studies is summarized in Molinas and Mommandi (2009); NCHRP Synthesis Report 254, "Service Life of Drainage Pipe," 1998; and, NCHRP Synthesis 474, "Service Life of Culverts," 2015.

2.4 EVALUATION OF HDPE PIPE PERFORMANCE

The Blackwell and Yin (2002) study for the Missouri Department of Transportation investigated the installation and initial performance of two 60-in ADS HDPE pipes. This deflection/performance study examined how two large HDPE pipes with the same diameter performed when placed under crossroads with different installation procedures. Pipe 1 had only 4 in of bedding and a lower compaction than Pipe 2. Neither pipe installation met Missouri DOT standards. However, Pipe 2 was considered to have a better installation than Pipe 1, and was found to have far less deflection. The study determined that deflection over time increased for both pipes. Pipe 1 started at a maximum of 4.6% deflection, and after 26 months the deflection increased to 8.2%. There was less installation data for Pipe 2, but it ultimately experienced 5% (maximum allowable) deflection. The study showed how installation procedures influence immediate and long-term performance and deflection of pipes.

The Gassman et al. (2000) study entitled "Performance Evaluation of HDPE Culvert Pipes" inspected 45 HDPE pipes in South Carolina. Methods included both a mandrel set to 5% deflection, and visual inspections using a video camera. From these tests it was found that 36% of pipes inspected had circumferential cracks, localized bulges, tears or punctures, or deflections greater than 5% with the following details:

- 18% of the pipes had circumferential cracks
- 20% had localized bulges
- 7% had tears or punctures
- 20% had deflections greater than 5%

Of these results, Gassman et al. attributed most of the issues to poor construction techniques or incorrect backfill materials.

- 40% of the pipes backfilled with Class 4 soils did not pass the mandrel test
- Only 12% with Class 2 did not pass the mandrel test
- Class 3 backfill had no failed tests

- All pipe end damage was attributed to installation practices, mowers, and vehicle loads

Evaluation of HDPE Pipe Performance on Kentucky DOT and Ohio DOT Construction Projects was studied independently by Pipeline and Drainage Consultants (2005), utilizing visual observation through video inspections and laser-ring technology. For the Kentucky DOT projects, 7 installations were evaluated. The key findings of the study were:

- The average-maximum recorded corrugation in originally smooth-walled pipes was 0.5 in. As a result, it is suggested that the Manning's *n* may be more than two times higher (0.024) than the manufacturer's suggested value of 0.010.
- The authors were uncertain about how cracking affected the pipe structurally. However, it was observed that it caused problems when the inner liner pushed up and caught debris. Radial cracking was observed in approximately 20% of pipe sections.
- Sagging and ponding were observed in 26% of pipe sections.
- The majority of the pipes would fail a 5%-deflection test, and most pipes also would fail a 10%-deflection test.

Recommendations for the Kentucky DOT were:

- Further monitoring should be conducted.
- Post-installation deflection and video inspection should be required.
- Deflection should be limited to a maximum of 5%, with the anticipation of some post-construction creep.

Thirteen installations were evaluated for the Ohio DOT projects. The key findings of the study were:

- The maximum-recorded corrugation depth was 0.56 inch, with a typical average depth of approximately 0.39 inch. These pipes had a manufacturer's-suggested Manning's *n* value of 0.012. A typical corrugated metal pipe with 0.5 inch corrugations has Manning's *n* of 0.022.
- Of the cross drains that were inspected, cracking had increased by a factor of 4-7 since 2001.
- Several types of cracks were observed, including: radial cracks in the inner wall of the liner; cracking of dimpled areas; cracking in flattened inverts; longitudinal cracking in the crown in heavily-deflected areas; diagonal cracking in buckled wall sections; and, cracking in inverts resulting from bulges caused by improper bedding.
- The majority of the pipes would fail a 5%-deflection test, and most pipes also would fail a 10%-deflection test.

Recommendations from the Ohio DOT were:

- Further monitoring of HDPE pipe installations should be conducted.
- Post-installation video inspection and deflection testing should be required for quality control and quality assurance.
- Deflection should be limited to 5%, with the anticipation of some post-construction creep.
- All monitoring points established on a previous research project should be measured and evaluated for long-term performance.

- Specifications should ensure that correct bedding and backfill requirements, proper densities, and proper compaction efforts are achieved as outlined in ASTM D 2321 and AASHTO Section 30.
- A uniform pipe assessment/inspection program should be adopted for quality control and for long-term performance monitoring.
- A quality control / quality assurance inspection program should be established for all drainage materials and structures.
- Video inspection and laser profiling should be evaluated for adoption into the ODOT specification for quality control and quality assurance.

More recently, Abolmaali et al. (2010), University of Texas at Arlington, conducted a comprehensive study entitled "Evaluation of HDPE Pipelines' Structural Performance." As part of this study, 61 sites in 10 states were analyzed, utilizing visual observation through video inspections and laser-ring technology. In their study, Abolmaali et al. identified six structural-failure modes. They are:

- Cracking/fracture failure (fracture, rip, and rupture), where cracks may be in either longitudinal, diagonal, or radial directions
- Excessive-deformation failure – the common limit of 5% was adopted for indicating excessive deformation
- Inverse-curvature failure due to buckling phenomena, which creates inverse curvature from excessive loads on the pipe
- Joint-displacement failure, where excessive joint displacement results in a gap between two adjacent pipe segments
- Corrugation-growth failure, where plastic deformation of pipes' interior liners due to the transfer of stress from the outer to the inner wall causes waviness of the interior pipe surface
- Buckling failure, which results in deformation due to large circumferential stresses, and causes radial wavy surfaces of the pipe

The recommendations from the University of Texas at Arlington study were:

- Due to the different and multiple modes of failure experienced by the pipes identified in the study, it is evident that the knowledge of the long-term performance properties of HDPE pipes subjected to diverse service load is limited. Further studies are needed to identify HDPE's long-term properties in order to avoid the unexpected failures observed in that study.
- Since 100% of the pipes experienced corrugation growth, a comprehensive study should be conducted to establish post-installation Manning's *n* values.
- Since 69% of the pipes tested experienced an excessive-deformation mode of failure (as high as 34% deformation), the long-term stiffness properties of HDPE pipes should be investigated.
- The progressive-failure characteristics of HDPE pipes should be investigated in order to identify the causes of multiple failure modes in most of the pipes investigated.

3. METHODOLOGY

In this section, the methodology followed in HDPE pipe inspections is presented and discussed. First, field-inspection methodologies are presented. Next, the advantages of laser-ring technology are discussed.

3.1 FIELD-INSPECTION METHODOLOGIES

The four commonly-used methods of HDPE pipe inspections are:

Mandrel Inspection (used commonly for new pipe installations)

Mandrels (Figures 6 and 7), which are sized physically to stop at any deflection or ovality exceeding design tolerance in a pipe, are pulled through pipes.

Figure 6. Typical mandrel

Figure 7. Mandrel being pulled through a culvert pipe

Manual Inspection (when possible)

Visual inspections are used to determine locations and extents of potential problems. Physical measurements are made at specific pipe locations to record:

- Deflections
- Joint separation
- Extent of deterioration or puncture of pipe walls

Figure 8. Personnel conducting visual inspection and recording physical attributes

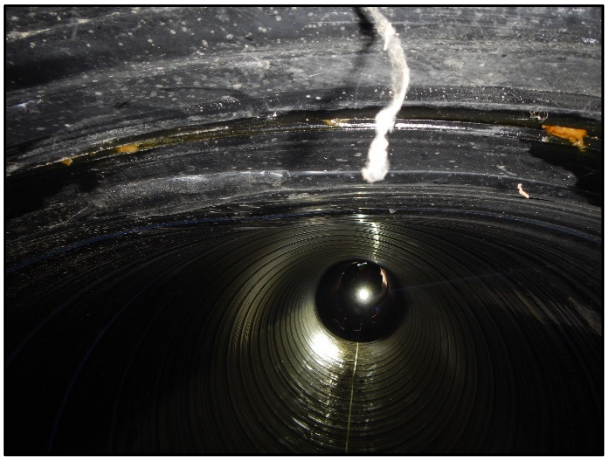

Figure 9. Observed pipe failure detected through visual inspection

Video Inspection (CCTV or other)

Inspections using closed-circuit television (CCTV) or other video-recording methods are frequently performed. For video inspections in this study a CUES K2 portable CCTV system, coupled with a P&T zoom camera, steerable Pipe Ranger camera transporter, a wheeled dolly with a 500-ft Gold M/C TV cable, wired and wireless controllers, and DVR-SD digital recording were used. CCTV inspection has the following advantages:

- Provides a thorough inspection of pipe walls, joints, and potential deterioration of pipe material
- Provides a historical record of the condition of the pipe to determine performance over time
- Can be used on the majority of sizes and materials of pipes
- Inspecting with video is particularly effecitve when coupled with manual inspection and measurements

Figure 10. CCTV inspection of an HDPE pipe under CDOT T-Rex project

Figure 21. CCTV inspection of an HDPE pipe under CDOT T-Rex project

Laser-Ring Inspection in Conjunction with CCTV Operation

The laser-ring profiler is a tool for use with a CCTV survey system and camera to collect survey data containing measurements of faults and other features inside a pipeline. The data obtained includes measurements of pipe size, laterals, and water levels, as well as automatic analysis of pipe ovality and capacity up to 30 times a second. With this technology a ring of laser light is projected onto the internal pipe surface. The laser image is in the field of view of a camera as the camera moves through the pipe and a video recording is made. Analysis is performed on the ring of light using Laser Profiler software to build a digital pipe profile. The technology is for use live or with pre-recorded video (tape, CD, or DVD). For the present study, a CUES laser profiling and measurement system with a six-head laser, skid assemblies, laser profiler, and measurement software was used.

Figure 32. Laser-ring profiler with a skid system

3.2 BENEFITS OF LASER-RING INSPECTION

Benefits of laser-ring inspections include:

- Provides the ability to measure:
  - Pipe length
  - Pipe diameter (360º)
  - Deviations in pipe diameter (deflections) along the pipe length
  - Locations of pipe joints
- Provides the ability to inspect all sizes of common highway pipes
- Relatively-quick inspection times, improving the efficiency of inspections
- Minimal field calibrations are required for analysis
- Provides a detailed analysis with data and reports on the condition of the pipe

- Equipment can be operated with relatively minimal training
- Analysis only requires knowledge of common issues with pipes and how they correlate with the resulting data
- Provides the ability to monitor pipe performance and deterioration over time to help prevent pipe failure

Figure 43. Typical laser ring projected onto the internal surface of failed pipe

Figure 14. Setting up for laser-ring equipment inside an HDPE pipe under I-25

Figure 55. Close-up of a separated joint using CCTV recording

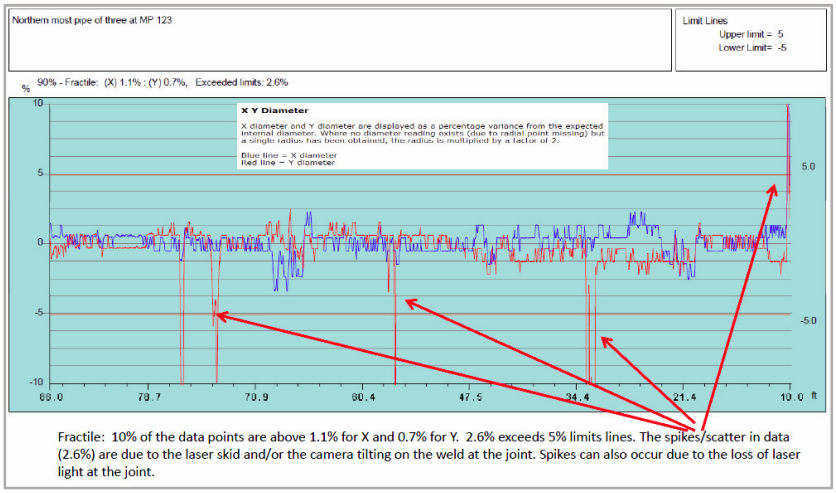

Figure 66. Reported output from Laser Profiler software

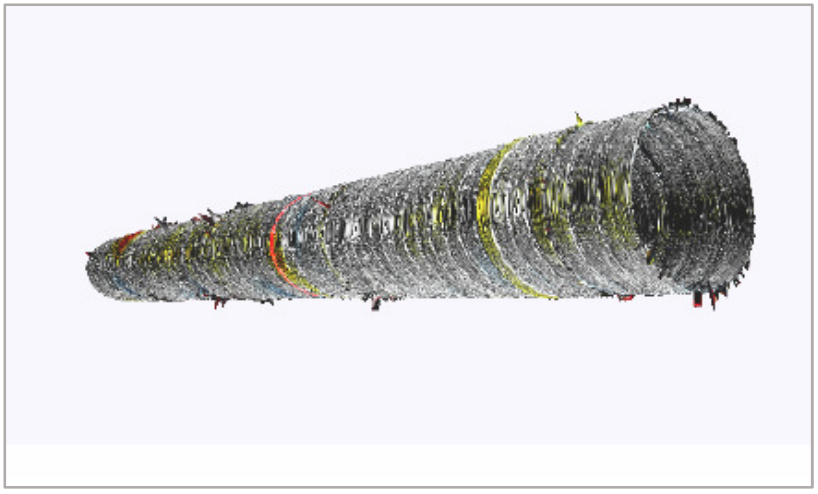

Figure 17. Reported output from Laser Profiler

3.3 LASER-RING INSPECTION CONCEPT

Camera Unit

- The camera unit consists of a robotic trolley with a mounted, rotatable CCTV camera.
- The trolley is connected to the video display system via a strong cable, with the CCTV cabling running parallel to it.
- The video-display system is attached to a winch system that sends cable release and retract lengths for the purpose of determining the location of the camera with respect to the pipe length.
- The camera trolley can be operated at variable speeds.

Figure 18. Robotic trolley with mounted, rotatable CCTV camera

Figure 19. Remote video display and recording system

Laser-Ring Unit

- The laser-ring unit consists of a sled of variable sizes for different pipes, with an attached 360º ring laser and battery.
- The laser-ring sled is attached to the camera unit via rope or cabling, and is pulled behind the camera unit at a slow speed.
- The laser-ring calibration is conducted after the pipe inspection, and consists of setting the laser behind the camera unit at the same distance used during inspection.
- A measuring device (meter/yard stick) is then held horizontally on top of the laser while the camera is recording. This provides distance measurements that will correlate to pixel distance of the video.

Inspection Process

- Manual inspections, photographs, and measurements of diameter and damage should always be completed if possible.
- Initially, the camera unit is sent through the pipe being inspected to video all joints and pipe walls for visual inspection.
- The laser unit (sled) is then attached to the camera unit on the other end of the pipe.
- A 360º laser ring is emitted onto the internal surface of the pipe.
- The laser unit and camera should sit horizontally, parallel to the pipe to provide video of the "perfect circle" of the laser. The projected laser ring should stay perpendicular to the angle of the camera.
- Minor debris accumulation in the pipe (sediment, leaves, etc.) should have minimal impact on the accuracy of the analysis.
- Major debris may either prevent passage through the pipe, or may cause errors in the results. Major debris should be cleared from the pipe if possible.
- If the laser and camera are separate units, the laser unit sits behind the camera unit within view of the camera at a distance of roughly 2 to 3 times the pipe diameter.
- Once the laser has been set at the appropriate distance, the pipe ends should be covered to eliminate as much light as possible. This allows the camera to record the laser light as clearly as possible.
- The camera-unit trolley then records the laser as it is pulled back through the pipe.
- A slow speed works best for collecting accurate data.
- With a system where the laser and camera are separate units, data may not be able to be collected towards the end of the pipe due to the distance between the camera and the laser.
- Once the inspection is complete the calibration is conducted.

Figure 20. Calibration of laser-ring device

Figure 21. Calibration of laser-ring device

Figure 22. Recorded video imagery along with location and other pertinent information

Figure 7. Recorded video imagery with location information under CDOT's T-Rex project

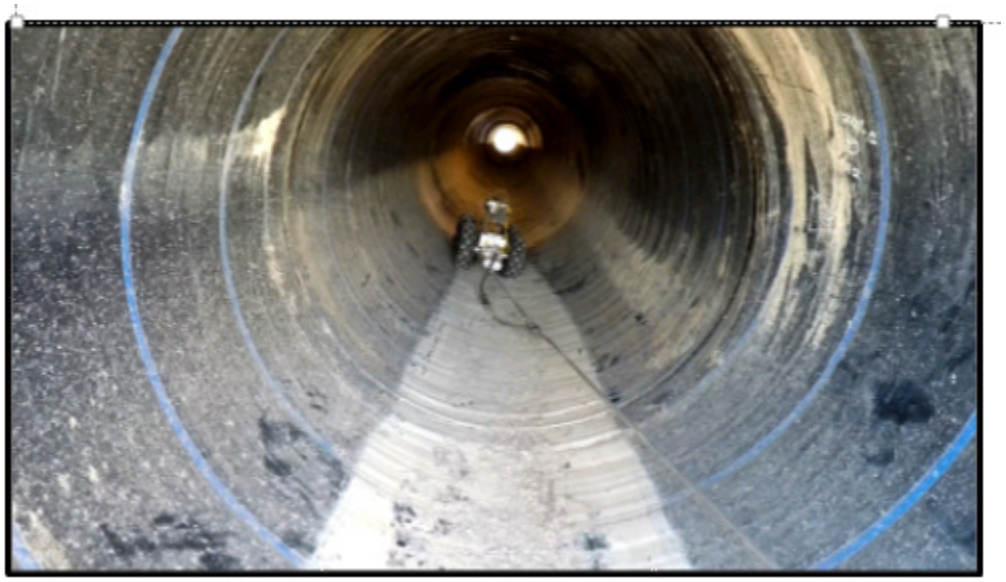

Figure 24. Mobilizing the robotic trolley during the inspection process

Figure 25. Laser ring reflected on the pipe surface under Interstate 25 at Fountain Creek

4. FIELD-DATA COLLECTION

4.1 HDPE PIPE INSTALLATION AND TRENCH-DIMENSIONS DATA

As a part of the HDPE pipe-performance study, a field trip to CDOT Region 3, Grand Junction, Colorado, was conducted to observe one of the stages of a 3,000-ft HDPE pipe installation. Figures 26 through 32 show the observed stages of a typical CDOT HDPE pipe installation for trench width, depth, and material placement.

Figure 26. Preparation for the installation of a 3,000-ft HDPE pipeline

Figure 27.8 Preparation for the installation of a 3,000-ft HDPE pipeline

Figure 28. Trench dimensions for HDPE pipe installation

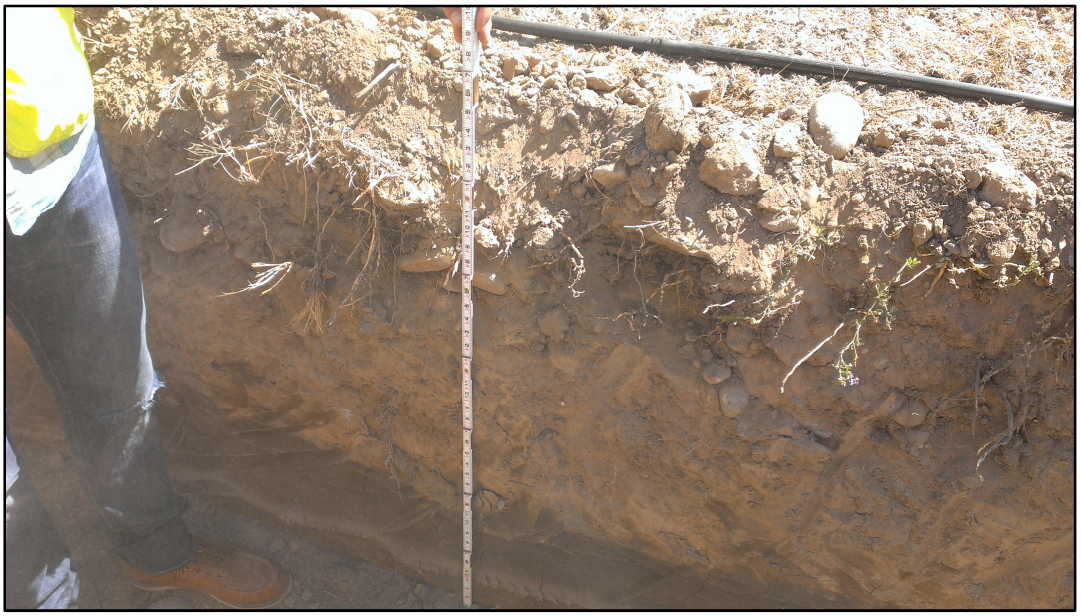

Figure 29. Trench dimensions for HDPE pipe installation

Figure 30. Trench dimensions for HDPE pipe installation

Figure 31. HDPE pipe installation

4.2 HDPE PIPE PERFORMANCE INSPECTIONS

Two sites were selected for pipe-performance inspections. The first site was on Interstate 25 near Colorado Springs, in CDOT Region 2 (Figure 32). This site offered a close proximity to eight 48-inch HDPE cross culverts, and had easy access for the CCTV equipment. The site was also desirable since in 2013 a laser-ring pipe inspection had been performed to document the initial pipeline properties. The pipes along the inspection site had minimal cover (approximately 12 inches). However, they had been fortified using a spiral steel belt.

Figure 32. Pipe inspection site near Colorado Springs, CDOT Region 2

The second HDPE performance test section was along the CDOT's T-Rex project site in Denver. To locate HDPE pipes along T-Rex was challenging since, due to complaints about their performance, they had been removed from a majority of the drainage lines along the project. Figures 33 and 34 provide the site information of the I-25 segment selected for the inspections. As shown in these figures, the HDPE pipe drainage lines are located in the shoulder region of the Interstate 25 highway and are buried 11 ft. As such, they do not carry heavy, cyclic highway traffic (the reason they were left in place).

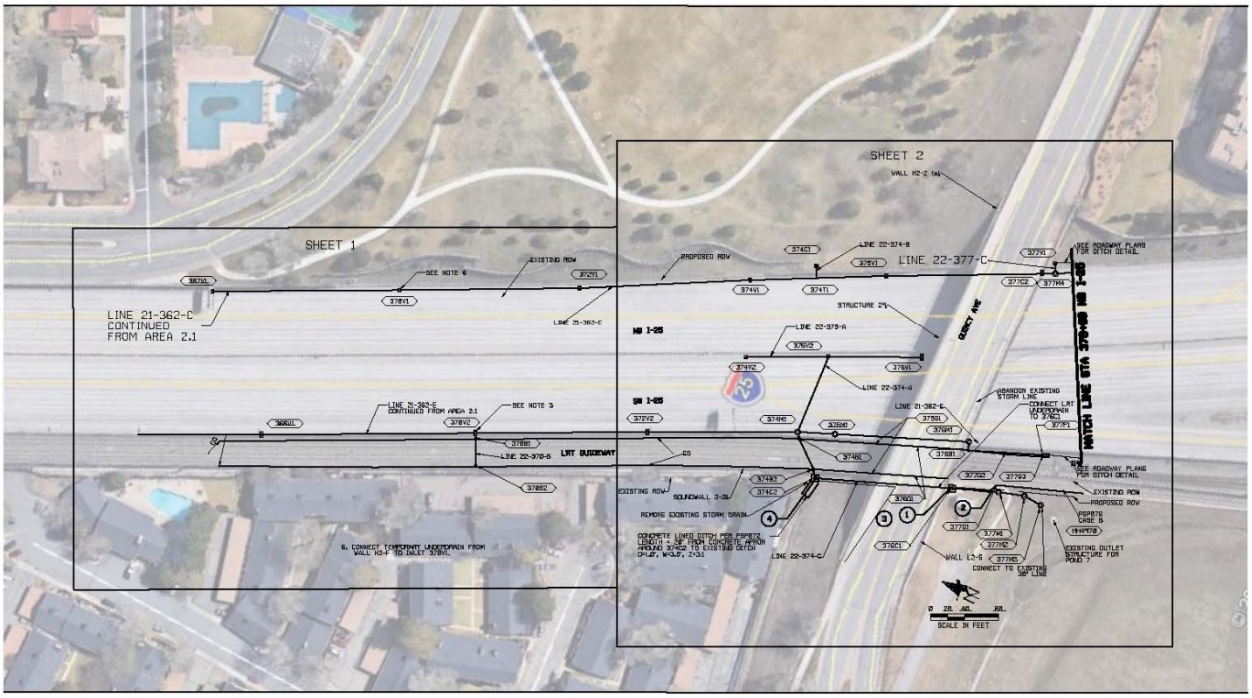

Figure 33. Location of HDPE pipe-inspection site on Interstate 25 along CDOT's T-Rex project site

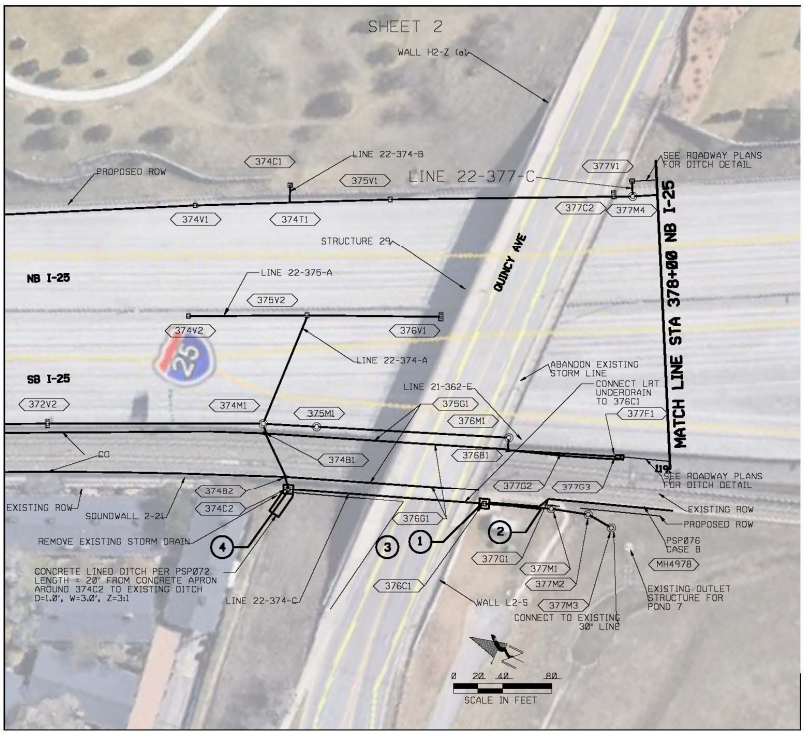

Figure 34. Location of pipe-inspection site along T-Rex project

Figure 35. Motorized robot carrying CCTV entering HDPE pipe near Colorado Springs, CDOT Region 2

Figure 3610. Motorized robot carrying CCTV entering HDPE pipe along T-Rex Project site on I-25

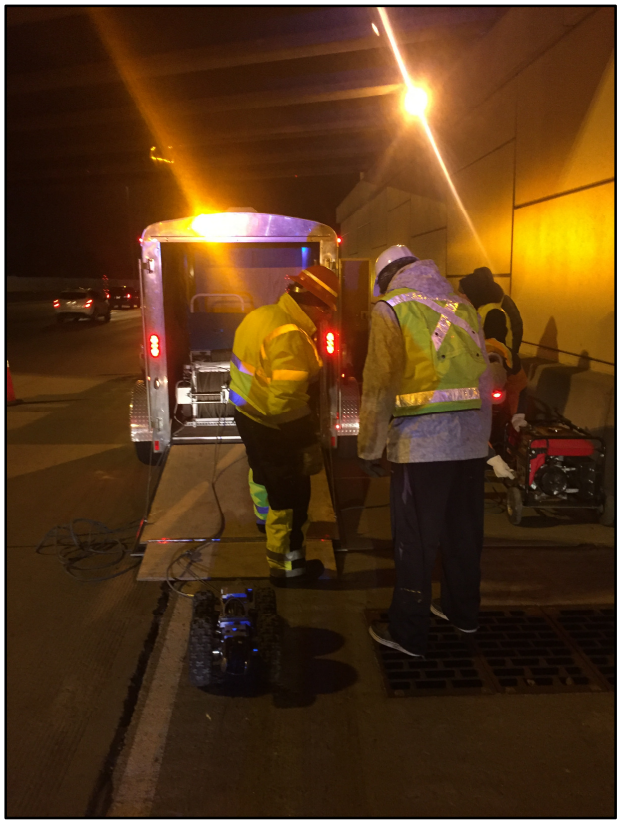

Figure 37. CDOT Maintenance providing access to T-Rex HDPE site

Figure 38. CDOT Maintenance providing access to T-Rex HDPE site

Figure 39. CDOT Maintenance crew providing access to T-Rex HDPE site

Figure 40. CDOT Maintenance crew providing access to T-Rex HDPE site

5. DATA ANALYSIS

5.1 FIELD-DATA COLLECTION RESULTS

5.1.1 T-Rex Area Pipes on I-25

A section of I-25 near the Quincy overpass was coned off on December 5, 2016 to conduct a performance inspection of the HDPE storm drains in the area. Several factors limited the amount of pipe that could be inspected, including difficulties in removing the bolts attaching the grates on the drop inlets, and removing the grates themselves. Also, heavy loads of sediment were in the inverts of the pipes. The inspection was limited to approximately 182 ft of estimated 36-inch HDPE. The pipe was inspected with a Cues robotic pipeline-inspection system. Figures 42 and 43 present photos from a CCTV inspection of HDPE pipes along CDOT's T-REX Project site and show the heavy loads of sediment. As stated above, this section of the drainage pipeline lies on the shoulder region of I-25 and therefore is not subject to heavy cyclic loading. The pipeline is buried 11 ft below the highway pavement and appeared to be sagging in areas. The overall shape of the structure appeared to be round, and the joints appeared to be performing as expected. A laser profile could not be conducted due to the amount of debris in the system. Some of the adjacent pipes coming into the two drop inlets were observed and appeared to be performing satisfactorily. It is recommend that the pipes be cleaned and fully inspected.

Figure 111. CCTV inspection of T-Rex HDPE pipes

Project Name: I-25 Denver	
Date: 12/5/2016	**Pipe ID:**
Asset Location:	**Start ID:** Drop Inlet
Length Surveyed: 183.2	**End ID:** Drop Inlet
Run Number:	**Direction:** Downstream
Pipe Size: 36	**Pipe Type:** HDPE

Distance	Fault Observation	Picture
0.0	Start Inspection	
37.0	Heavy Debris in Invert	
56.8	View down barrel	
90.0	Debris in invert	
120.2	View down barrel	

Figure 42. Photos from CCTV inspection of HDPE pipes along CDOT's T-REX project site

Distance	Fault Observation	Picture
154.9	View down barrel	
169.5	Debris coming into drop inlet	
183.2	Drop Inlet	
183.2	End Inspection	

Figure 43. Photos from CCTV inspection of HDPE pipes along CDOT's T-REX project site

5.1.2 Fountain Colorado Pipes

Along I-25 near Colorado Springs in CDOT Region 2 a total of 5 pipes were video and laser profiled on September 30, 2013 and December 5, 2016. Also, a manual inspection was conducted on three additional pipes during the 2016 inspection. In 2013 a straight line, non-pan-and-tilt, portable camera unit was utilized for the inspection. In 2016 a robotic pan-and-tilt camera was utilized.

Table 1 presents the summary results of laser-ring profiling near Colorado Springs, CDOT Region 2 in a comparative analysis with 2013 measurements (Table 2). The 5 pipes inspected in 2016 had been previously inspected in 2013 after their installation, and provide insight into the development of deformation in HDPE pipes. As shown in the last column of Table 1, none of the pipes under study had exceeded the 5% deflection in 2013. After 4 years of operation, however, 3 of the 5 pipes had reached 5% deflection. It is recommended that these pipes be inspected in the future to ensure that their performance does not deteriorate.

Table 1. Summary results of laser-ring profiling near Colorado Springs, CDOT Region 2

Location: Fountain Colorado
Route: I-25
Pipe Use: Culvert/Cross Drain

Date Inspected: 9/30/13 (Red indicating potential changes in deflection since 2013).

Deflection data was gathered at a frame rate of approximately 1 frame per every 0.1 ft. With 180 measurements taken per frame of video. Total readings per pipe section ranged from approximately 712,000 to 770,000.

Location	Date	Pipe Type	Pipe Size	Distance (ft)	Start ID	End ID	Deflection (2.5%)	Deflection (5%)	Observations
MP 123, Northern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection less than 2.5%, slight dent in left springline, wooden stake driven through crown near inlet end. No significant change in deflection since 2013.
MP 123, Center Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	92% of readings below 2.5%	100% of readings below 5%, .	Max deflection approximately 4% at 23 ft, small dent at left springline at 73 ftl, wooden stakes driven through crown of pipe near inlet end. Deflection at 5% in 2016.
MP 123, Southern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection approximately 2.5% at 24 ft, wooden stake driven through crown of pipe near inlet. Deflections still below 5%. No significant change in deflection since 2013.
MP 122.5	9/30/2013	DuroMaxx	48-inch	102	Outlet	Inlet	86.8% of reading below 2.5%	100% of readings below 5%, .	Max deflection approximately 2.8% at 88 ft. Deflection at 4.8% in 2016
MP 122	9/30/2013	DuroMaxx	48-inch	103	Outlet	Inlet	77.2% of readings below 2.5%	<1.9% of readings above 5%	Max deflection approximately 5.30% near inlet end (approx. 90 to 88 ft). Deflection at 5.8% in 2016, crown flattening and possible inverse curvature has occurred. Pipe moderately racked in right crown. Remainder of pipe 4% or less. Small puncture due to stake near outlet, pipe slightly racked at 8 ft. Slight hump at right haunch at 46 ft. Slight dent in invert at 56 ft

Table 2. Summary results of laser-ring profiling near Colorado Springs, CDOT Region 2 (2013)

Location: Fountain Colorado
Route: I-25
Pipe Use: Culvert/Cross Drain
Date Inspected: 9/30/13

Location	Date	Pipe Type	Pipe Size	Distance (ft)	Start ID	End ID	Deflection (2.5%)	Deflection (5%)	Observations
MP 123, Northern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection less than 2.5%, slight dent in left springline, wooden stake driven through crown near inlet end.
MP 123, Center Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	92% of readings below 2.5%	100% of readings below 5%, .	Max deflection approximately 4% at 23 ft, small dent at left springline at 73 ftl, wooden stakes driven through crown of pipe near inlet end.
MP 124, Southern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection approximately 2.5% at 24 ft, wooden stake driven through crown of pipe near inlet.
MP 122.5	9/30/2013	DuroMaxx	48-inch	102	Outlet	Inlet	86.8% of reading below 2.5%	100% of readings below 5%, .	Max deflection approximately 2.8% at 88 ft
MP 122	9/30/2013	DuroMaxx	48-inch	103	Outlet	Inlet	77.2% of readings below 2.5%	<1.9% of readings above 5%	Max deflection approximately 5.30% near inlet end (approx. 90 to 88 ft). Pipe moderately racked in right crown. Remainder of pipe 4% or less. Small puncture due to stake near outlet, pipe slightly racked at 8 ft. Slight hump at right haunch at 46 ft. Slight dent in invert at 56 ft.

Figure 4412. Manual inspection of I-25 HDPE cross-culverts near Colorado Springs

Table 3. Summary of manual-inspection results near Colorado Springs, CDOT Region 2 (2013)

12/5/2016 - Fountain, CO - Mile Marker 122.5 - 48" HDPE Pipe - Start at East End

Pipe Station (ft)	Vertical Diameter (ft)	Horizontal Diameter (ft)	Diagonal Diameter (ft)	Notes
9	3.66	3.56	3.54	3 punctures at STA 8
20	3.61	3.63	-	
24	3.63	3.67	3.51	STA 26.25 joint separation 2 in max
35	3.65	3.68	3.65	
50	3.60	3.73	3.71	STA 48.16 joint separation 1.06 in max
56	3.54	3.73	3.59	Minor bulge at pipe invert
70.25	3.47	3.67	3.50	STA 70.25 joint separation 1.13 in max
86	3.65	3.67	3.60	
92.08	3.43	3.68	3.48	Deflection at joint
100	3.63	3.65	3.62	

12/5/2016 - Fountain, CO - Mile Marker 123.01 - 36" HDPE Pipe - Start at East End

Pipe Station (ft)	Vertical Diameter (ft)	Horizontal Diameter (ft)	Diagonal Diameter (ft)	Notes
0	2.69	2.68	2.67	Inlet damaged by traffic
25	2.52	2.75	2.60	
50	2.63	2.73	2.69	
75	2.67	2.71	2.69	
90	2.67	2.58	2.58	

12/5/2016 - Fountain, CO - Mile Marker 123.02 - 36" HDPE Pipe - Start at East End

Pipe Station (ft)	Vertical Diameter (ft)	Horizontal Diameter (ft)	Diagonal Diameter (ft)	Notes
0	2.69	2.58	2.71	Inlet damaged
25	2.52	2.75	2.60	
45	2.63	2.71	2.67	
75	2.67	2.71	2.69	
90	2.65	2.60	2.65	

5.2 DATA FROM LITERATURE REVIEW

One of the objectives of the current research study was to investigate the existence of HDPE performance data from states similar to CDOT. As pointed out in the literature review section of this report in Section 2, the University of Texas at Arlington (UT) conducted such a study in 2010 covering 10 states, including nearby Utah and Kansas. In the University of Texas study, structural performance of 191 HDPE pipelines located in 10 different states throughout the nation was investigated. The sites were selected to cover diverse geographical locations. In the study, manual inspections using qualitative and quantitative observations, a detailed quantitative pipeline-inspection camera, and pipeline laser-profiling-unit measurements were performed utilizing the same equipment and methodologies followed in the current inspection program. The failure modes identified for all tested pipelines included:

- Excessive deformation
- Cracking/fracture
- Inverse curvature
- Joint displacement
- Buckling
- Corrugation growth

All of these are commonly recognized as failure modes in the literature, and do not represent any controversial definitions. The UT study showed that 100% of the pipelines tested suffered from some or many of these failure modes. As shown in Table 5, in 68% of the pipes tested, the limiting maximum deformation (Y, X, and/or ovality) of 5% was exceeded. A maximum deformation value of 34% was observed, and the average of maximum deformations was 7.6% for all pipelines inspected. This study indicates that the structural health and integrity of the installed HDPE pipelines tested are generally below acceptable levels of serviceability.

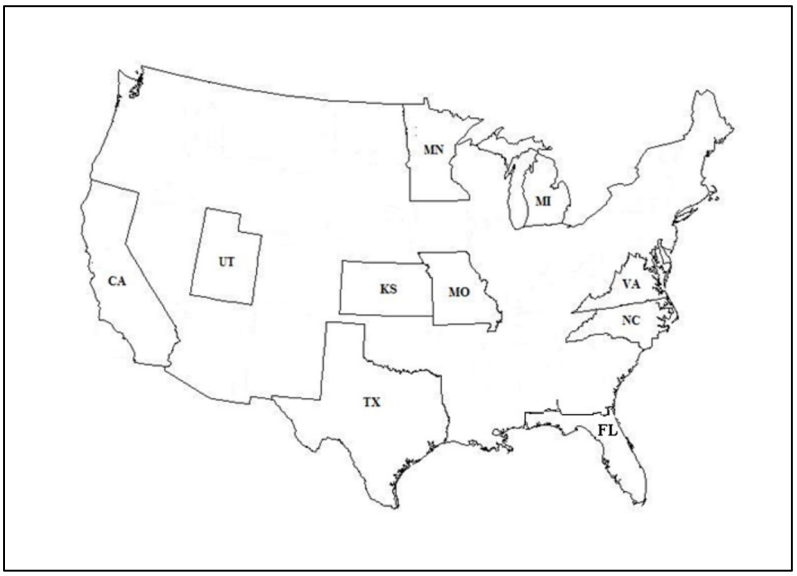

Figure 45. States covered in University of Texas at Arlington, 2010, HDPE pipe-performance study

Table 4. States included in the University of Texas at Arlington 2010 study

State	Number of site locations	Number of pipelines	Total length of the pipelines	
			(ft)	(m)
Texas	9	22	2,800	854
North Carolina	6	11	600	183
Virginia	8	21	3,000	915
Minnesota	9	31	8,700	2,652
Kansas	3	10	1,655	505
Missouri	4	13	1,400	427
California	2	29	2,545	776
Utah	2	10	1,525	465
Michigan	16	29	5,149	1,570
Florida	2	15	4,405	1,343
Total	61	191	31,779	9,689

Table 5. Percentage of HDPE pipe failures in each state

State	Excessive deforamtion	Cracking / Fracture	Inverse Curvature	Joint Displacement	Buckling	Corrugation Growth
Texas	38%	23%	18%	27%	18%	100%
North Carolina	75%	73%	0%	73%	27%	100%
Virginia	100%	26%	11%	32%	16%	100%
Minnesota	58%	26%	0%	26%	3%	100%
Kansas	70%	50%	30%	0%	20%	100%
Missouri	69%	20%	0%	0%	0%	100%
California	56%	69%	21%	7%	3%	100%
Utah	100%	40%	40%	20%	20%	100%
Michigan	82%	33%	10%	19%	23%	100%
Florida	73%	42%	17%	100%	42%	100%
Total	69%	40%	15%	30%	17%	100%

Table 6. Maximum observed HDPE pipe deformations in each state

State	Number of site locations	Number of pipelines	Total length of the pipelines		Maximum deformation	Average of maximum deformation	Percentage of pipelines with excessive deformation (>5%)
			(ft)	(m)	(%)	(%)	(%)
Texas	9	22	2,800	854	22.5	6.8	38
North Carolina	6	11	600	183	10.4	6.3	75
Virginia	8	21	3,000	915	22.3	10.5	100
Minnesota	9	31	8,700	2,652	15	6.4	58
Kansas	3	10	1,655	505	10.4	6.8	70
Missouri	4	13	1,400	427	8.8	5	69
California	2	29	2,545	776	15.3	5.9	52
Utah	2	10	1,525	465	34	10.4	100
Michigan	16	29	5,149	1,570	23.1	10.5	82
Florida	2	15	4,405	1,343	10.3	6.3	73
Total	61	191	31,779	9,689	34	7.5	69

Figure 46 presents a summary of experience with Kentucky DOT's HDPE pipeline installations. Measurements show that after the initial-installation phase, recorded deflections continually increased through time. In almost all Kentucky DOT pipe installations, measured deflections exceeded the maximum 5% failure limit.

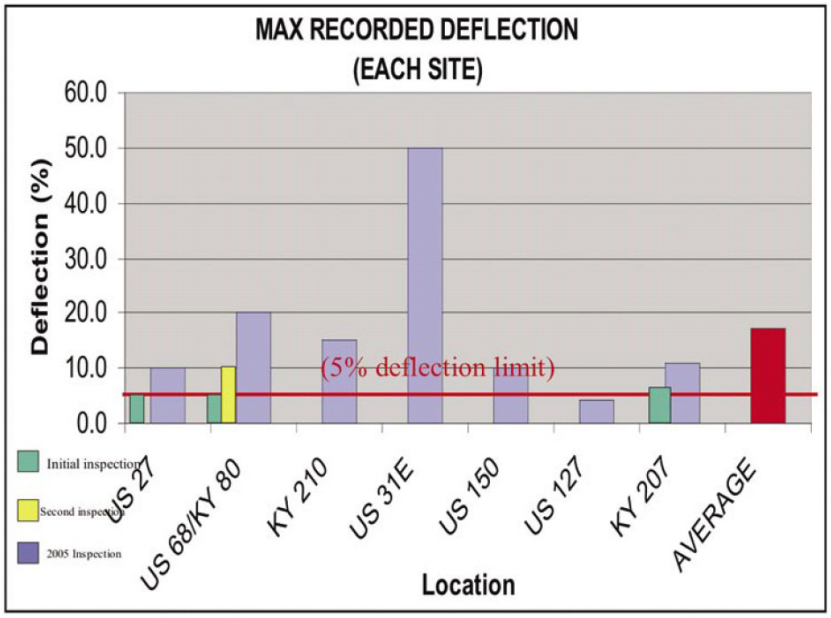

Figure 13. Experience with Kentucky DOT's HDPE pipe performance.

5.3 CDOT EXPERIENCE AT T-REX PROJECT

During construction of the T-Rex Project there were numerous Nonconformance Report and Evaluation (NCR/NCE) forms submitted by Southeast Corridor Constructors (SECC). Appendix 4 presents a compilation of these reports. Some of these reports state that HDPE pipe problems were encountered in the field with shallow cover and excavation around HDPE pipes. It is noted that at some locations it may be necessary to remove previously-installed HDPE and replace it with RCP. In order to resolve these nonconformance issues, SECC requested to change all remaining HDPE to RCP (6/23/2003).

6. SUMMARY AND CONCLUSIONS

In this study, performance of HDPE pipes under CDOT highways was investigated by:

- Conducting an extensive literature review
- Field studies utilizing manual inspection
- CCTV video inspections
- Laser-profiling technology
- Observing CDOT HDPE pipe-installation projects

The objectives of the study and methodologies used to achieve these objectives are presented in Section 1 of this report. Section 2 presents results of an extensive literature review covering various aspects of HDPE problems. Methodology, including equipment and procedures used in conducting field inspections, is described in Section 3. Field data collection and measurement results are presented in Section 4, and the Data Analysis results are discussed in Section 5.

An extensive literature search was conducted in order to assess the current methodologies used by CDOT and other highway agencies to measure the performance of HDPE pipe installations. In general, most DOTs have encountered HDPE performance problems in the form of excess deformation (greater than 5%). The general conclusion from the literature review is that structural integrity of the installed HDPE pipelines which were tested by various DOTs is generally below acceptable levels of serviceability. Further testing is needed to evaluate the long-term performance of HDPE pipes.

In general, it is recommended that all monitoring points established on prior research projects be measured and re-evaluated for long-term hydraulic and structural performance. Studies by Kentucky, Ohio, Missouri, South Carolina transportation departments and others have demonstrated the difficulty in achieving problem-free installations of HDPE pipes, and that these pipes do not always perform in accordance with idealized, theoretical conditions. In numerous test cases significant-to-severe deflections, corrugation growth, crown and invert flattening, racking, sagging, and radial cracking have been observed in pipe sections.

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APPENDIX I – FOUNTAIN COLORADO, DUROMAXX LASER PROFILE INSPECTION, I-25, MP 122, MP 122.5, AND MP 123 (2013)

LEO JOHN FLECKENSTEIN

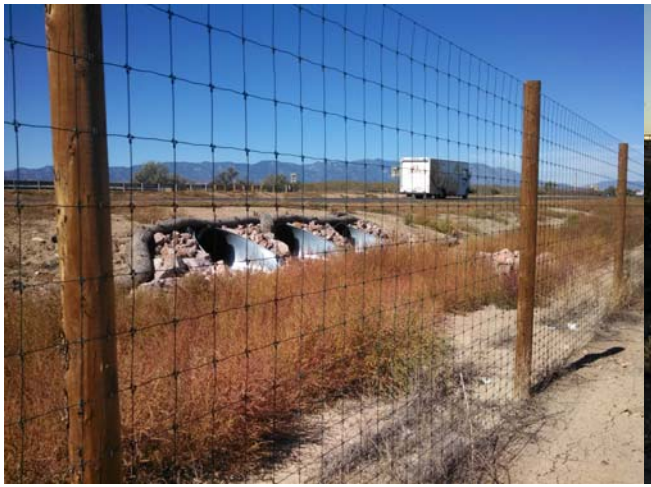
Fountain Colorado
DuroMaxx Laser Profile Inspection
I-25, MP 122, MP 122.5, and MP 123

September 30, 2013

By

Leo John Fleckenstein

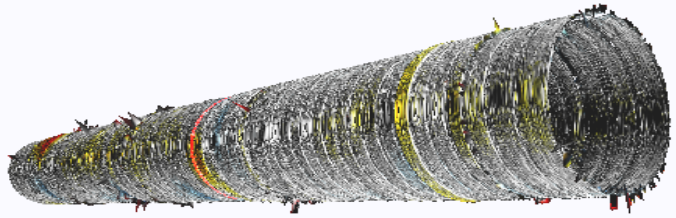
Project Summary: A total of 5 pipes were video and laser profiled on September 30, 2013. A straight line/non pan and tilt portable camera unit was utilized for the inspection. Joints were noted and observed during the inspection. Joint separation was minor to moderate with no significant distress or soil migration observed. Some minor racking, dents, and sags were also noted. Limited construction information was available. Several of the structures have limited cover. Minor post construction damage was noted towards the ends of several of the structures as straw wattles were placed over the pipe ends and wooden stakes driven through the crown of the pipes. The stakes do not appear to causing any structural issues with the performance of the pipes. Four of the five pipes were under 5% deflection for their full length. One pipe had a small localized area where pipe deflection was measured at 5.3% near the end of the structure. The non-uniform nature of the deflection and the fact that the deflected area is outside of the paved roadway would suggest that this deformation occurred during the installation process.
The first 10 to 16 ft of the pipes near the outlet end of the structures could not be laser profiled due to the distance between the camera and the laser. Each pipe was totally captured/recorded on the straight line video Inspection.



Location: Fountain Colorado
Route: I-25
Pipe Use: Culvert/Cross Drain
Date Inspected: 9/30/13

Location	Date	Pipe Type	Pipe Size	Distance (ft)	Start ID	End ID	Deflection (2.5%)	Deflection (5%)	Observations
MP 123, Northern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection less than 2.5%, slight dent in left springline, wooden stake driven through crown near inlet end.
MP 123, Center Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	92% of readings below 2.5%	100% of readings below 5%, .	Max deflection approximately 4% at 23 ft, small dent at left springline at 73 ftl, wooden stakes driven through crown of pipe near inlet end.
MP 124, Southern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection approximately 2.5% at 24 ft, wooden stake driven through crown of pipe near inlet.
MP 122.5	9/30/2013	DuroMaxx	48-inch	102	Outlet	Inlet	86.8% of reading below 2.5%	100% of readings below 5%, .	Max deflection approximately 2.8% at 88 ft
MP 122	9/30/2013	DuroMaxx	48-inch	103	Outlet	Inlet	77.2% of readings below 2.5%	<1.9% of readings above 5%	Max deflection approximately 5.30% near inlet end (approx. 90 to 88 ft). Pipe moderately racked in right crown. Remainder of pipe 4% or less. Small puncture due to stake near outlet, pipe slightly racked at 8 ft. Slight hump at right haunch at 46 ft. Slight dent in invert at 56 ft.

Deflection data was gathered at a frame rate of approximately 1 frame per every 0.1 ft. With 180 measurements taken per frame of video. Total readings per pipe section ranged from approximately 712,000 to 770,000.




MP 123, I-25, 36-Inch DuroMaxx


North


MP 123, I-25, 36-Inch DuroMaxx
Northern Pipe

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection

(20.0) GO - General Observation Remark: Joint No. 1

(30.0) GO - General Observation Remark: Slight dent left springline

(40.0) GO - General Observation Remark: View of joint at 40 ft.

(60.0) GO - General Observation Remark: View of joint at 66 ft.

(80.0) GO - General Observation Remark: Stake driven through crown of pipe at 84 ft.

(88.0) EI - End Inspection

Total Distance: 0

ID Number: Inlet

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection	01:14 00:00:00	
20.0	General Observation Remarks: Joint No. 1	03:13 00:00:26	
30.0	General Observation Remarks: Slight dent left springline	07:04 00:00:40	

Distance	Fault Observation	Time	Picture
40.0	General Observation Remarks: View of joint at 40 ft.	8:10 00:00:45	
60.0	General Observation Remarks: View of joint at 66 ft.	10:33 00:01:13	
80.0	General Observation Remarks: Stake driven through crown of pipe at 84 ft.	12:37 00:01:45	

Distance	Fault Observation	Time	Picture
88.0	End Inspection	13:48 00:01:55	

Created with the POSM report generator

XY Diameter Summary Report

Pipe well under 5% deflection, spikes in data due to camera tilting at joint

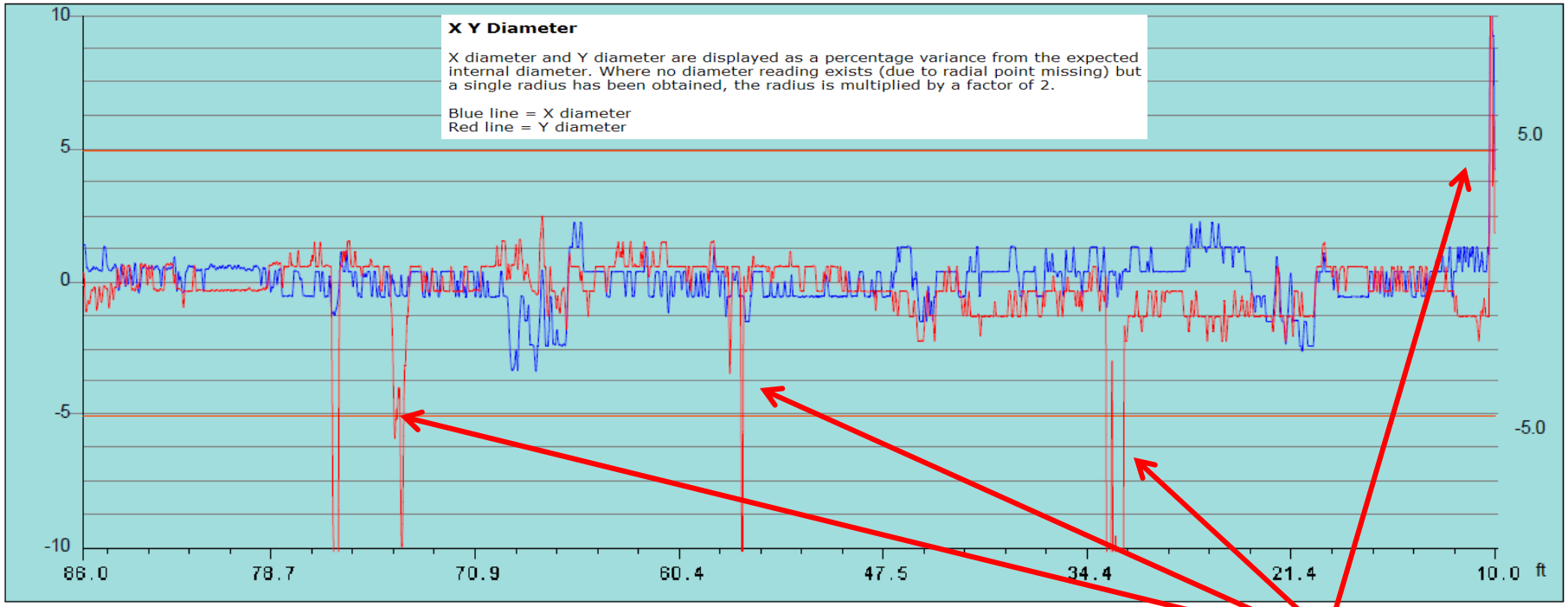
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

Comments

Northern most pipe of three at MP 123

Limit Lines
Upper limit = 5
Lower Limit= -5

% 90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%



Fractile: 10% of the data points are above 1.1% for X and 0.7% for Y. 2.6% exceeds 5% limits lines. The spikes/scatter in data (2.6%) are due to the laser skid and/or the camera tilting on the weld at the joint. Spikes can also occur due to the loss of laser light at the joint.

XY Deflection Summary Report

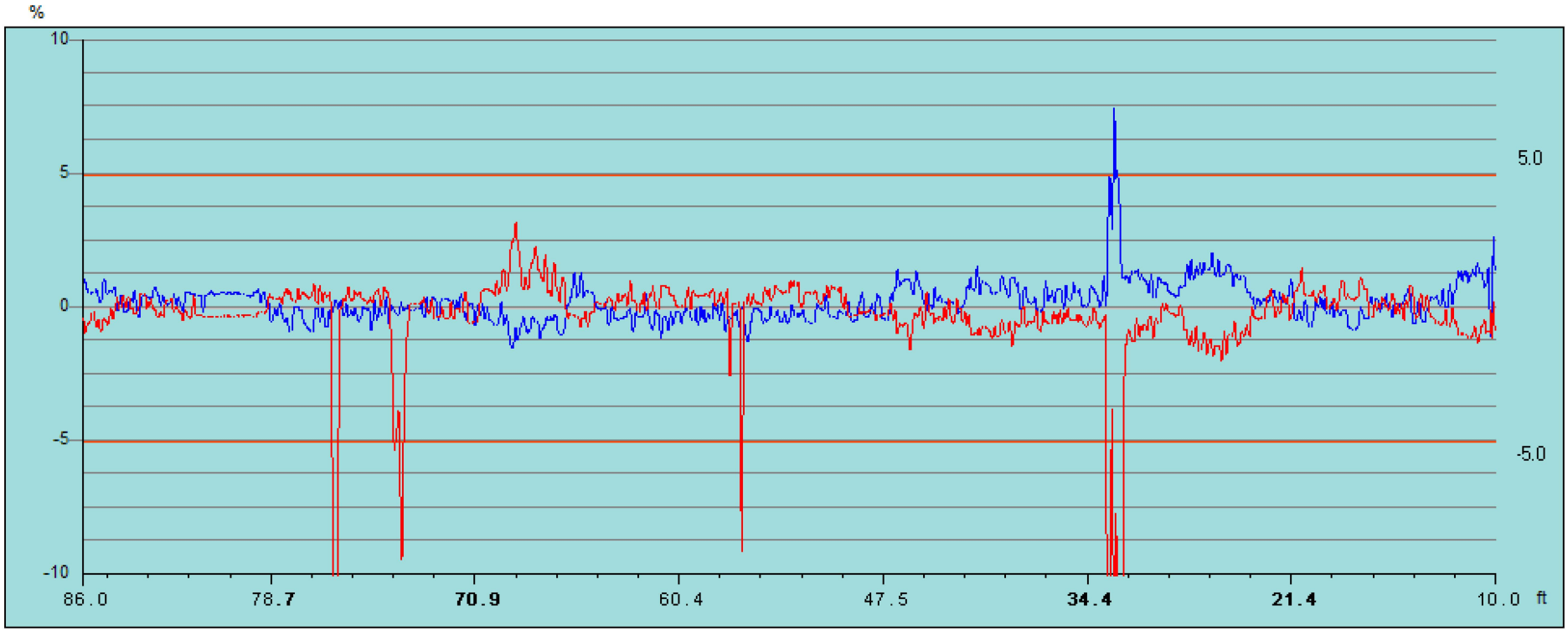
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

Comments

Northern most pipe of three at MP 123

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joints

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

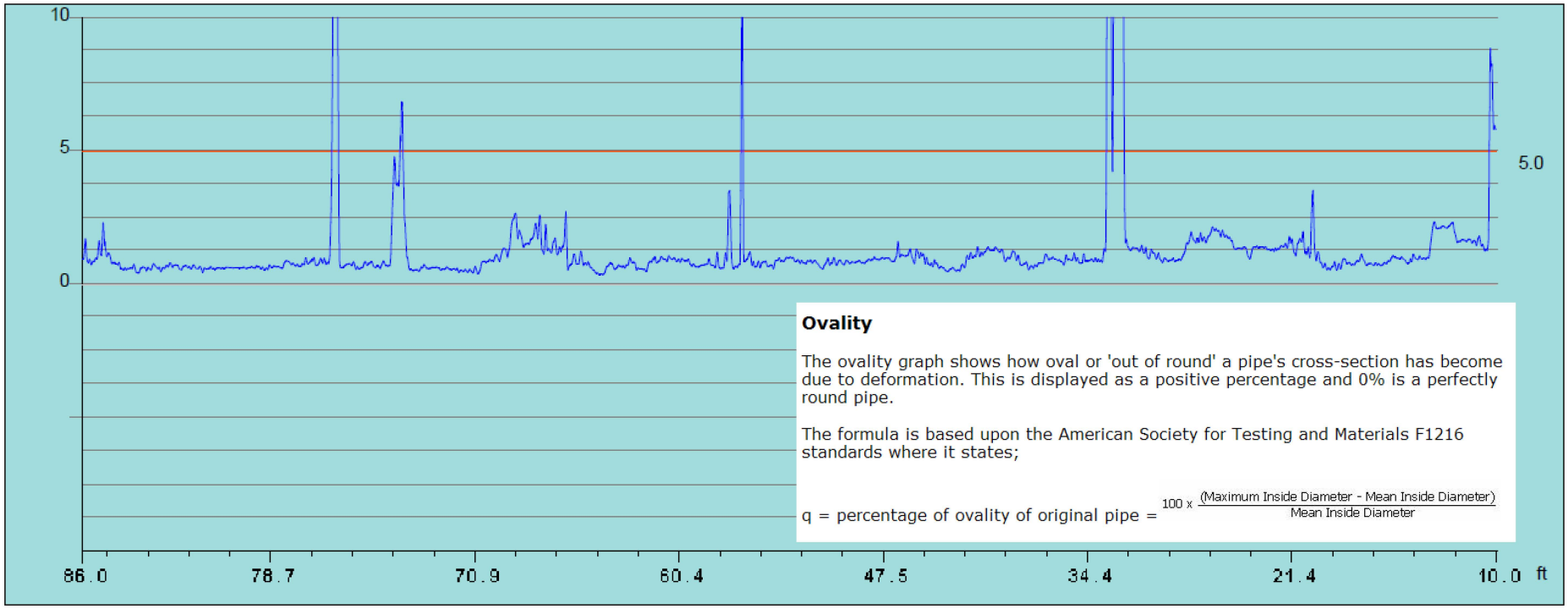
Comments

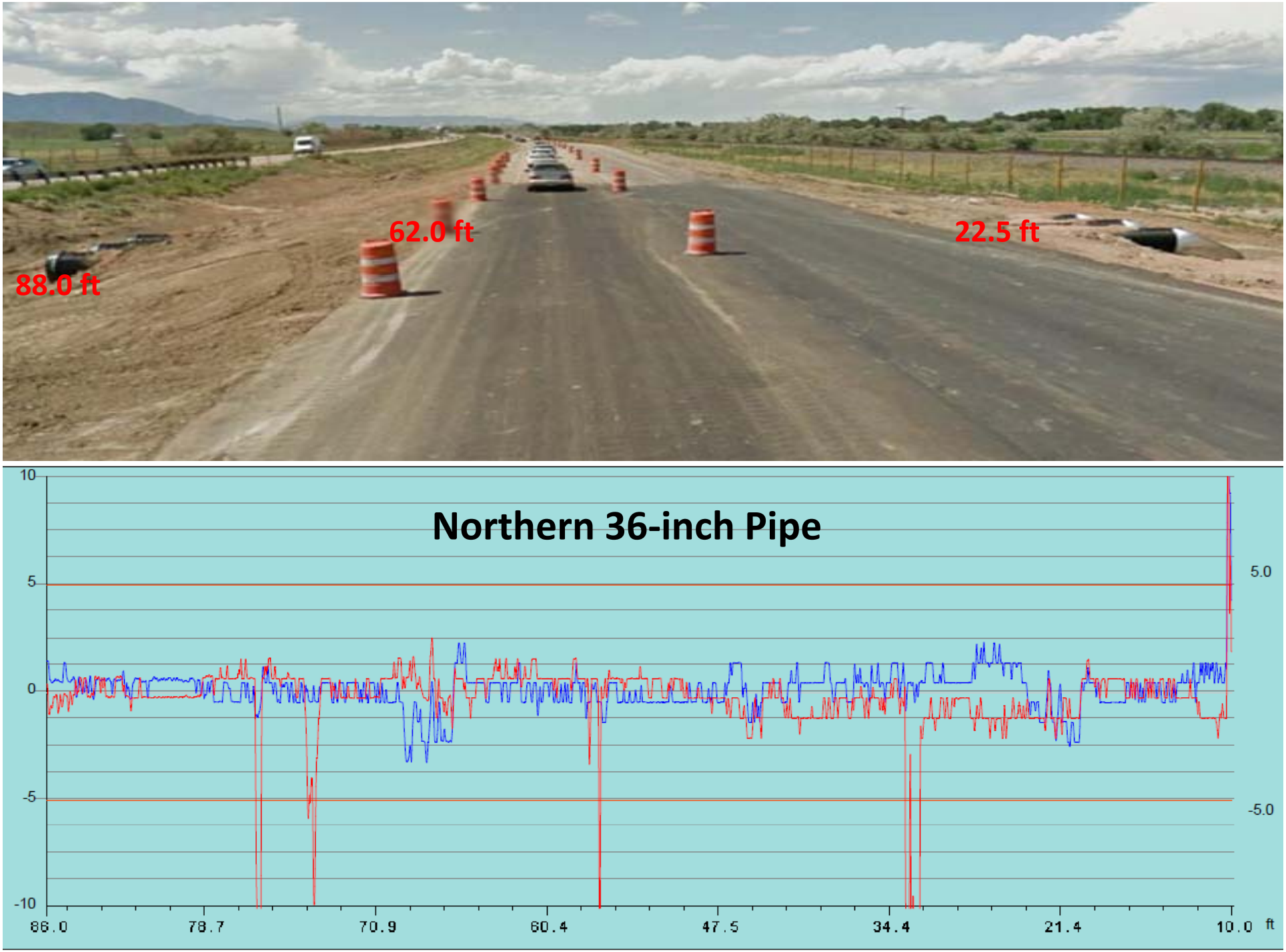
Northern most pipe of three at MP 123

Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 1.8%, Exceeded limits: 2.7%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance

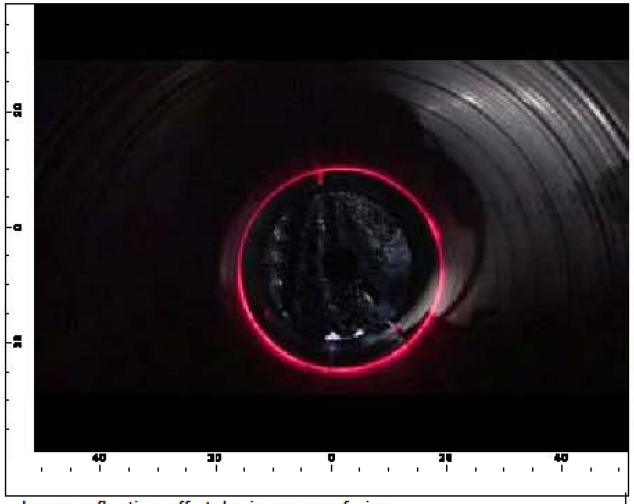



88.0 ft
62.0 ft
22.5 ft
Northern 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
86.0
78.7
70.9
60.4
47.5
34.4
21.4
10.0
ft

XY Diameter Observations Report

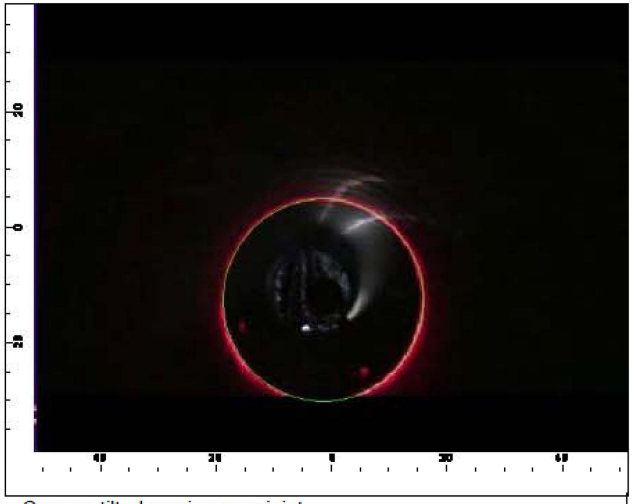
MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

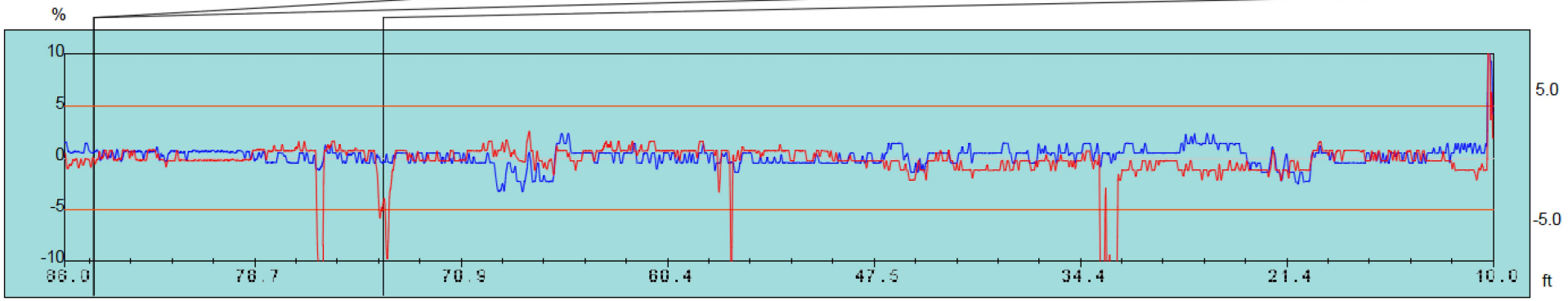


Laser reflecting off stake in crown of pipe.

Stake for erosion control driven through crown of pipe.



Camera tilted coming over joint

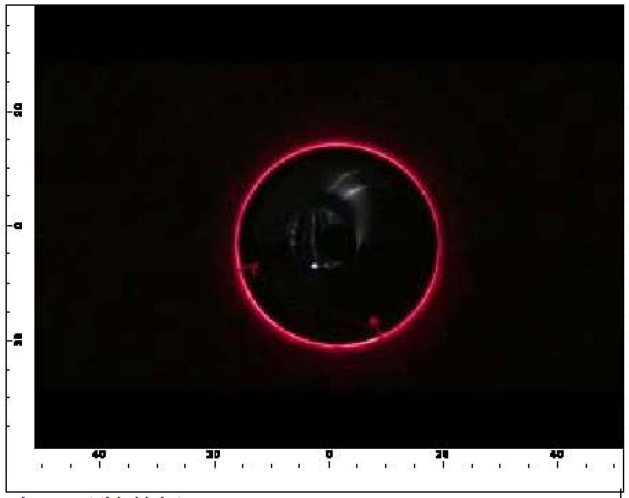


90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%

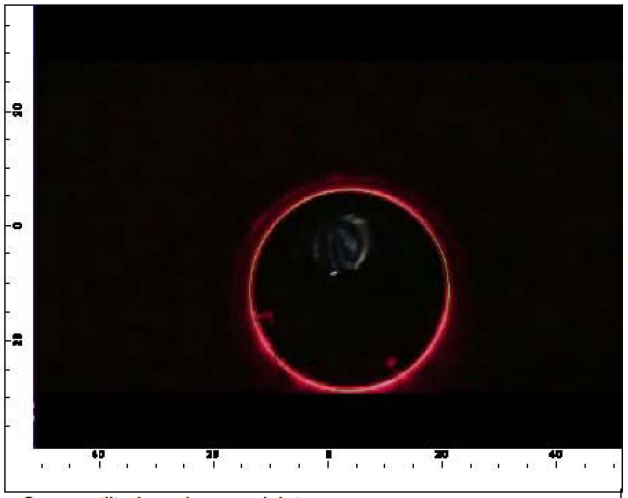
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

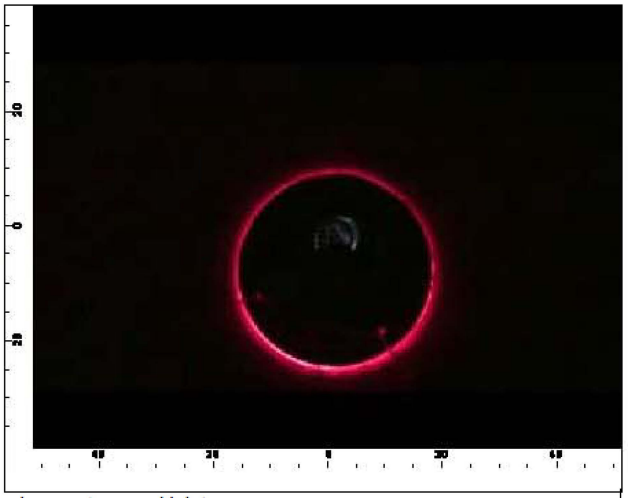
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in



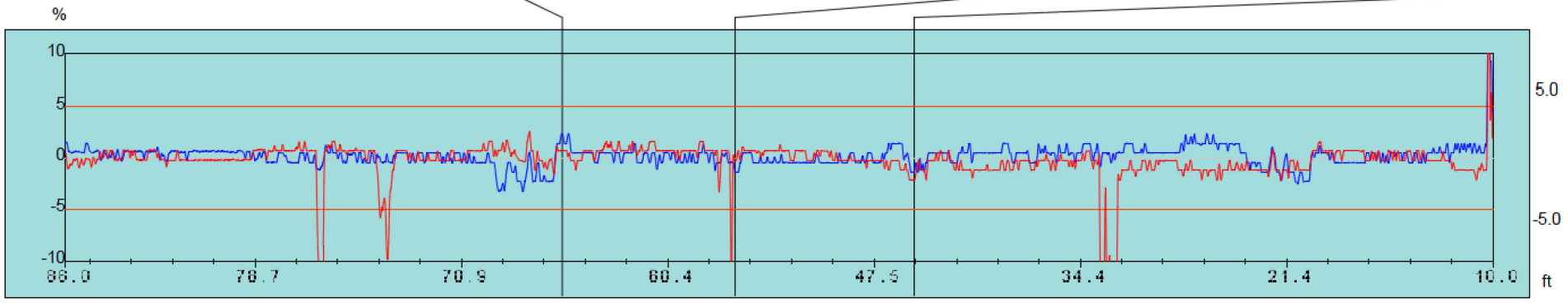
Laser at third joint



Camera tilted coming over joint



Laser at second joint

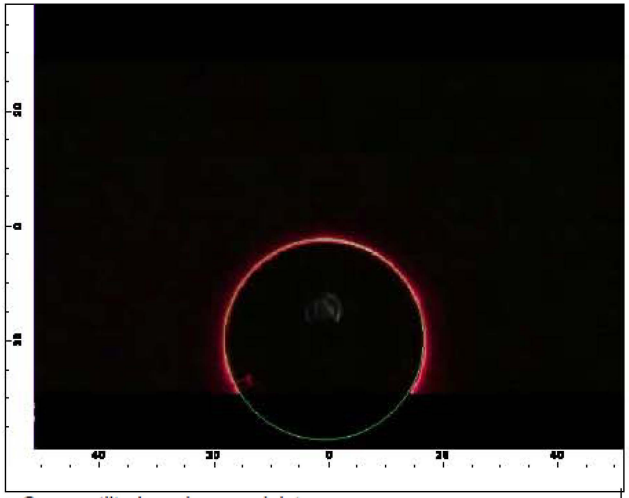


90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%

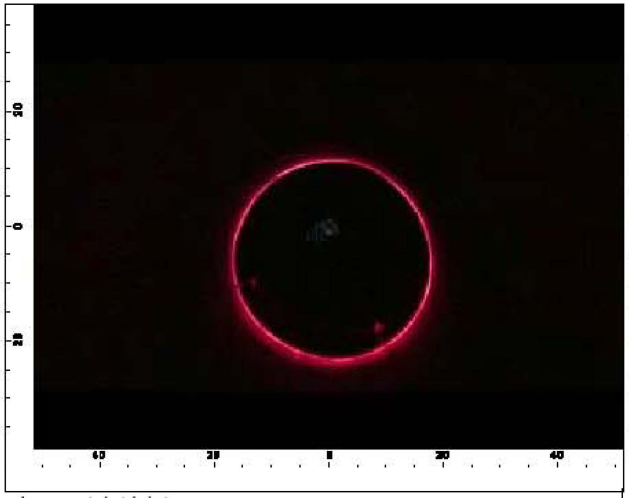
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

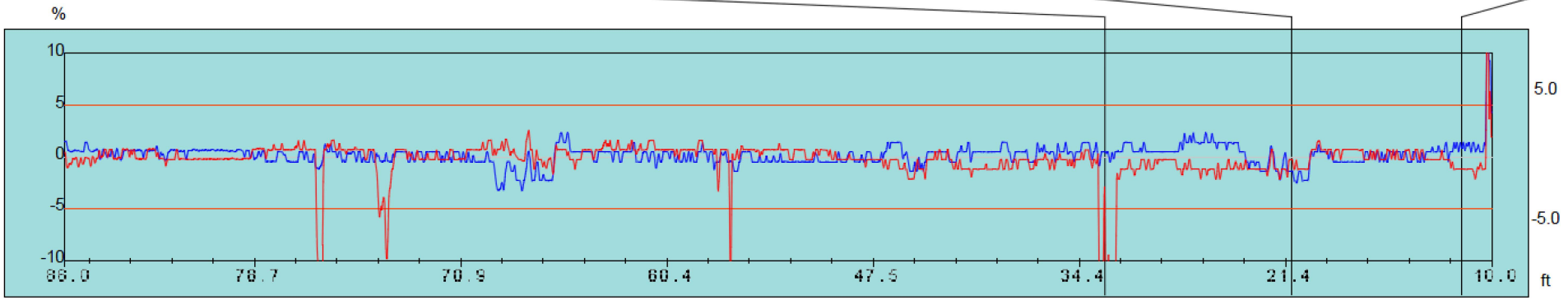


Camera tilted coming over joint



Laser at 1st joint

View of pipe at start, no noticeable deflection or defects.



90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%


MP 123, I-25, 36-Inch DuroMaxx
Center Pipe

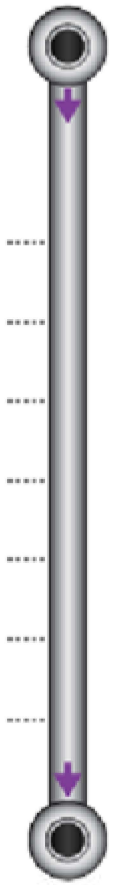
Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123, Center Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection Remark: Start inspection, center pipe
(20.0) GO - General Observation Remark: View of joint at 21 ft.
(40.0) GO - General Observation Remark: View of joint at 43 ft.
(63.0) GO - General Observation Remark: View of joint at 65 ft.
(73.0) GO - General Observation Remark: Small dent at left springline
(78.0) GO - General Observation Remark: Small dent at left springline
(82.0) GO - General Observation Remark: Wood stakes driven through crown of pipe



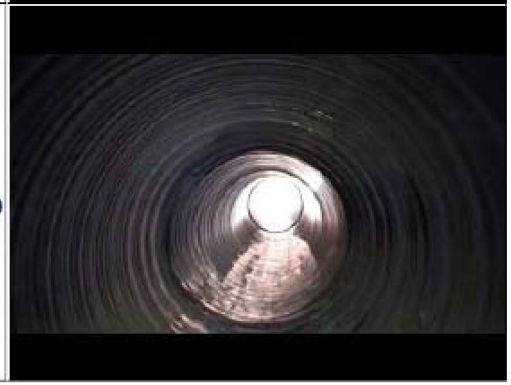
Total Distance: 0

ID Number: Inlet

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123, Center Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection Remarks: Start inspection, center pipe	01:09 00:00:00	
20.0	General Observation Remarks: View of joint at 21 ft.	04:45 00:01:14	
40.0	General Observation Remarks: View of joint at 43 ft.	05:44 00:01:39	

Distance	Fault Observation	Time	Picture
63.0	General Observation Remarks: View of joint at 65 ft.	07:52 00:02:14	
73.0	General Observation Remarks: Small dent at left springline	09:22 00:02:30	
78.0	General Observation Remarks: Small dent at left springline	10:33 00:02:53	

Distance	Fault Observation	Time	Picture
82.0	General Observation Remarks: Wood stakes driven through crown of pipe	11:40 00:03:10	

Created with the POSM report generator

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

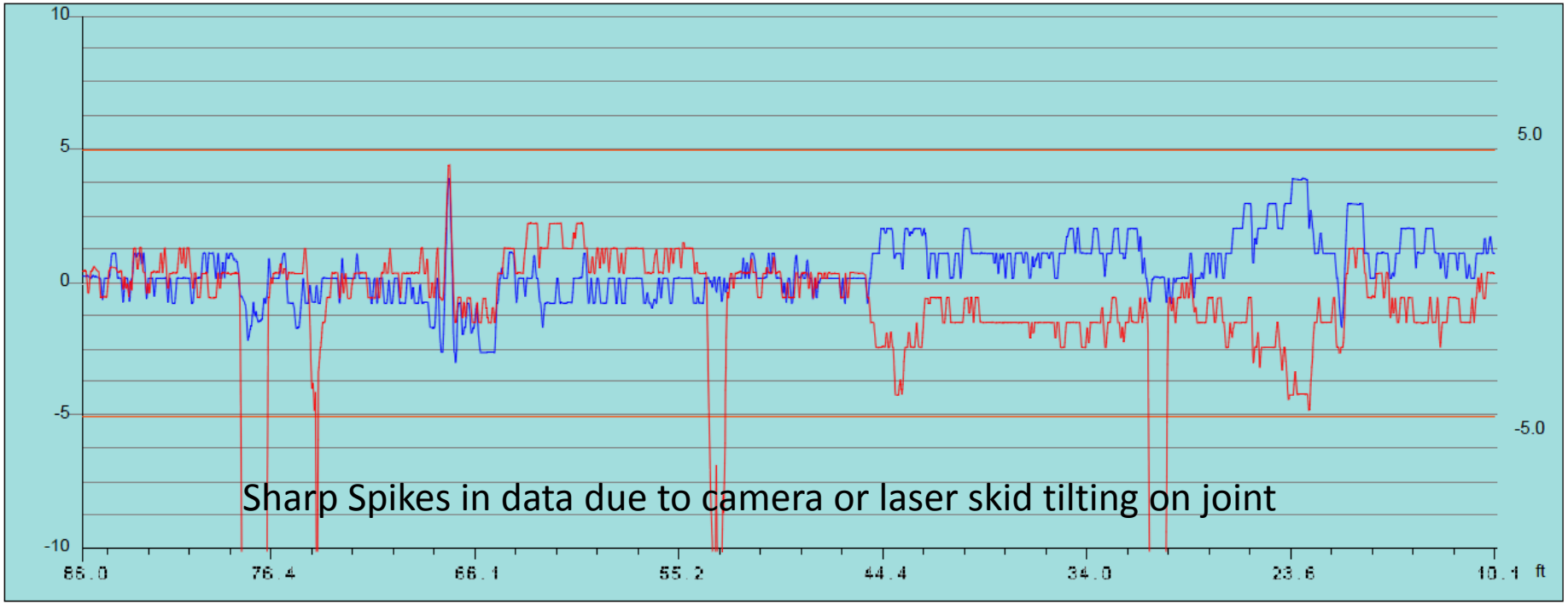
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

Comments

MP 123, I-25, Cross Drain, Center Pipe

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%



XY Deflection Summary Report

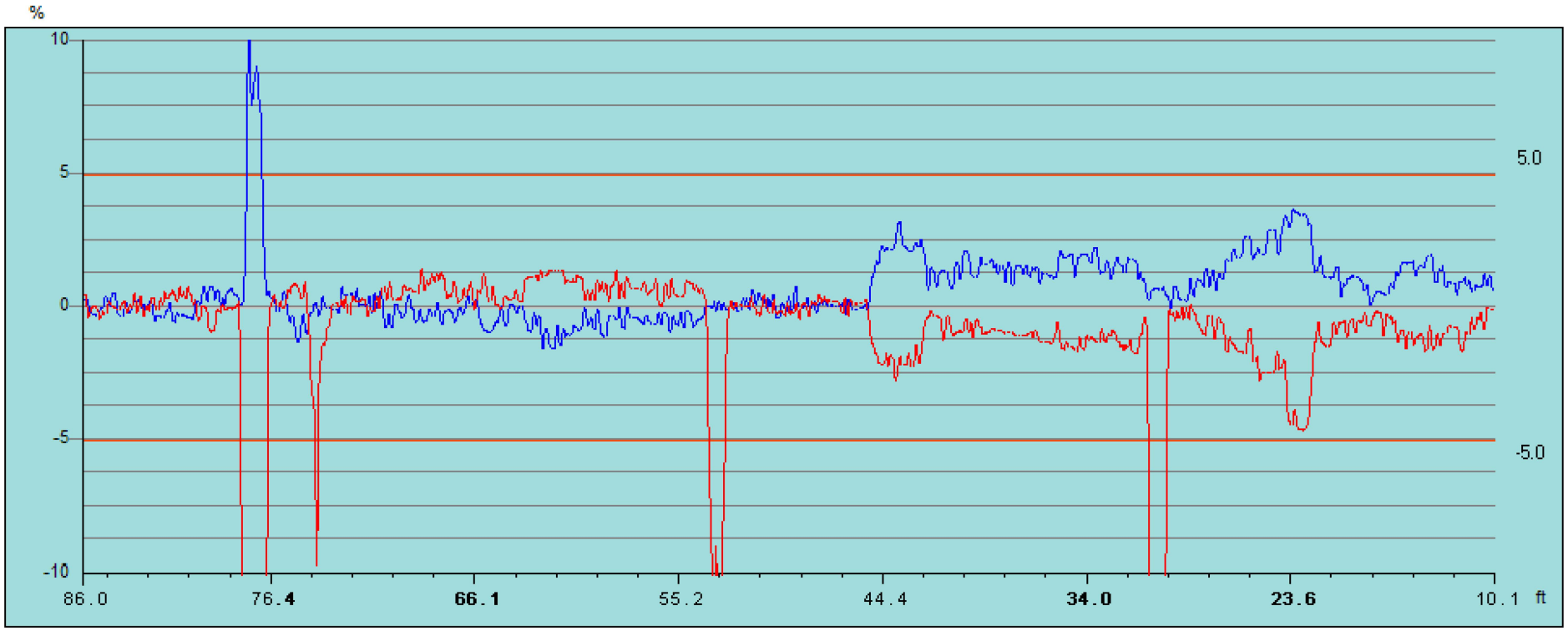
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

Comments

MP 123, I-25, Cross Drain, Center Pipe

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joints

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

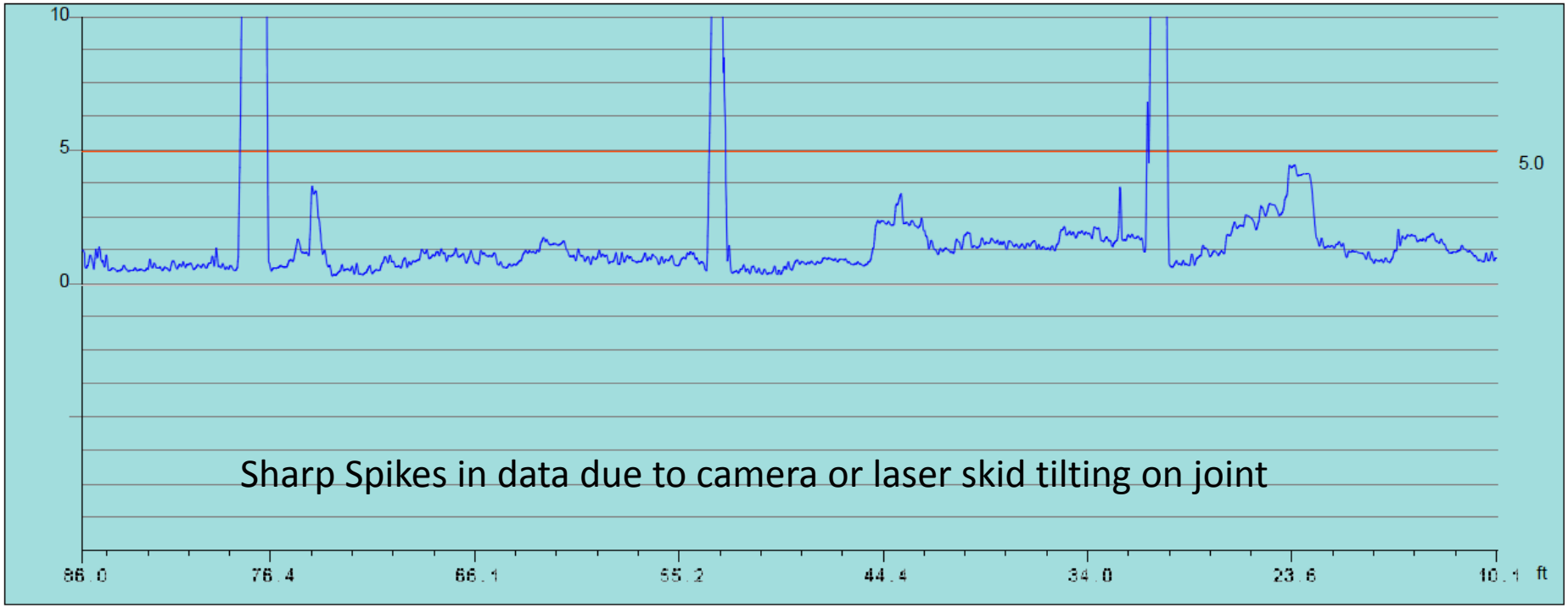
Comments

MP 123, I-25, Cross Drain, Center Pipe

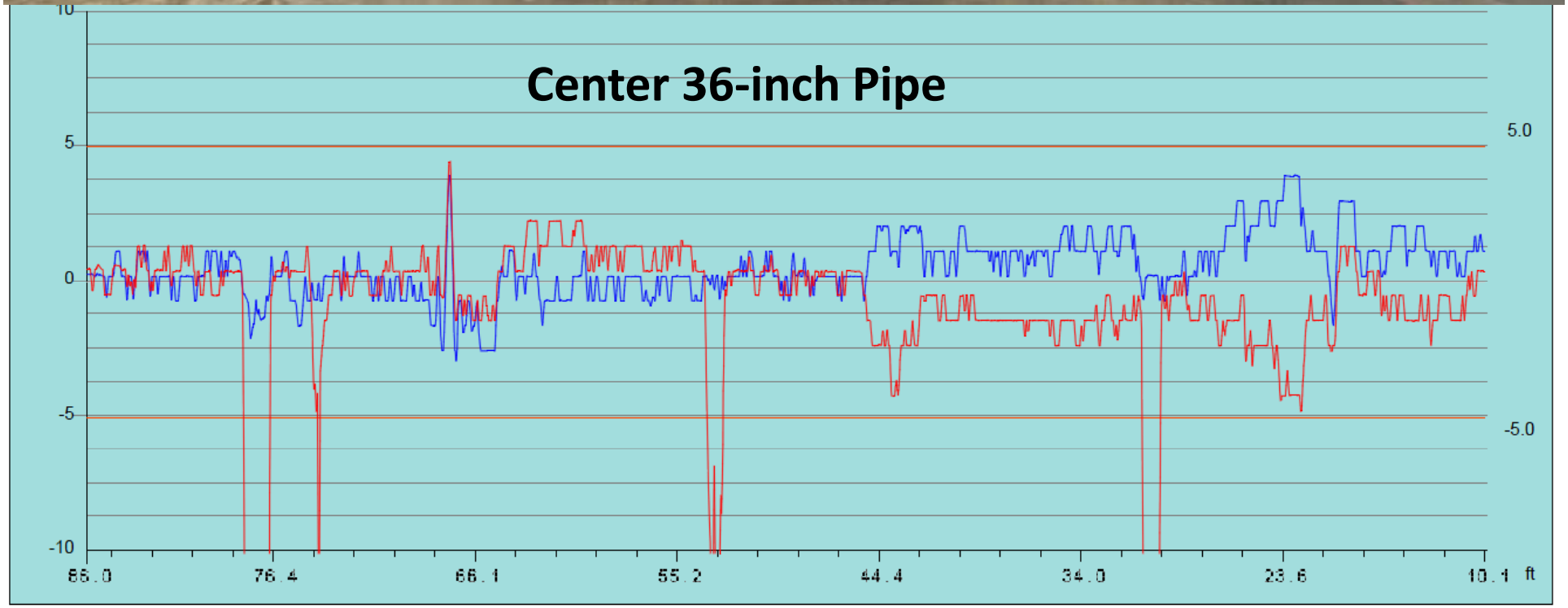
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 2.6%, Exceeded limits: 4.4%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



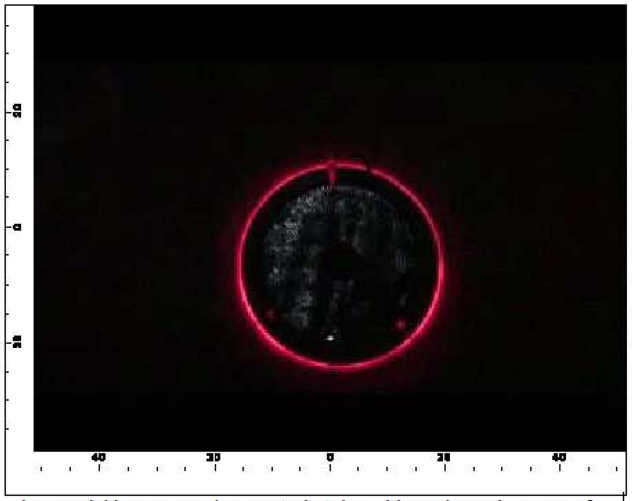

88.0 ft
62.0 ft
22.5 ft


Center 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
88.0
76.4
66.1
55.2
44.4
34.0
23.6
10.1
ft

XY Diameter Observations Report

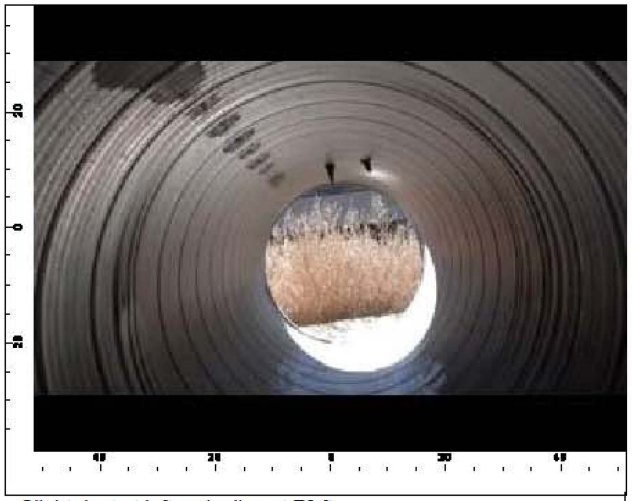
MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

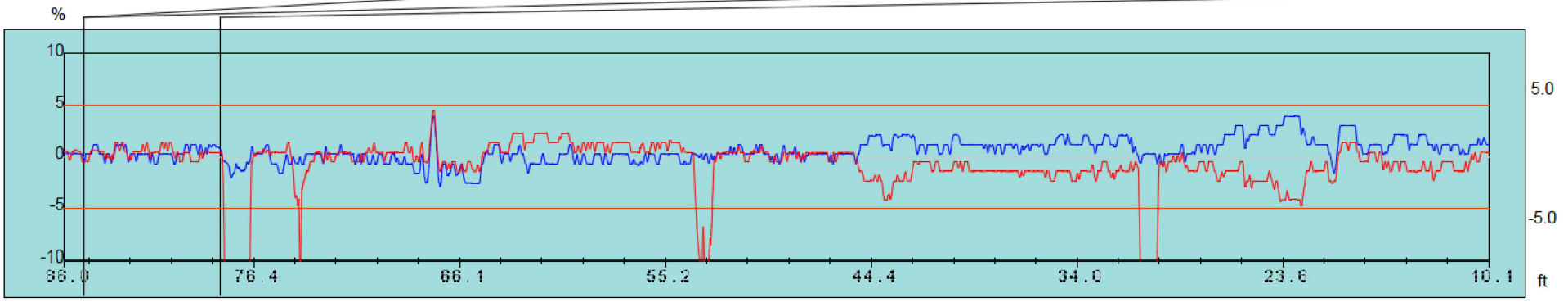


Laser picking up erosion control stakes driven through crown of pipe.

Stakes from erosion control devices.



Slight dent at left springline at 78 ft.

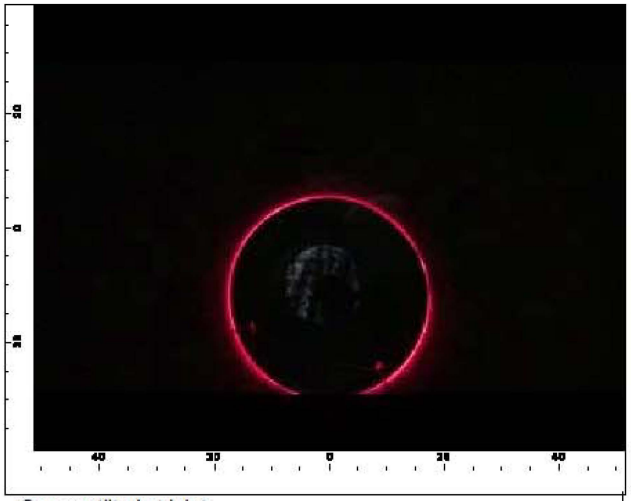


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

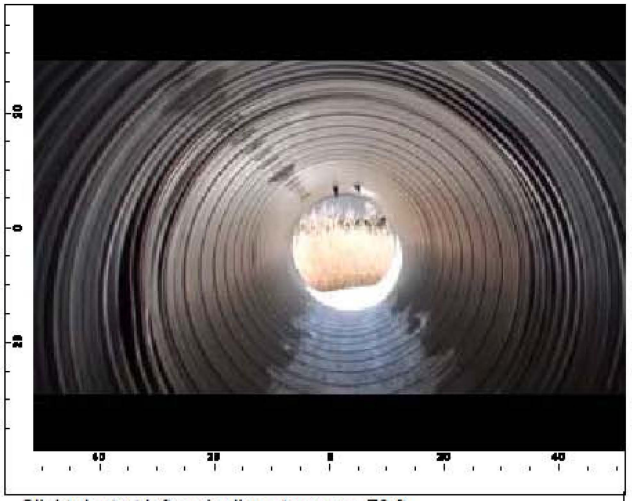
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

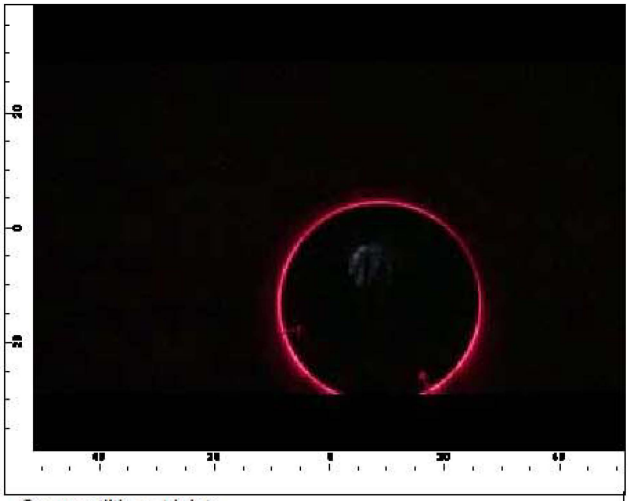
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



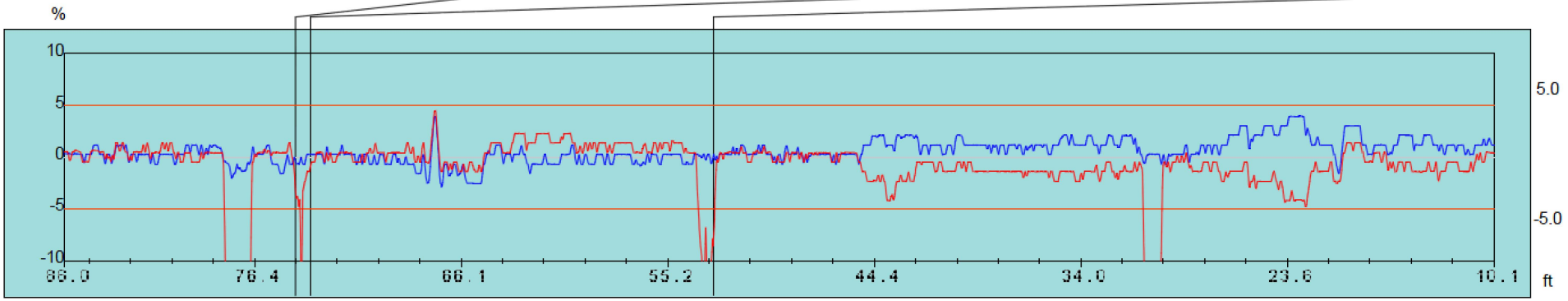
Camera tilted at joint



Slight dent at left springline at approx. 73 ft.



Camera tilting at joint

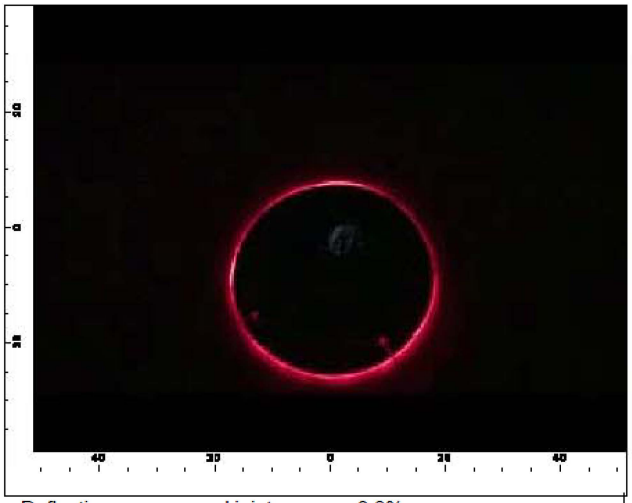


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

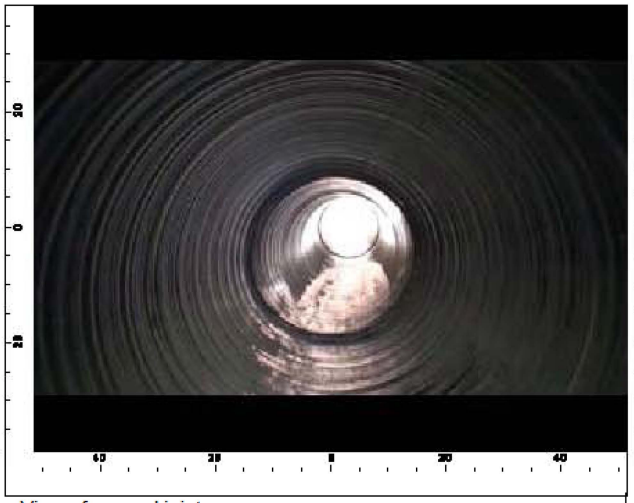
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

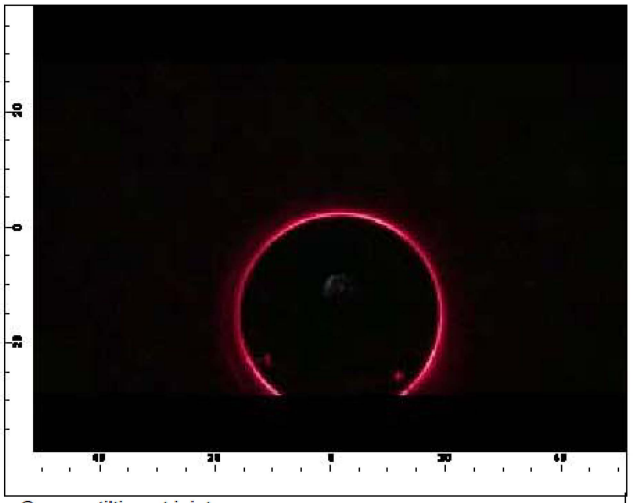
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



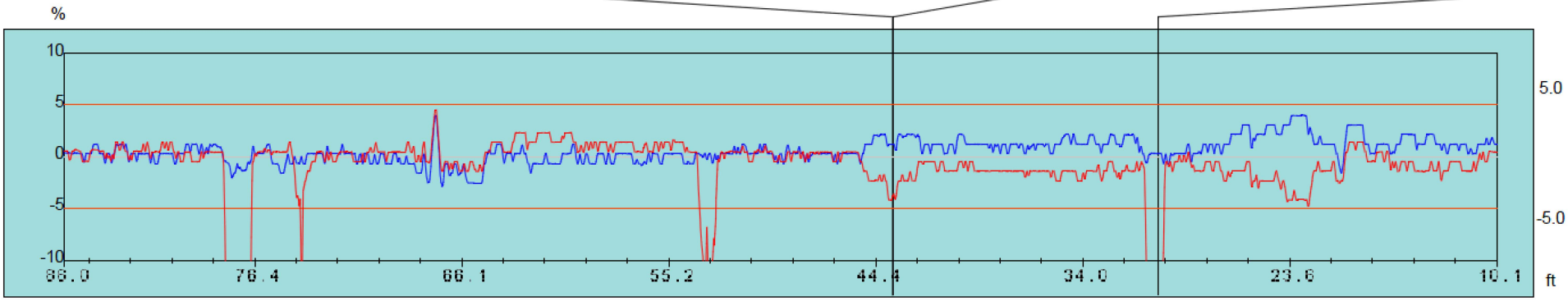
Deflection near second joint, approx. 3.8%.



View of second joint.



Camera tilting at joint

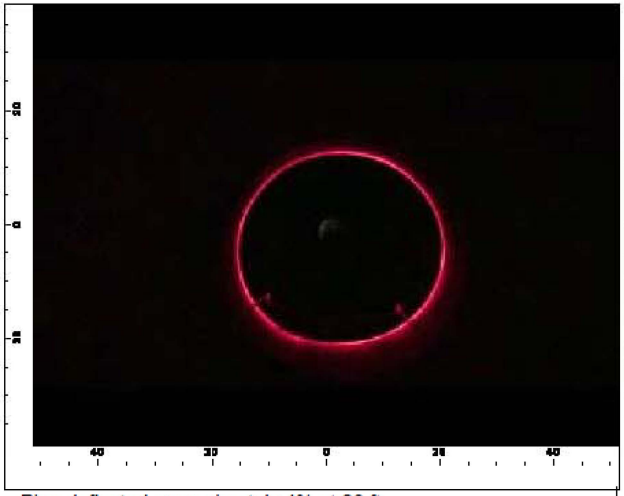


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

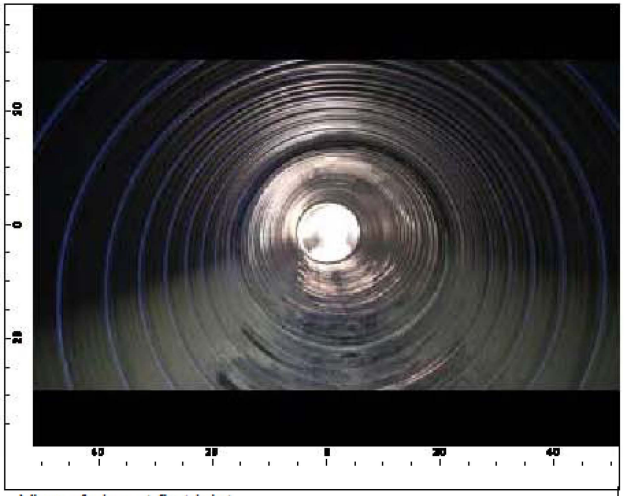
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

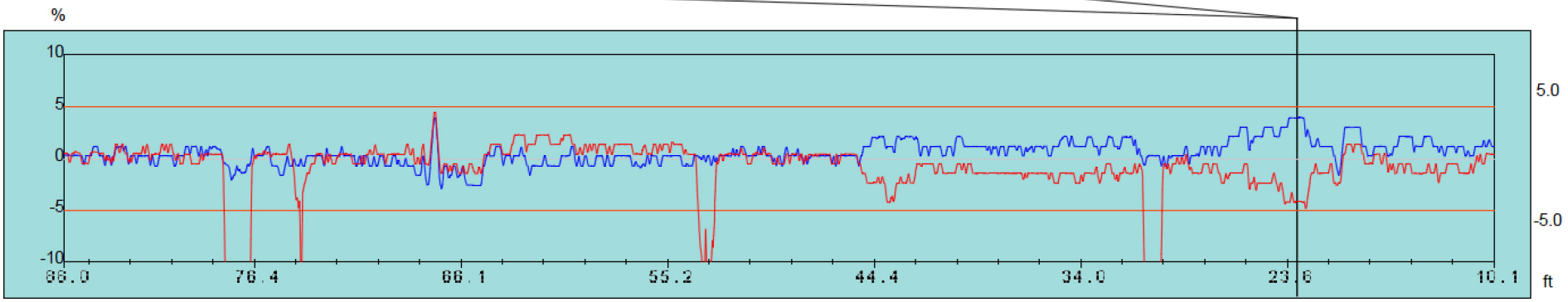
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



Pipe deflected approximately 4% at 23 ft.



View of pipe at first joint.



90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%


MP 123, I-25, 36-Inch DuroMaxx
Southern Pipe

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: Southern Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection Remark: View from outlet

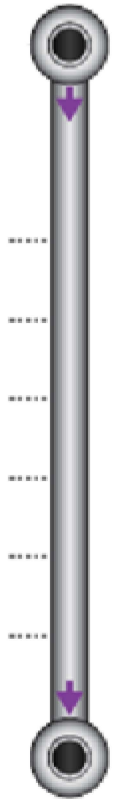
(22.0) GO - General Observation Remark: Joint at 22 ft.

(44.0) GO - General Observation Remark: Joint at 44 ft

(66.0) GO - General Observation Remark: Joint at 66 ft.

(84.0) GO - General Observation Remark: Stake through crown of pipe

(88.0) EI - End Inspection



Total Distance: 0

ID Number: Inlet

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: Southern Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection Remarks: View from outlet	01:47 00:00:00	
22.0	General Observation Remarks: Joint at 22 ft.	2:30:17 00:00:36	
44.0	General Observation Remarks: Joint at 44 ft	2:31:30 00:01:05	

Distance	Fault Observation	Time	Picture
66.0	General Observation Remarks: Joint at 66 ft.	2:32:18 00:01:26	
84.0	General Observation Remarks: Stake through crown of pipe	2:33:18 00:01:54	
88.0	End Inspection	2:33:47 00:02:01	

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

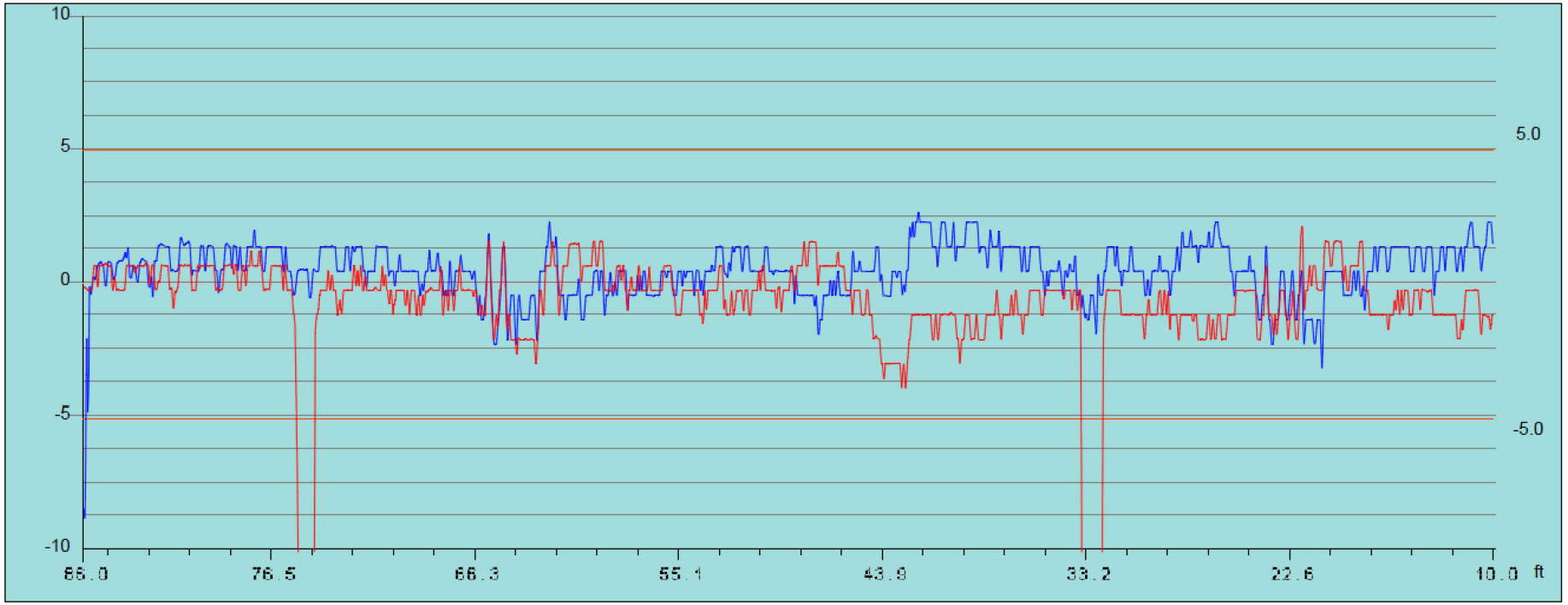
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%



XY Deflection Summary Report

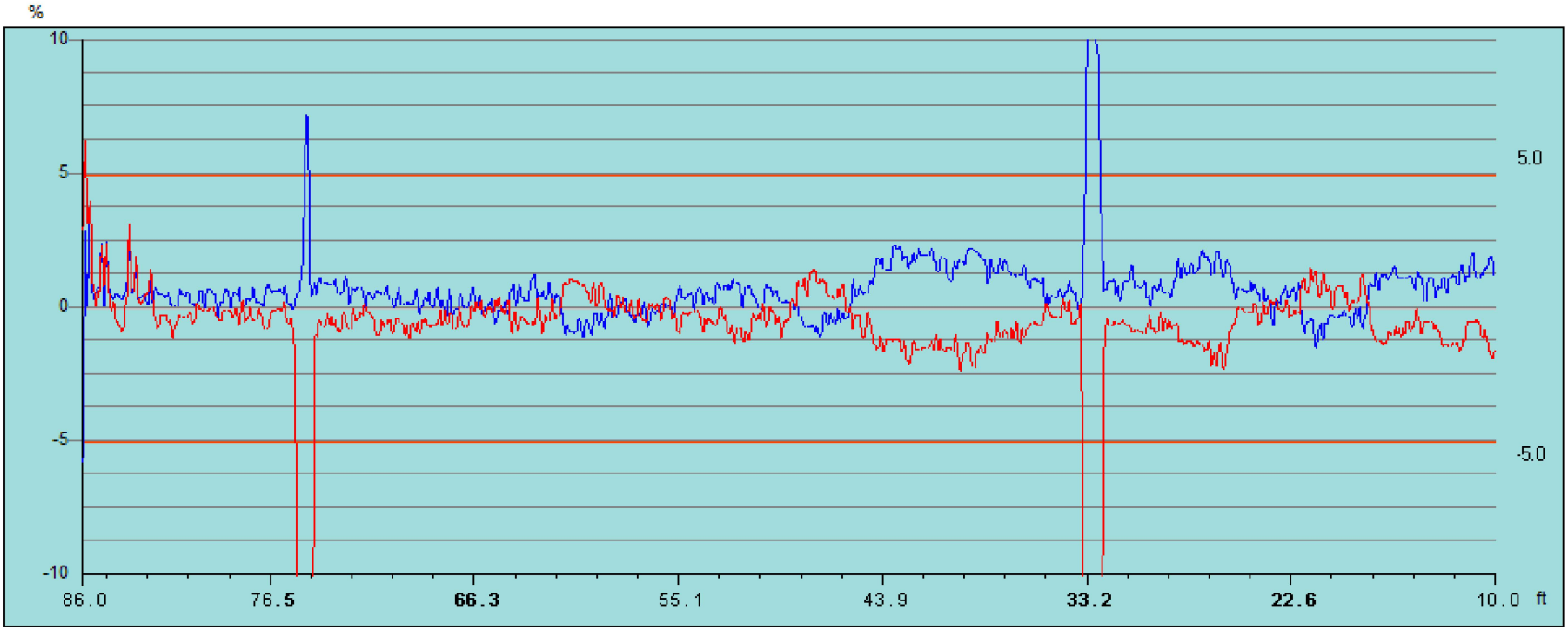
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joint

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

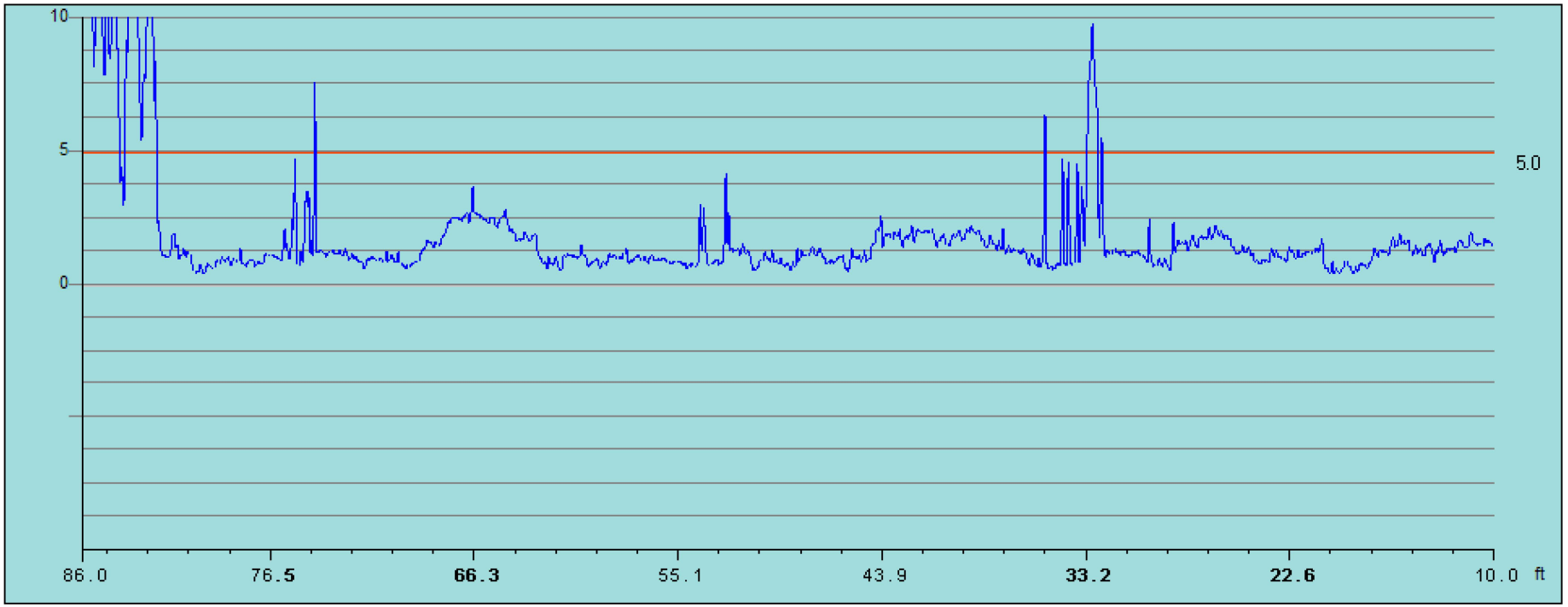
Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

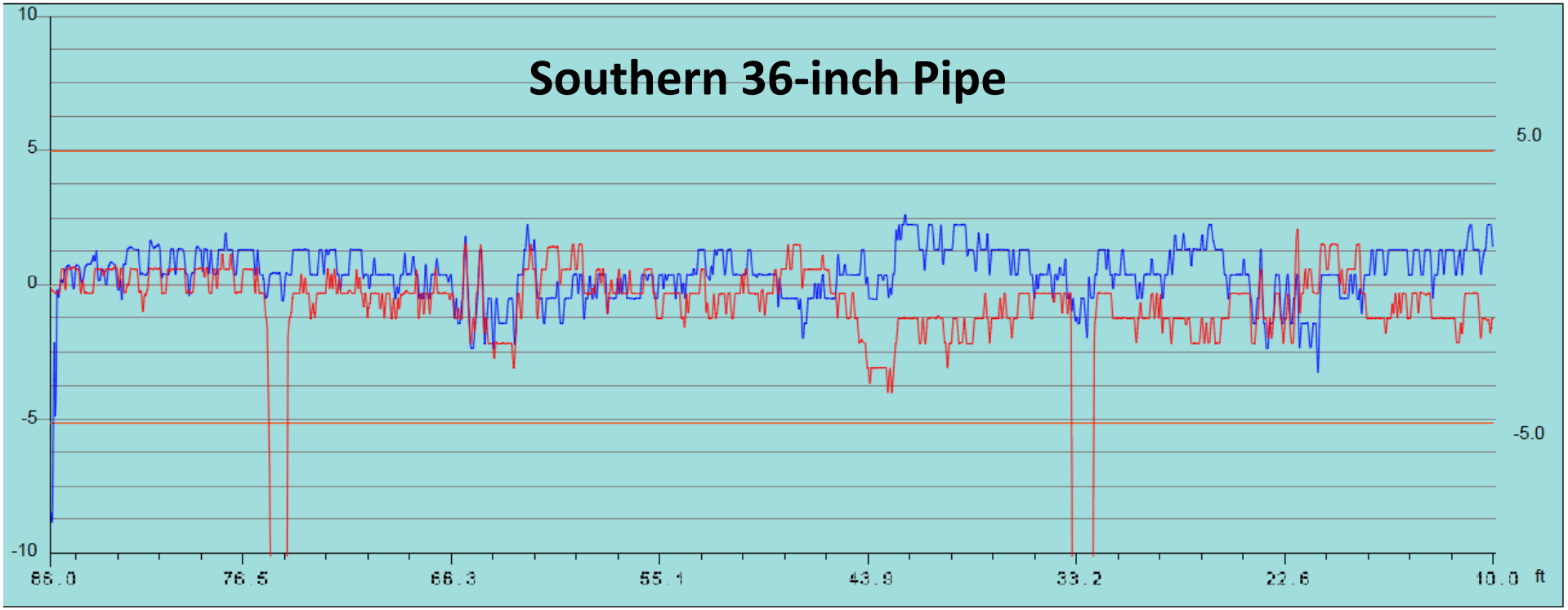
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 2.6%, Exceeded limits: 5.6%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



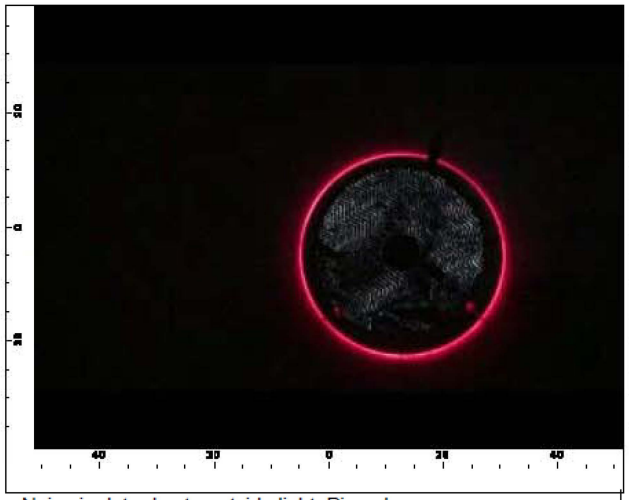

88.0 ft
62.0 ft
22.5 ft


Southern 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
86.0
76.5
66.3
55.1
43.9
33.2
22.6
10.0
ft

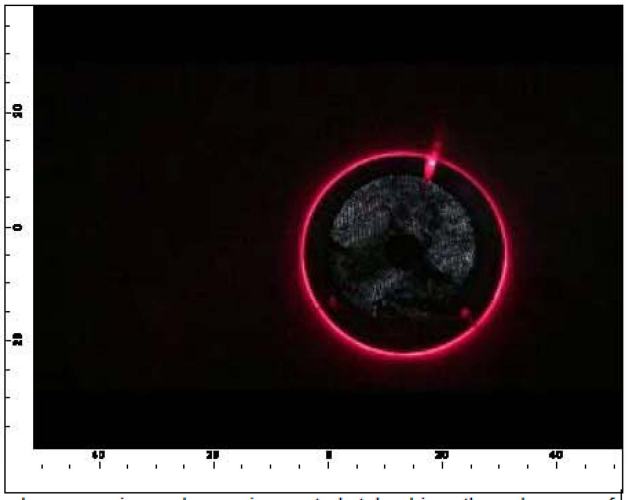
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

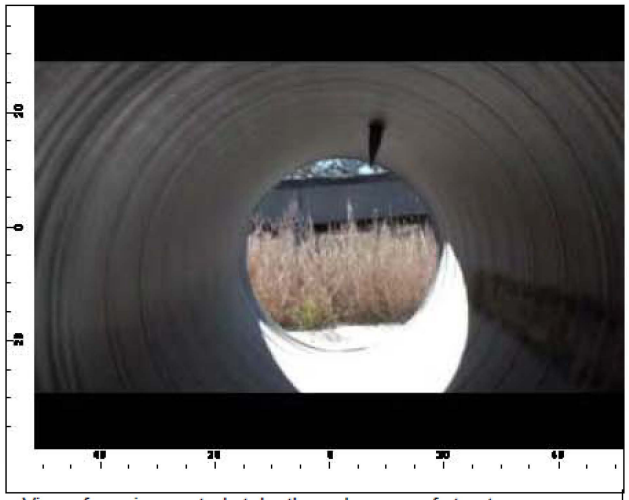
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



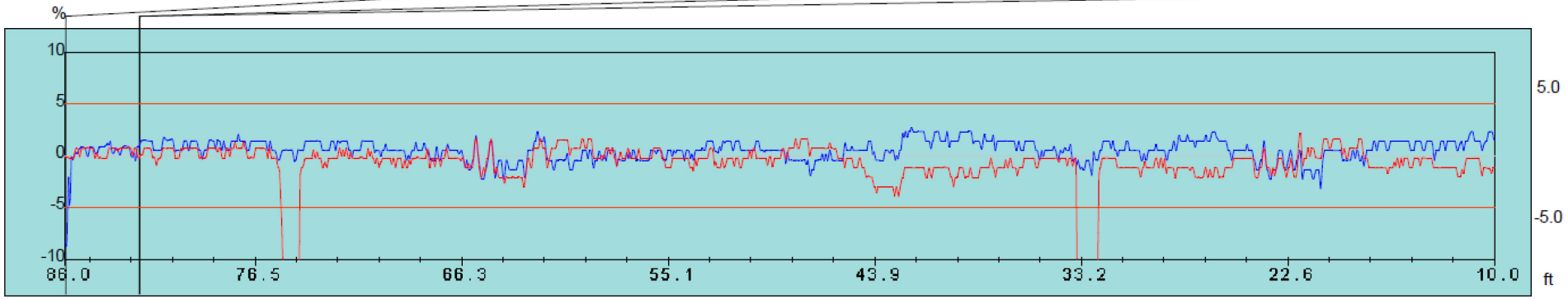
Noise in data due to outside light. Pipe okay.



Laser passing under erosion control stake driven through crown of pipe.



View of erosion control stake through crown of structure.

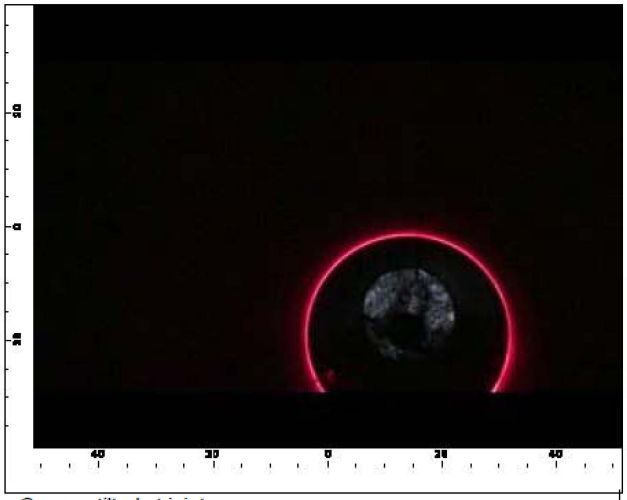


90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%

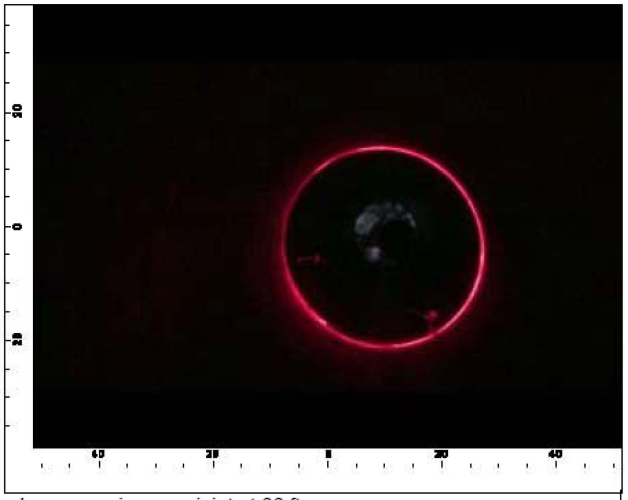
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

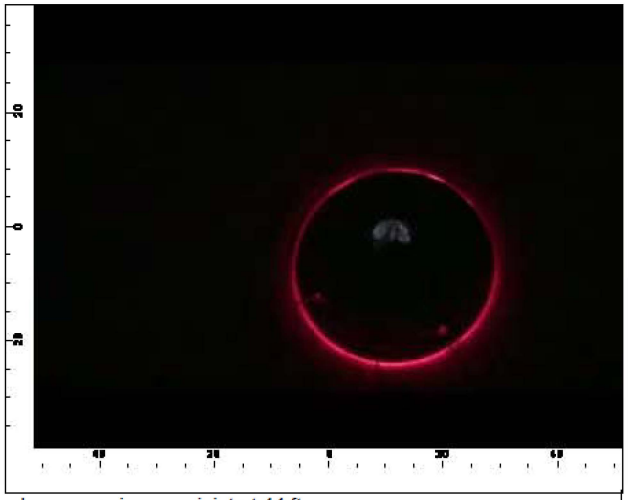
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



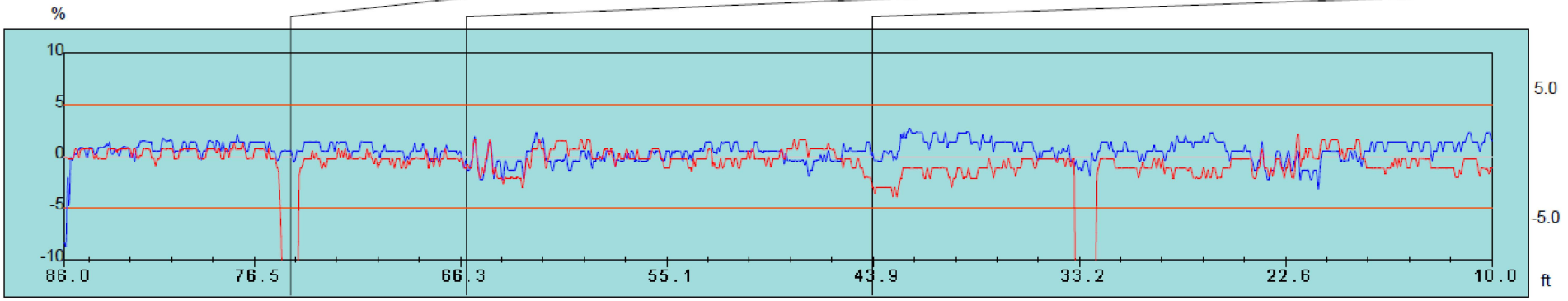
Camera tilted at joint



Laser passing over joint at 66 ft.



Laser passing over joint at 44 ft.

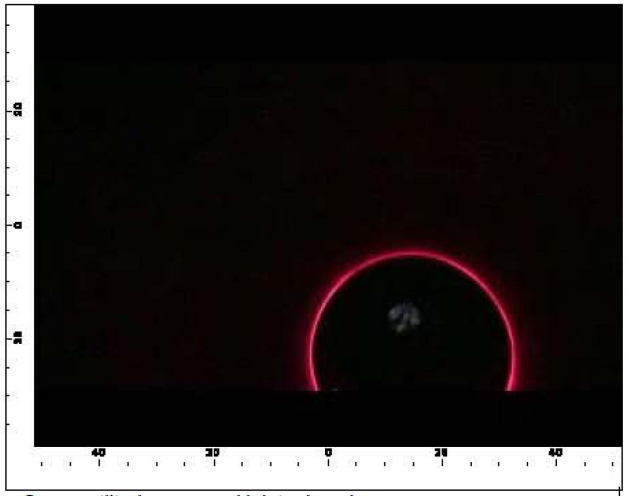


90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%

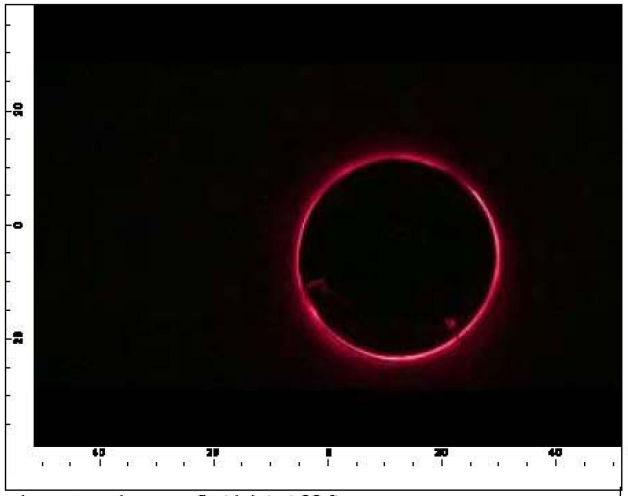
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

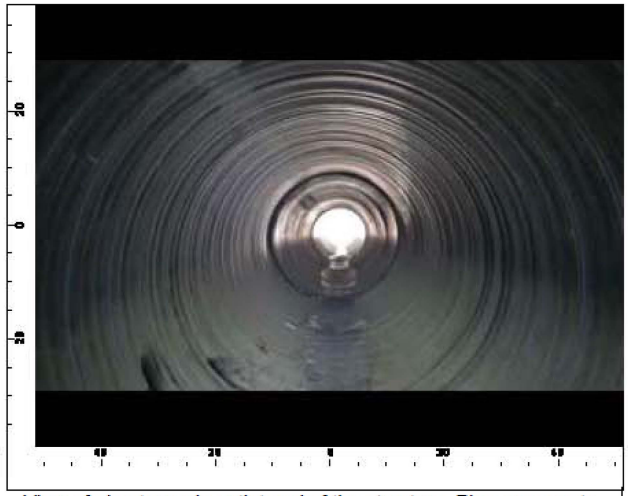
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



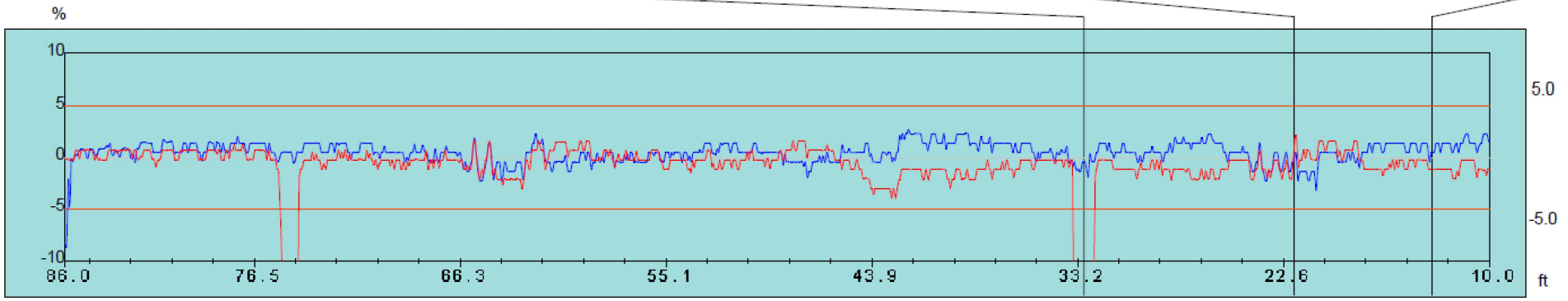
Camera tilted on second joint, pipe okay.



Laser passing over first joint at 22 ft.



View of pipe towards outlet end of the structure. Pipe appears to be round and uniform.



90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%


MP 122.5, I-25, 48-Inch DuroMaxx

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122.5
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection

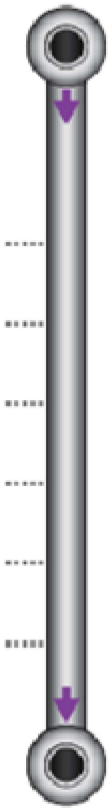
(22.0) GO - General Observation Remark: View of first joint at approx 22 ft.

(44.0) GO - General Observation Remark: View of second joint at approx. 44 ft.

(66.0) GO - General Observation Remark: View of third joint at approx. 66 ft.

(88.0) GO - General Observation Remark: View of fourth joint at approx. 88 ft.

(102.0) EI - End Inspection

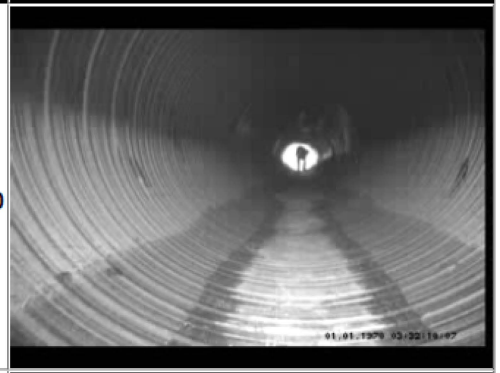
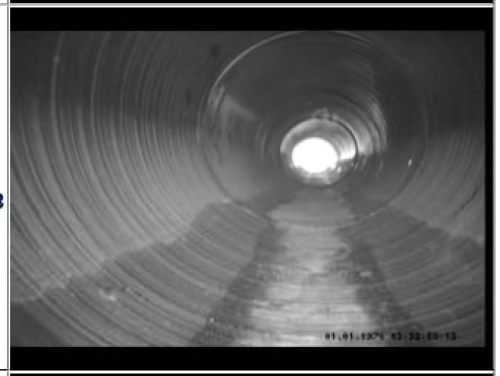


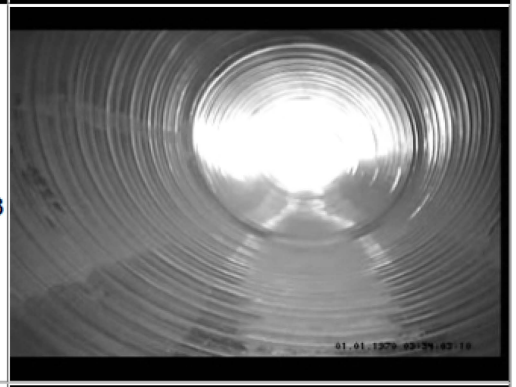
Total Distance: 0

ID Number: Inlet

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch
Pipe ID: MP 122.5
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection	04:18 00:00:00	
22.0	General Observation Remarks: View of first joint at approx 22 ft.	06:09 00:00:48	
44.0	General Observation Remarks: View of second joint at approx. 44 ft.	07:51 00:01:24	

Distance	Fault Observation	Time	Picture
66.0	General Observation Remarks: View of third joint at approx. 66 ft.	10:39 00:01:53	
88.0	General Observation Remarks: View of fourth joint at approx. 88 ft.	11:51 00:02:27	
102.0	End Inspection	13:12 00:03:15	

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

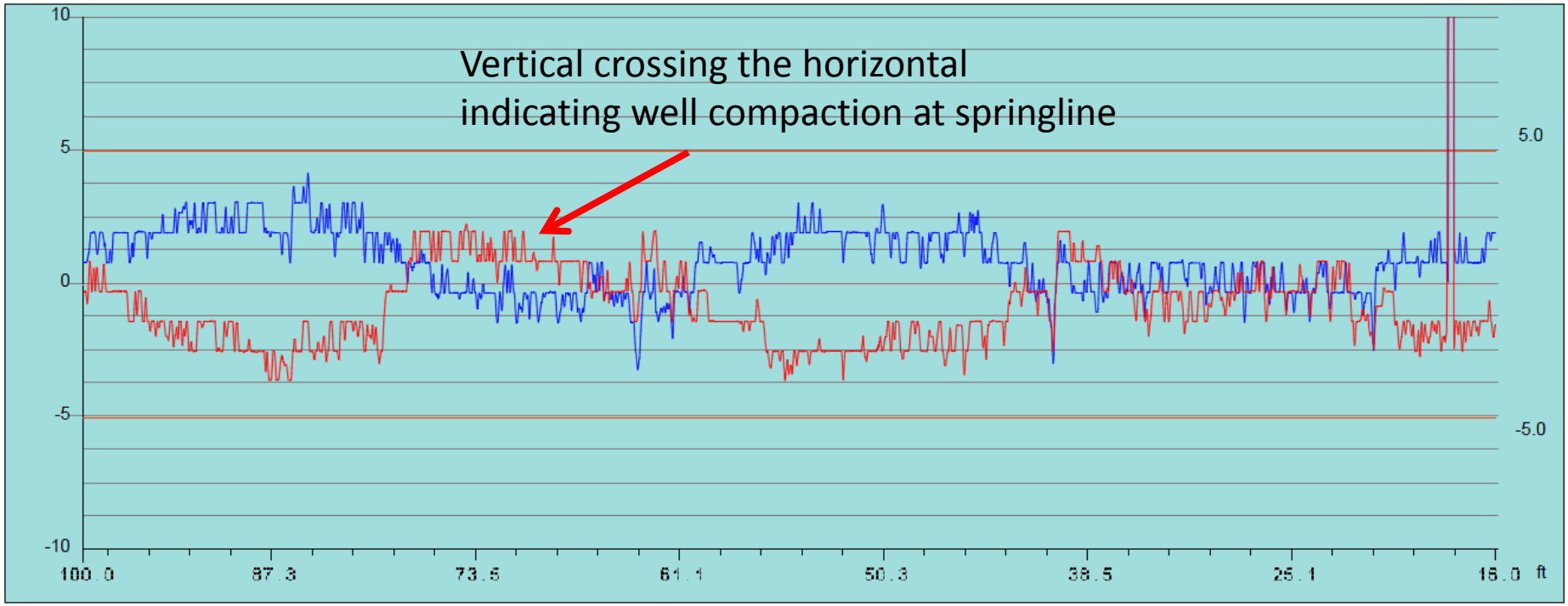
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

Comments

I-25, MP 122.5, 48-inch DuroMaxx

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.2% : (Y) 0.9%, Exceeded limits: 0.3%



XY Deflection Summary Report

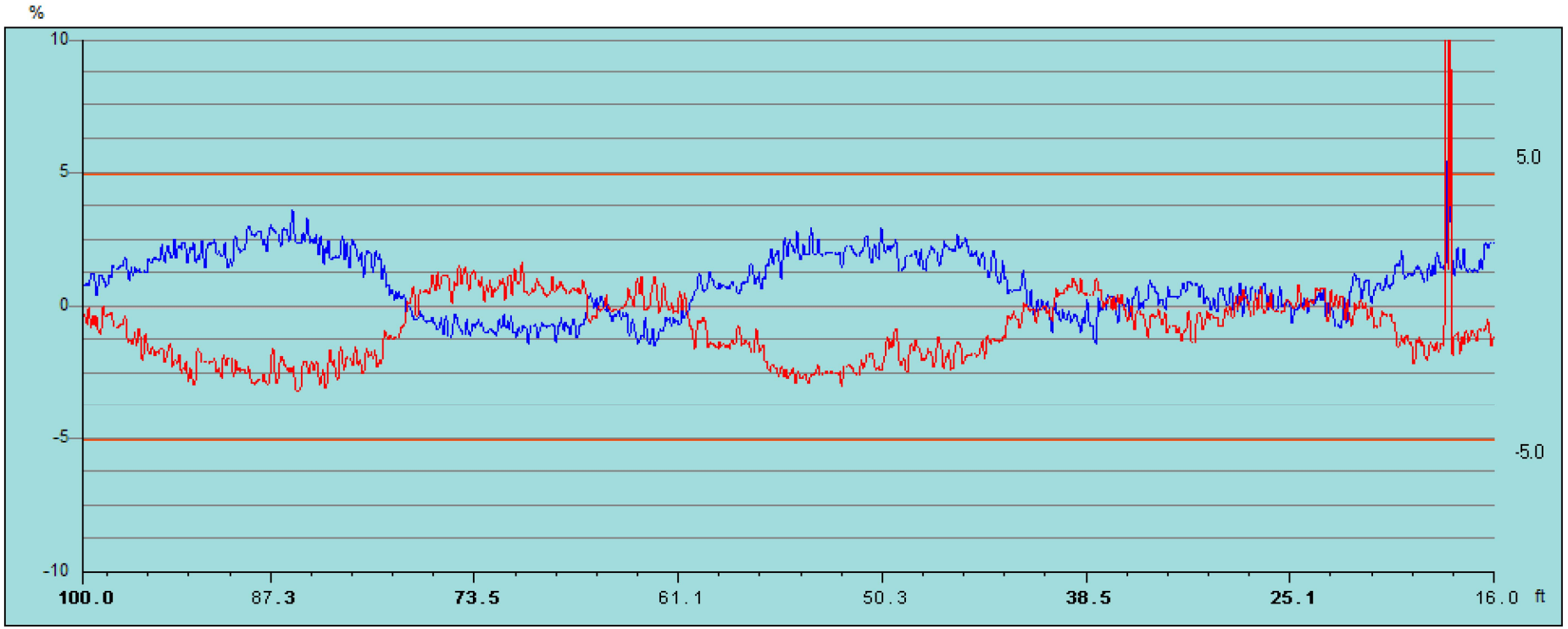
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

Comments

I-25, MP 122.5, 48-inch DuroMaxx

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joint

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

Comments

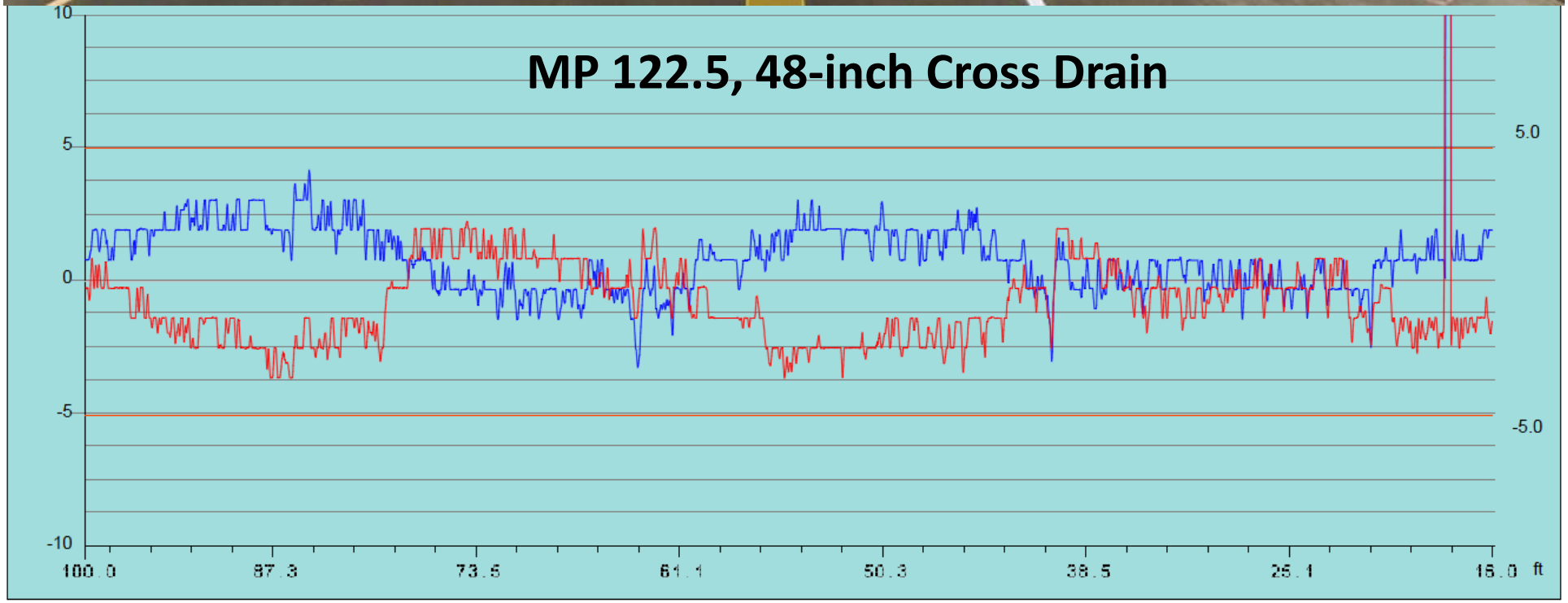
I-25, MP 122.5, 48-inch DuroMaxx

Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 3.2%, Exceeded limits: 0.3%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance

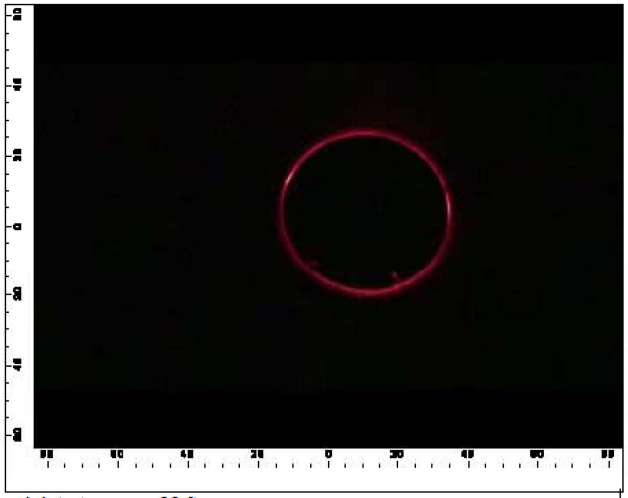

74 ft
33 ft


MP 122.5, 48-inch Cross Drain
10
5
0
-5
-10
5.0
-5.0
100.0
87.3
73.5
61.1
50.3
38.5
25.1
13.0
ft

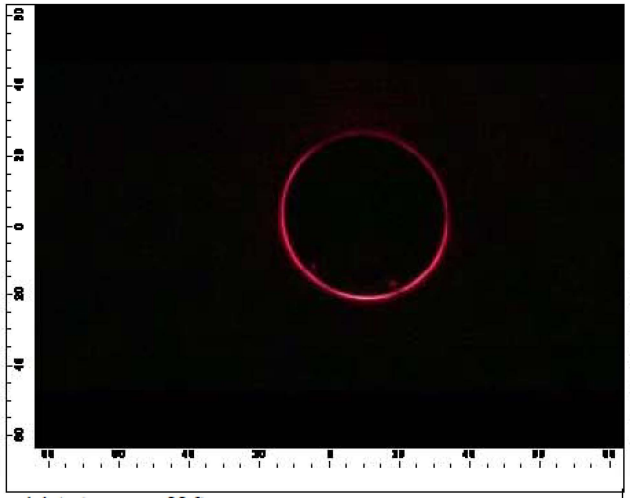
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

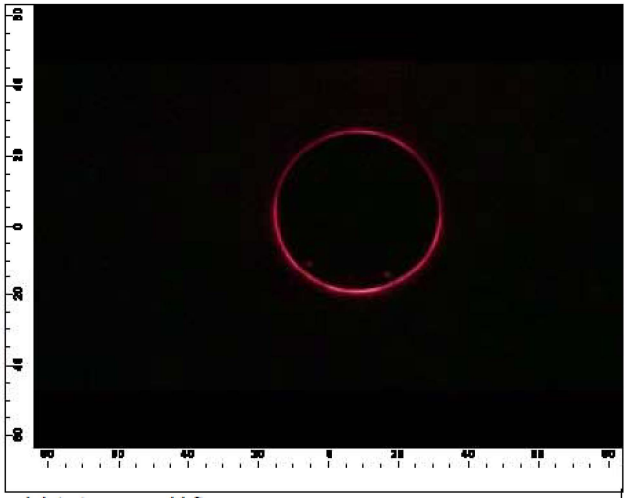
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



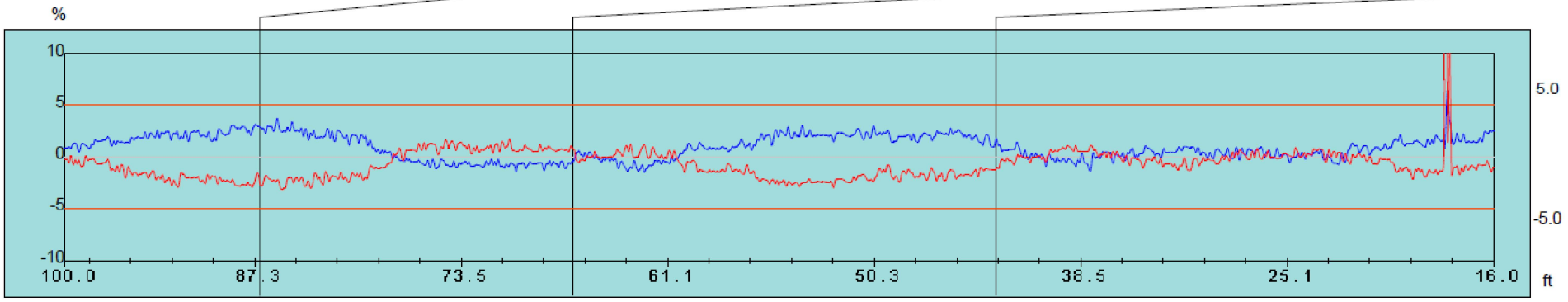
Joint at approx 88 ft.



Joint at approx. 66 ft.



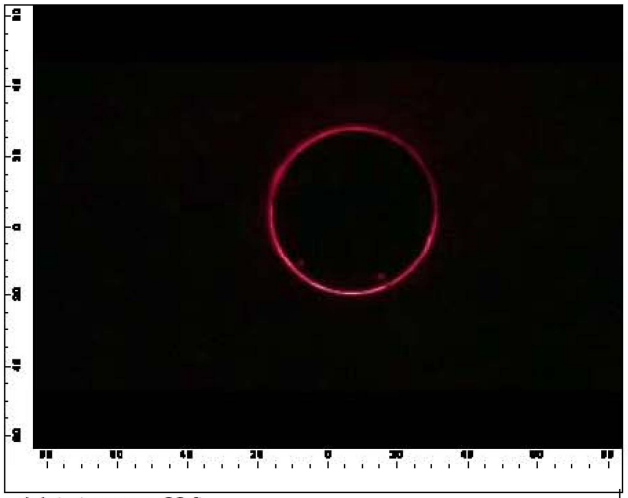
Joint at approx. 44 ft.



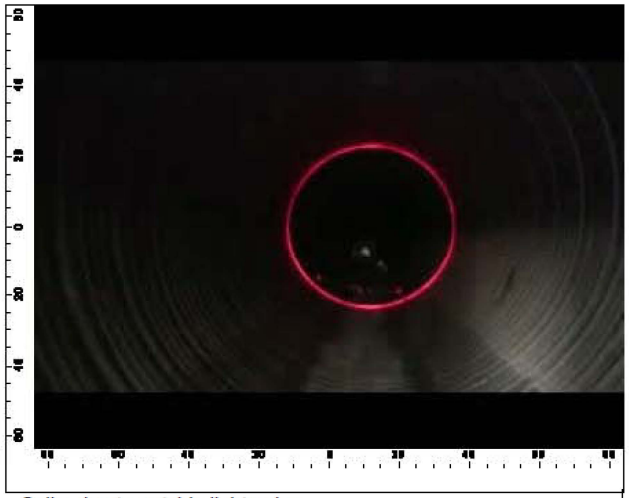
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

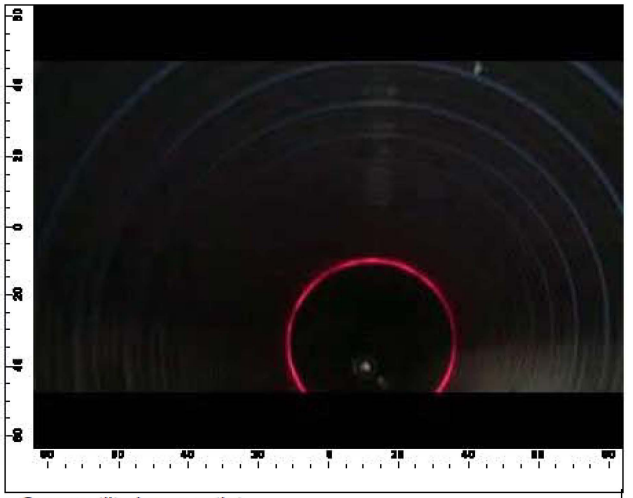
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



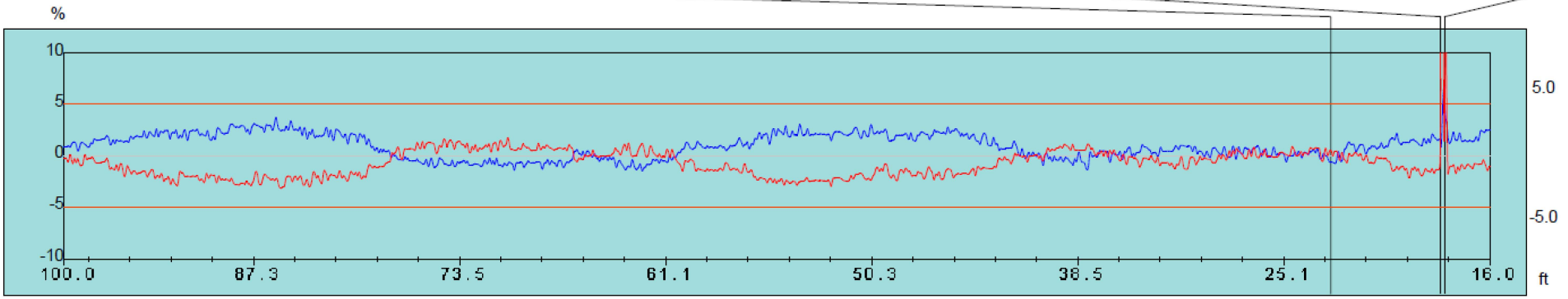
Joint at approx. 22 ft.



Spike due to outside light noise.



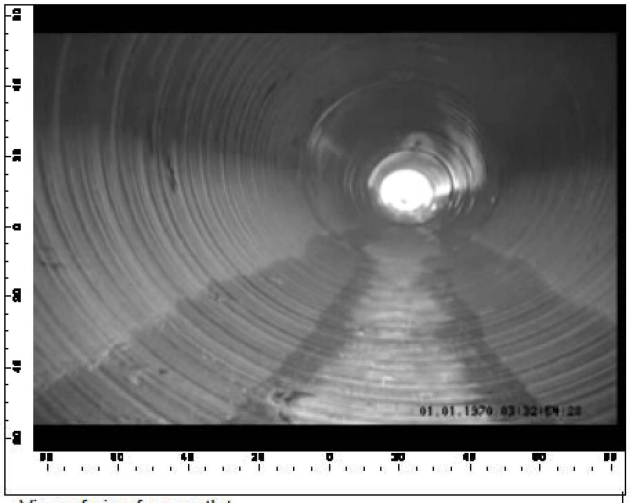
Camera tilted near outlet



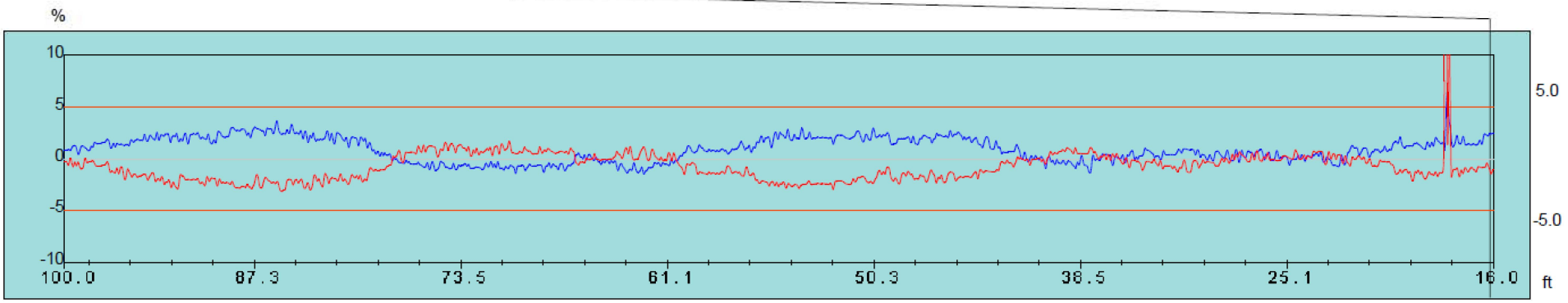
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



View of pipe from outlet

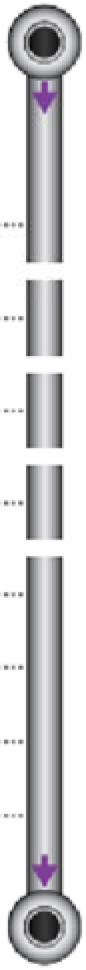



MP 122, I-25, 48-Inch DuroMaxx

Project Name: I-25, Fountain, Colorado

Date:
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx



ID Number: Outlet

(2.0) SI - Start Inspection

(8.0) GO - General Observation Remark: Pipe slightly racked, small puncture at crown from stake at 10 ft.

(26.0) GO - General Observation Remark: View of joint at 26 ft.

(46.0) GO - General Observation Remark: View of joint at 46 ft. Slight hump at right haunch.

(56.0) GO - General Observation Remark: Slight dent in invert at 56 ft.

(70.0) GO - General Observation Remark: View of joint at 70 ft.

(90.0) GO - General Observation Remark: Pipe slight racked in right crown.

(103.0) EI - End Inspection Remark: End inspection, view of laser skid at inlet.

Total Distance: 0

ID Number: Inlet

Project Name: I-25, Fountain, Colorado

Date:
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection	43 00:00:00	
8.0	General Observation Remarks: Pipe slightly racked, small puncture at crown from stake at 10 ft.	02:30 00:00:43	
26.0	General Observation Remarks: View of joint at 26 ft.	12:08 00:01:27	

Distance	Fault Observation	Time	Picture
46.0	General Observation Remarks: View of joint at 46 ft. Slight hump at right haunch.	14:40 00:02:17	
56.0	General Observation Remarks: Slight dent in invert at 56 ft.	16:11 00:02:33	
70.0	General Observation Remarks: View of joint at 70 ft.	17:18 00:03:03	

Distance	Fault Observation	Time	Picture
90.0	General Observation Remarks: Pipe slight racked in right crown.	18:41 00:03:48	
103.0	End Inspection Remarks: End inspection, view of laser skid at inlet.	21:21 00:04:14	

XY Diameter Summary Report

Pipe under 5% deflection in horizontal and vertical deflection plot

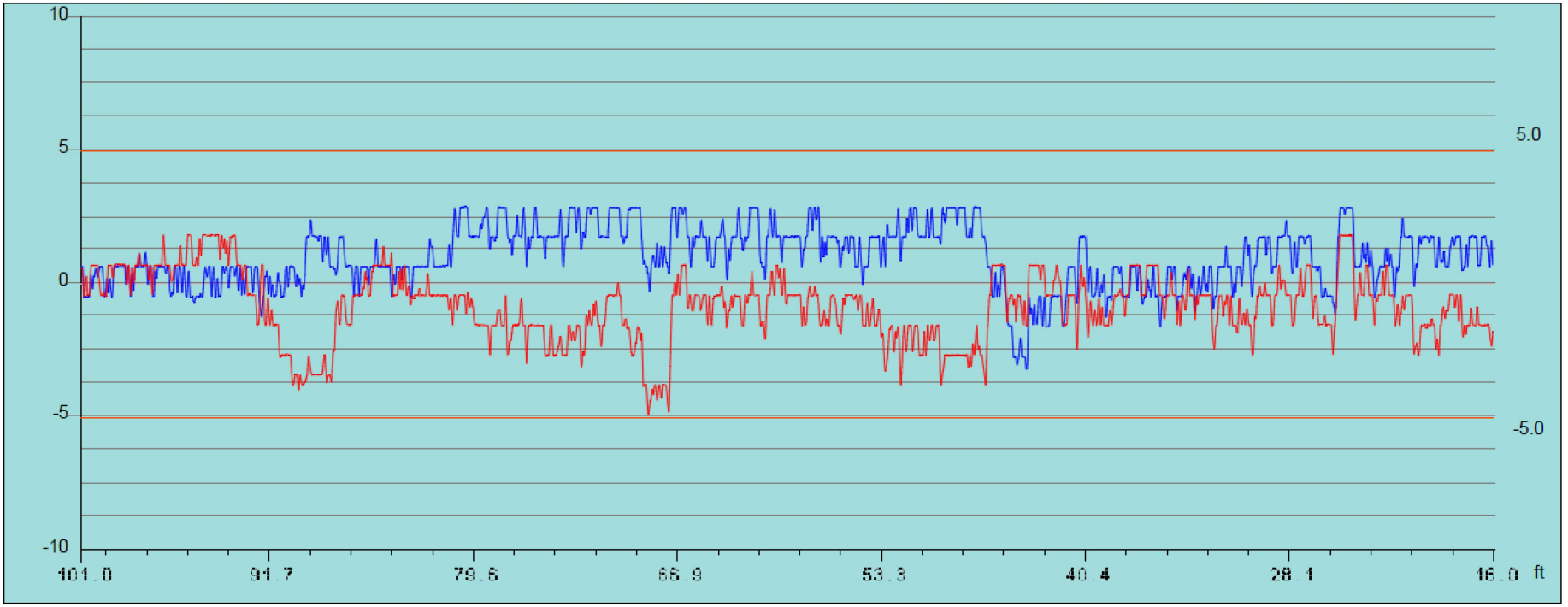
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%



XY Deflection Summary Report

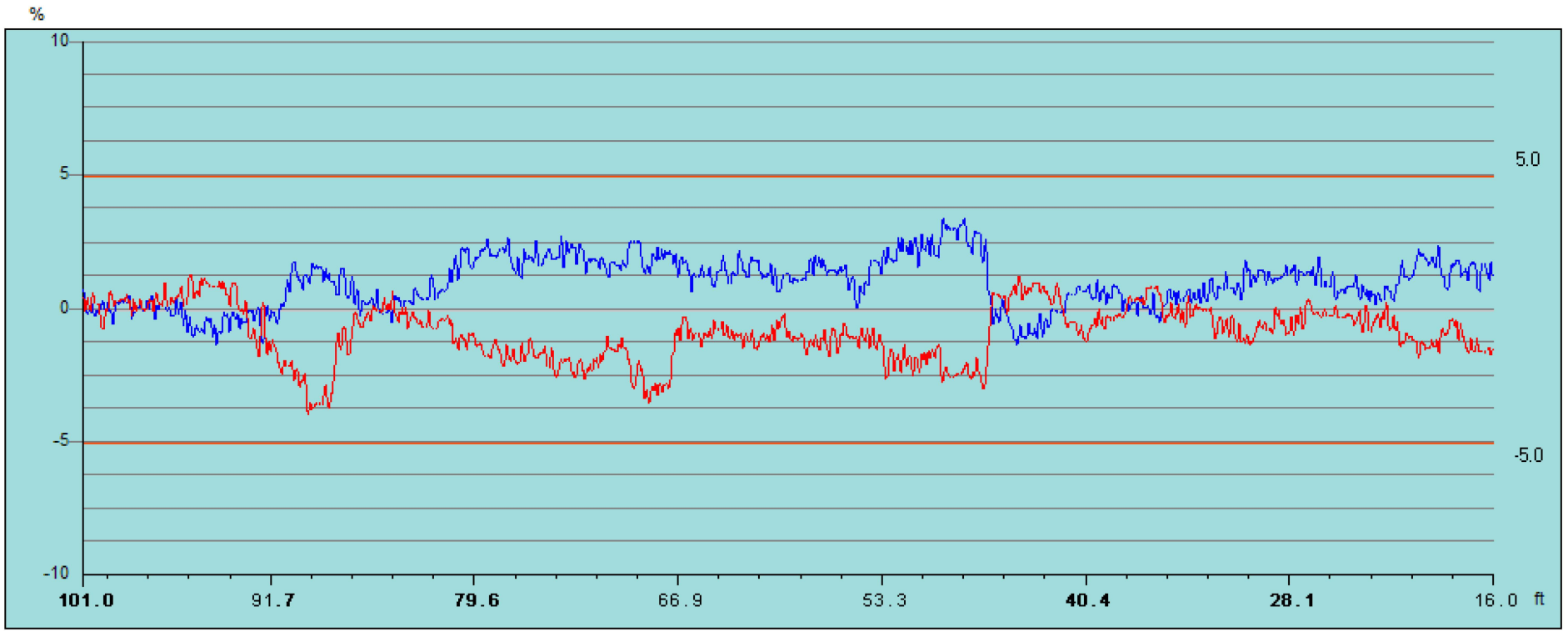
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality slightly over 5% at 90 ft. Spike due to camera tilting at joint.

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

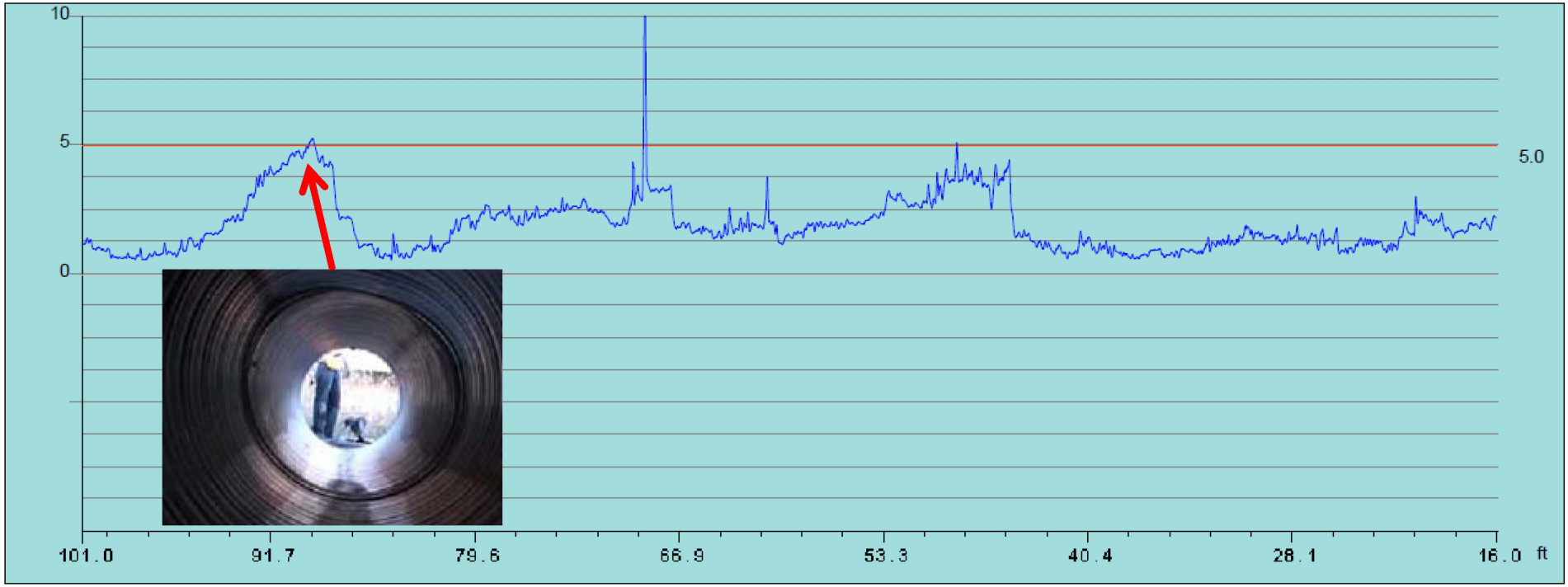
Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

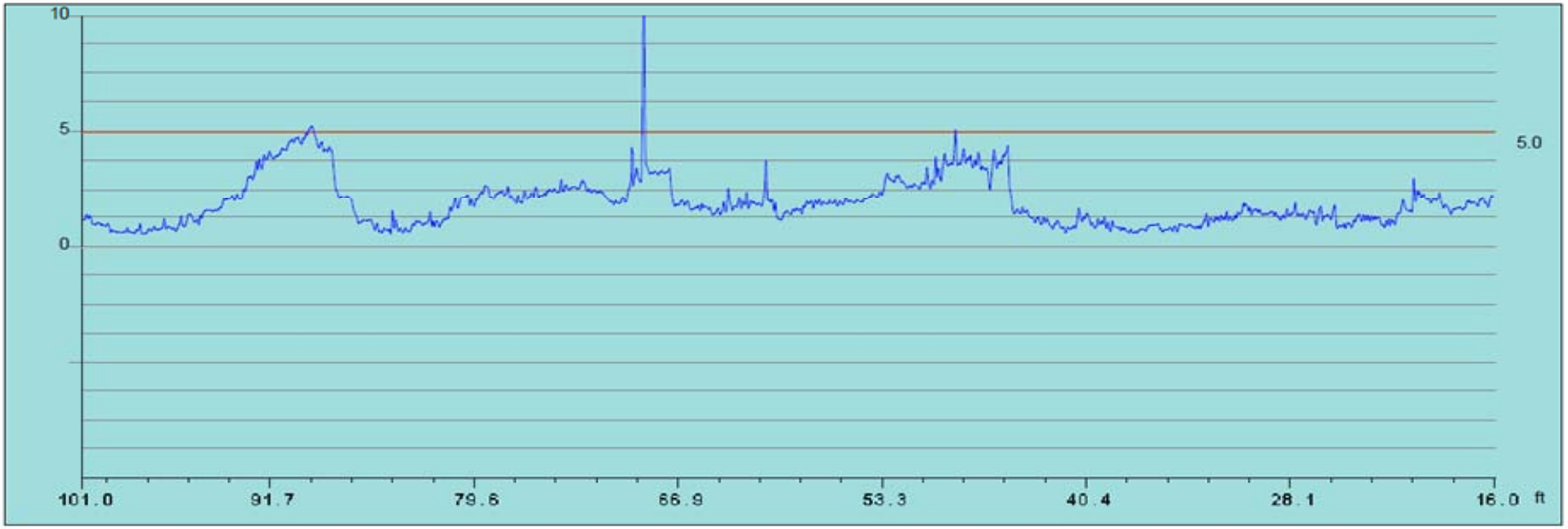
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 3.5%, Exceeded limits: 0.8%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



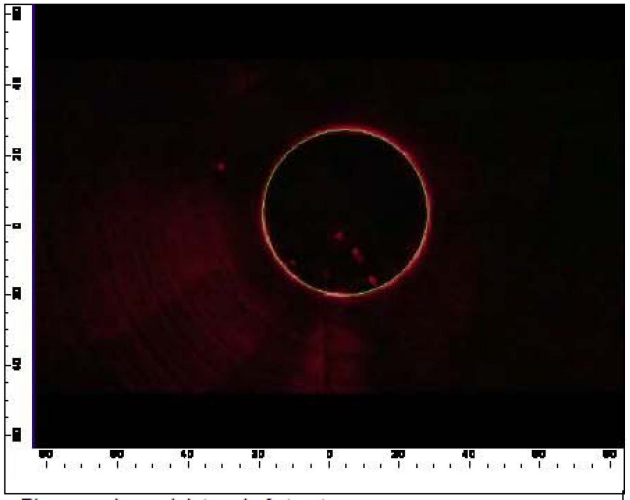

79 ft
34 ft


10
5
0
5.0
101.0
91.7
79.6
66.9
53.3
40.4
28.1
16.0
ft

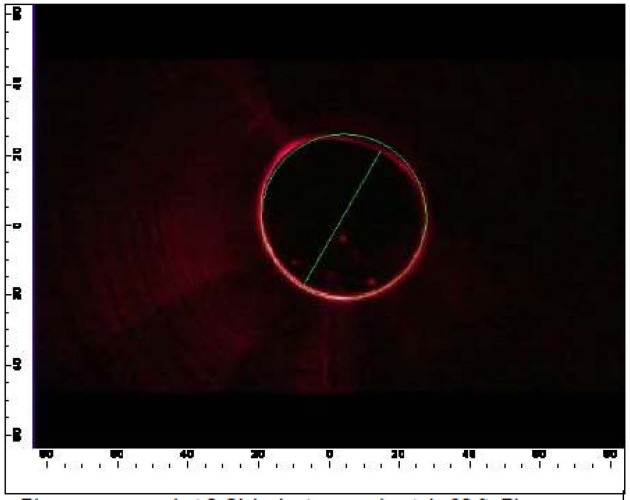
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

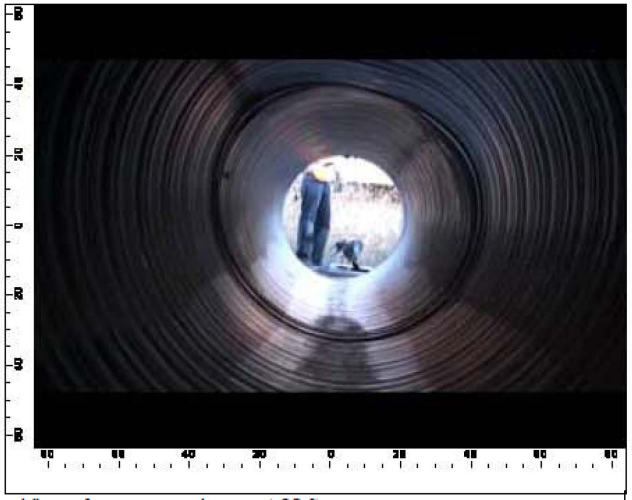
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in



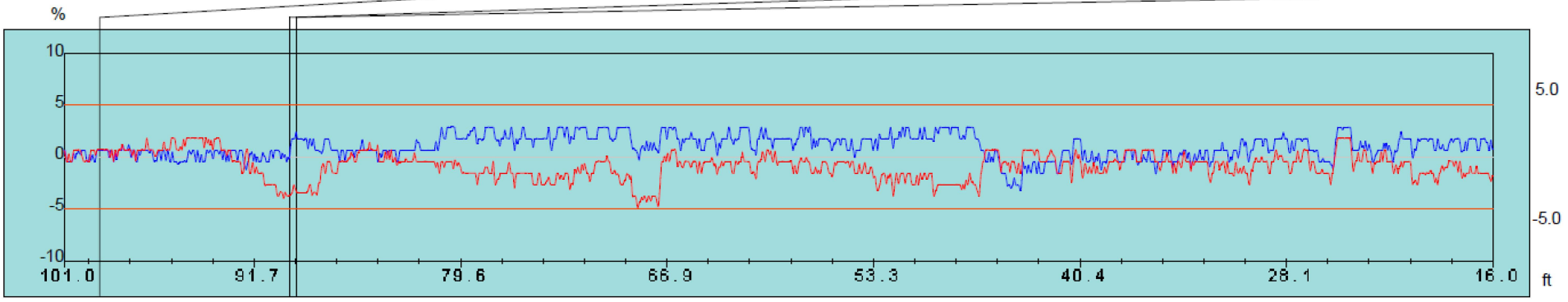
Pipe round near inlet end of structure.



Pipe compressed at 2 O'clock at approximately 90 ft. Pipe deflected approximately 5.3%.



View of compressed area at 90 ft.

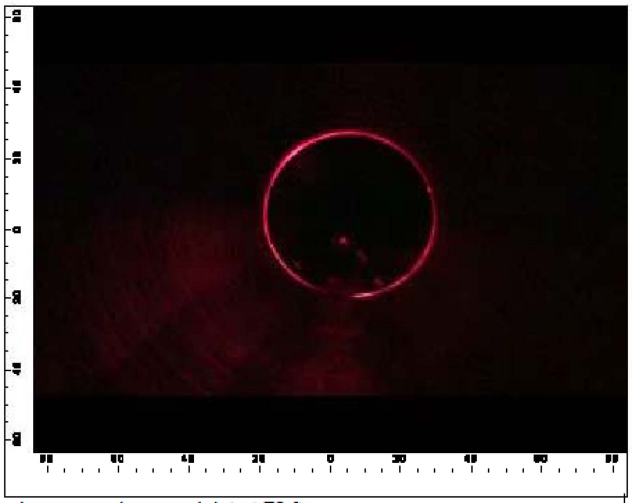


90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

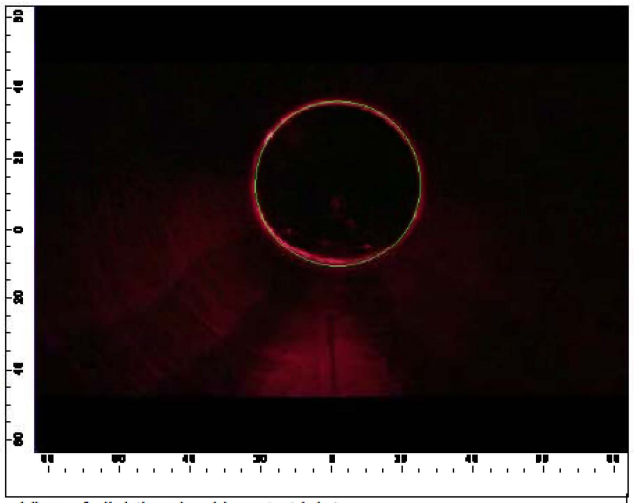
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

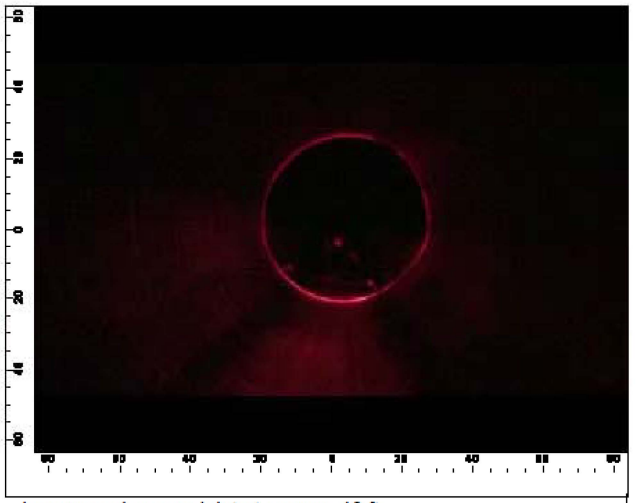
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in



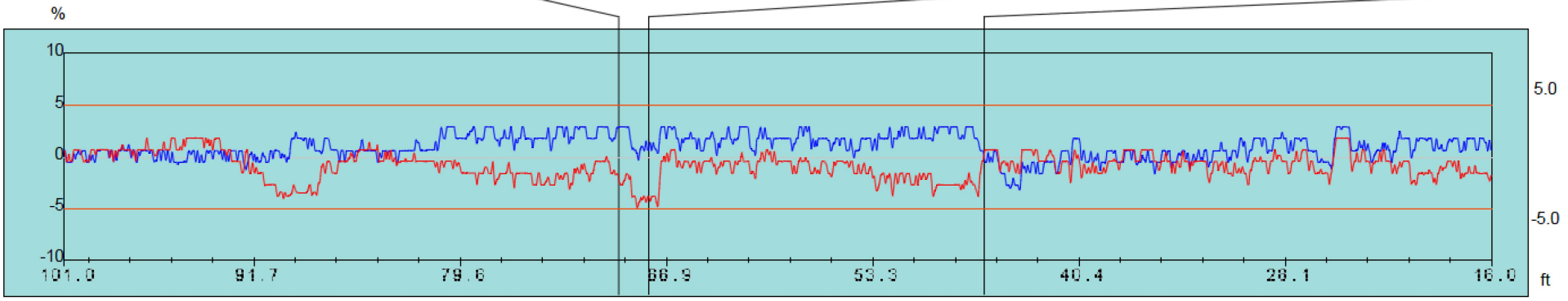
Laser passing over joint at 70 ft.



View of slightly raised invert at joint.



Laser passing over joint at approx. 46 ft.

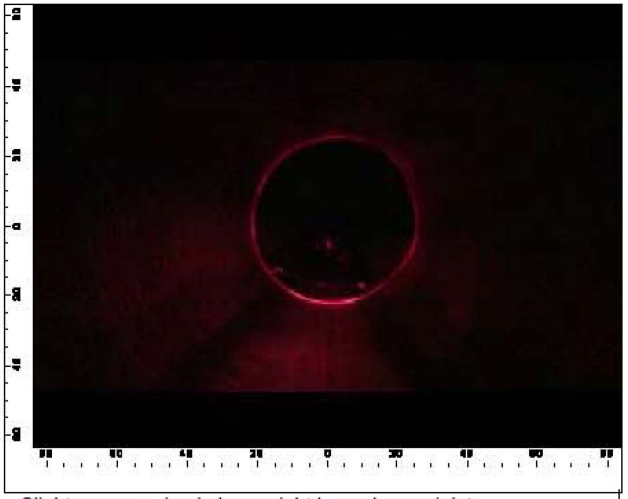


90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

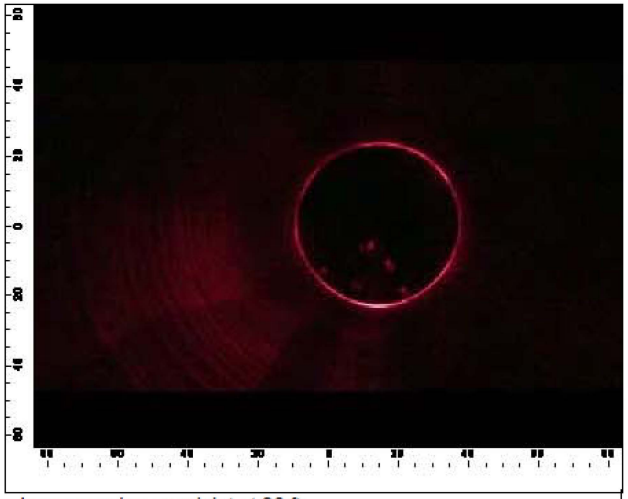
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

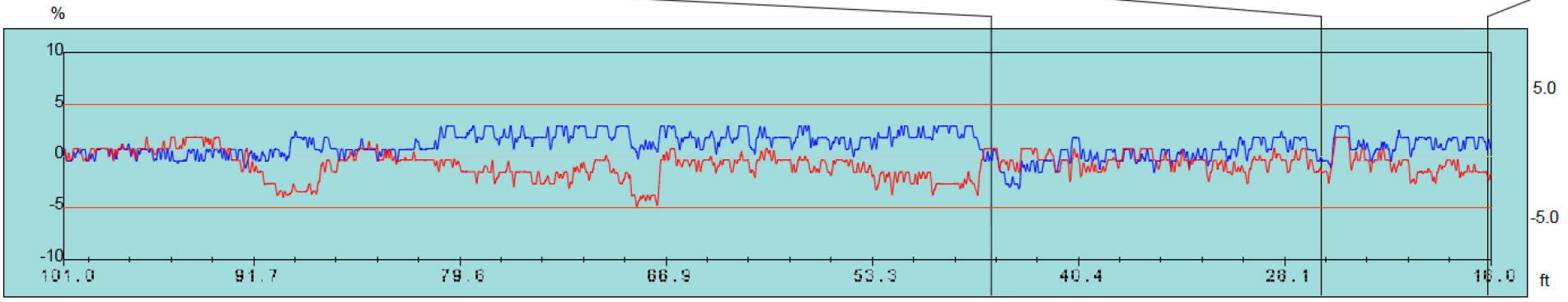


Slight compression in lower right haunch near joint.



Laser passing over joint at 26 ft.

View from outlet end, pipe slight racked near outlet end not caught by laser.



90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

APPENDIX II – FOUNTAIN COLORADO, DUROMAXX LASER PROFILE INSPECTION, I-25, MP 122, MP 122.5, AND MP 123 (2016)

LEO JOHN FLECKENSTEIN

Fountain Colorado
3 Year Performance Comparison
DuroMaxx Laser Profile Inspection1
I-25, MP 122, MP 122.5, and MP 123

September 30, 2013 vs December 5, 2016
(Draft Report December 16, 2016)

By

Leo John Fleckenstein

Hydrau-Tech, Inc,
And
Colorado DOT

Project Summary: A total of 5 pipes were video and laser profiled on September 30, 2013 and December 5, 2016. (A manual inspection was conducted on three additional pipes during the 2016 inspection. In 2013 a straight line/non pan and tilt portable camera unit was utilized for the inspection. In 2016 a robotic pan and tilt camera was utilized. (Images below)

Project Summary Continued: Joints were noted and observed during the both inspections. Joint separation was minor to moderate with no significant distress or soil migration observed. Some minor racking, dents, and sags were also noted. Limited construction information was available. Several of the structures have limited cover. In 2013 minor post construction damage was noted towards the ends of several of the structures as straw wattles were placed over the pipe ends and wooden stakes driven through the crown of the pipes. The stakes do not appear to causing any structural issues with the performance of the pipes. In 2016 severe damage was noted at the inlet end in two of the three pipes located at milepost 123. Apparently due to vehicle damage. In 2013 four of the five pipes were under 5% deflection for their full length. One pipe had a small localized area where pipe deflection was measured at 5.3% near the end of the structure. The non-uniform nature of the deflection and the fact that the deflected area is outside of the paved roadway would suggest that this deformation occurred during the installation process. The first 10 to 16 ft of the pipes near the outlet end of the structures could not be laser profiled due to the distance between the camera and the laser. Since the 2013 three out of the 5 pipes are showing some slight increase in deflection.

Location: Fountain Colorado
Route: I-25
Pipe Use: Culvert/Cross Drain

Date Inspected: 9/30/13 (Red indicating potential changes in deflection since 2013).

Deflection data was gathered at a frame rate of approximately 1 frame per every 0.1 ft. With 180 measurements taken per frame of video. Total readings per pipe section ranged from approximately 712,000 to 770,000.

Location	Date	Pipe Type	Pipe Size	Distance (ft)	Start ID	End ID	Deflection (2.5%)	Deflection (5%)	Observations
MP 123, Northern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection less than 2.5%, slight dent in left springline, wooden stake driven through crown near inlet end. No significant change in deflection since 2013.
MP 123, Center Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	92% of readings below 2.5%	100% of readings below 5%, .	Max deflection approximately 4% at 23 ft, small dent at left springline at 73 ftl, wooden stakes driven through crown of pipe near inlet end. Deflection at 5% in 2016.
MP 123, Southern Pipe	9/30/2013	DuroMaxx	36-inch	88	Outlet	Inlet	100% of readings below 2.5%		Max deflection approximately 2.5% at 24 ft, wooden stake driven through crown of pipe near inlet. Deflections still below 5%. No significant change in deflection since 2013
MP 122.5	9/30/2013	DuroMaxx	48-inch	102	Outlet	Inlet	86.8% of reading below 2.5%	100% of readings below 5%, .	Max deflection approximately 2.8% at 88 ft. Deflection at 4.8% in 2016
MP 122	9/30/2013	DuroMaxx	48-inch	103	Outlet	Inlet	77.2% of readings below 2.5%	<1.9% of readings above 5%	Max deflection approximately 5.30% near inlet end (approx. 90 to 88 ft). Deflection at 5.8% in 2016, crown flattening and possible inverse curvature has occurred. Pipe moderately racked in right crown. Remainder of pipe 4% or less. Small puncture due to stake near outlet, pipe slightly racked at 8 ft. Slight hump at right haunch at 46 ft. Slight dent in invert at 56 ft .


MP 123, I-25, 36-Inch DuroMaxx


North


MP 123, I-25, 36-Inch DuroMaxx
Northern Pipe

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection

(20.0) GO - General Observation Remark: Joint No. 1

(30.0) GO - General Observation Remark: Slight dent left springline

(40.0) GO - General Observation Remark: View of joint at 40 ft.

(60.0) GO - General Observation Remark: View of joint at 66 ft.

(80.0) GO - General Observation Remark: Stake driven through crown of pipe at 84 ft.

(88.0) EI - End Inspection

Total Distance: 0

ID Number: Inlet

POSMSOFTWARE

Project Name: MP 123 Fountain Colorado	
Date: 12/5/2016	**Pipe ID:** Northern Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 78.2	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Inlet

(0.0) SI - Start Inspection

(10.2) - View Down Pipe

(18.8) - Joint

(32.7) - View down barrel

(40.4) - Joint

(54.0) - View down barrel

(61.3) - Joint

(71.3) - Puncture through crown of pipe and damaged pipe end

(78.2) EI - End Inspection

Total Distance: 78.2

ID Number: Outlet

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection	01:14 00:00:00	
20.0	General Observation Remarks: Joint No. 1	03:13 00:00:26	
30.0	General Observation Remarks: Slight dent left springline	07:04 00:00:40	

Project Name: MP 123 Fountain Colorado

Date: 12/5/2016	**Pipe ID:** Northern Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 78.2	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Distance	Fault Observation	Picture
0.0	Start Inspection	
10.2	ViewDown Pipe	
18.8	Joint	
32.7	View down barrel	
40.4	Joint	

Distance	Fault Observation	Time	Picture
40.0	General Observation Remarks: View of joint at 40 ft.	8:10 00:00:45	
60.0	General Observation Remarks: View of joint at 66 ft.	10:33 00:01:13	
80.0	General Observation Remarks: Stake driven through crown of pipe at 84 ft.	12:37 00:01:45	

Distance	Fault Observation	Picture
54.0	View down barrel	
61.3	Joint	
71.3	Puncture through crown of pipe and damaged pipe end	
78.2	End Inspection	

Created with the POSM report generator Back

Distance	Fault Observation	Time	Picture
88.0	End Inspection	13:48 00:01:55	

Created with the POSM report generator

XY Diameter Summary Report

Pipe well under 5% deflection, spikes in data due to camera tilting at joint

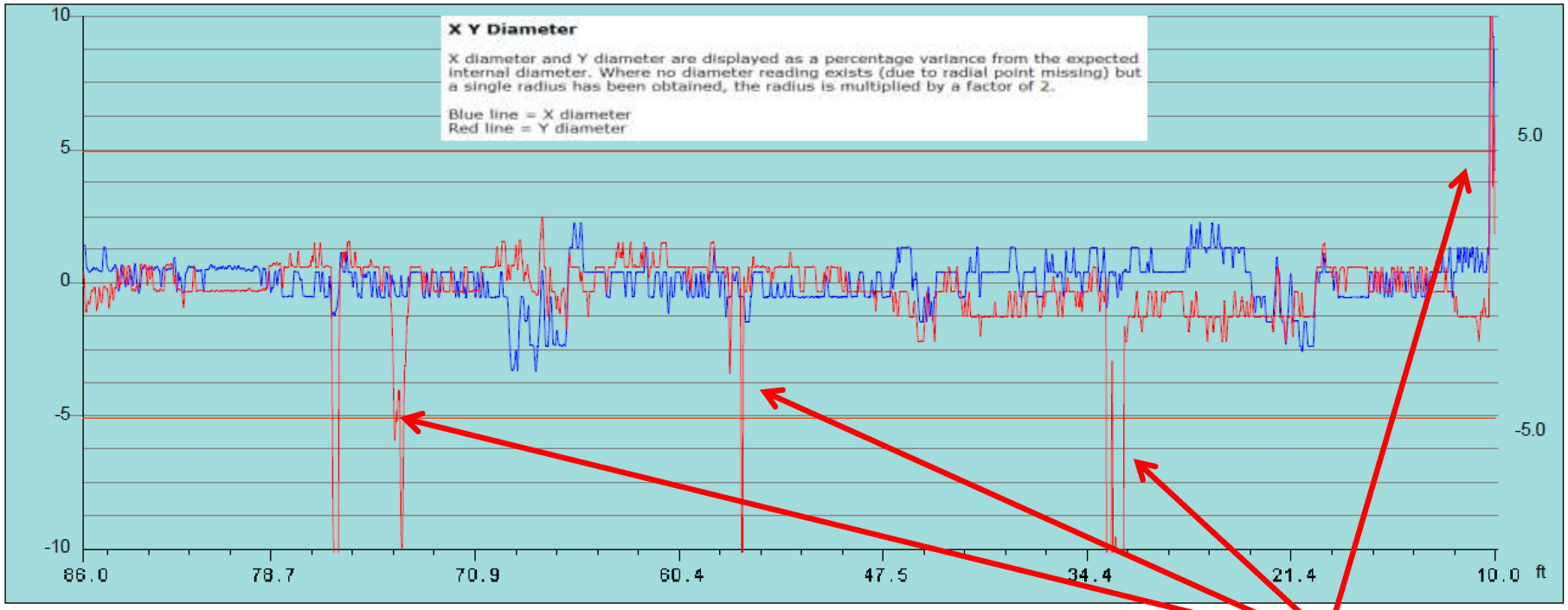
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

Comments

Northern most pipe of three at MP 123

Limit Lines
Upper limit = 5
Lower Limit= -5

% 90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%



Fractile: 10% of the data points are above 1.1% for X and 0.7% for Y. 2.6% exceeds 5% limits lines. The spikes/scatter in data (2.6%) are due to the laser skid and/or the camera tilting on the weld at the joint. Spikes can also occur due to the loss of laser light at the joint.

XY Deflection Summary Report

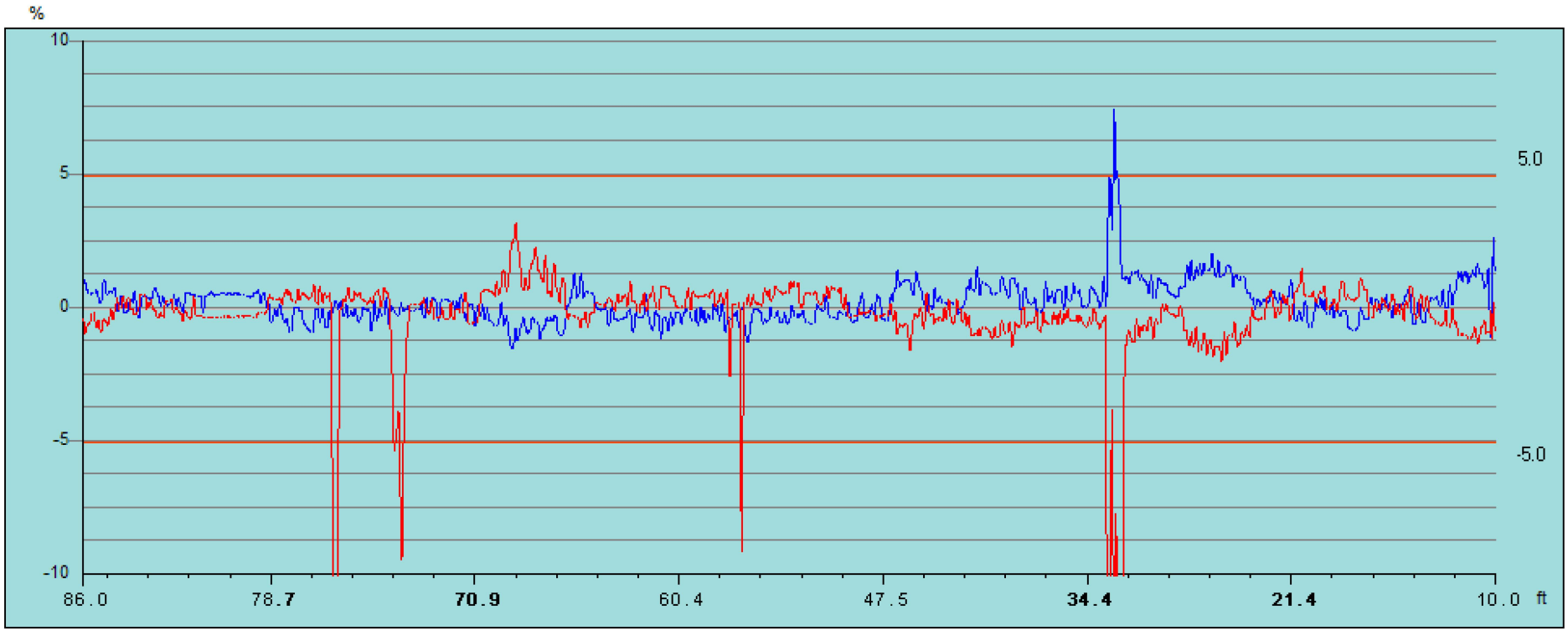
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

Comments

Northern most pipe of three at MP 123

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joints

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

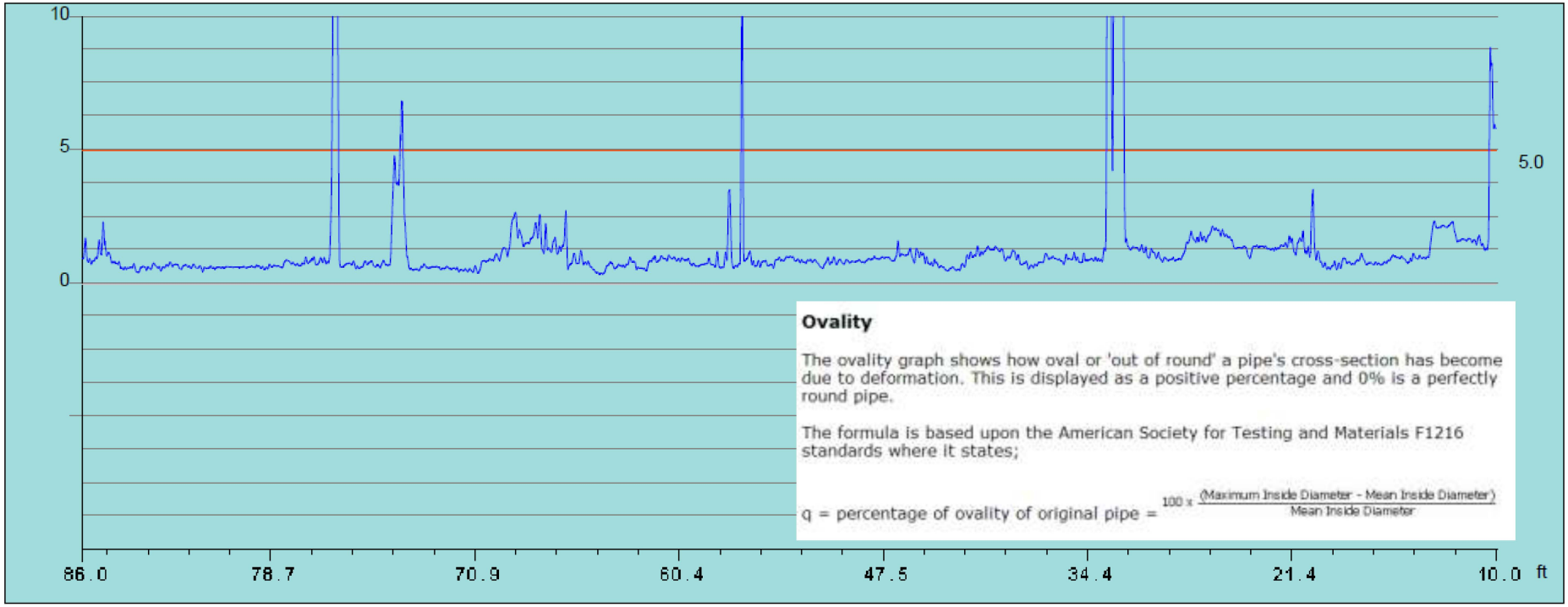
Comments

Northern most pipe of three at MP 123

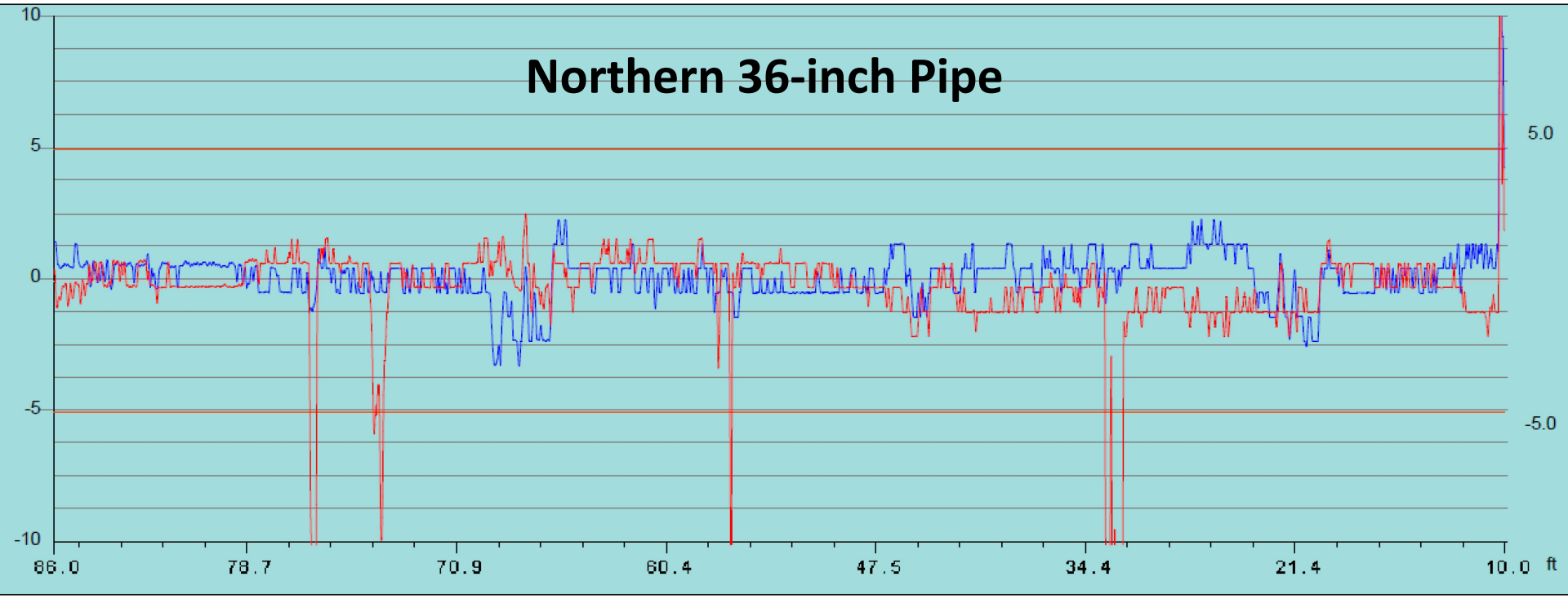
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 1.8%, Exceeded limits: 2.7%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



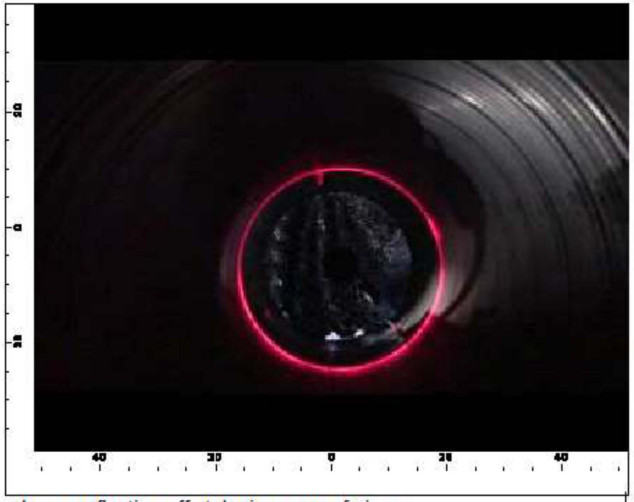

88.0 ft
62.0 ft
22.5 ft


Northern 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
86.0
78.7
70.9
60.4
47.5
34.4
21.4
10.0
ft

XY Diameter Observations Report

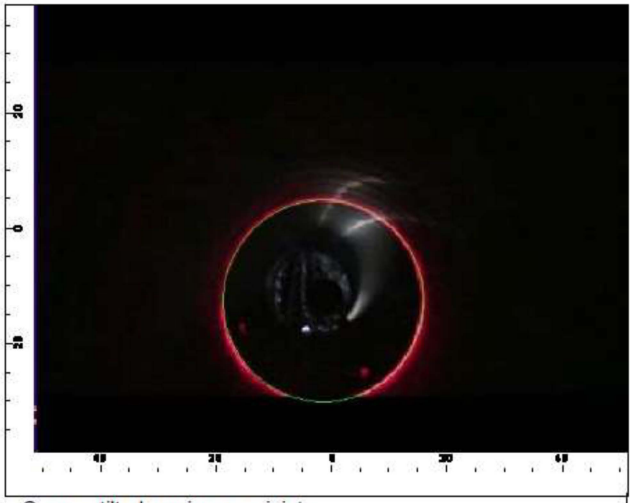
MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in

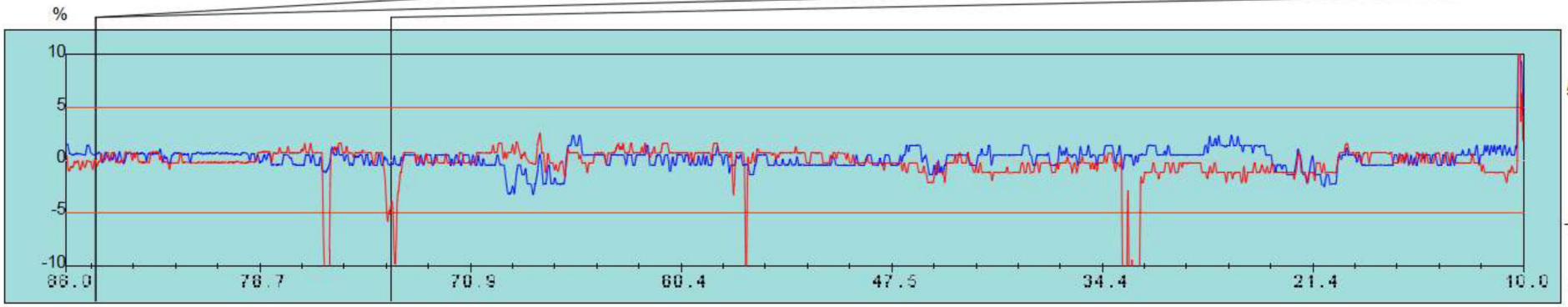


Laser reflecting off stake in crown of pipe.

Stake for erosion control driven through crown of pipe.



Camera tilted coming over joint

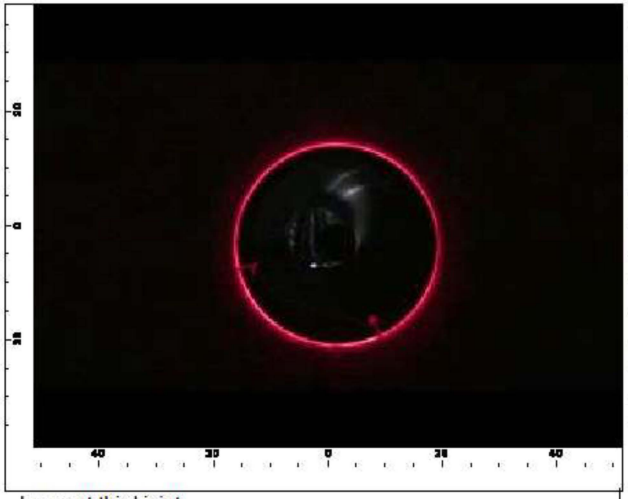


90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%

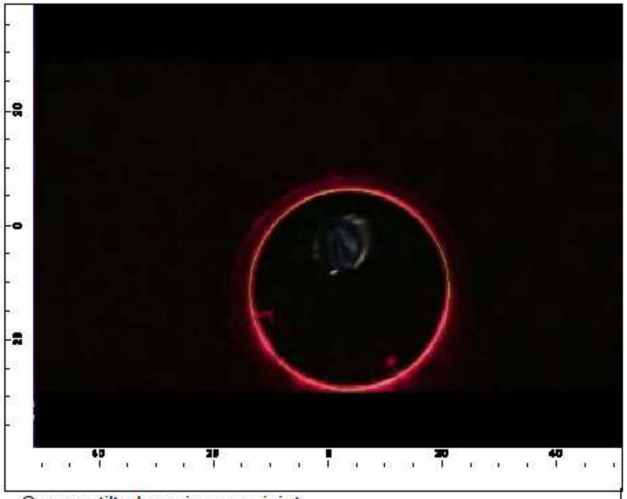
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

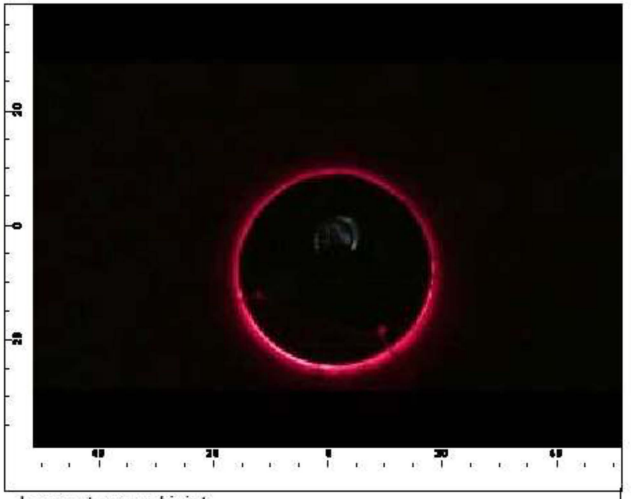
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in



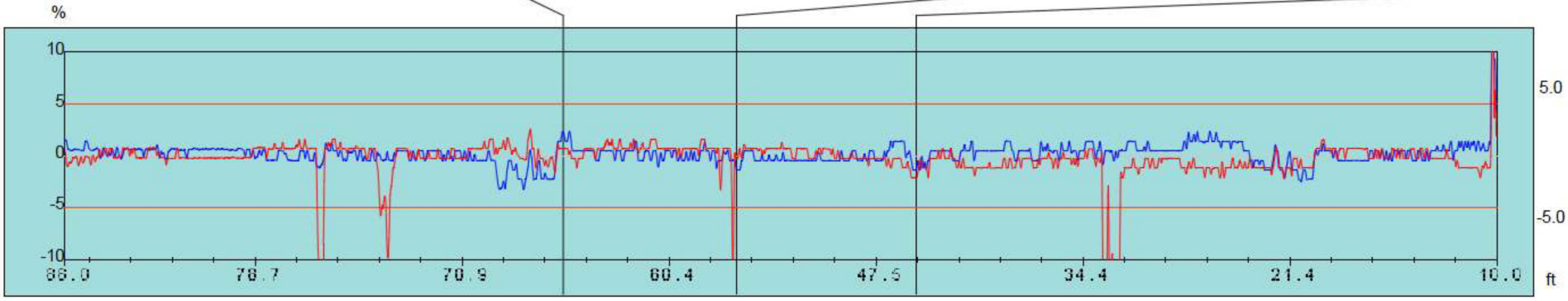
Laser at third joint



Camera tilted coming over joint



Laser at second joint

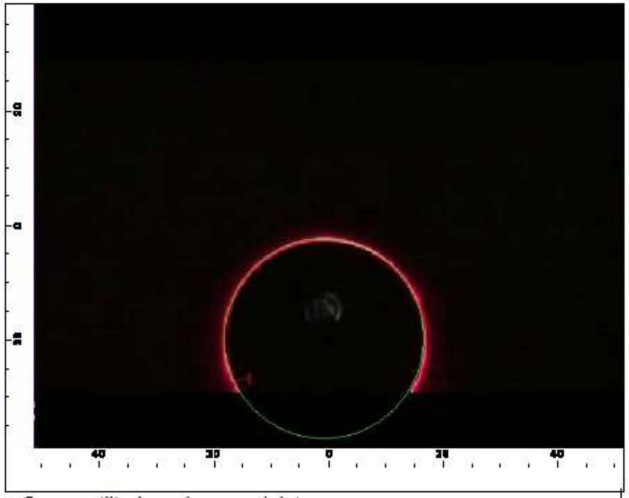


90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%

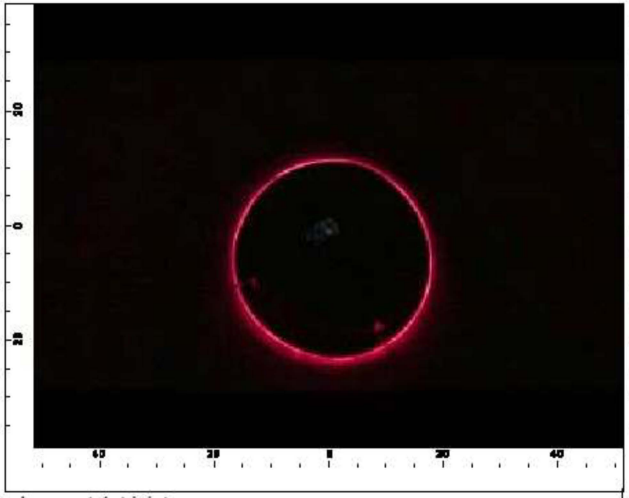
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado

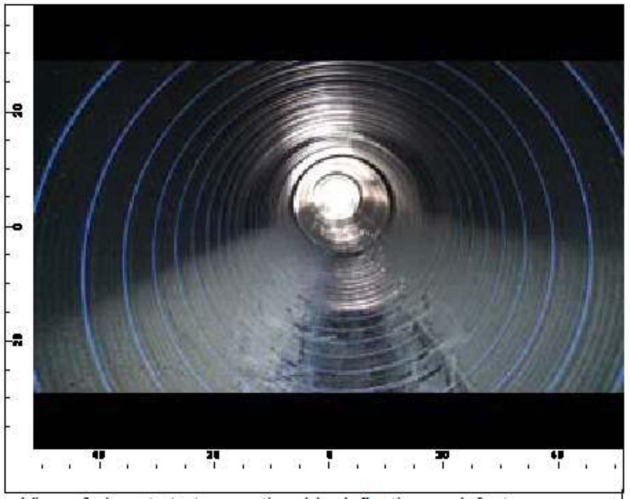
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	North Pipe	Finish No	North Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	34.92 in



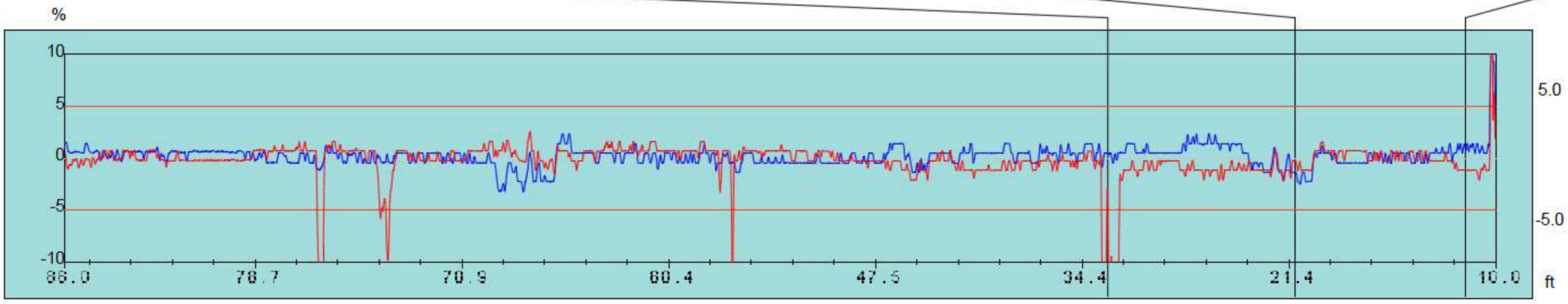
Camera tilted coming over joint



Laser at 1st joint



View of pipe at start, no noticeable deflection or defects.

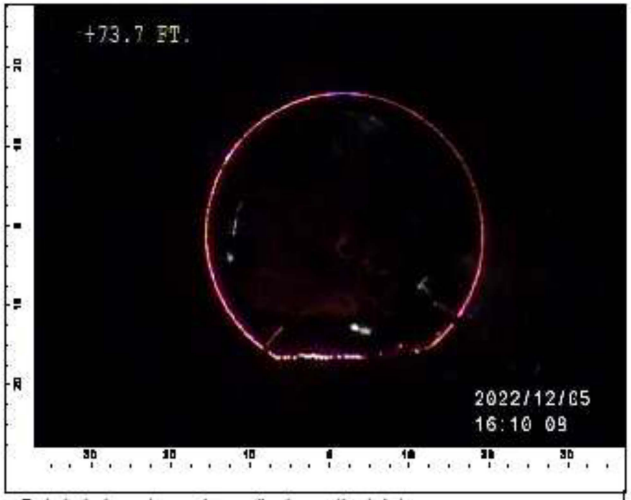


90% - Fractile: (X) 1.1% : (Y) 0.7%, Exceeded limits: 2.6%

Ovality Observations Report

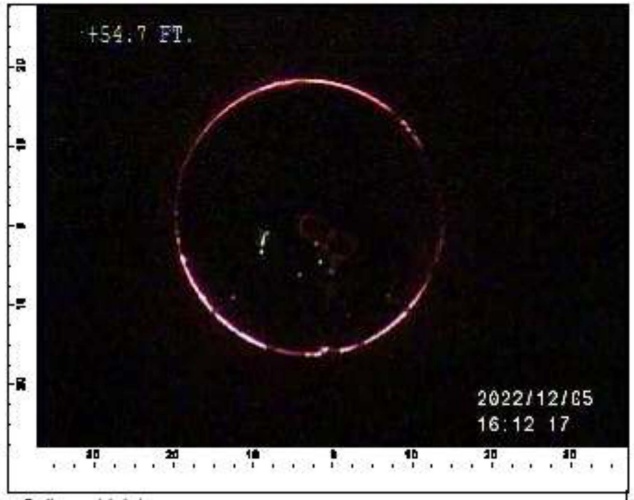
Pipe under 5% deflection

Site ID		Asset No.	MP 123 North	Date	12/15/2016
City	Fountain			Material	
Start No	Outlet	Finish No	Inlet	Pipeline Length	0 ft
Location		Location		Internal Diameter	35.16 in

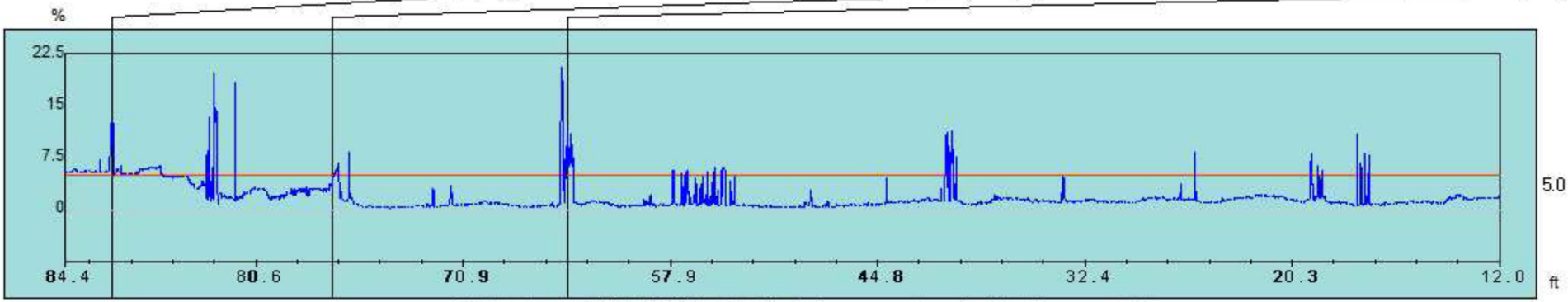


Debris in invert causing spike in vertical data.

Noise causing spike in data



Spikes at joints



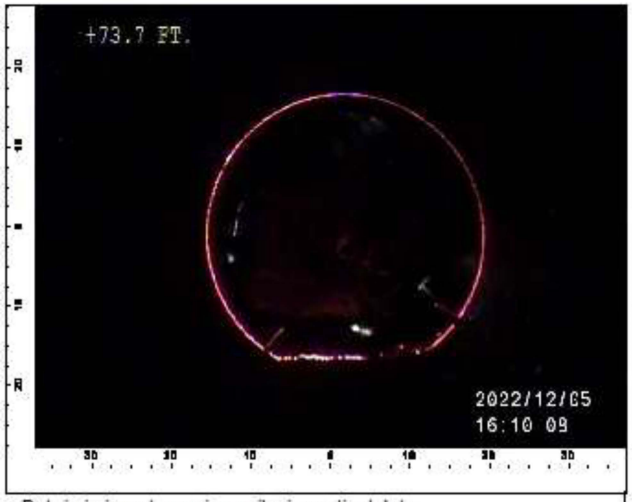
Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance

90% - Fractile: 4.8%, Exceeded limits: 5.8%

XY Diameter Observations Report

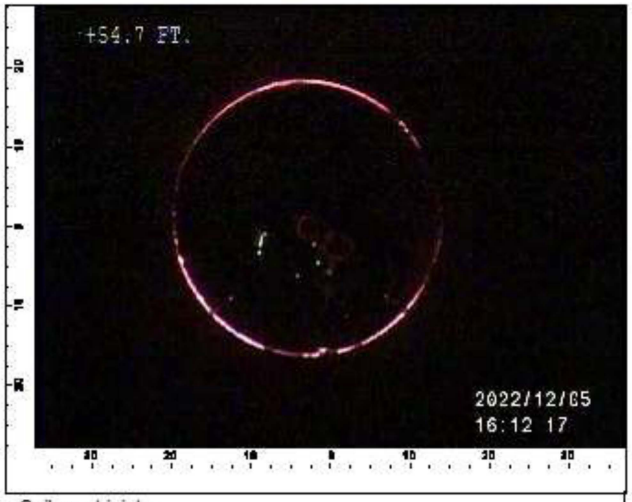
Pipe under 5% Deflection

Site ID		Asset No.	MP 123 North	Date	12/15/2016
City	Fountain			Material	
Start No	Outlet	Finish No	Inlet	Pipeline Length	0 ft
Location		Location		Internal Diameter	35.16 in

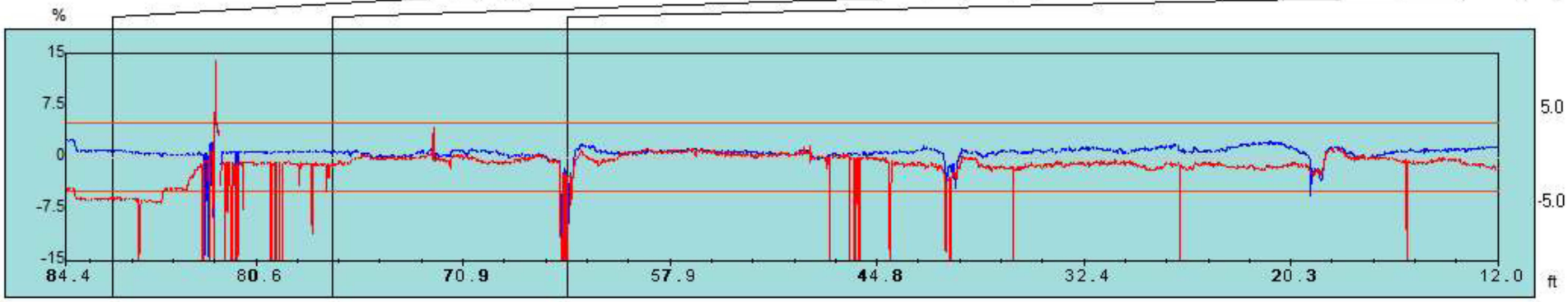


Debris in invert causing spike in vertical data.

Noise causing spike in data

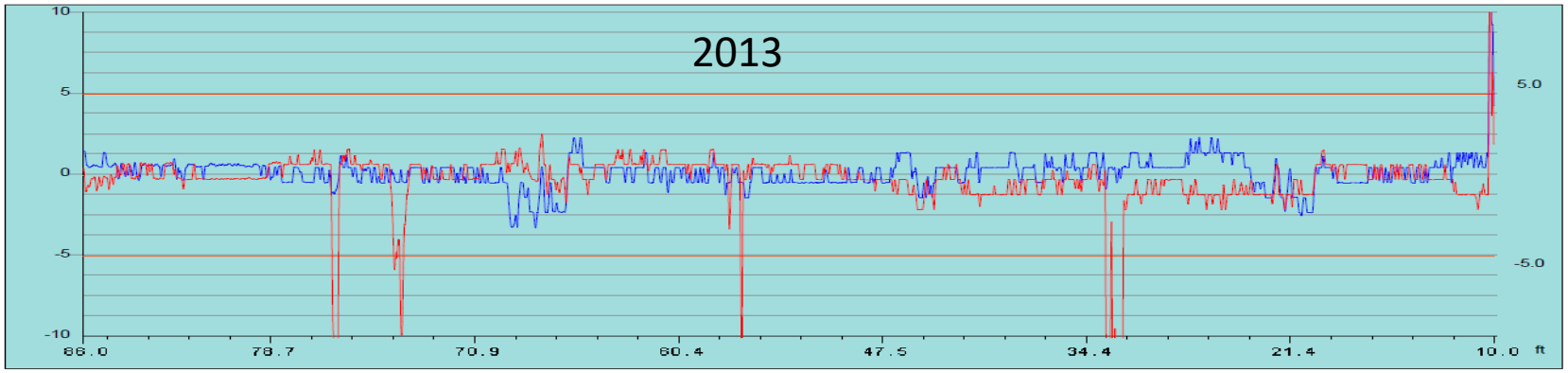


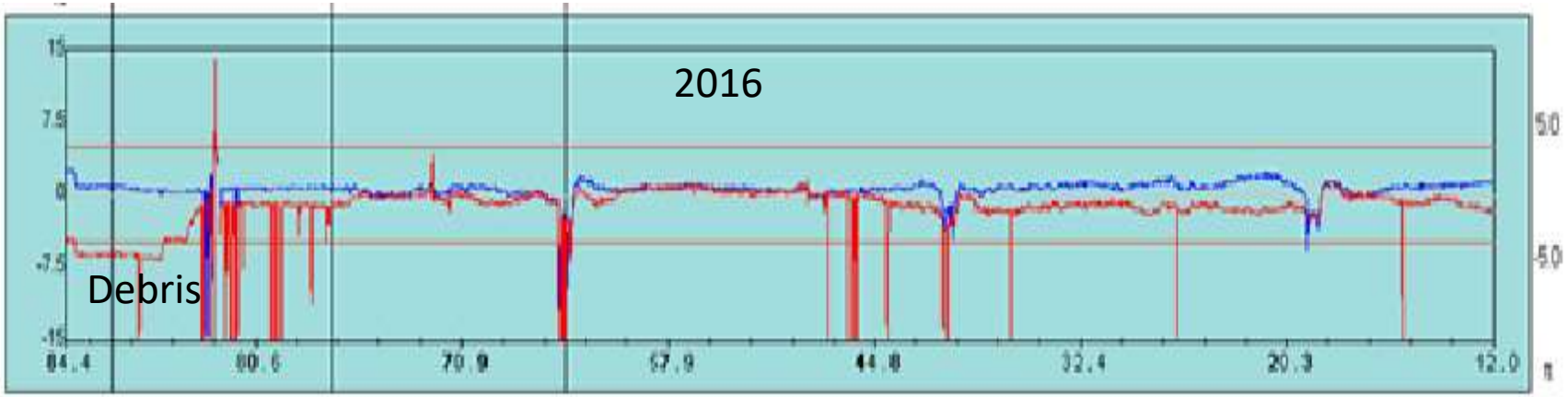
Spikes at joints



90% - Fractile: (X) 1.3% : (Y) 0.4%, Exceeded limits: 4.7%

Performance Summary MP 123 (Northern Pipe)





The inlet end of the structure had been severely damaged by a vehicle, minor punctures from construction stakes were still visible. Overall no significant change was observed in the overall condition or shape of the structure.


MP 123, I-25, 36-Inch DuroMaxx
Center Pipe

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123, Center Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection Remark: Start inspection, center pipe
(20.0) GO - General Observation Remark: View of joint at 21 ft.
(40.0) GO - General Observation Remark: View of joint at 43 ft.
(63.0) GO - General Observation Remark: View of joint at 65 ft.
(73.0) GO - General Observation Remark: Small dent at left springline
(78.0) GO - General Observation Remark: Small dent at left springline
(82.0) GO - General Observation Remark: Wood stakes driven through crown of pipe

Total Distance: 0

ID Number: Inlet

Created with the POSM report generator

POSMSOFTWARE

Project Name: MP 123 Fountain Colorado

Date: 12/5/2016	**Pipe ID:** Middle Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 78	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Inlet

(0.0) SI - Start Inspection
(8.6) - View down barrel
(18.7) - Joint
(28.8) - View down barrel
(40.0) - Joint
(50.7) - View down barrel
(61.6) - Joint
(63.2) - Dent Remark: Dent at 9 O'clock
(78.0) EI - End Inspection Remark: End of pipe damaged

Total Distance: 78

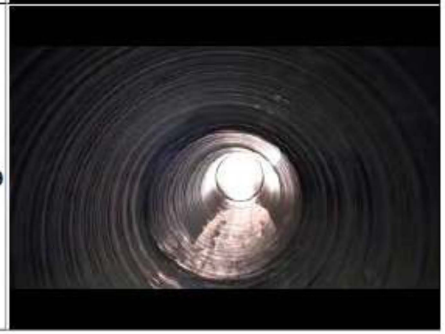
ID Number: Outlet

Created with the POSM report generator Back

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: MP 123, Center Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection Remarks: Start inspection, center pipe	01:09 00:00:00	
20.0	General Observation Remarks: View of joint at 21 ft.	04:45 00:01:14	
40.0	General Observation Remarks: View of joint at 43 ft.	05:44 00:01:39	

POSMSOFTWARE

Project Name: MP 123 Fountain Colorado

Date: 12/5/2016	**Pipe ID:** Middle Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 78	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Distance	Fault Observation	Picture
0.0	Start Inspection	
8.6	View down barrel	
18.7	Joint	
28.8	View down barrel	
40.0	Joint	

Distance	Fault Observation	Time	Picture
63.0	General Observation Remarks: View of joint at 65 ft.	07:52 00:02:14	
73.0	General Observation Remarks: Small dent at left springline	09:22 00:02:30	
78.0	General Observation Remarks: Small dent at left springline	10:33 00:02:53	

Distance	Fault Observation	Picture
50.7	View down barrel	
61.6	Joint	
63.2	Dent Remarks: Dent at 9 O'clock	
78.0	End Inspection Remarks: End of pipe damaged	

Created with the POSM report generator Back

Distance	Fault Observation	Time	Picture
82.0	General Observation Remarks: Wood stakes driven through crown of pipe	11:40 00:03:10	

Created with the POSM report generator

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

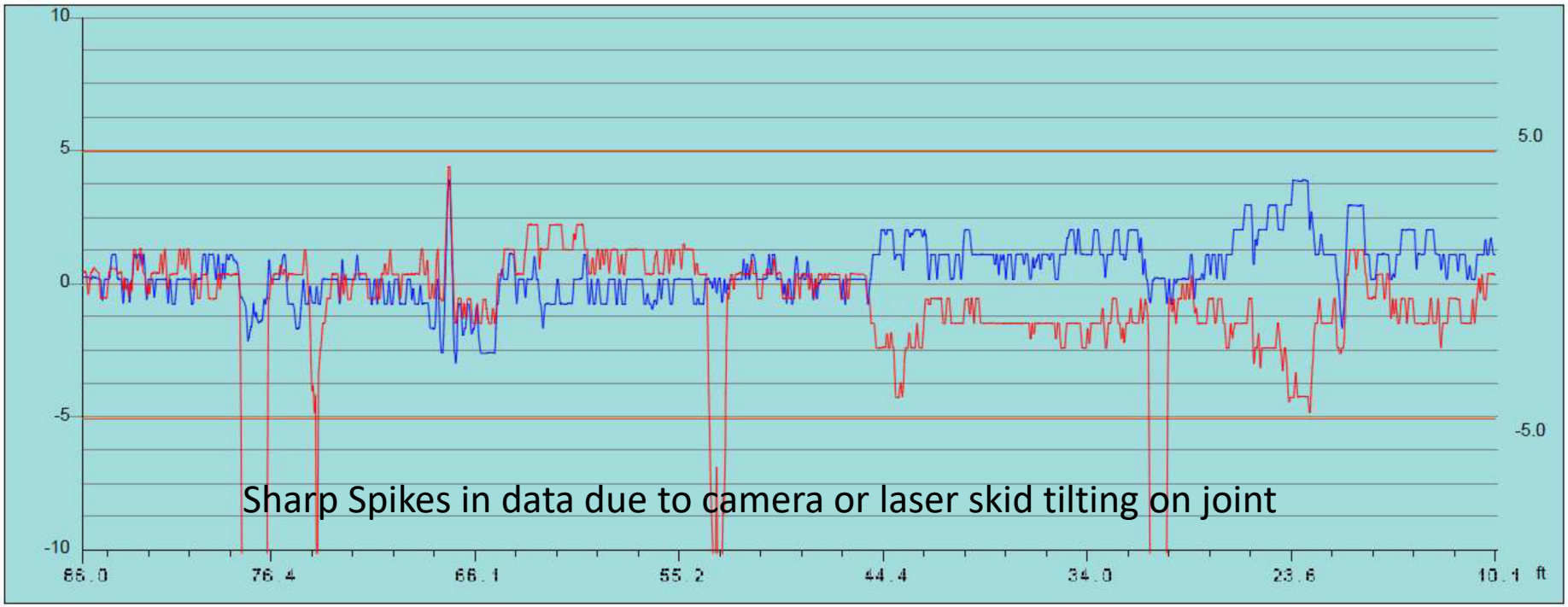
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

Comments

MP 123, I-25, Cross Drain, Center Pipe

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%



XY Deflection Summary Report

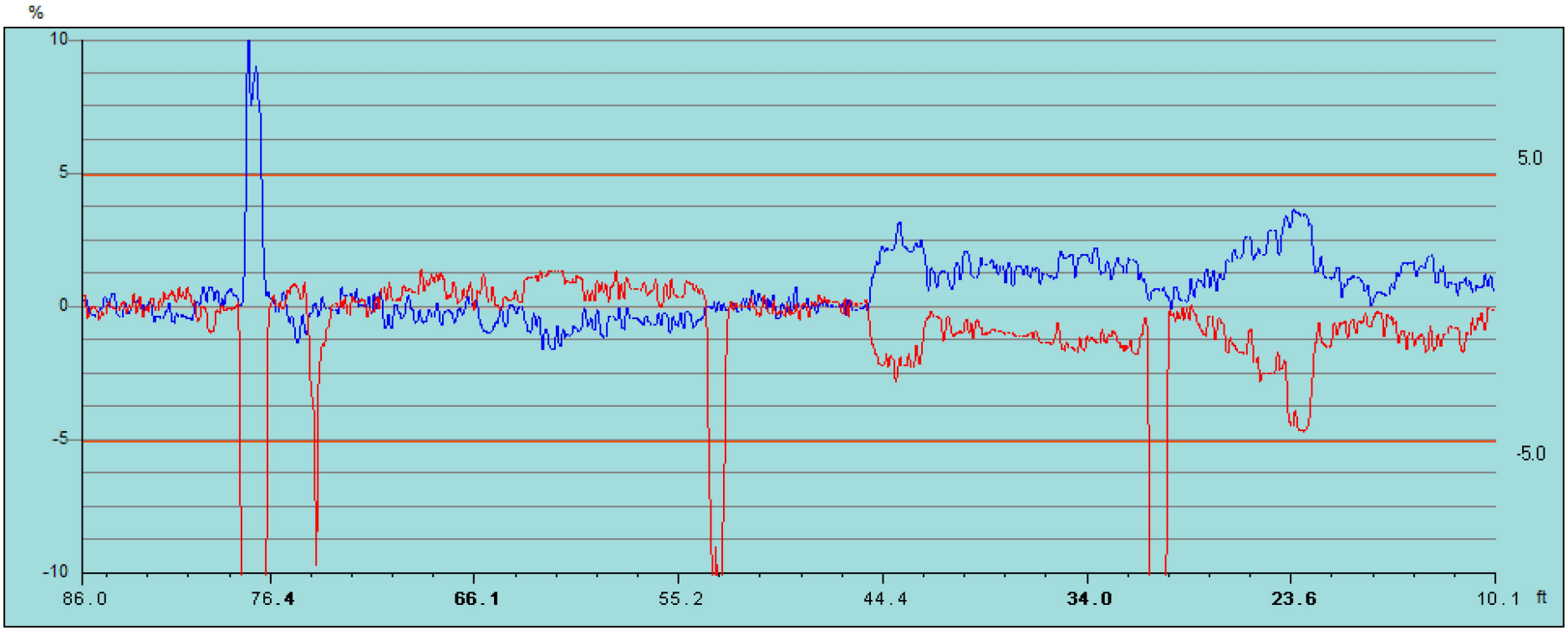
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

Comments

MP 123, I-25, Cross Drain, Center Pipe

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joints

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

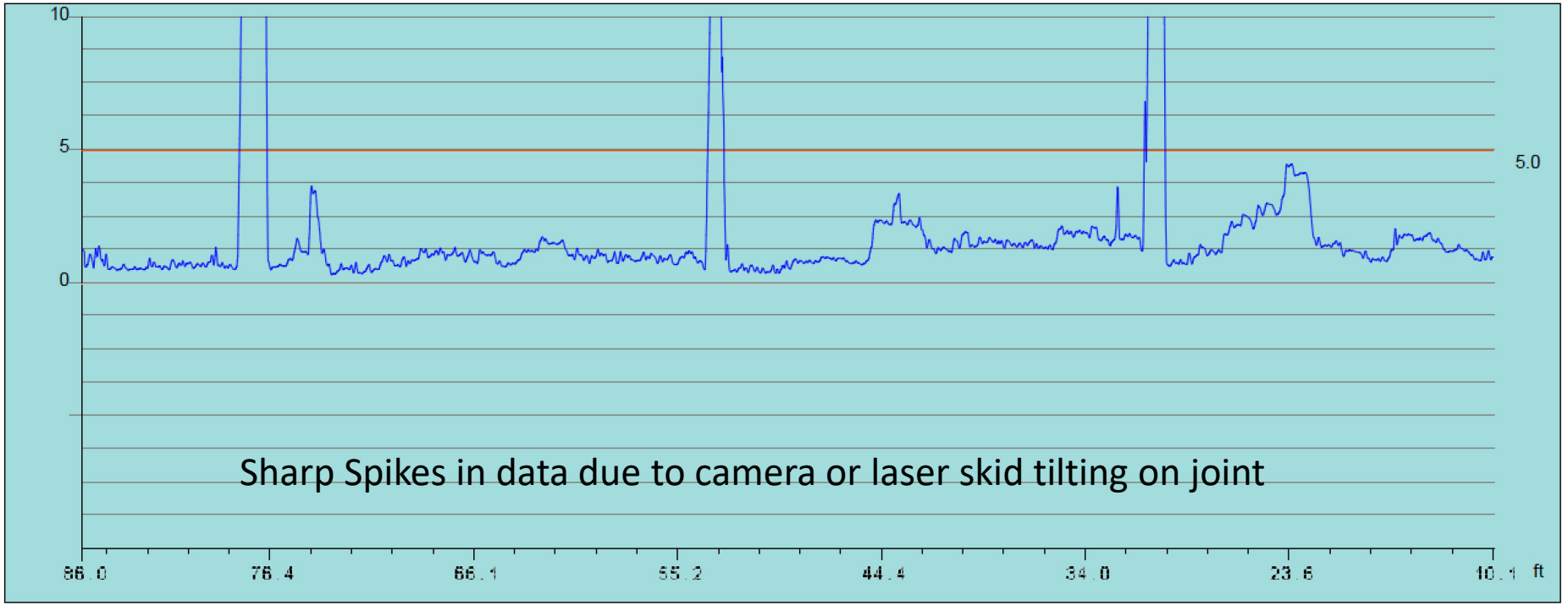
Comments

MP 123, I-25, Cross Drain, Center Pipe

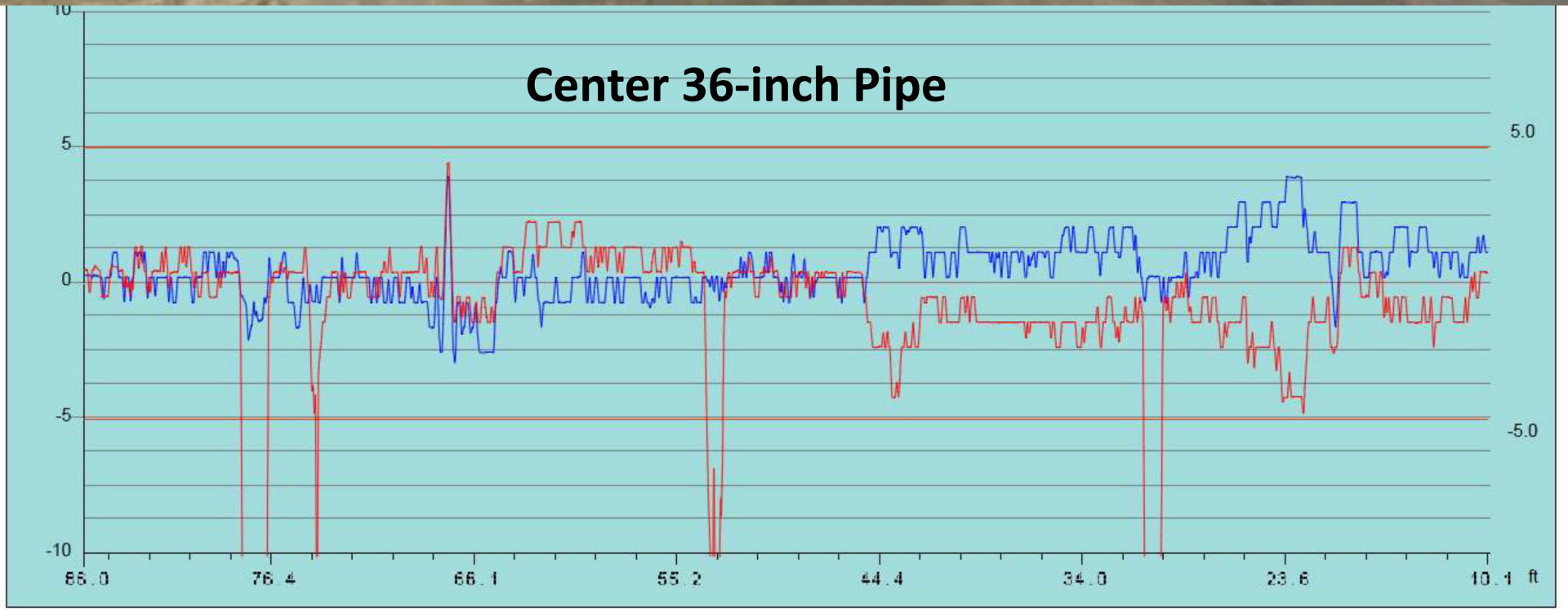
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 2.6%, Exceeded limits: 4.4%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



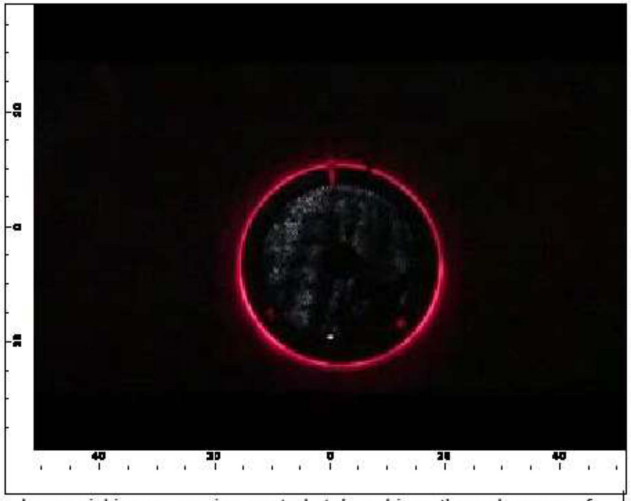

88.0 ft
62.0 ft
22.5 ft


Center 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
86.0
76.4
66.1
55.2
44.4
34.0
23.6
10.1
ft

XY Diameter Observations Report

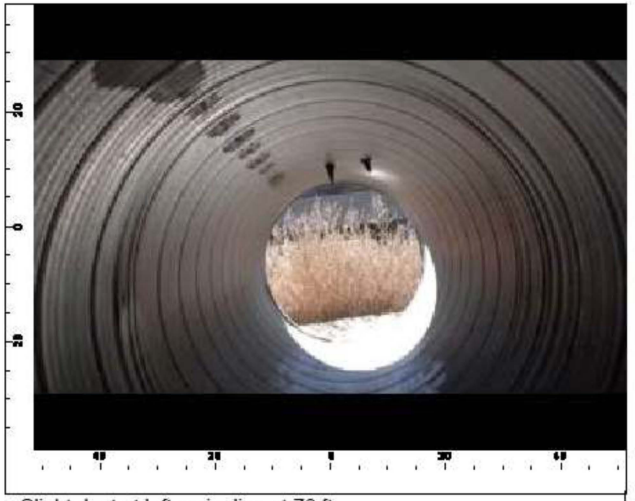
MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in

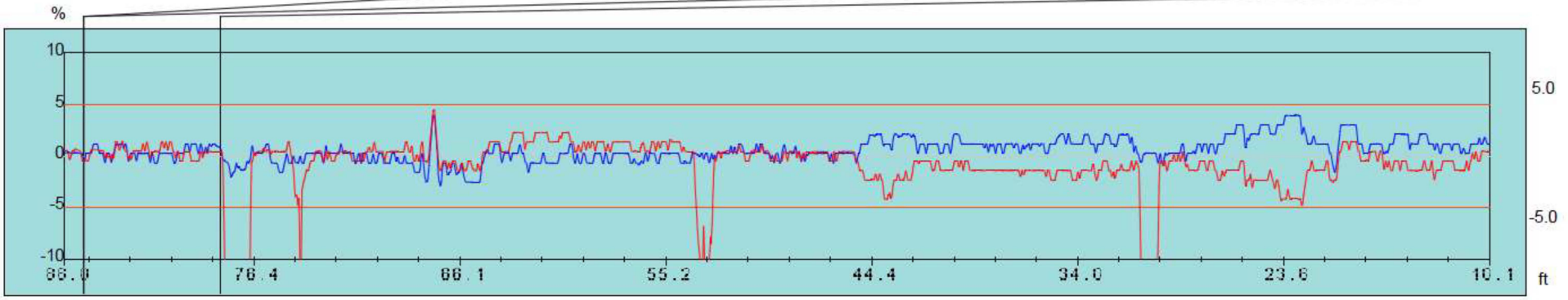


Laser picking up erosion control stakes driven through crown of pipe.

Stakes from erosion control devices.



Slight dent at left springline at 78 ft.

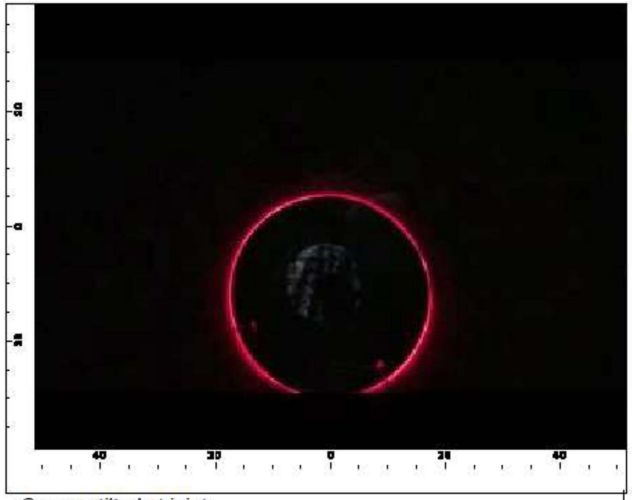


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

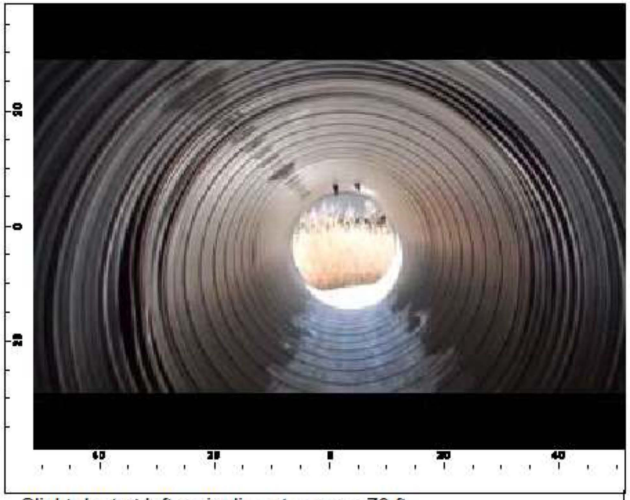
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

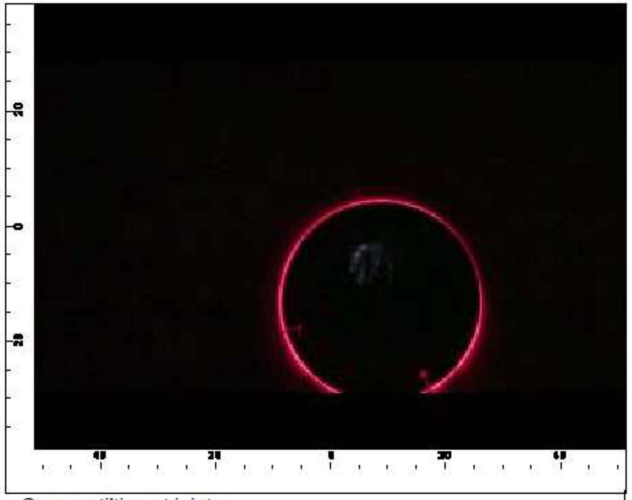
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



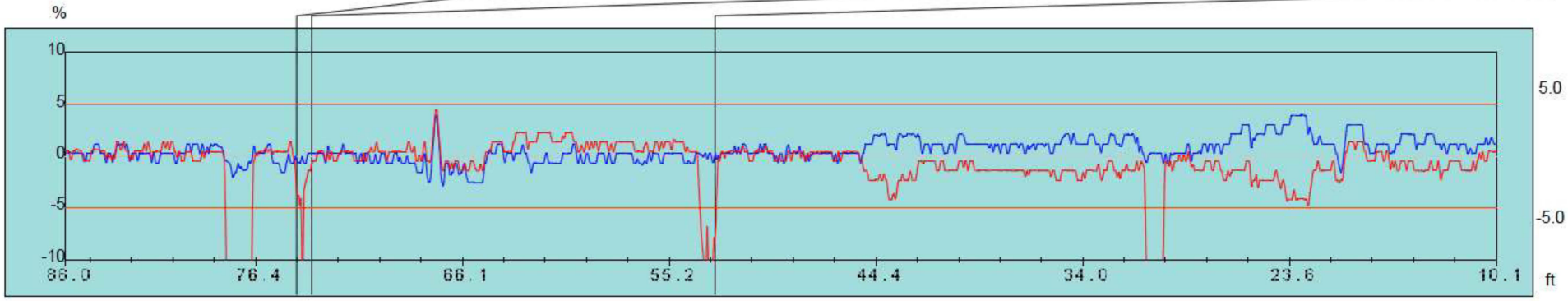
Camera tilted at joint



Slight dent at left springline at approx. 73 ft.



Camera tilting at joint

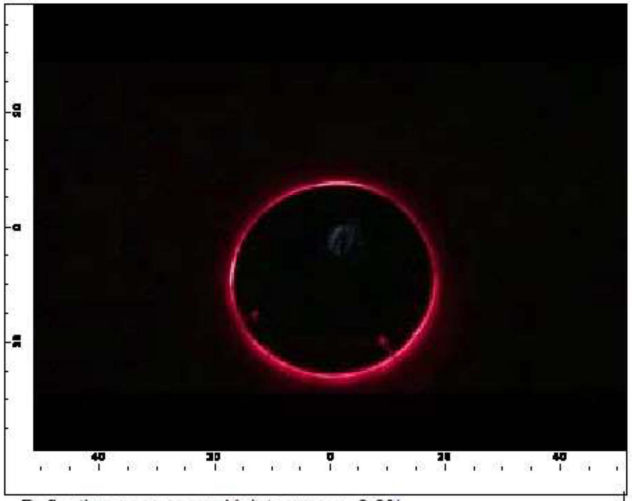


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

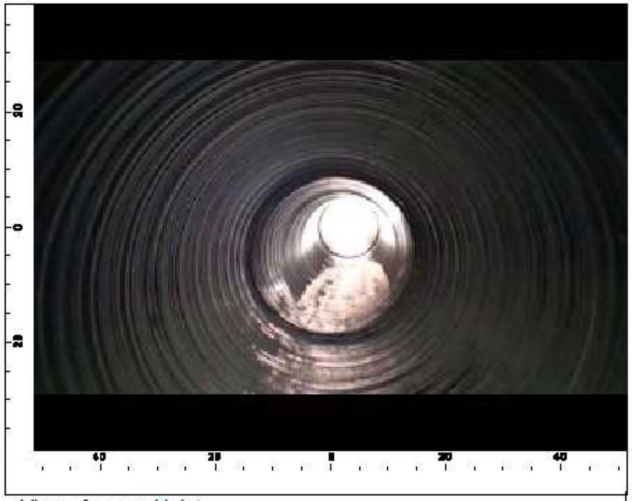
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

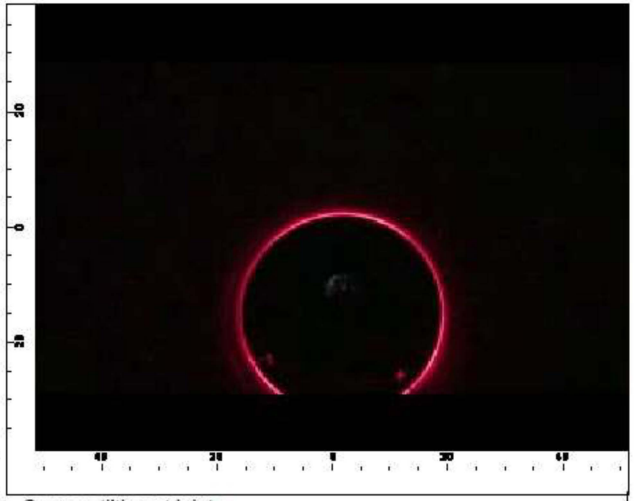
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



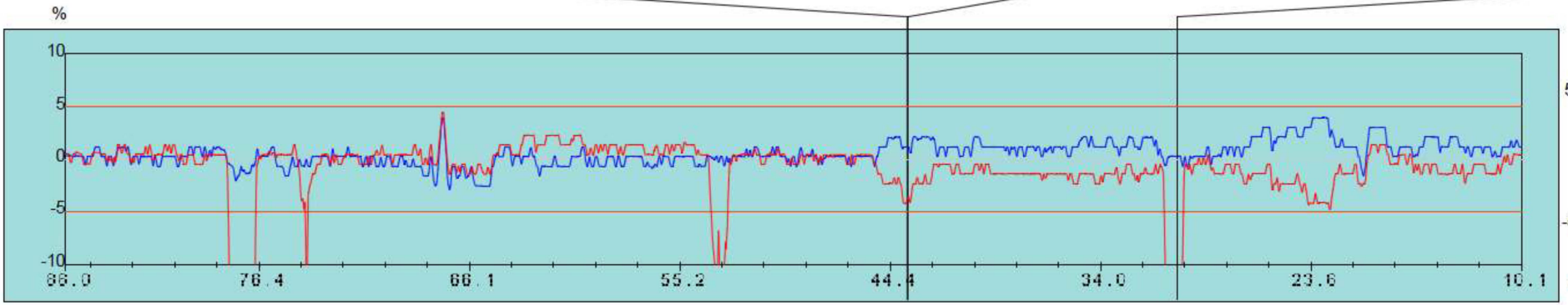
Deflection near second joint, approx. 3.8%.



View of second joint.



Camera tilting at joint

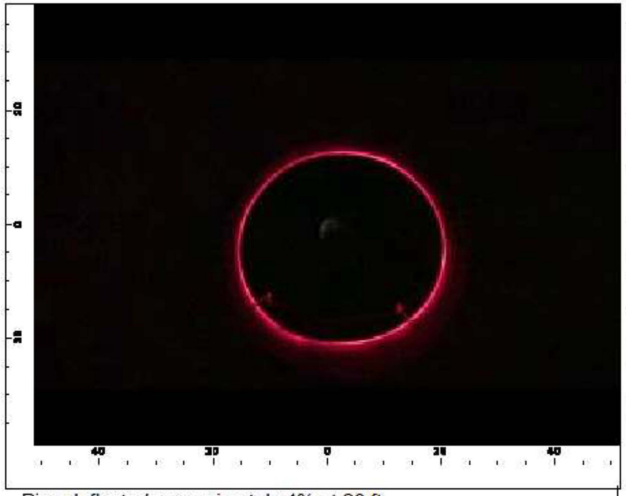


90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

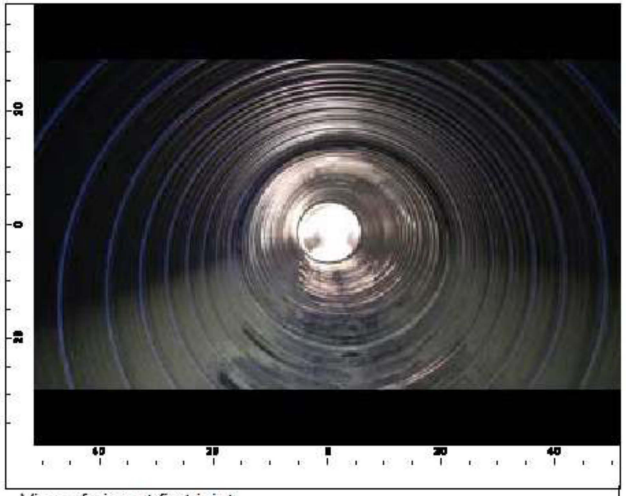
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Center Pipe)

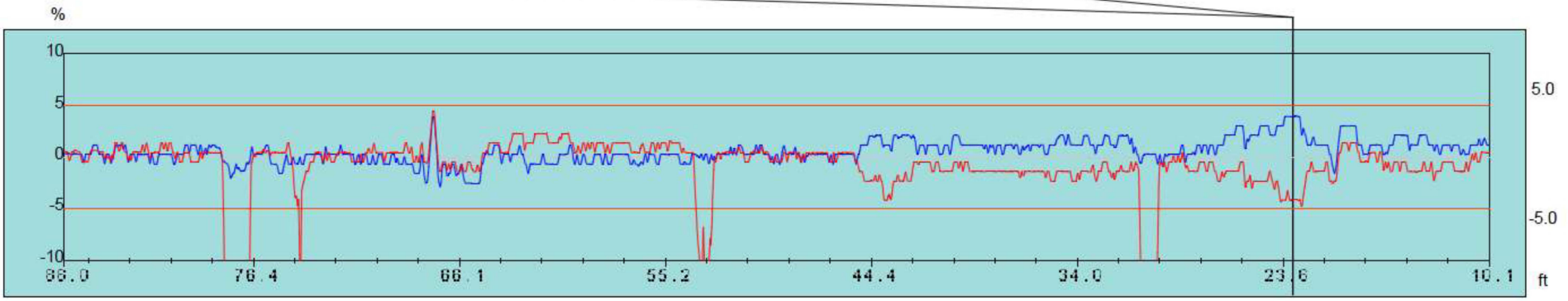
Site ID		Asset No.	I-25, MP 123	Date	10/9/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Center Pipe	Finish No	Center Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35 in



Pipe deflected approximately 4% at 23 ft.



View of pipe at first joint.



90% - Fractile: (X) 2.1% : (Y) 1.3%, Exceeded limits: 4.3%

XY Diameter Observations Report

Pipe Deflected Near 5%

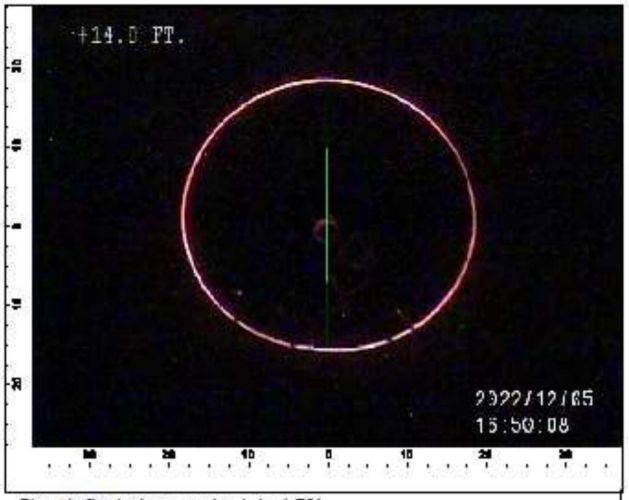
Site ID
City Fountain
Start No Outlet
Location

Asset No. MP 123 Mid

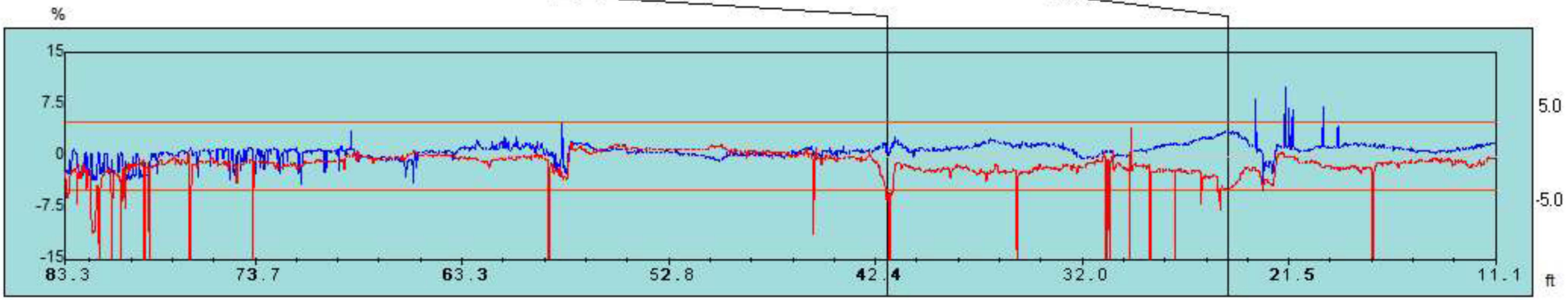
Finish No Inlet
Location

Date 12/15/2016
Material DuroMaxx
Pipeline Length 78 ft
Internal Diameter 35.4 in

Pipe deflected near 5%.

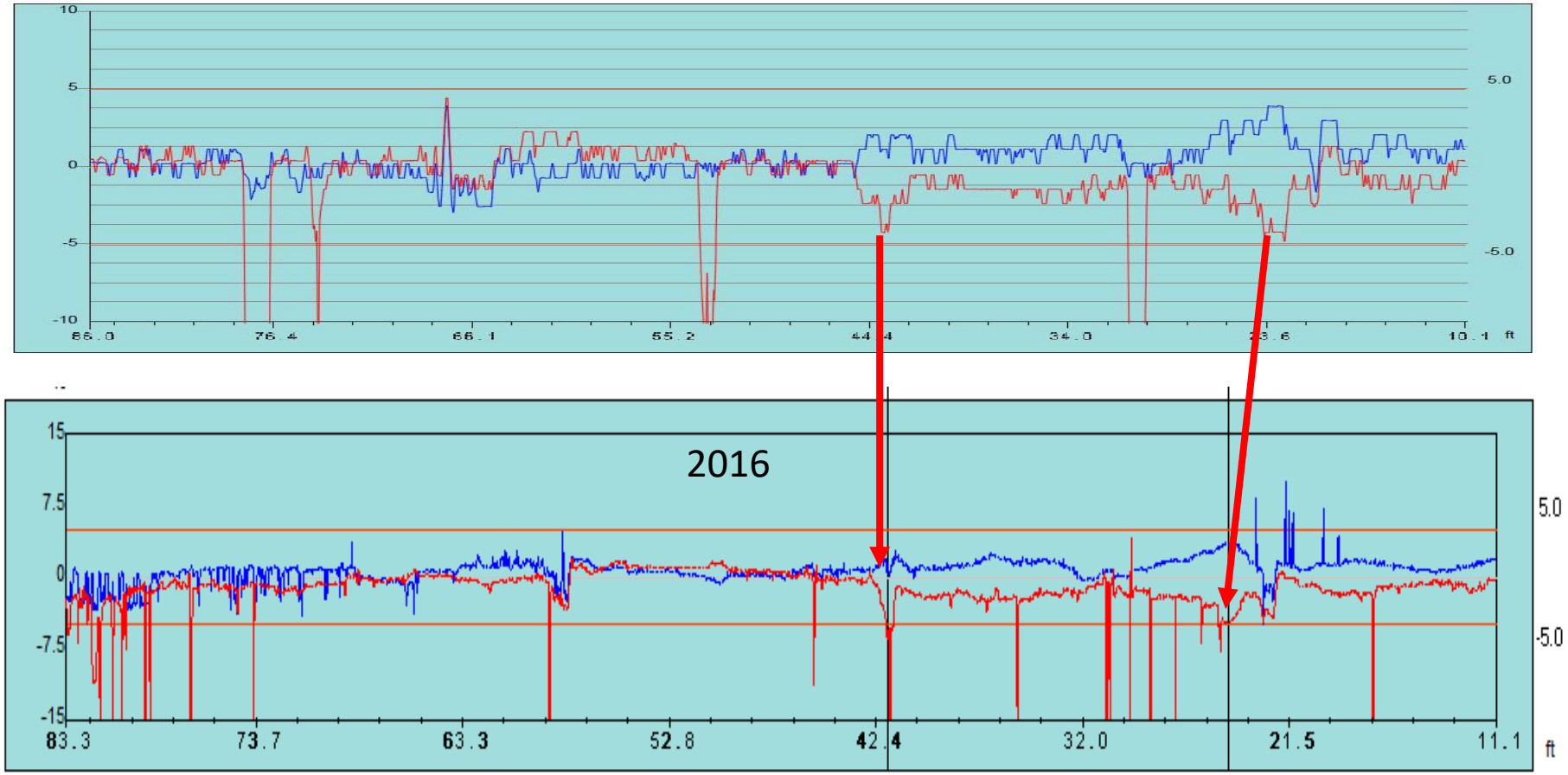


Pipe deflected approximately 4.7%.



90% - Fractile: (X) 1.8% : (Y) 0.8%, Exceeded limits: 3.4%

Performance Summary MP 123 (Middle Pipe)



The inlet end of the structure had been severely damaged by a vehicle, minor punctures from construction stakes were still visible. It appears that some possible slight increase in deflection has occurred around at 23 and 42 ft. Deflection at 5%.


MP 123, I-25, 36-Inch DuroMaxx
Southern Pipe

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: Southern Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Ou

(2.0) SI - Start Inspection Remark: View from outlet

(22.0) GO - General Observation Remark: Joint at 22 ft.

(44.0) GO - General Observation Remark: Joint at 44 ft

(66.0) GO - General Observation Remark: Joint at 66 ft.

(84.0) GO - General Observation Remark: Stake through crown of pipe

(88.0) EI - End Inspection

Total Distance: 0

ID Number: In

Created with the POSM report generator

POSMSOFTWARE

Project Name: MP 123 Fountain Colorado	
Date: 12/5/2016	**Pipe ID:** South Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 81.8	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Inlet

(9.2) - View down barrel

(19.2) - Joint

(32.7) - View down barrel

(41.3) - Joint

(54.4) - View down barrel

(62.7) - Joint

(72.3) - Possible puncture at 1 O'clock

(81.8) EI - End Inspection

Total Distance: 81.8

ID Number: Outlet

Created with the POSM report generator Back

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 36

Pipe ID: Southern Pipe
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection Remarks: View from outlet	01:47 00:00:00	
22.0	General Observation Remarks: Joint at 22 ft.	2:30:17 00:00:36	
44.0	General Observation Remarks: Joint at 44 ft	2:31:30 00:01:05	

POSMSOFTWARE

Project Name: MP 123 Fountain Colorado

Date: 12/5/2016	**Pipe ID:** South Pipe
Asset Location:	**Start ID:** Outlet
Length Surveyed: 81.8	**End ID:** Inlet
Run Number:	**Direction:** Upstream
Pipe Size: 48-inch	**Pipe Type:** DuraMaxx

Distance	Fault Observation	Picture
9.2	Viewdown barrel	
19.2	Joint	
32.7	Viewdown barrel	
41.3	Joint	
54.4	Viewdown barrel	

Distance	Fault Observation	Time	Picture
66.0	General Observation Remarks: Joint at 66 ft.	2:32:18 00:01:26	
84.0	General Observation Remarks: Stake through crown of pipe	2:33:18 00:01:54	
88.0	End Inspection	2:33:47 00:02:01	

Created with the POSM report generator

Distance	Fault Observation	Picture
62.7	Joint	
72.3	Possible puncture at 1 O'clock	
81.8	End Inspection	

Created with the POSM report generator Back

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

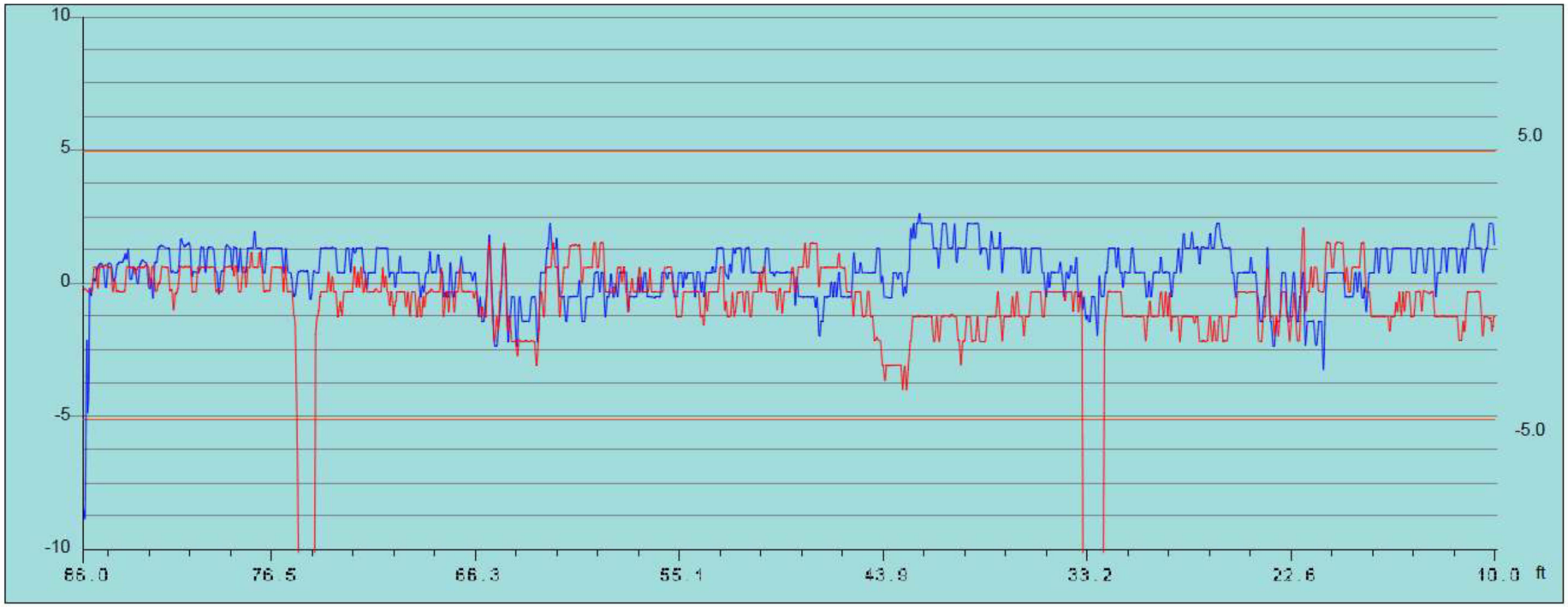
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%



XY Deflection Summary Report

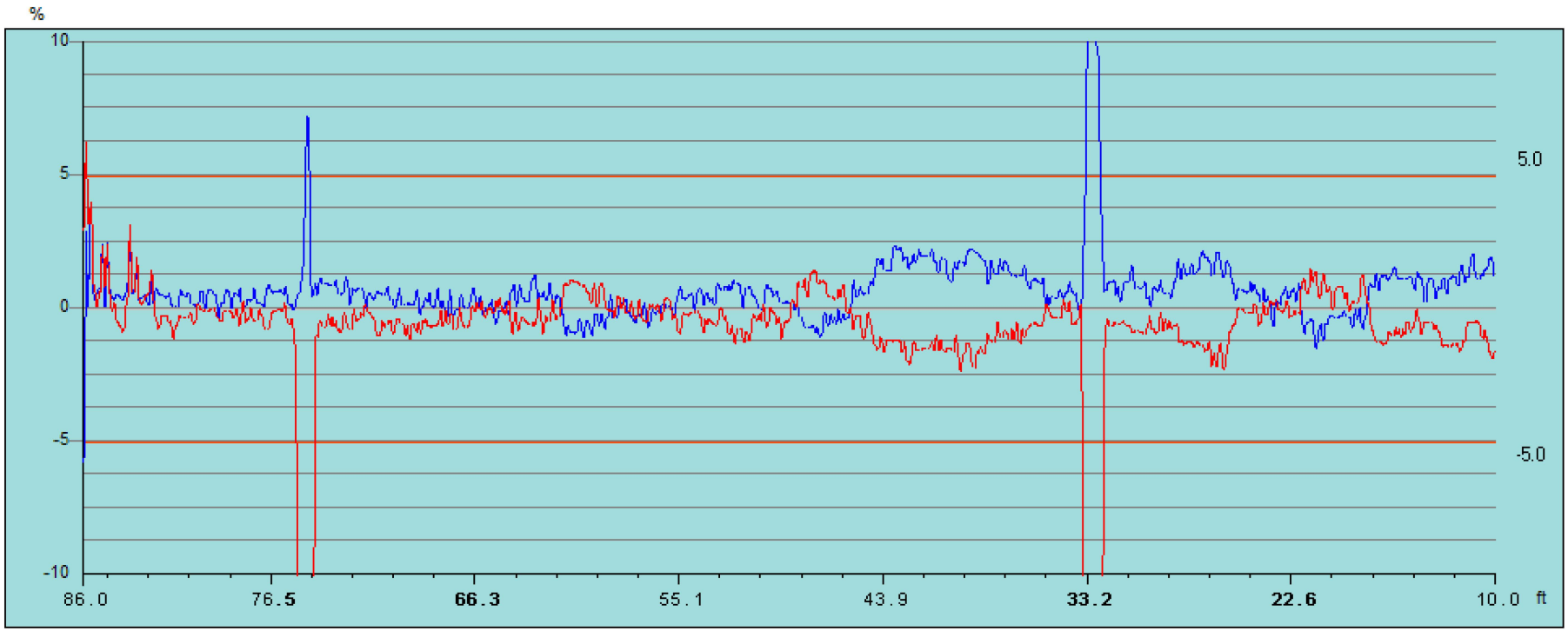
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joint

Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in

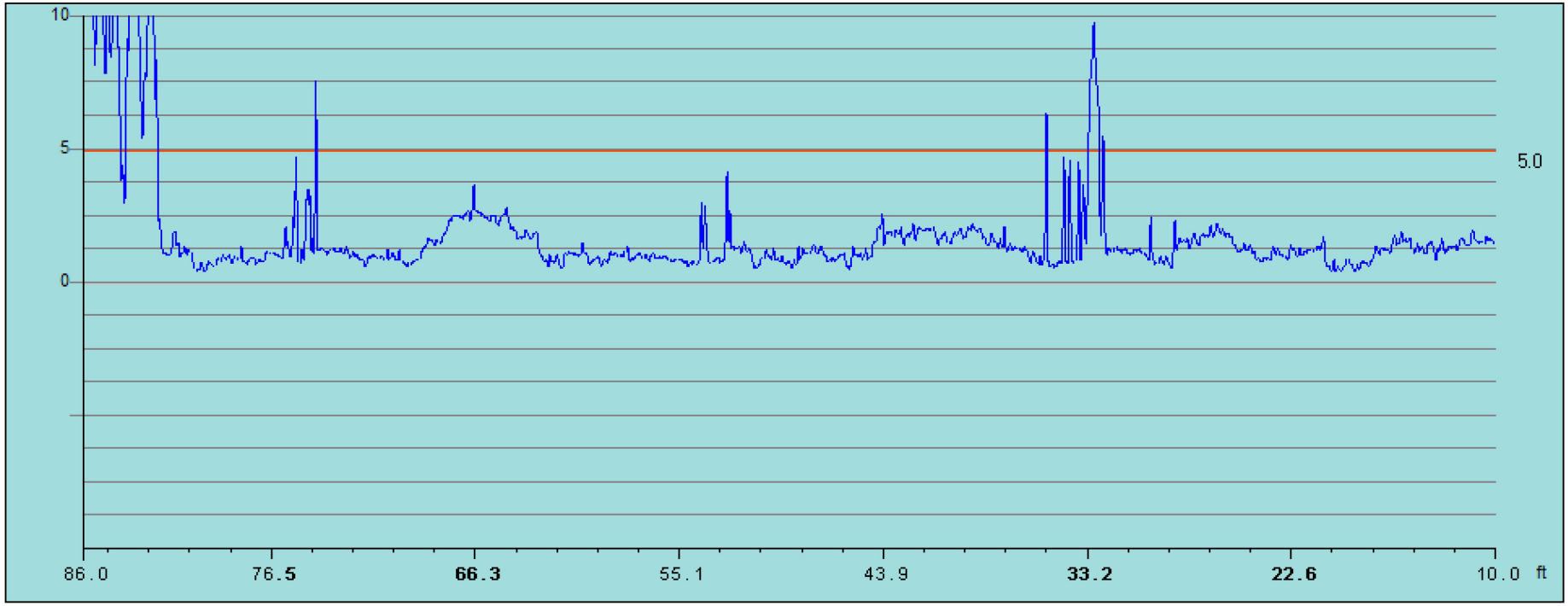
Comments

I-25, MP 123, 36-inch Southern Pipe, Cross Drain

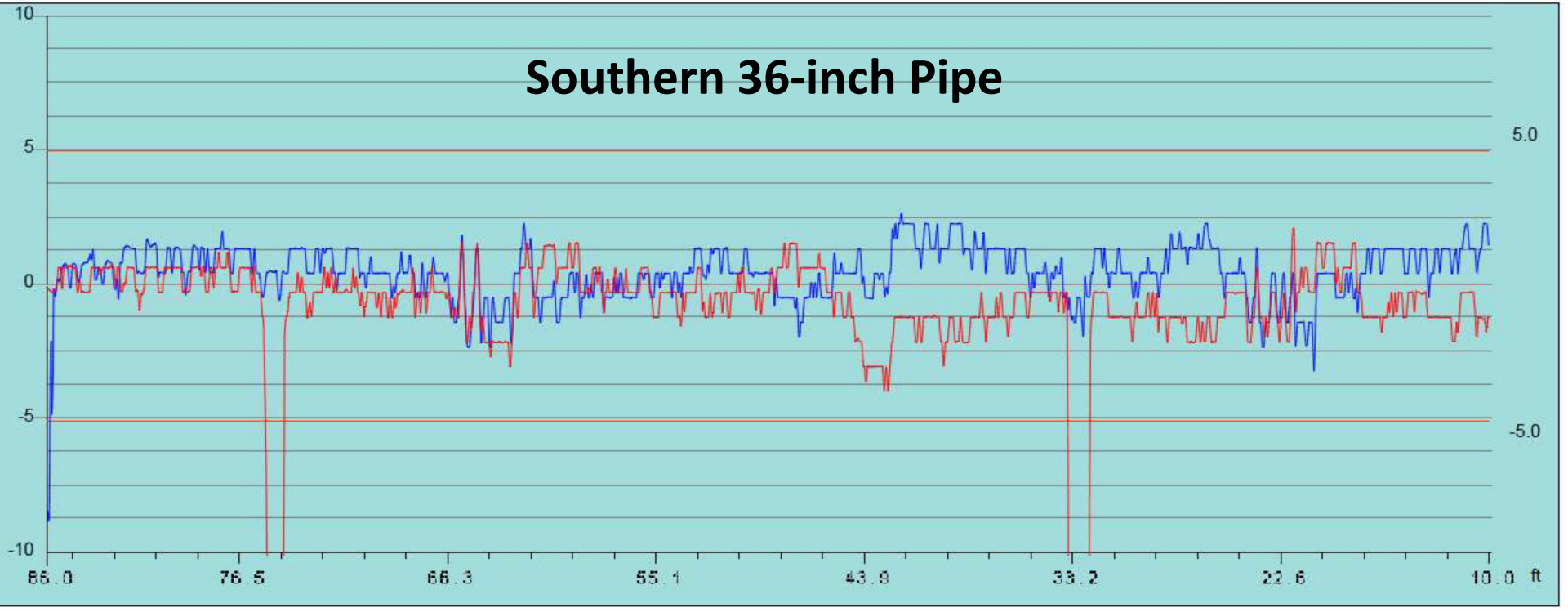
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 2.6%, Exceeded limits: 5.6%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



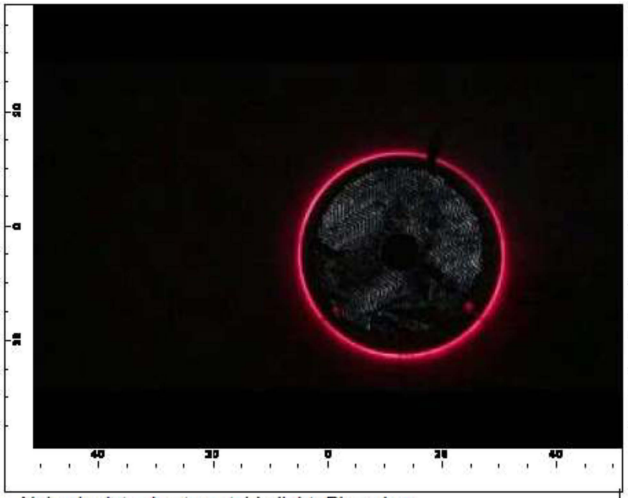

88.0 ft
62.0 ft
22.5 ft


Southern 36-inch Pipe
10
5
0
-5
-10
5.0
-5.0
88.0
76.5
66.3
55.1
43.9
33.2
22.6
10.0
ft

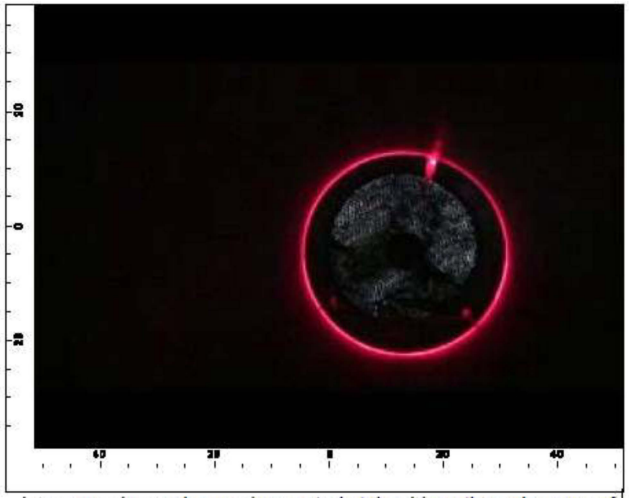
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

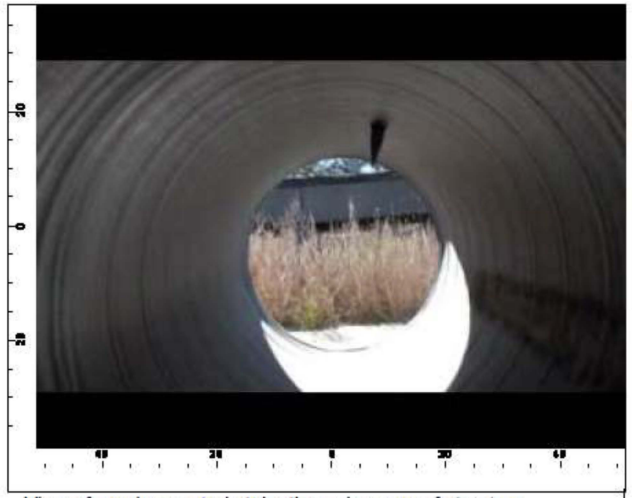
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



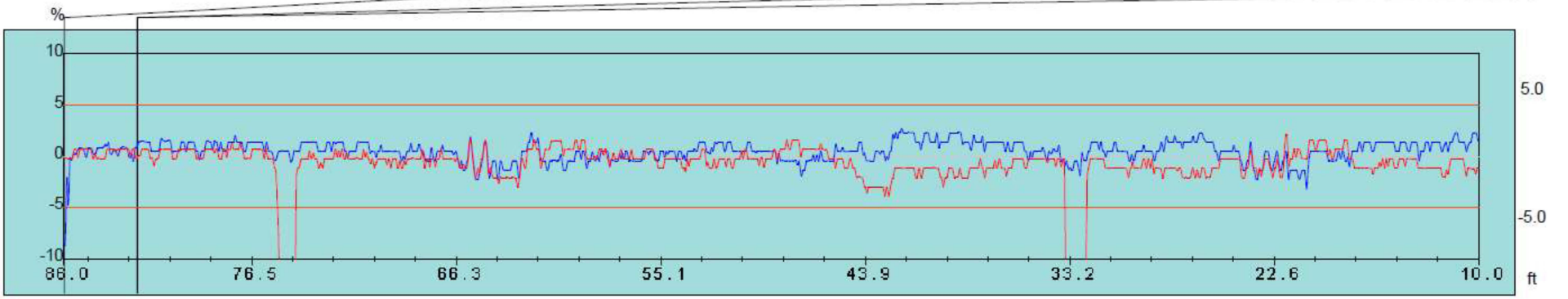
Noise in data due to outside light. Pipe okay.



Laser passing under erosion control stake driven through crown of pipe.



View of erosion control stake through crown of structure.

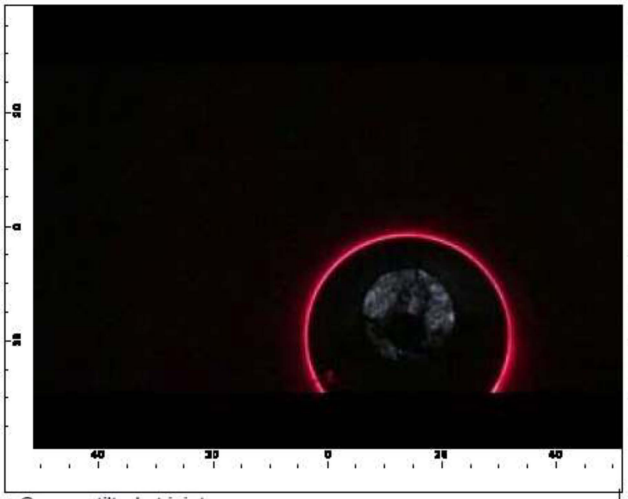


90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%

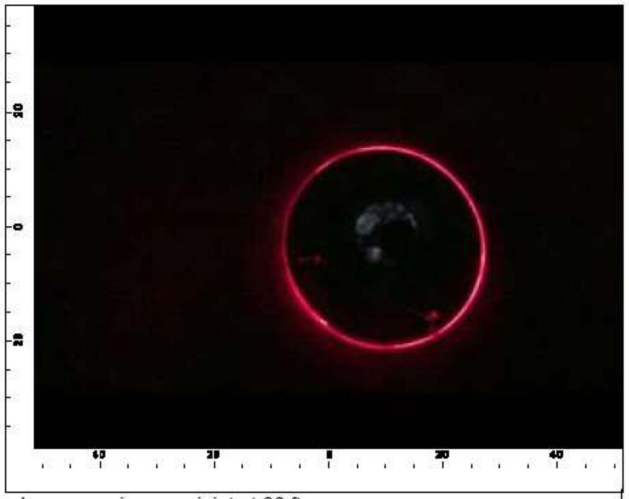
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

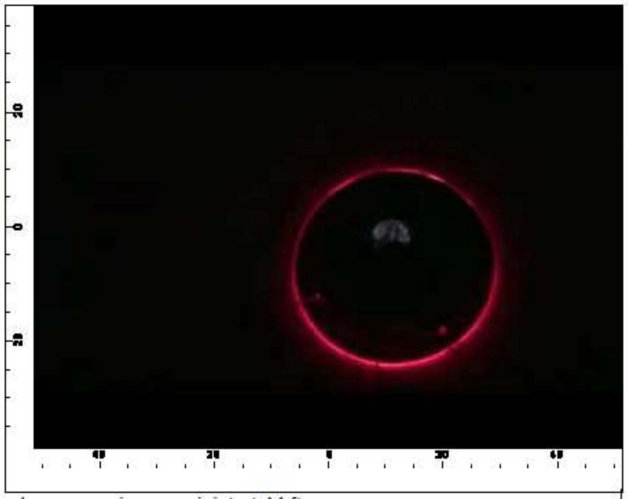
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



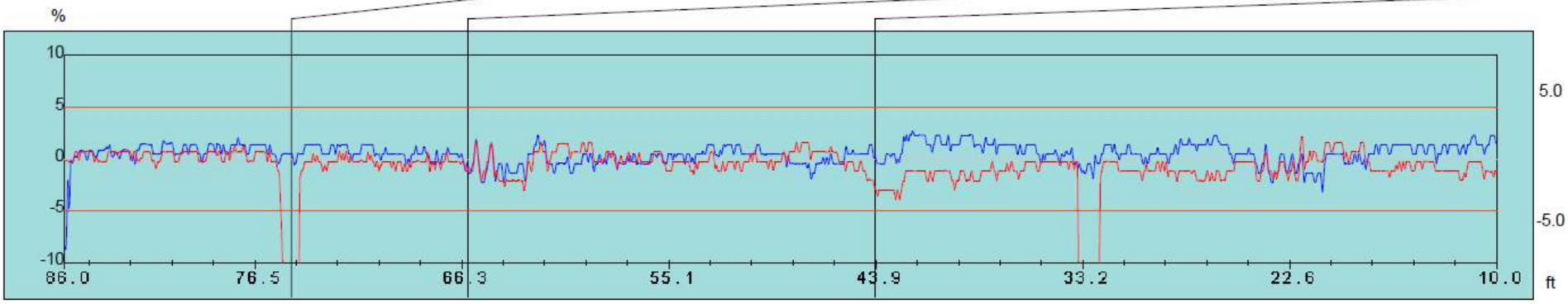
Camera tilted at joint



Laser passing over joint at 66 ft.



Laser passing over joint at 44 ft.

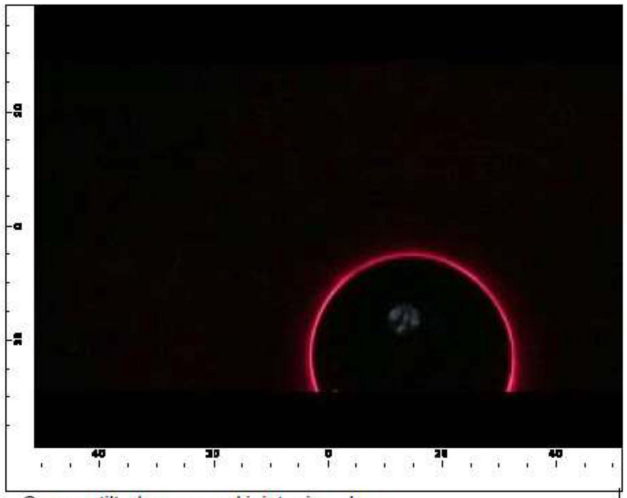


90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%

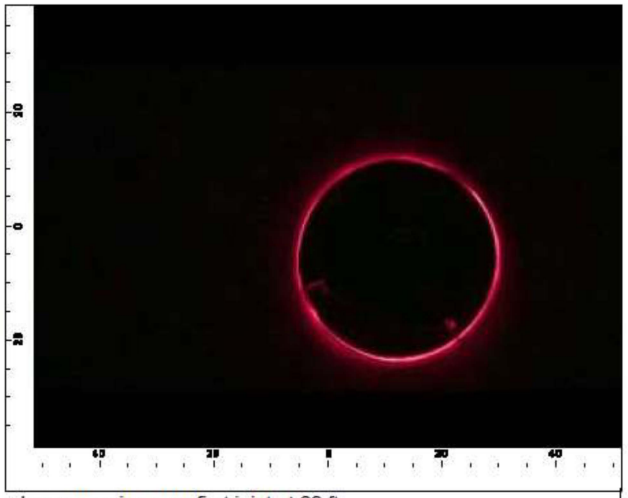
XY Diameter Observations Report

MP 123, I-25, DuroMaxx Installation, Fountain, Colorado (Southern Pipe)

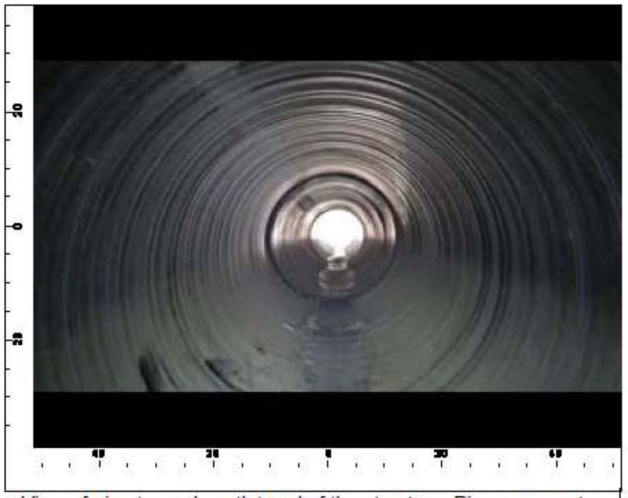
Site ID		Asset No.	I-25, MP 123	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Southern Pipe	Finish No	Southern Pipe	Pipeline Length	88 ft
Location	Outlet	Location	Inlet	Internal Diameter (Expected)	35.24 in



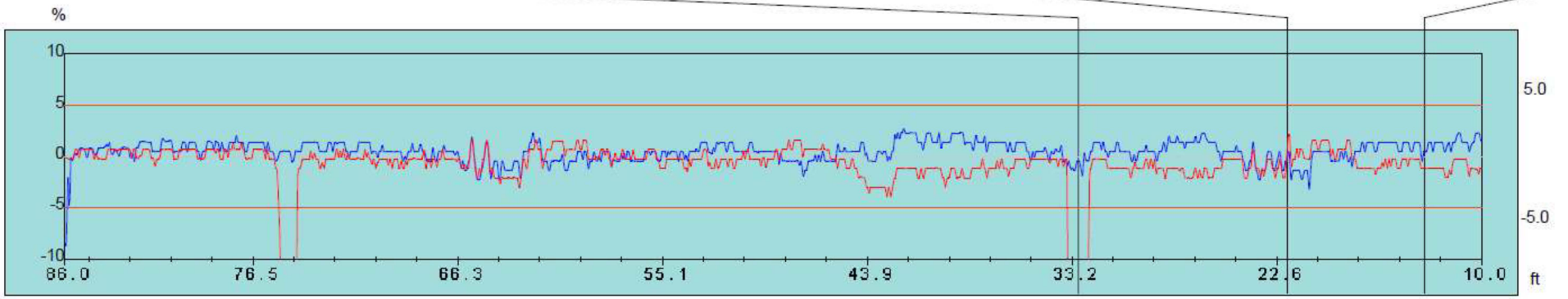
Camera tilted on second joint, pipe okay.



Laser passing over first joint at 22 ft.



View of pipe towards outlet end of the structure. Pipe appears to be round and uniform.



90% - Fractile: (X) 1.4% : (Y) 0.7%, Exceeded limits: 2.9%

XY Diameter Summary Report

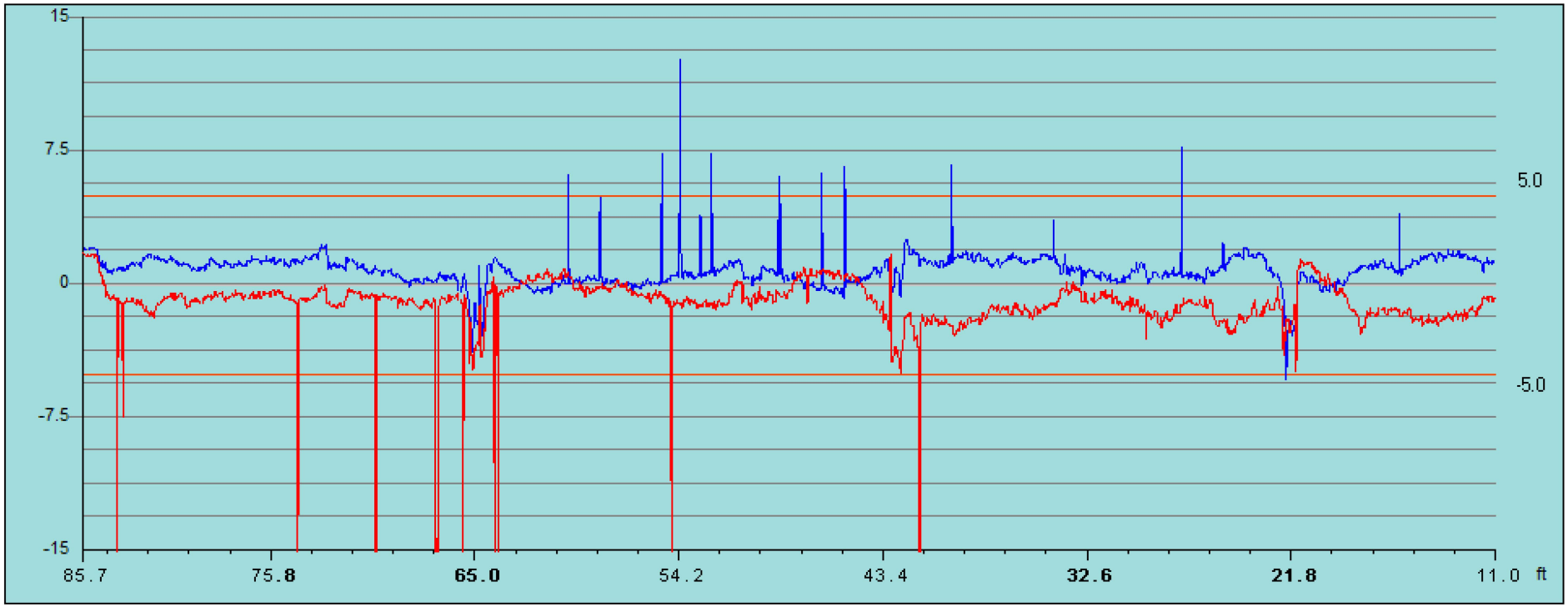
Pipe under 5.0% Deflection

Site ID		Asset No.	MP 123 South	Date	12/15/2016
City	Fountain			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	88 ft
Location		Location		Internal Diameter	35.39 in

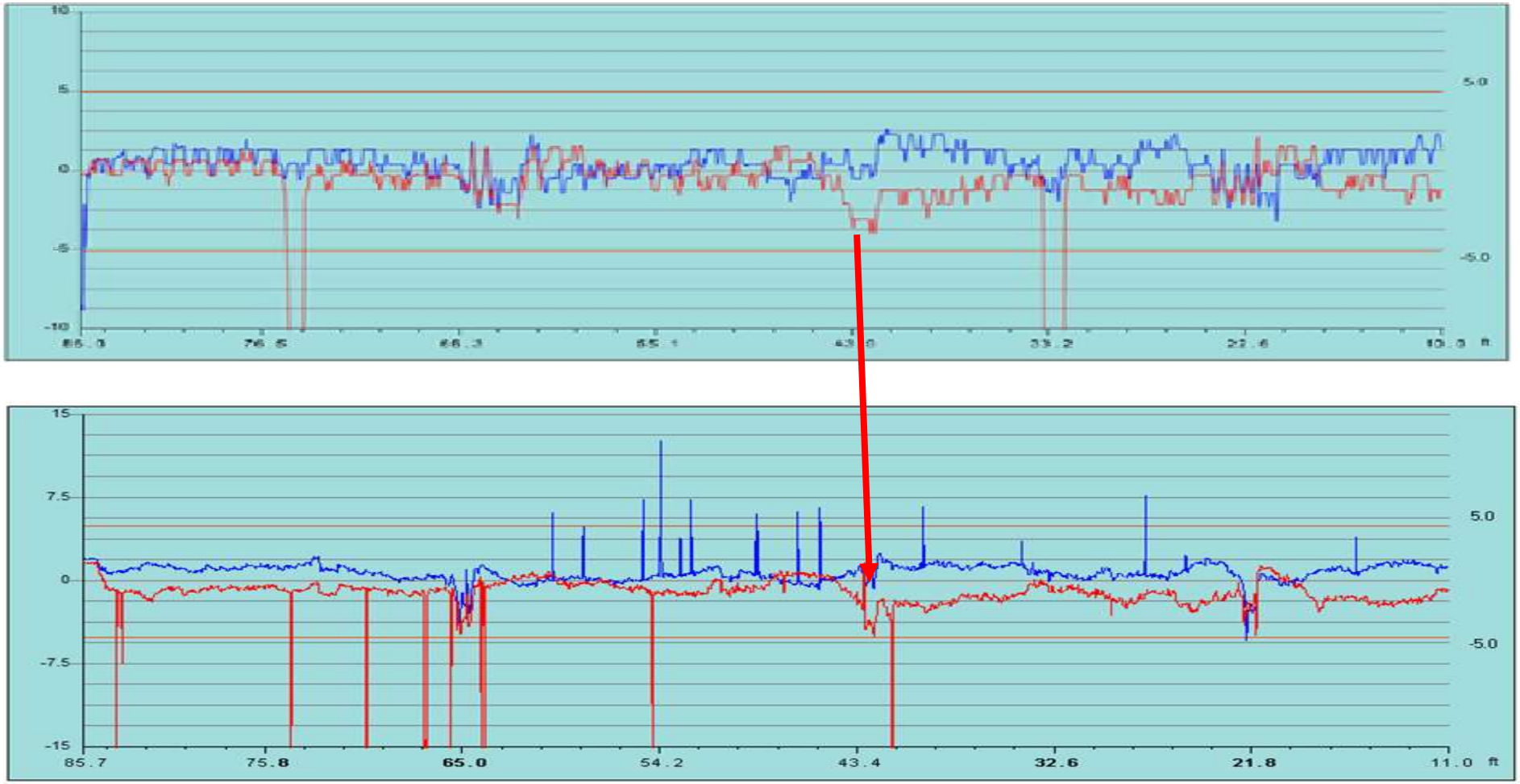
Comments

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 1.6% : (Y) 0.3%, Exceeded limits: 1.5%



Performance Summary MP 123 (Southern Pipe)



Minor punctures from construction stakes were still visible at the inlet end. Deflections are still below 5%. Some slight possible movement might have occurred around 44 ft.


MP 122.5, I-25, 48-Inch DuroMaxx

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122.5
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection

(22.0) GO - General Observation Remark: View of first joint at approx 22 ft.

(44.0) GO - General Observation Remark: View of second joint at approx. 44 ft.

(66.0) GO - General Observation Remark: View of third joint at approx. 66 ft.

(88.0) GO - General Observation Remark: View of fourth joint at approx. 88 ft.

(102.0) EI - End Inspection

Total Distance: 0

ID Number: Inlet

Created with the POSM report generator

POSMSOFTWARE

Project Name: MP 122.5 Fountain Colorado	
Date: 12/5/2016	Pipe ID:
Asset Location:	Start ID: Outlet
Length Surveyed: 96.3	End ID: Inlet
Run Number:	Direction: Upstream
Pipe Size: 48-inch	Pipe Type: DuraMaxx

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Inlet

(0.0) SI - Start Inspection

(1.4) - Puncture in crown of pipe

(14.7) - View down barrel

(18.3) - Joint

(32.2) - View down barrel

(39.2) - Joint

(61.2) - Joint

(67.0) - View down barrel

(76.5) - Pipe appears slightly deflected

(86.5) - Joint

(96.3) EI - End Inspection

Total Distance: 96.3

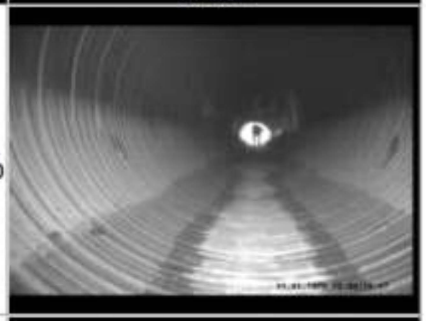
ID Number: Outlet

Created with the POSM report generator Back

Project Name: I-25, Fountain, Colorado

Date: 9/30/2013
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122.5
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

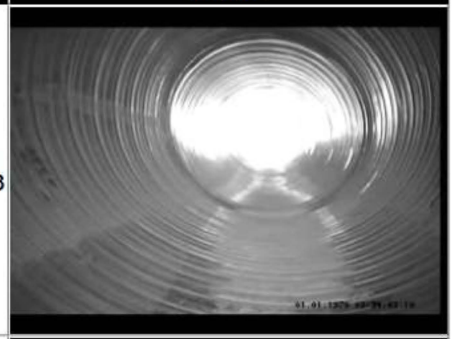
Distance	Fault Observation	Time	Picture
2.0	Start Inspection	04:18 00:00:00	
22.0	General Observation Remarks: View of first joint at approx 22 ft.	06:09 00:00:48	
44.0	General Observation Remarks: View of second joint at approx. 44 ft.	07:51 00:01:24	

POSMSOFTWARE

Project Name: MP 122.5 Fountain Colorado

Date: 12/5/2016	Pipe ID:
Asset Location:	Start ID: Outlet
Length Surveyed: 96.3	End ID: Inlet
Run Number:	Direction: Upstream
Pipe Size: 48-inch	Pipe Type: DuraMaxx

Distance	Fault Observation	Picture
0.0	Start Inspection	
1.4	Puncture in crown of pipe	
14.7	View down barrel	
18.3	Joint	
32.2	View down barrel	

Distance	Fault Observation	Time	Picture
66.0	General Observation Remarks: View of third joint at approx. 66 ft.	10:39 00:01:53	
88.0	General Observation Remarks: View of fourth joint at approx. 88 ft.	11:51 00:02:27	
102.0	End Inspection	13:12 00:03:15	

Created with the POSM report generator

Distance	Fault Observation	Picture
39.2	Joint	
61.2	Joint	
67.0	View down barrel	
76.5	Pipe appears slightly deflected	
86.5	Joint	
96.3	End Inspection	

Created with the POSM report generator Back

XY Diameter Summary Report

Pipe under 5% deflection, spikes in data due to camera tilting at joint

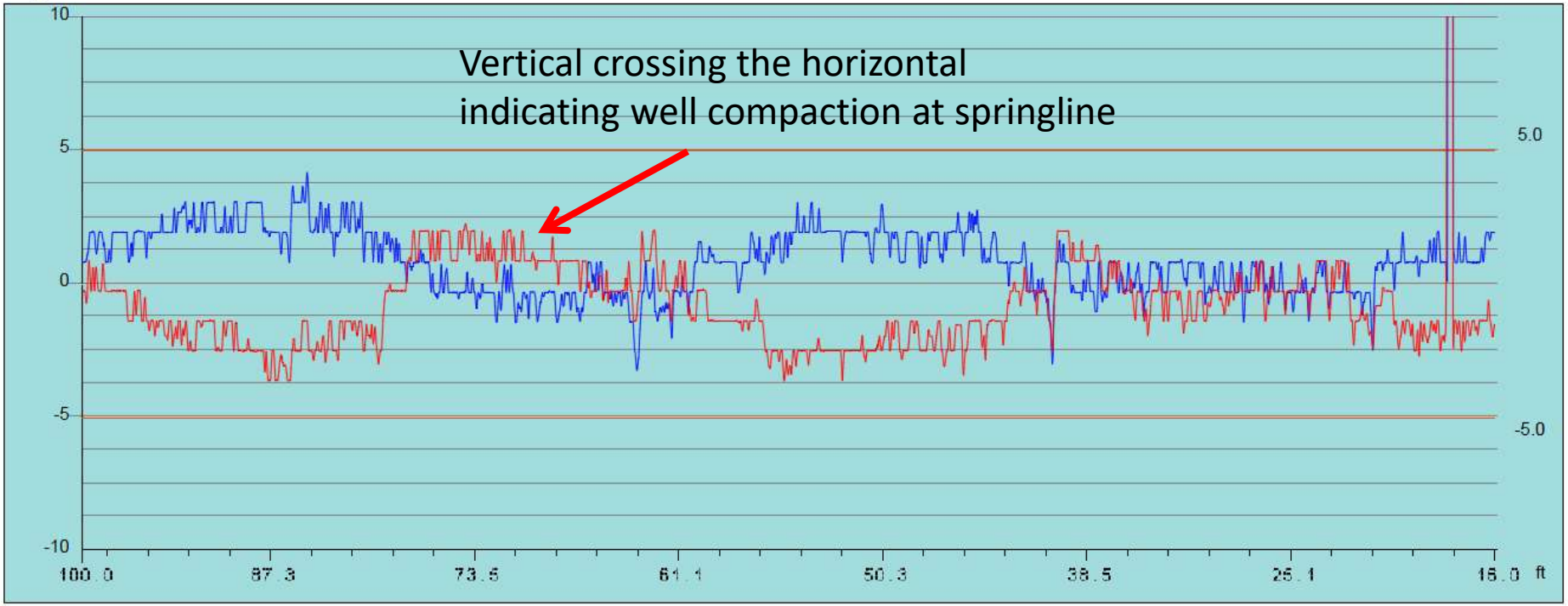
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

Comments

I-25, MP 122.5, 48-inch DuroMaxx

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.2% : (Y) 0.9%, Exceeded limits: 0.3%



XY Deflection Summary Report

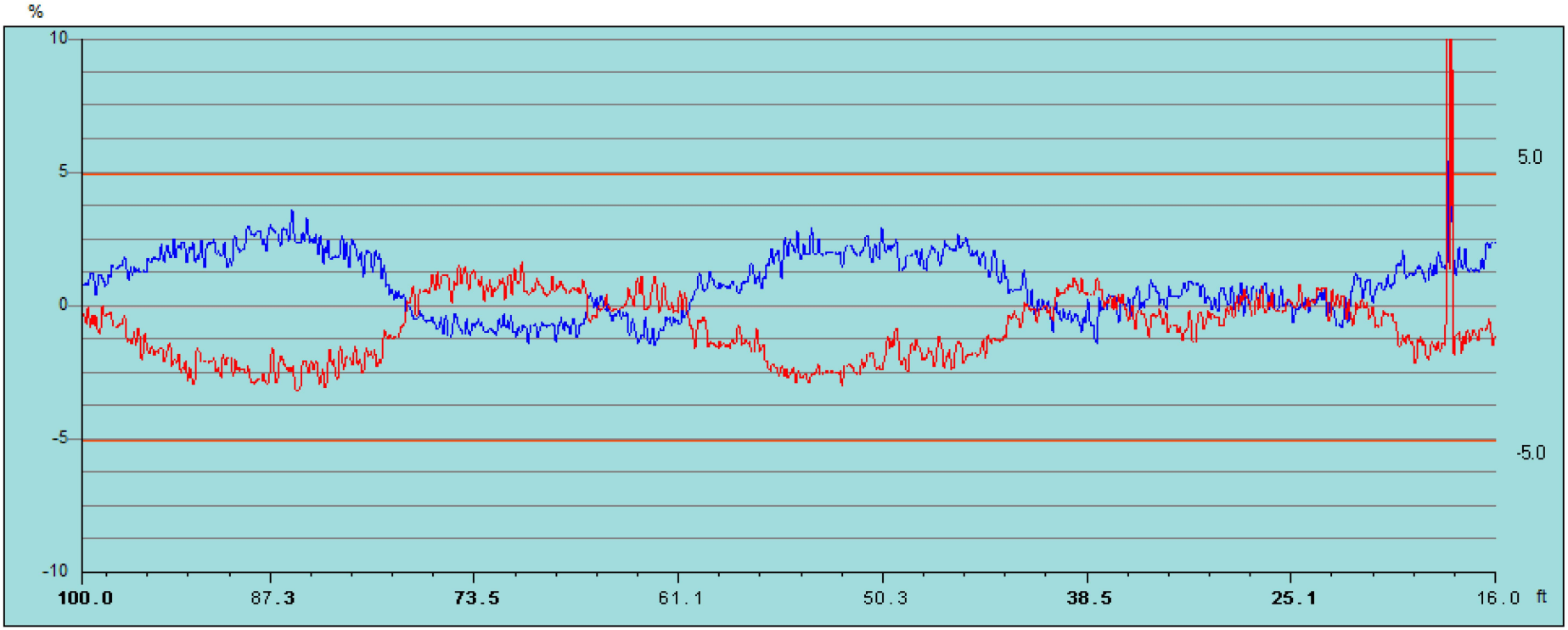
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

Comments

I-25, MP 122.5, 48-inch DuroMaxx

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality under 5%, spikes due to camera going over joint

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in

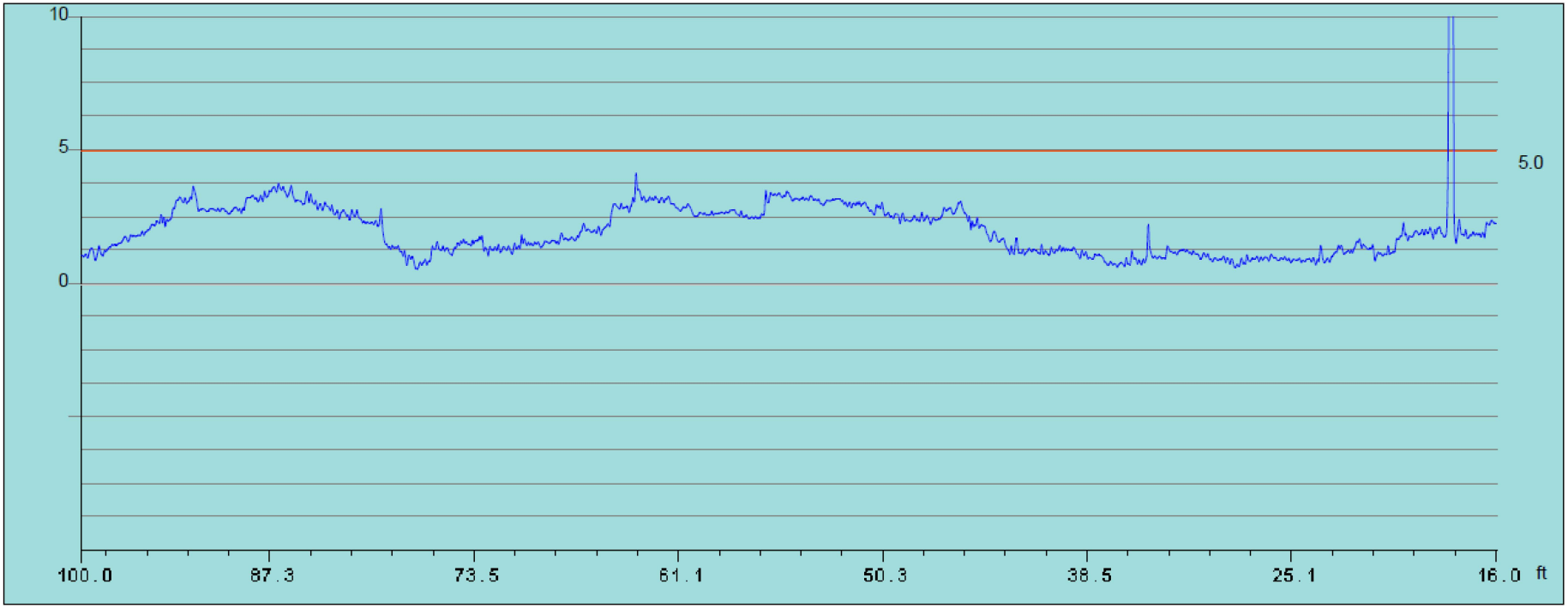
Comments

I-25, MP 122.5, 48-inch DuroMaxx

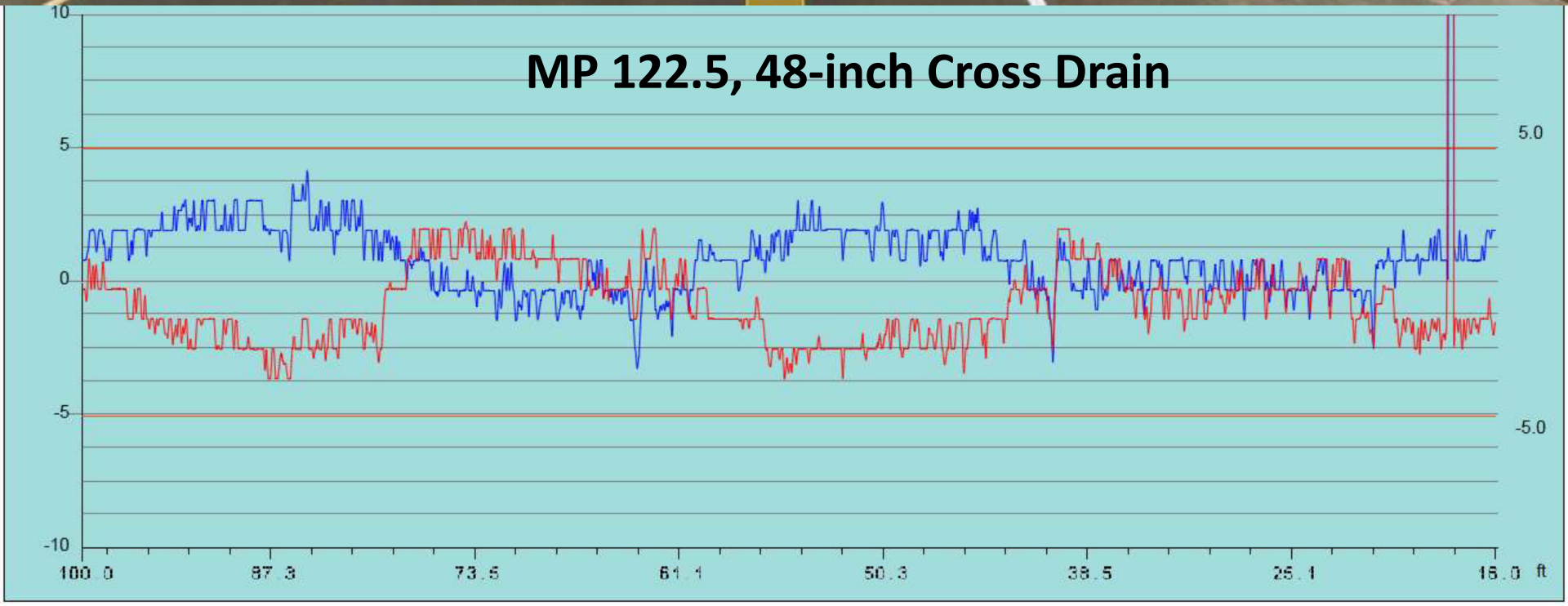
Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 3.2%, Exceeded limits: 0.3%

Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



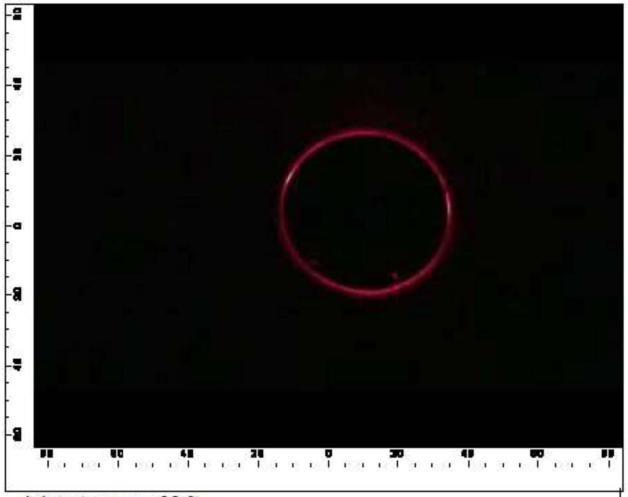

74 ft
33 ft


MP 122.5, 48-inch Cross Drain
10
5
0
-5
-10
5.0
-5.0
100.0
87.3
73.5
61.1
50.3
38.5
26.1
16.0
ft

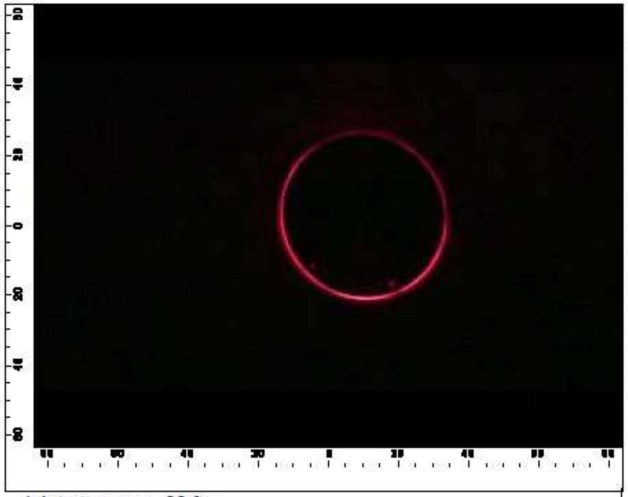
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

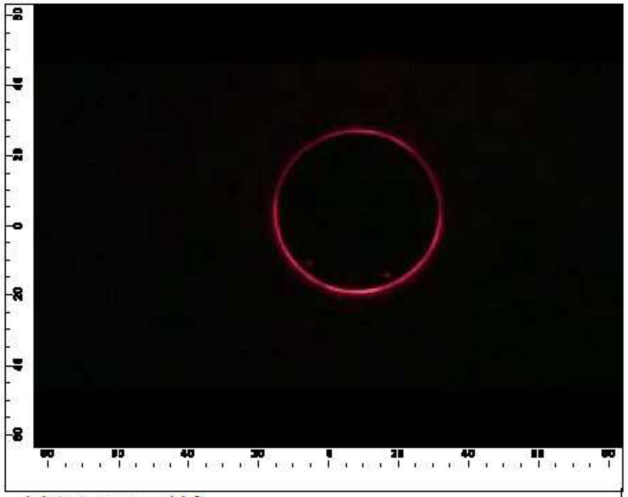
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



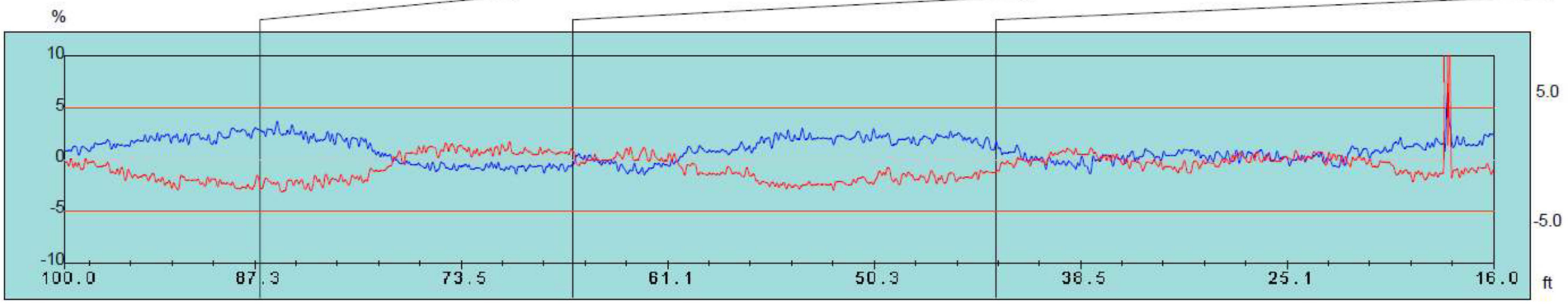
Joint at approx 88 ft.



Joint at approx. 66 ft.



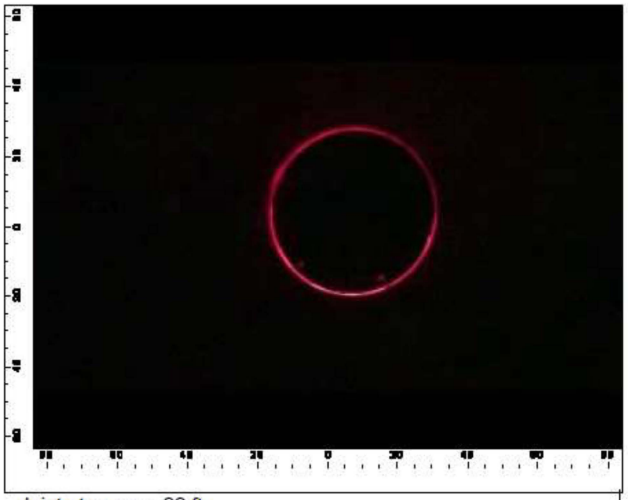
Joint at approx. 44 ft.



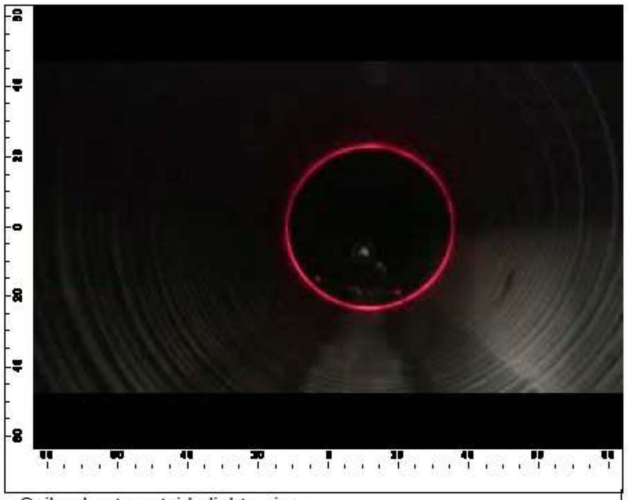
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

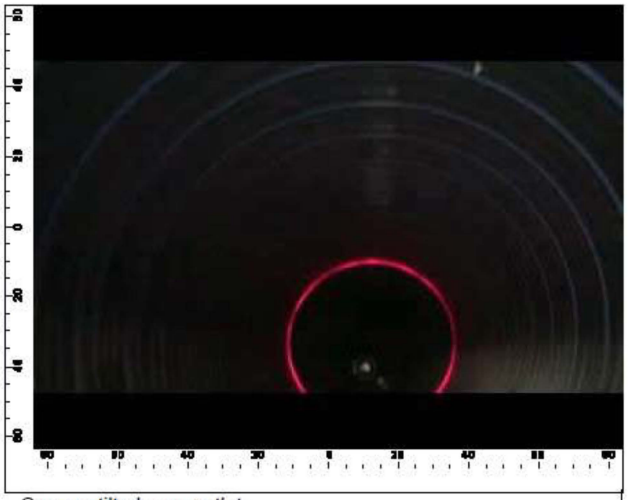
Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



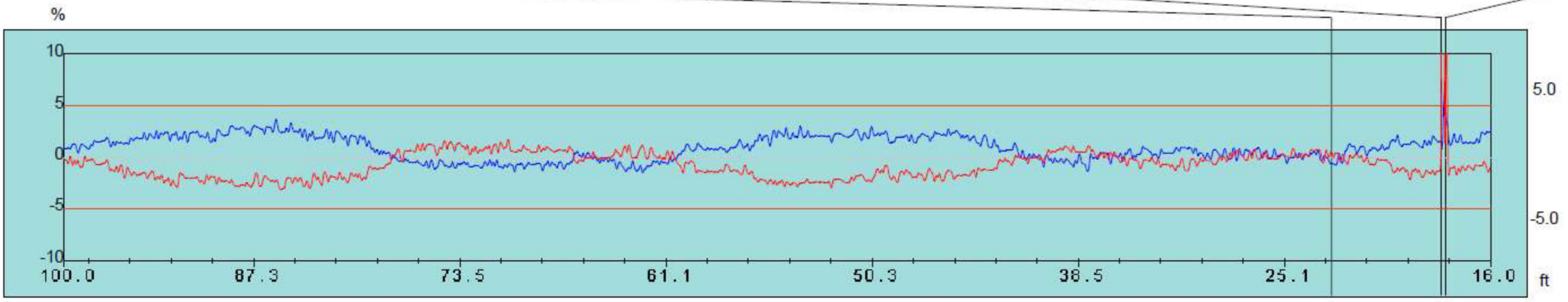
Joint at approx. 22 ft.



Spike due to outside light noise.



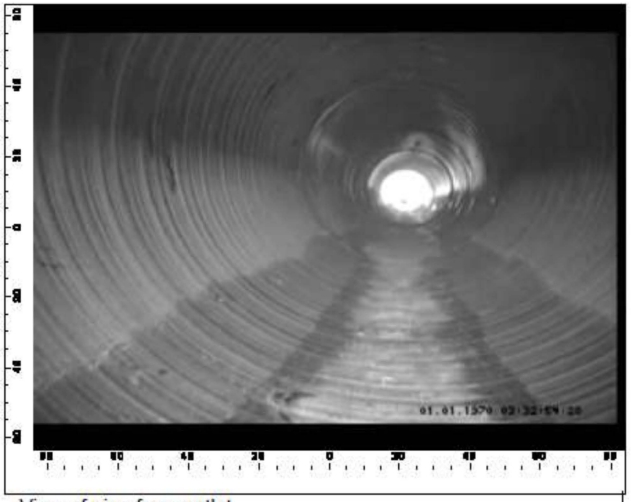
Camera tilted near outlet



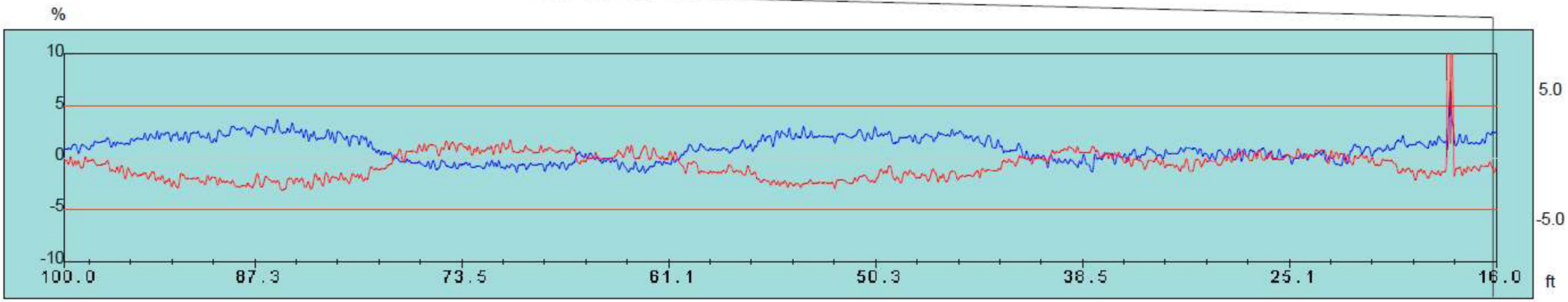
XY Deflection Observations Report

MP 122.5, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 122.5	Date	9/30/2013
City	Fountain, Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	102 ft
Location	MP 122.5	Location	MP 122.5	Internal Diameter (Expected)	46.92 in



View of pipe from outlet

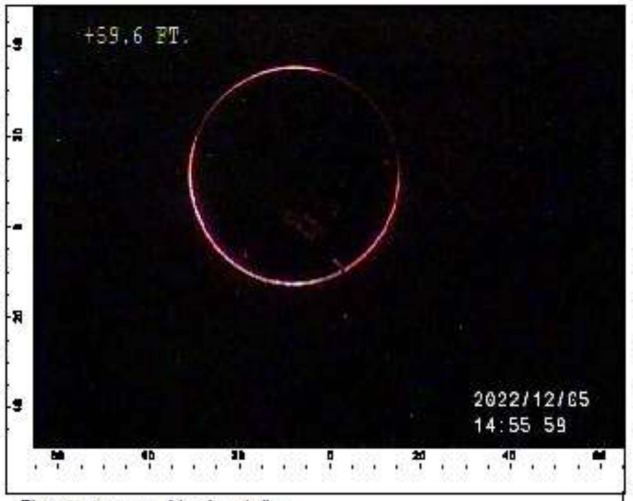


XY Diameter Observations Report

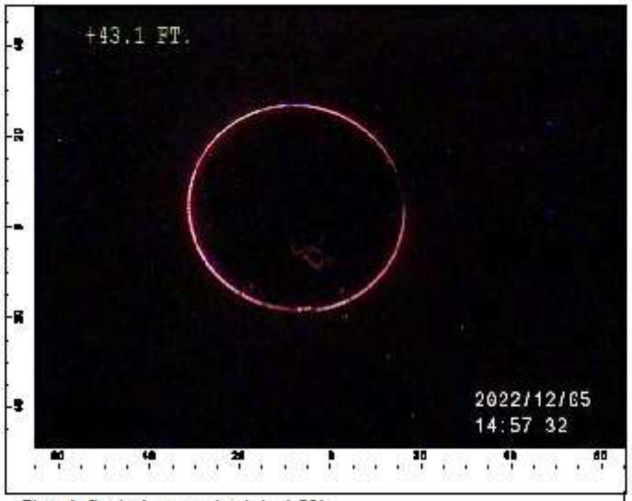
Pipe Deflected Approximately 4.6%

Site ID		Asset No.	MP 122.5	Date	12/15/2016
City	Fountain			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	96.3 ft
Location		Location		Internal Diameter	47.13 in

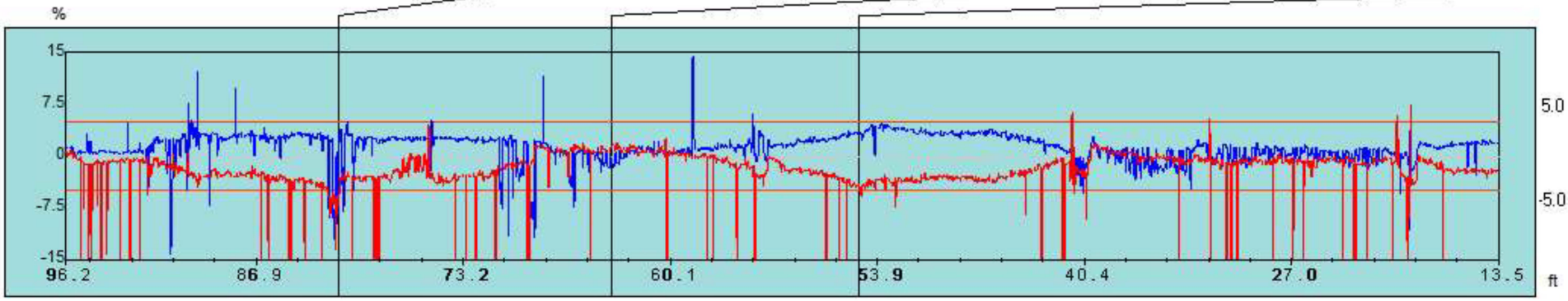
Tractor Bouncing causing scatter in data.



Pipe compressed horizontally

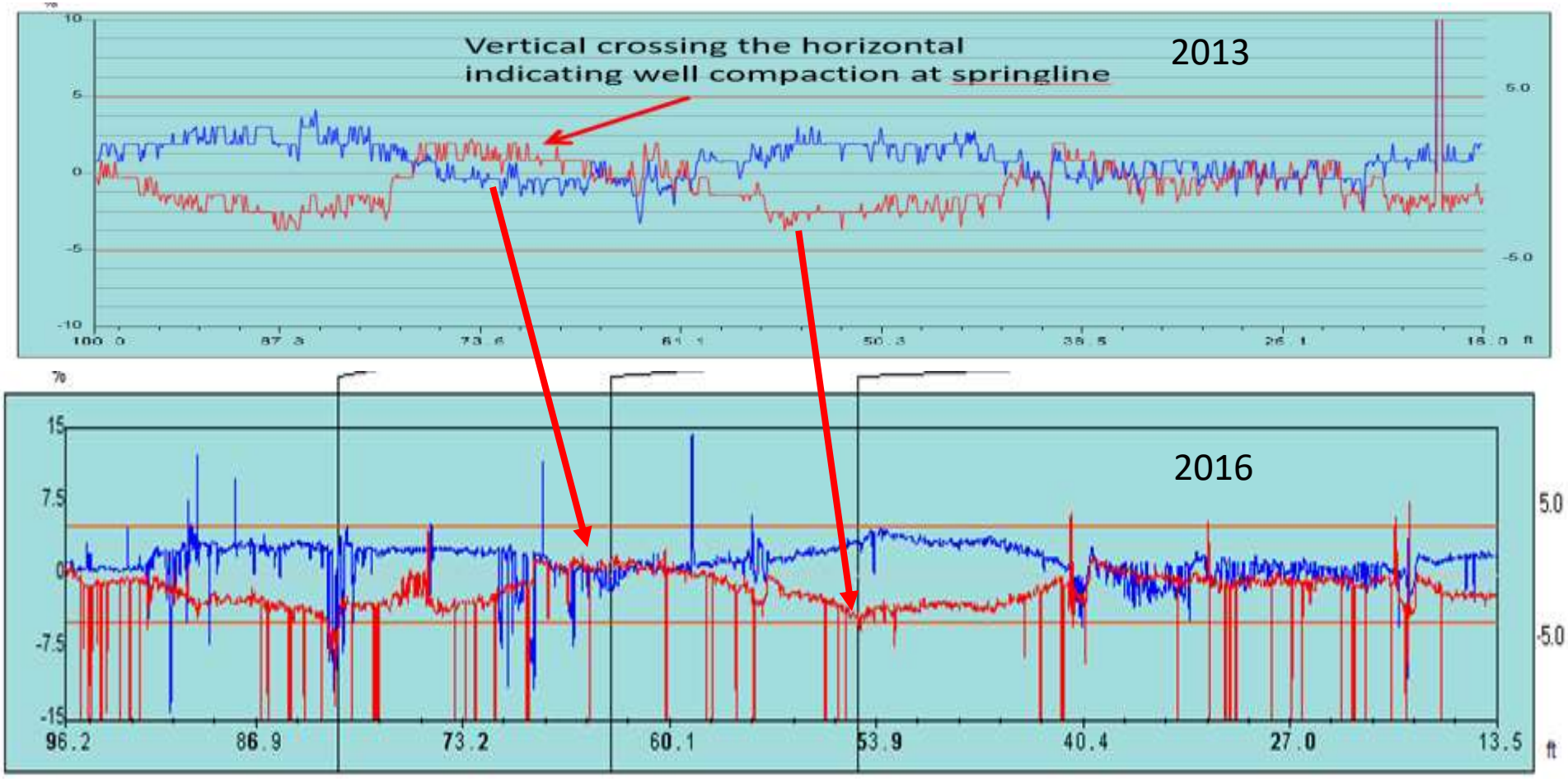


Pipe deflected approximately 4.6%.



90% - Fractile: (X) 3.2% : (Y) 0.5%, Exceeded limits: 6.1%

Performance Summary MP 122.5



Minor puncture was noted near the outlet end during the 2016 inspection that was not documented during the 2013 inspection. Deflection is still under 5%, but it appears that additional deflection has occurred in the center of the structure since the 2013 inspection.


MP 122, I-25, 48-Inch DuroMaxx

Project Name: I-25, Fountain, Colorado

Date:
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

ID Number: Outlet

(2.0) SI - Start Inspection

(8.0) GO - General Observation Remark: Pipe slightly racked, small puncture at crown from stake at 10 ft.

(26.0) GO - General Observation Remark: View of joint at 26 ft.

(46.0) GO - General Observation Remark: View of joint at 46 ft. Slight hump at right haunch.

(56.0) GO - General Observation Remark: Slight dent in invert at 56 ft.

(70.0) GO - General Observation Remark: View of joint at 70 ft.

(90.0) GO - General Observation Remark: Pipe slight racked in right crown.

(103.0) EI - End Inspection Remark: End inspection, view of laser skid at inlet.

Total Distance: 0

ID Number: Inlet

Created with the POSM report generator

POSMSOFTWARE

Project Name: MP 122 Fountain Colorado	
Date: 12/5/2016	Pipe ID:
Asset Location:	Start ID: Outlet
Length Surveyed: 98.2	End ID: Inlet
Run Number:	Direction: Upstream
Pipe Size: 48-inch	Pipe Type: DuraMaxx

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Inlet

(0.0) SI - Start Inspection

(1.6) GO - General Observation Remark: Noticeable deflection 2 O'clock

(14.3) GO - General Observation Remark: View down barrel

(22.7) - Joint

(39.0) GO - General Observation Remark: Pipe crown slightly wavey

(44.8) - Joint Remark: Joint

(66.1) - Joint Remark: Joint

(69.0) GO - General Observation Remark: View down barrel, dent and deflection visible

(73.5) - Dent Remark: Visible dent at 10 and 11 O'clock

(80.0) - Deflection

(88.0) - Joint

(98.2) EI - End Inspection

Total Distance: 98.2

ID Number: Outlet

Created with the POSM report generator Back

Project Name: I-25, Fountain, Colorado

Date:
Asset Location:
Distance: 0
Run Number:
Pipe Size: 48-inch

Pipe ID: MP 122
Start ID: Outlet
End ID: Inlet
Direction: Upstrm
Pipe Type: DuroMaxx

Distance	Fault Observation	Time	Picture
2.0	Start Inspection	43 00:00:00	
8.0	General Observation Remarks: Pipe slightly racked, small puncture at crown from stake at 10 ft.	02:30 00:00:43	
26.0	General Observation Remarks: View of joint at 26 ft.	12:08 00:01:27	

PDSMSOFTWARE

Project Name: MP 122 Fountain Colorado

Date: 12/5/2018	Pipe ID:
Asset Location:	Start ID: Outlet
Length Surveyed: 98.2	End ID: Inlet
Run Number:	Direction: Upstream
Pipe Size: 48-inch	Pipe Type: DuraMaxx

Distance	Fault Observation	Picture
0.0	Start Inspection	
1.6	General Observation Remarks: Noticeable deflection 2 O'clock	
14.3	General Observation Remarks: View down barrel	
22.7	Joint	
39.0	General Observation Remarks: Pipe crown slightly wavey	

Distance	Fault Observation	Time	Picture
46.0	General Observation Remarks: View of joint at 46 ft. Slight hump at right haunch.	14:40 00:02:17	
56.0	General Observation Remarks: Slight dent in invert at 56 ft.	16:11 00:02:33	
70.0	General Observation Remarks: View of joint at 70 ft.	17:18 00:03:03	

Distance	Fault Observation	Picture
44.8	Joint Remarks: Joint	
66.1	Joint Remarks: Joint	
69.0	General Observation Remarks: View down barrel, dent and deflection visible	
73.5	Dent Remarks: Visible dent at 10 and 11 O'clock	
80.0	Deflection	
88.0	Joint	

Distance	Fault Observation	Time	Picture
90.0	General Observation Remarks: Pipe slight racked in right crown.	18:41 00:03:48	
103.0	End Inspection Remarks: End inspection, view of laser skid at inlet.	21:21 00:04:14	

Created with the POSM report generator

Distance	Fault Observation	Picture
98.2	End Inspection	

Created with the POSM report generator Back

XY Diameter Summary Report

Pipe under 5% deflection in horizontal and vertical deflection plot

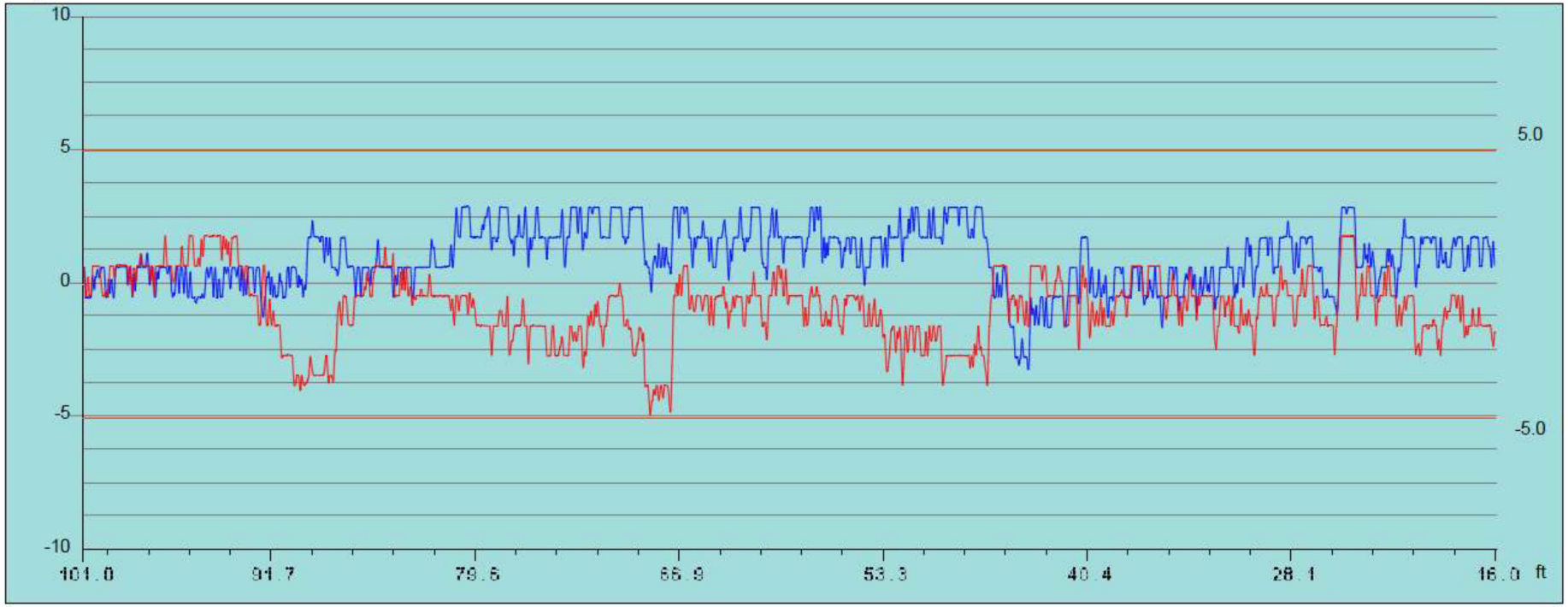
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5

90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%



XY Deflection Summary Report

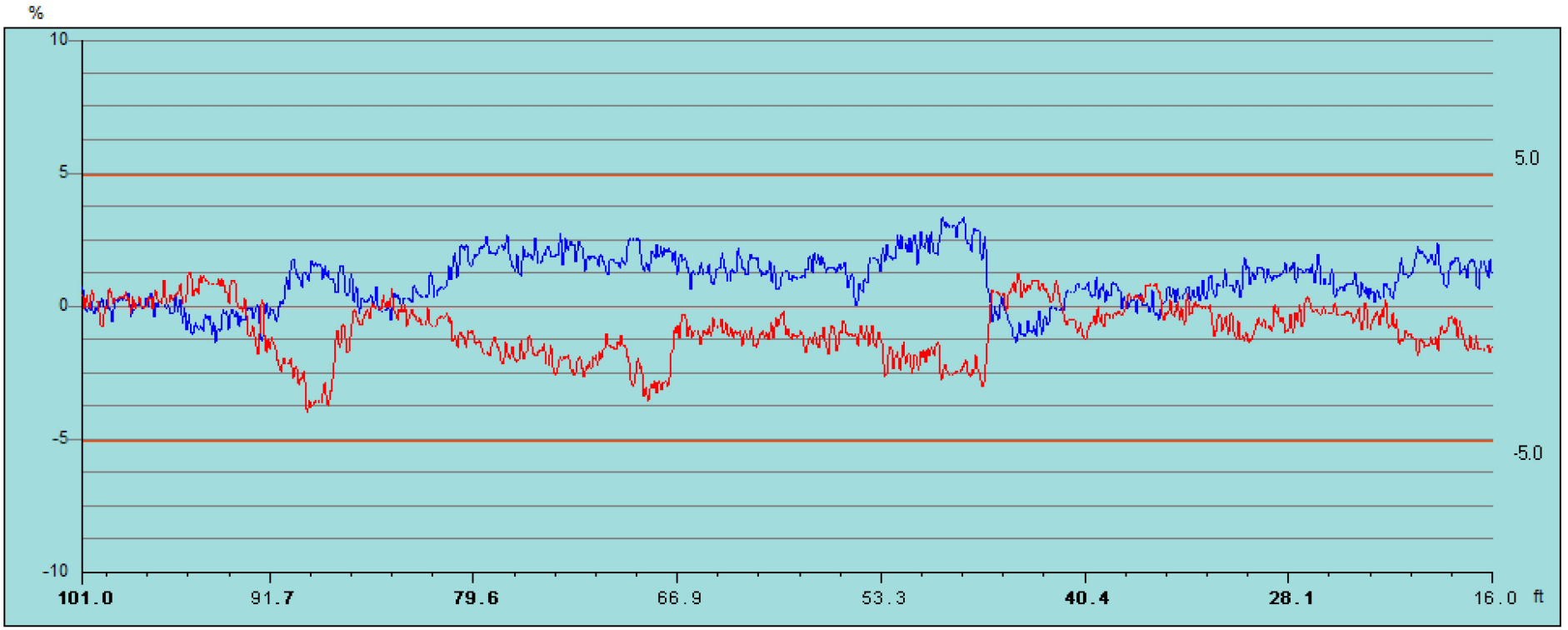
Pipe under 5% (Deflection based off Median I.D. per frame of video)

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= -5



Ovality Summary Report

Ovality slightly over 5% at 90 ft. Spike due to camera tilting at joint.

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

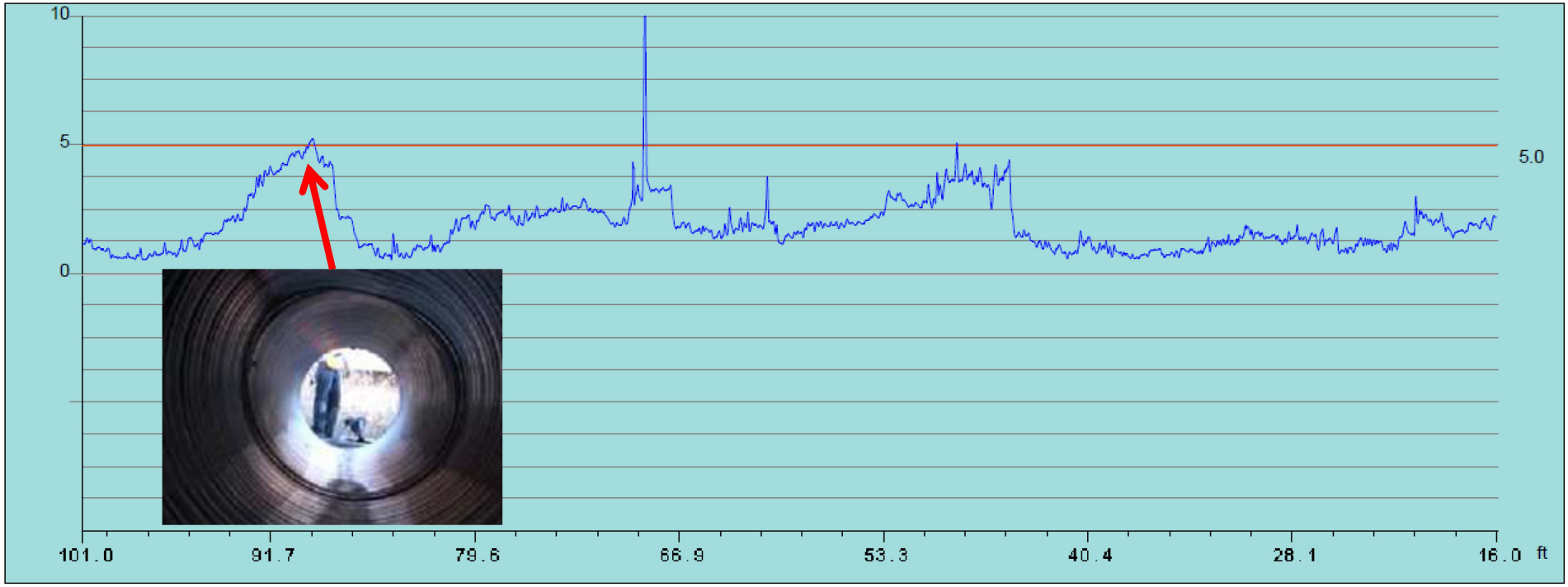
Comments

I-25, MP 122.0, 48-inch, DuroMaxx Cross Drain

Limit Lines
Upper limit = 5
Lower Limit= 5

90% - Fractile: 3.5%, Exceeded limits: 0.8%

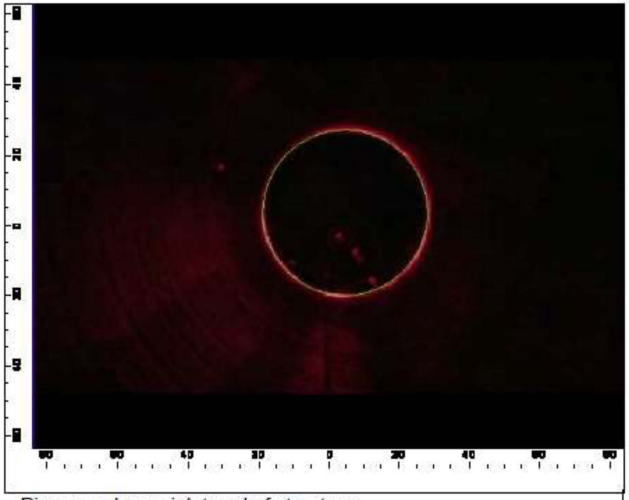
Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance



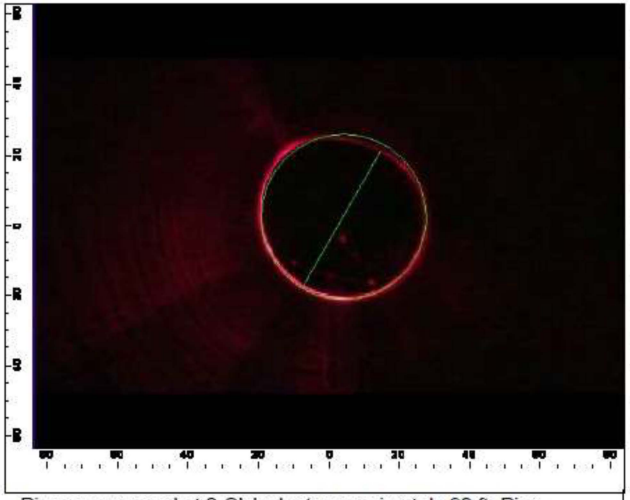
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

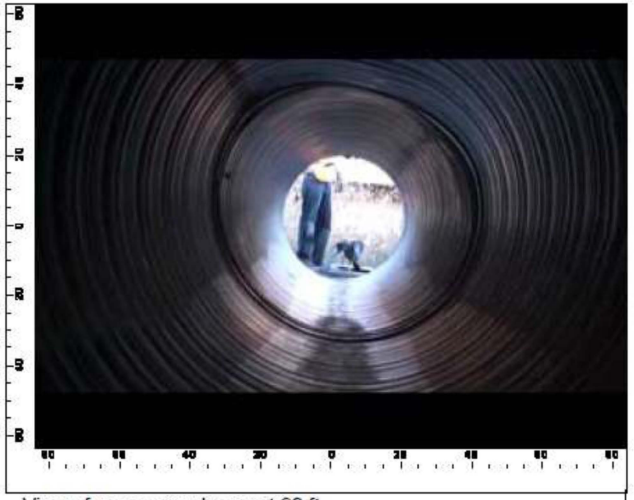
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in



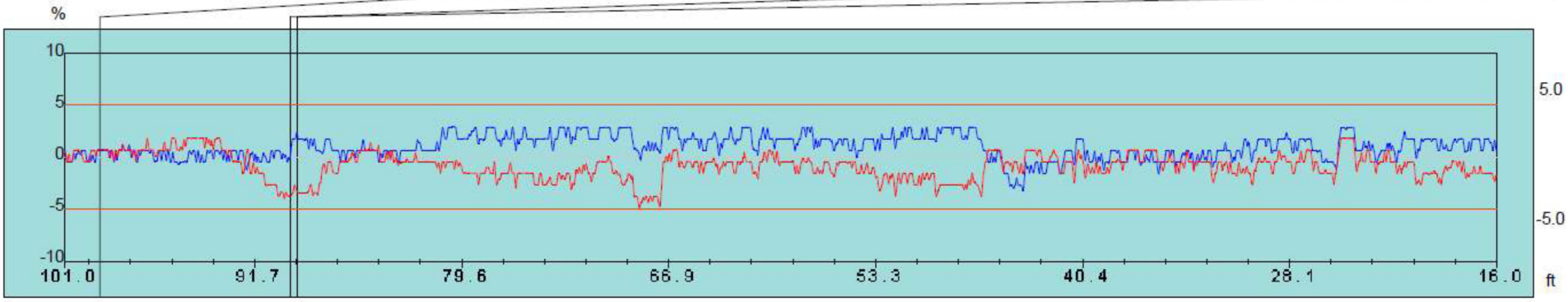
Pipe round near inlet end of structure.



Pipe compressed at 2 O'clock at approximately 90 ft. Pipe deflected approximately 5.3%.



View of compressed area at 90 ft.

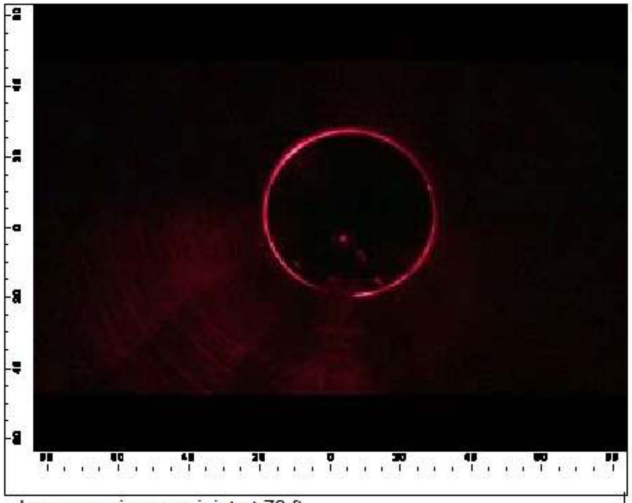


90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

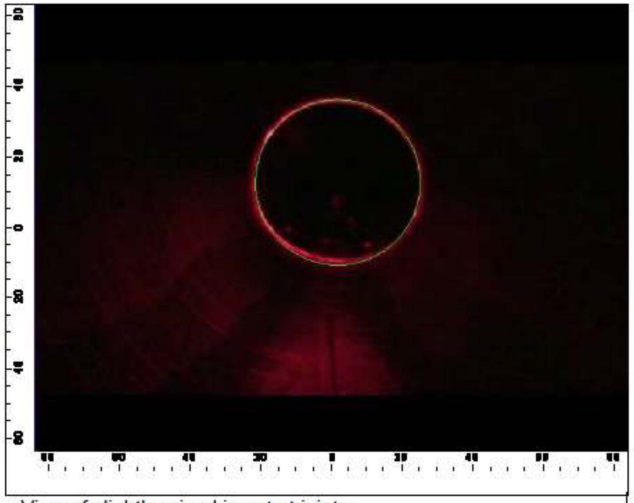
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

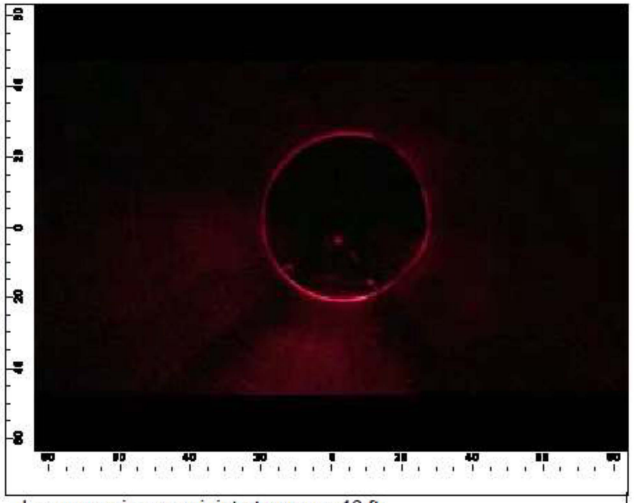
Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in



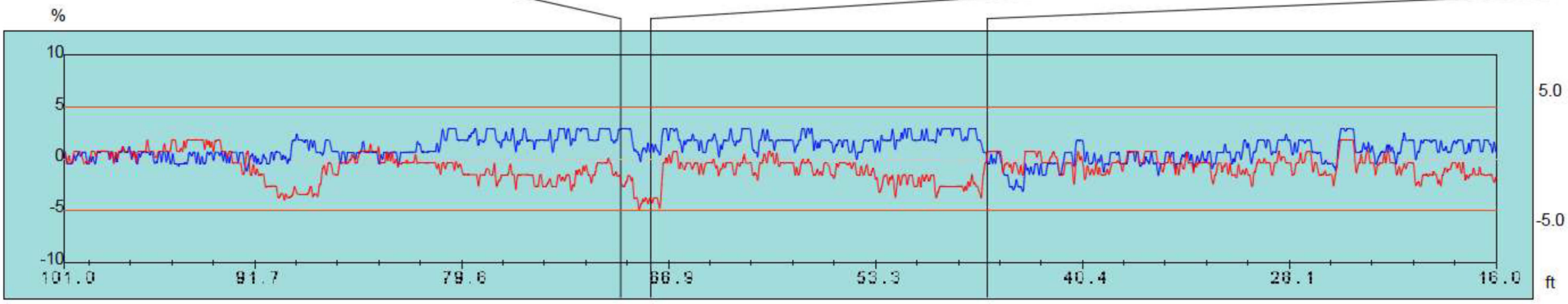
Laser passing over joint at 70 ft.



View of slightly raised invert at joint.



Laser passing over joint at approx. 46 ft.

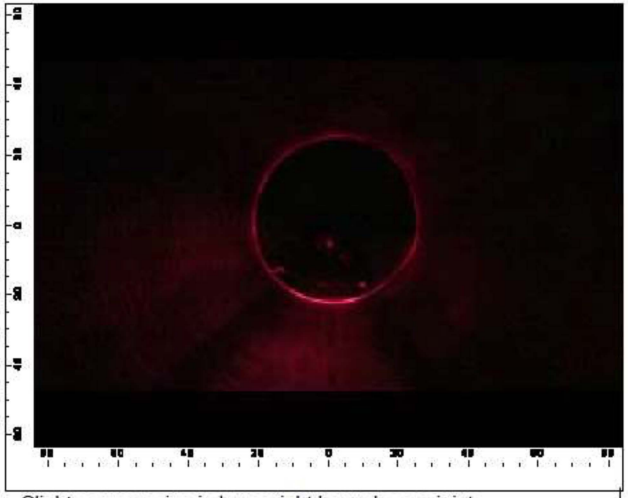


90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

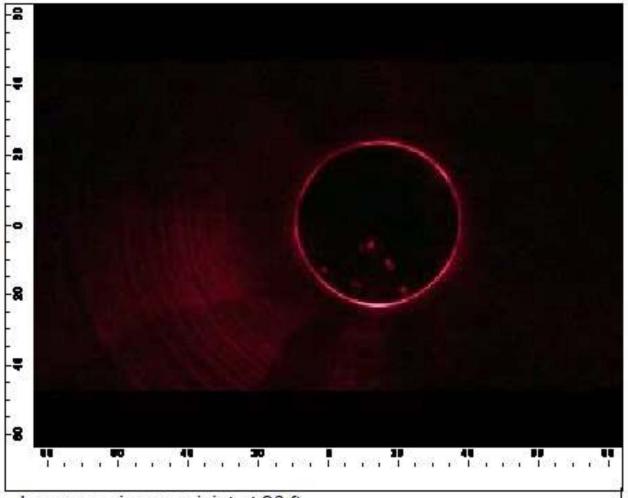
XY Diameter Observations Report

MP 122, I-25, DuroMaxx Installation, Fountain, Colorado

Site ID		Asset No.	I-25, MP 122.0	Date	9/30/2013
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	103 ft
Location	MP 122	Location	MP 122	Internal Diameter (Expected)	47.01 in

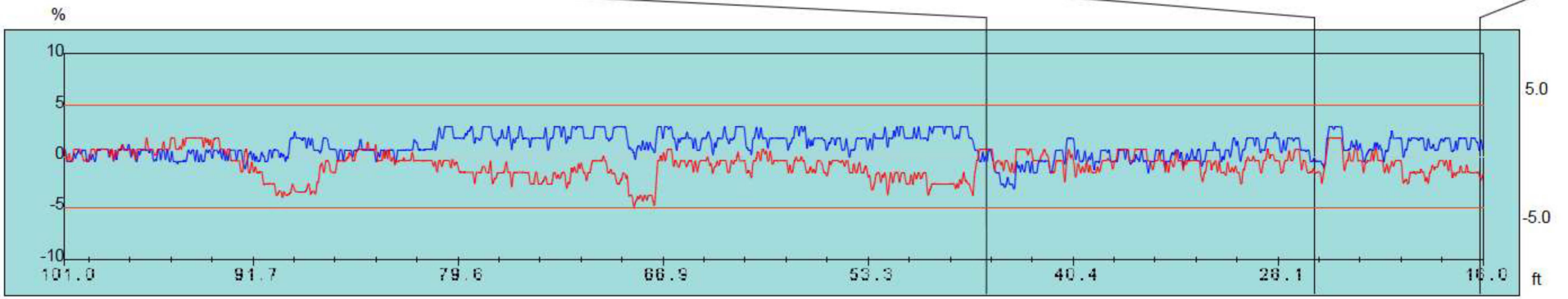


Slight compression in lower right haunch near joint.



Laser passing over joint at 26 ft.

View from outlet end, pipe slight racked near outlet end not caught by laser.



90% - Fractile: (X) 2.7% : (Y) 0.7%, Exceeded limits: 0.0%

Ovality Observations Report

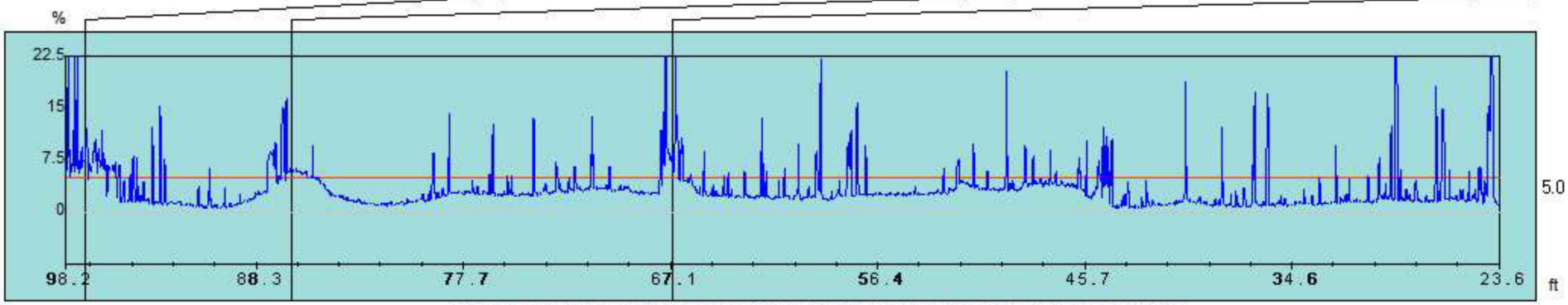
Pipe Deflected Approximately 5.8% at 87 ft.

Site ID		Asset No.	MP 122	Date	12/15/2016
City	Fountain Colorado			Material	DuroMaxx
Start No Location	Outlet	Finish No Location	Inlet	Pipeline Length	100 ft
				Internal Diameter	47.43 in

Noise in data due to outside light.

Pipe deflected approximately 5.8%.

Low laser light in invert causing spike in data.



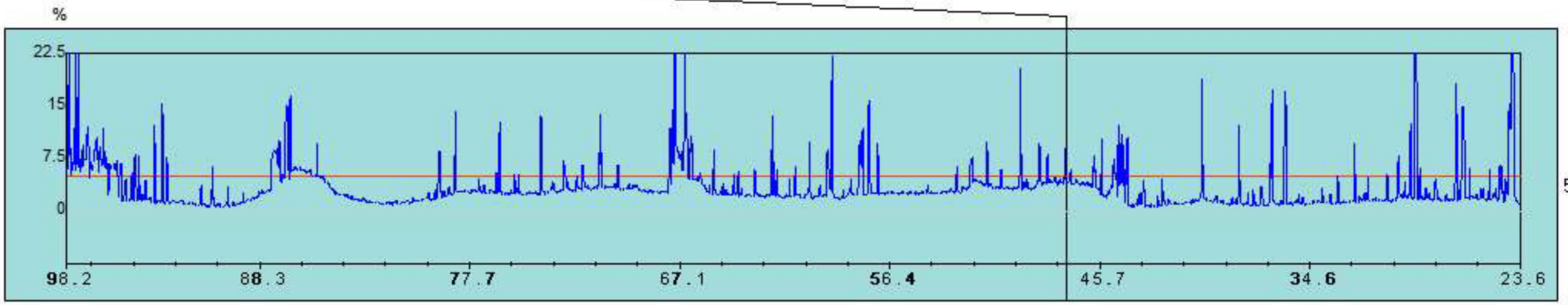
Ovality 'q' (as per ASTM F 1216 Standard Practice) as a percentage of original pipe versus distance

90% - Fractile: 6.2%, Exceeded limits: 14.8%

Ovality Observations Report

Site ID		Asset No. MP 122	Date 12/15/2016
City	Fountain Colorado		Material DuroMaxx
Start No Location	Outlet	Finish No Location	Inlet	Pipeline Length	100 ft
			Internal Diameter	47.43 in

Pipe slightly racked.



90% - Fractile: 6.2%, Exceeded limits: 14.8%

XY Diameter Observations Report

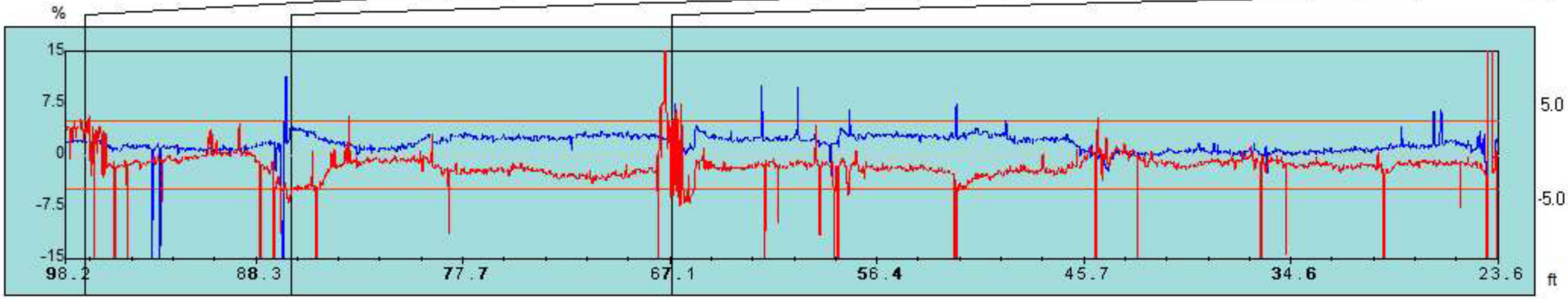
Pipe Deflected Approximately 5.8%

Site ID		Asset No. MP 122	Date 12/15/2016
City	Fountain Colorado		Material DuroMaxx
Start No	Outlet	Finish No Inlet	Pipeline Length 100 ft
Location		Location	Internal Diameter 47.43 in

Noise in data due to outside light.

Pipe deflected approximately 5.8%.

Low laser light in invert causing spike in data.

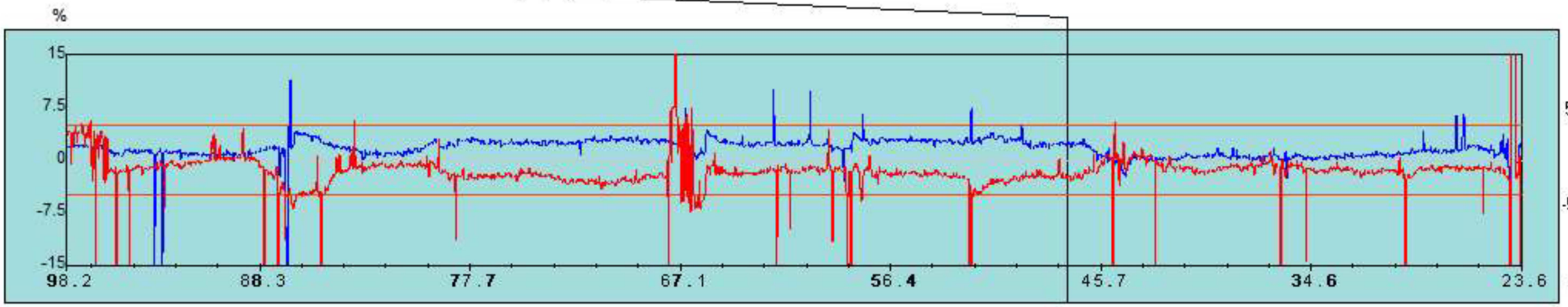


90% - Fractile: (X) 2.9% : (Y) 0.0%, Exceeded limits: 5.5%

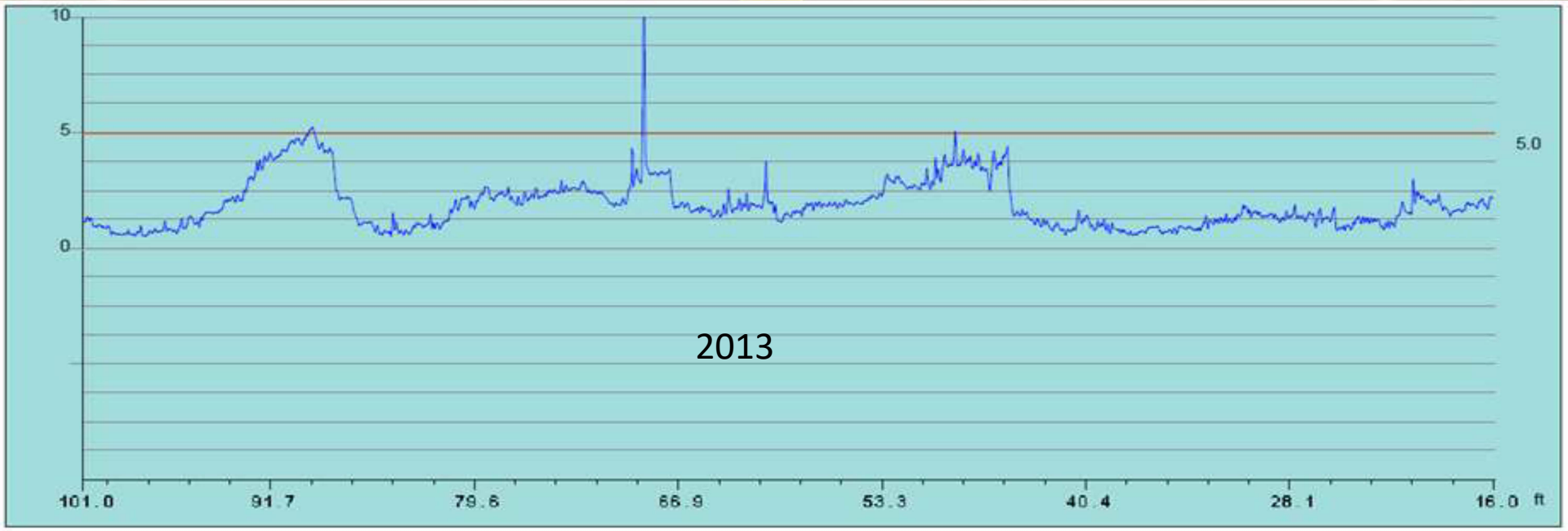
XY Diameter Observations Report

Site ID		Asset No.	MP 122	Date	12/15/2016
City	Fountain Colorado			Material	DuroMaxx
Start No	Outlet	Finish No	Inlet	Pipeline Length	100 ft
Location		Location		Internal Diameter	47.43 in

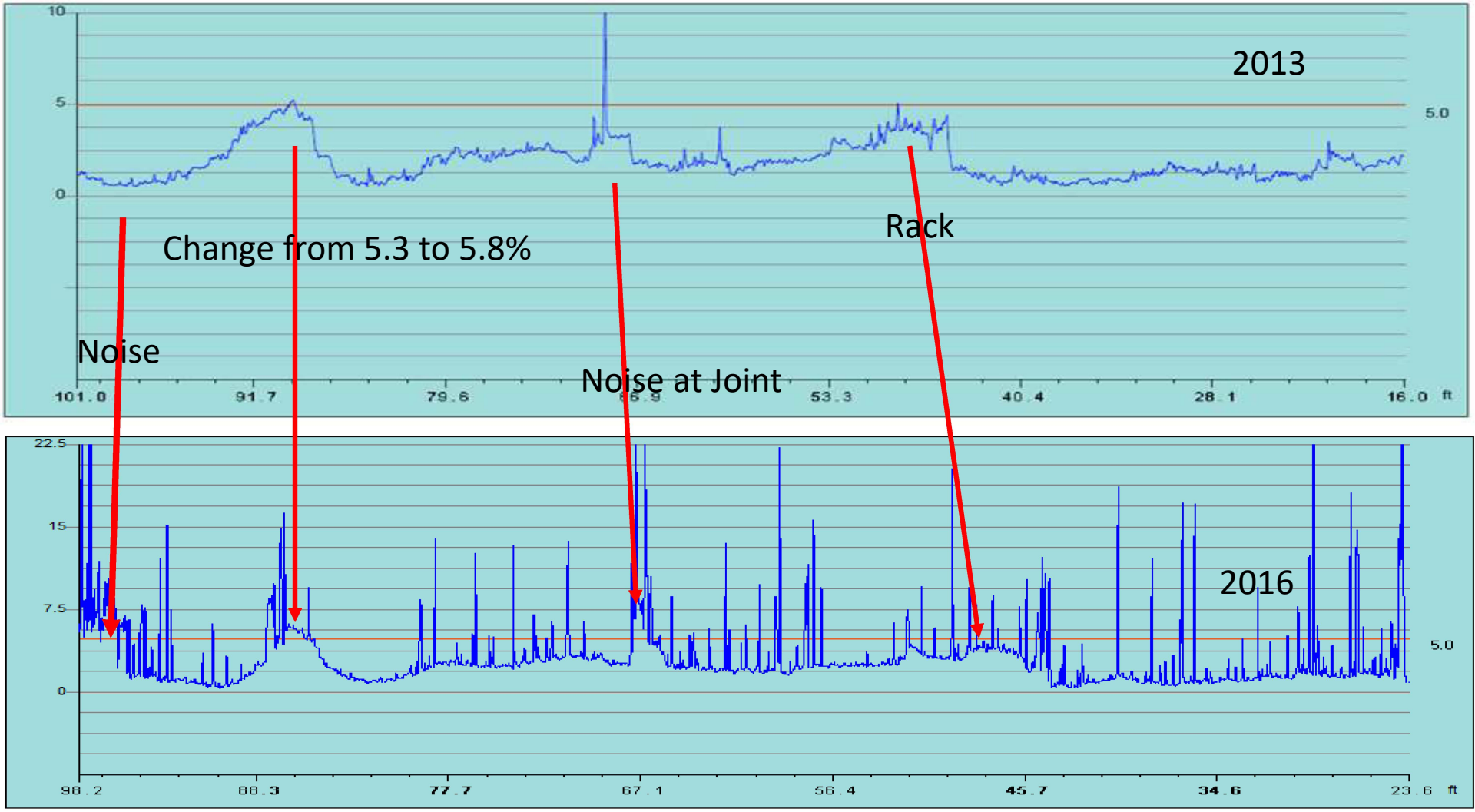
Pipe slightly racked. Deflected approximately 4.3%.




79 ft
34 ft


10
5
0
5.0
2013
101.0
91.7
79.6
66.9
53.3
40.4
28.1
16.0 ft

Performance Summary MP 122



Racking, Deflection, Minor punctures have been documented near the outlet end of the structure. Uneven flowline/hump and wall waviness have been documented mid pipe. Dent, deflection and racking has been documented towards the inlet end. Increased has occurred towards the inlet end of the structure that is not under pavement. Crown and possible invert curvature has occurred.

Conclusion: Punctures through the wall of the pipes observed during the 2013 inspection have not impacted the performance of the structures. Most of the punctures were due to the shallow cover and damage due to wooden stakes driven through the crown of the pipe during placement of straw wattles. Severe damage was observed in the inlet ends of two of the three pipes at MP 123 due to vehicle damage. Only a slight increase in deflection was observed in three of the five structures. Four of the structures are at or below 5%, and the other is at 5.8% with some signs of crown flattening and potential inverse curvature. This is outside the pavement area and in areas of shallow cover. In summary no significant changes have been observed since the 2013 inspection other than the damage due to vehicle damage. Settlement within the pavement reported in one of the locations does not appear to be due to issues with the underlying pipe structures.




APPENDIX III – DENVER COLORADO
HDPE PERFORMANCE INSPECTION
HDPE STORM DRAIN, I-25 AND QUINCY AVENUE

LEO JOHN FLECKENSTEIN

DECEMBER 5, 2016

Denver Colorado
HDPE Performance Inspection
HDPE Storm Drain, I-25 and Quincy Avenue
December 5, 2016
(Draft Report December 16, 2016)

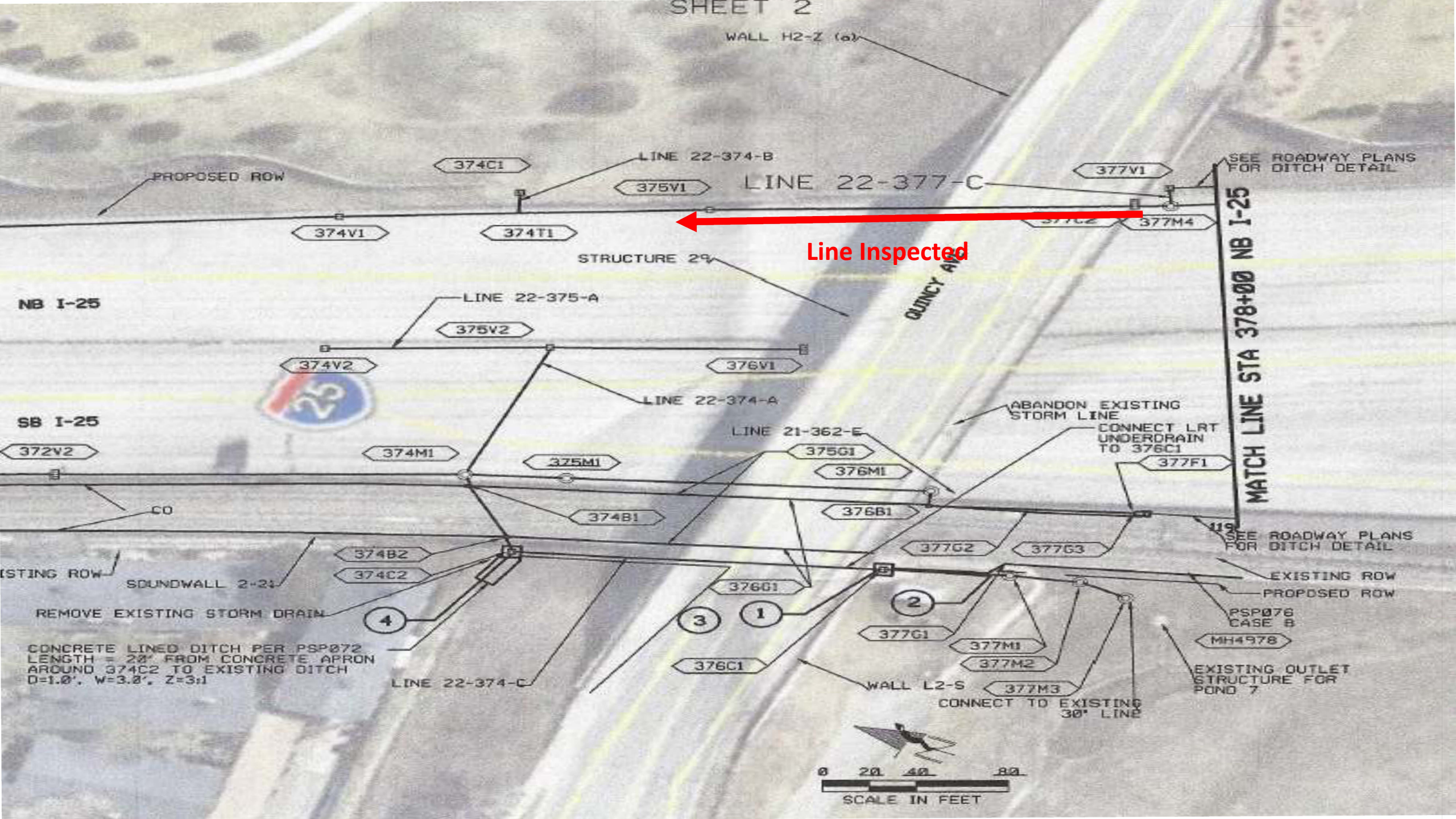
By

Leo John Fleckenstein

Hydrau-Tech, Inc.

And

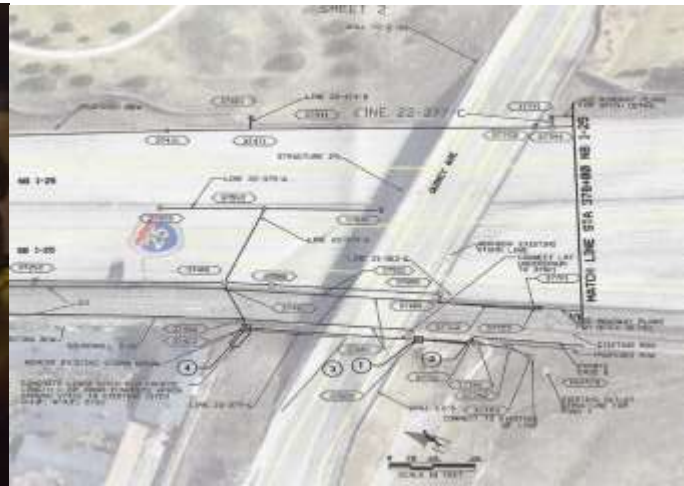
Colorado DOT


SHEET 2
WALL H2-Z (a)
LINE 22-374-B
374C1
375V1
LINE 22-377-C
377V1
SEE ROADWAY PLANS FOR DITCH DETAIL
PROPOSED ROW
374V1
374T1
377M4
Line Inspected
STRUCTURE 29
QUINCY AVE
MATCH LINE STA 378+00 NB I-25
NB I-25
LINE 22-375-A
375V2
374V2
376V1
LINE 22-374-A
SB I-25
ABANDON EXISTING STORM LINE
LINE 21-362-E
CONNECT LRT UNDERDRAIN TO 376C1
372V2
374M1
375M1
375G1
376M1
377F1
CO
376B1
374B1
SEE ROADWAY PLANS FOR DITCH DETAIL
377G2
377G3
374B2
374C2
EXISTING ROW
SOUNDWALL 2-21
376G1
PROPOSED ROW
REMOVE EXISTING STORM DRAIN
PSP076 CASE B
MH4978
CONCRETE LINED DITCH PER PSP072
LENGTH = 20' FROM CONCRETE APRON
AROUND 374C2 TO EXISTING DITCH
D=1.0', W=3.0', Z=3:1
377G1
377M1
377M2
376C1
LINE 22-374-C
WALL L2-S
377M3
EXISTING OUTLET STRUCTURE FOR POND 7
CONNECT TO EXISTING 30" LINE
0 20 40 80
SCALE IN FEET

Project Summary and Conclusions: A section of I-25 near the Quincy overpass was coned off on December 5, 2016 to conduct a performance inspection of the HDPE storm drains in the area. Several factors limited the amount of pipe that could be inspected including difficulties in removing the bolts attaching the grates on the drop inlets, and removing the grates themselves. Heavy loads of sediment was also in the invert of the pipes. The inspection was limited to approximately 182 ft of estimated 36-inch HDPE. The pipe was inspected with Cues robotic pipeline inspection system. The pipe appeared to be sagging in areas. The overall shape of the structure appeared to be round and the joints appeared to be performing as anticipated. A laser profile could not be conducted due to the amount of debris in the system. Some of the adjacent pipes coming into the two drop inlets were glanced into and appeared to be performing satisfactory. It is recommend that the pipes be cleaned and fully inspected.







Inspection

Project Name	I-25 Denver	**Date**	12/5/16
Direction	Downstream	**Pipe Type**	HDPE
Pipe Size	36	**Pipe ID**	
Start ID	Drop Inlet	**Start Location**	
End ID	Drop Inlet	**Completed**	Yes
Comments			

Inspection 2

Length Surveyed	183.2

POSMSOFTWARE

Project Name: I-25 Denver	
Date: 12/5/2016	**Pipe ID:**
Asset Location:	**Start ID:** Drop Inlet
Length Surveyed: 183.2	**End ID:** Drop Inlet
Run Number:	**Direction:** Downstream
Pipe Size: 36	**Pipe Type:** HDPE

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: Drop Inlet

(0.0) SI - Start Inspection

(37.0) - Heavy Debris in Invert

(56.8) - View down barrel

(90.0) - Debris in invert

(120.2) - View down barrel

(154.9) - View down barrel

(169.5) - Debris coming into drop inlet

(183.2) - Drop Inlet

(183.2) EI - End Inspection

Total Distance: 183.2

ID Number: Drop Inlet

Created with the POSM report generator Back

POSMSOFTWARE

Project Name: I-25 Denver	
Date: 12/5/2016	**Pipe ID:**
Asset Location:	**Start ID:** Drop Inlet
Length Surveyed: 183.2	**End ID:** Drop Inlet
Run Number:	**Direction:** Downstream
Pipe Size: 36	**Pipe Type:** HDPE

Distance	Fault Observation	Picture
0.0	Start Inspection	
37.0	Heavy Debris in Invert	
56.8	View down barrel	
90.0	Debris in invert	
120.2	View down barrel	

Distance	Fault Observation	Picture
154.9	View down barrel	
169.5	Debris coming into drop inlet	
183.2	Drop Inlet	
183.2	End Inspection	

APPENDIX IV - SOUTHEAST CORRIDOR CONSTRUCTORS NONCONFORMANCE REPORT AND EVALUATIONS

T-REX PROJECT, 2003

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709
Area: 3.1
Discipline: Drainage
Activity Number: 30001.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part IV: Identify Need for Nonconformance Evaluation

Note: NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name _____ Signature _____ Date _____

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709
Area: 3.1
Discipline: Drainage
Activity Number: 30001.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____
Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709
Area: 3.1
Discipline: Drainage
Activity Number: 30001.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

_____ _____ _____
Print or Type Name Signature Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

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TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709
Area: 3.1
Discipline: Drainage
Activity Number: 30001.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name _____ Signature _____ Date _____

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

Field Design Change Requested:
Change all remaining HDPE to RCP. This will require coring some precast concrete structures to accommodate the larger O.D. associated with RCP. If the gap between the pipe and the structure is greater than 3", collaring around the RCP will be required; if less than 3", grouting between the structure and the RCP would be the method of installation. Design has mentioned that there is a slight decrease in pipe capacity when switching to RCP, and it may be necessary to increase the pipe diameter at a few locations, or stay with HDPE at those locations. We will need to evaluate these areas on a case-by-case basis; the majority of pipe left to install can be switched from HDPE to RCP without any major design problems.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

If Drainage Design determines that it is necessary to upsize any particular pipe runs, or make any other significant changes, then separate FDC's may be processed to document those changes.

Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

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Does this field design change meet the requirements of the Contract?
☒ Yes
☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

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Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

Field Design Change Requested:
Change all remaining HDPE to RCP. This will require coring some precast concrete structures to accommodate the larger O.D. associated with RCP. If the gap between the pipe and the structure is greater than 3", collaring around the RCP will be required; if less than 3", grouting between the structure and the RCP would be the method of installation. Design has mentioned that there is a slight decrease in pipe capacity when switching to RCP, and it may be necessary to increase the pipe diameter at a few locations, or stay with HDPE at those locations. We will need to evaluate these areas on a case-by-case basis; the majority of pipe left to install can be switched from HDPE to RCP without any major design problems.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

If Drainage Design determines that it is necessary to upsize any particular pipe runs, or make any other significant changes, then separate FDC's may be processed to document those changes.

Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

Field Design Change Requested:
Change all remaining HDPE to RCP. This will require coring some precast concrete structures to accommodate the larger O.D. associated with RCP. If the gap between the pipe and the structure is greater than 3", collaring around the RCP will be required; if less than 3", grouting between the structure and the RCP would be the method of installation. Design has mentioned that there is a slight decrease in pipe capacity when switching to RCP, and it may be necessary to increase the pipe diameter at a few locations, or stay with HDPE at those locations. We will need to evaluate these areas on a case-by-case basis; the majority of pipe left to install can be switched from HDPE to RCP without any major design problems.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

If Drainage Design determines that it is necessary to upsize any particular pipe runs, or make any other significant changes, then separate FDC's may be processed to document those changes.

Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D113, D209

Location of Nonconformance: Drain Line 31-613-C

NB I-25 or I-225 Stationing: 631+00 (show nearest 500')

Description of NCR: Mandrill failed 28 feet South of structure 613S1 and 20 feet North of structure 614S1 on Drain Line 31-613-C. Concrete barrier and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

- ☐ Terry Constable
- ☐ Tim Nelson
- ☐ Anthony Crockett
- ☒ Brian Bullen
- ☐ Glen Tonak
- ☐ John Lee
- ☐ Pat McCready
- ☐ Kevin Segrue
- ☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
- ✓ SECC Document Control (NCR File)
- ✓ SECC QA Manager – Constable

SECC Design and Construction
- ✓ Post Design – Klemz, Uyematsu, Field Design Coord
- ____ Highways – Doug Brannan
- ____ Structures – 1 Don Muns, 2/3 Rich Westerheid
- ✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
- ____ Paving – Dave Ross
- ____ Survey – Jim Bodi
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Tim Mackin, Wilson, Larson
- ____ Stations – JD Vetter, Mackin, Larson
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Anthony Crockett, Brian Bullen
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ____ Procurement – Glen Tonak

T-REX Oversight and Other
- ✓ Oversight – Basner, Walker, Stevenson
- ____ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ____ Design Oversight –
- ____ Utility Company (DW-McQuade, DWWM-Gaines)

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-613-C at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____
Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711
Area: 3.1
Discipline: Drainage
Activity Number: 30251.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☒ Thoendel ☐ Ross ☐ Wilson ☐ Mackin ☐ Vetter

Commented [MC01]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D113, D209

Location of Nonconformance: Drain Line 31-613-C

NB I-25 or I-225 Stationing: 631+00 (show nearest 500')

Description of NCR: Mandrill failed 28 feet South of structure 613S1 and 20 feet North of structure 614S1 on Drain Line 31-613-C. Concrete barrier and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-613-C at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711
Area: 3.1
Discipline: Drainage
Activity Number: 30251.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

_____ _____ _____
Print or Type Name Signature Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐

Commented [MC01]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

_____ _____ _____
Print or Type Name Signature Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MC01]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____
Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order:** **YES** **NO** **(circle one)**

_____ _____ _____
Print or Type Name Signature Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

Field Design Change Requested:
Change all remaining HDPE to RCP. This will require coring some precast concrete structures to accommodate the larger O.D. associated with RCP. If the gap between the pipe and the structure is greater than 3", collaring around the RCP will be required; if less than 3", grouting between the structure and the RCP would be the method of installation. Design has mentioned that there is a slight decrease in pipe capacity when switching to RCP, and it may be necessary to increase the pipe diameter at a few locations, or stay with HDPE at those locations. We will need to evaluate these areas on a case-by-case basis; the majority of pipe left to install can be switched from HDPE to RCP without any major design problems.

Does this field design change meet the requirements of the Contract?
☒ Yes
☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

If Drainage Design determines that it is necessary to upsize any particular pipe runs, or make any other significant changes, then separate FDC's may be processed to document those changes.

Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part I: Identify Field Design Change Request or RFI

Requested by: Josh Schlee, SECC Phone: (303) 357-8456

☒ FDC (for work that has NOT been constructed)
☐ RFI

Reference Drawing Number: Various

Drawing Package Title: Drainage Plans (Profiles) Response needed by: 6/30/03

RFC Date of Drawings: Various

Description of Problem: (attach plan mark up if needed)
HDPE pipe problems encountered in the field with shallow cover (equipment running over installed pipe), and excavating around installed HDPE pipe. At some locations it may be necessary to remove previously installed HDPE and replace it with RCP.

Field Design Change Requested:
Change all remaining HDPE to RCP. This will require coring some precast concrete structures to accommodate the larger O.D. associated with RCP. If the gap between the pipe and the structure is greater than 3", collaring around the RCP will be required; if less than 3", grouting between the structure and the RCP would be the method of installation. Design has mentioned that there is a slight decrease in pipe capacity when switching to RCP, and it may be necessary to increase the pipe diameter at a few locations, or stay with HDPE at those locations. We will need to evaluate these areas on a case-by-case basis; the majority of pipe left to install can be switched from HDPE to RCP without any major design problems.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

☐ Construction requests that design work be tracked for possible back charge.

Subcontractor: _____

Part II: Distribution

TO:
- ✓ SECC Document Control (FDC File)
- ✓ T-REX Document Control – Shelle Pope

SECC Construction Quality Assurance
- ____ Structures – Tim Nelson
- ✓ Grading/Drainage – Brian Bullen, Anthony Crockett
- ____ Paving – Pat McCready
- ____ ITS – John Lee
- ____ LRT – Kevin Segrue
- ✓ Procurement – Glen Tonak

SECC Construction
- ✓ Survey – Jim Bodi
- ____ Paving – Dave Ross
- ____ MHT – Lloyd Maier, Luke Connelley
- ____ ITS/Elec – Bruce Wilson
- ____ LRT– Mackin, Wilson, Larson
- ✓ Stations – Mackin, Larson, Vetter
- ✓ Segment 1 – Carnazzo, Sato
- ✓ Segment 2/3 – Thoendel, Deml
- ✓ Dynalectric – Vecchione, Wright

T-REX Oversight and Other
- ✓ Oversight – Basner, Stevenson
- ✓ Segment 1 – Jeff Clevenger, Danielle Smith
- ✓ Segment 2/3 – Al Eastwood, David Wieder
- ✓ LRT – Starling, Bacus, Reitter, (Shrestha if Systems)
- ____ ITS – Gonzales, Lipp
- ✓ Design Oversight – John Griffith
- ✓ CCD Joe Barsoom

SECC Design Management
- ✓ Post Design Field Coordinators
- ✓ PDS Administration – Jeanette Bordner (FDC File)
- ✓ Design Management – Klemz, Wise, O'Malley
- ✓ Discipline Design Mgr – Roger Kilgore
- ✓ Design Coordinator for Construction – Laura Elliot
- ✓ Originator – Josh Schlee
- ✓ Steve Arent
- ✓ Scott Cromack, Jim Johnston, Jay Stepetin
- ✓ Lino Cruz, Jason Miner, Jeff Smith, Gabriel Gaytan
- ____
- ____

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part III: Response

Response: The requested change is acceptable. Drainage Construction shall mark-up all drainage profiles to indicate the locations where HDPE pipe is to be changed to RCP. Drainage Design will revise Q_{full} values, and check that velocity and HGL criteria are satisfied. A separate FDC shall then be processed for each Area containing the revised drainage profiles.

If Drainage Design determines that it is necessary to upsize any particular pipe runs, or make any other significant changes, then separate FDC's may be processed to document those changes.

Revised Plans needed before this change can be Implemented: Yes ☐ No ☒ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed: Separate FDC's shall be processed for each Area containing the revised drainage profiles.

Does this field design change meet the requirements of the Contract? ☒ Yes ☐ No If No, complete Parts V and VI

Design Work Charged to: Post-Design Services ☒ Design Target ☐ If PDS, Indicate WBS: _____ Hours: 200

Responded by: Don Clark Date: 6/27/03

Checked by: _____

Attachments: Yes ☐ No ☒

Part IV: Utility FDCs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

SOUTHEAST CORRIDOR CONSTRUCTORS

FIELD DESIGN CHANGE/RFI MEMO

Field Memo Number: G273 **Date of Request:** 6/23/03
Area: Project Wide **Discipline:** Drainage
Package: Drainage Plans (Profiles) **Contractor:** SECC

Part V: Final Proposed FDC Resolution by SECC (if change does not meet contract requirements)

Related Contract References:

Final FDC Resolution:

Cost Implications:

- ☐ No Cost Change
- ☐ Deductive Change – $ _____
- ☐ Deductive Change TBD

Agreement of FDC Resolution and Cost Implications proposed by SECC:

SECC Signature:

Print or Type Name	Signature	Date

To be signed by Tom Howell, Doug Brannan, Ben Carnazzo, Barry Thoendel, Bruce Wilson, Dave Ross, Tim Mackin, or JD Vetter as appropriate.

Part VI: Field Design Change acceptance (if change does not meet contract requirements)

T-REX Signature:

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the use of the described field design change for the subject application only. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if the accepted field design change results in a cost reduction.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D113, D209

Location of Nonconformance: Drain Line 31-613-C

NB I-25 or I-225 Stationing: 631+00 (show nearest 500')

Description of NCR: Mandrill failed 28 feet South of structure 613S1 and 20 feet North of structure 614S1 on Drain Line 31-613-C. Concrete barrier and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-613-C at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____
Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐ If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name _____ Signature _____ Date _____

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D113, D209

Location of Nonconformance: Drain Line 31-613-C

NB I-25 or I-225 Stationing: 631+00 (show nearest 500')

Description of NCR: Mandrill failed 28 feet South of structure 613S1 and 20 feet North of structure 614S1 on Drain Line 31-613-C. Concrete barrier and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711
Area: 3.1
Discipline: Drainage
Activity Number: 30251.20

Date Issued: 9/12/03
Contractor: SECC
Subcontractor: None
Supplier: None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?

- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-613-C at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 711 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30251.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name _____ Signature _____ Date _____

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 710 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MCO1]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D105, D205

Location of Nonconformance: Drain Line 31-536-A

NB I-25 or I-225 Stationing: 536+00 (show nearest 500')

Description of NCR: Mandrel failed 40 feet South of structure 536V1 and 2 feet South of structure 539V1 and 15 feet North of existing structure 539E1 on Drain Line 31-536-A. Concrete barrier and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: N/A
Supplier: N/A

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 710 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-536-A at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 710 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name _____ Signature _____ Date _____

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part I: Identify Nonconformance

Issued by: Jay Stepetin, SECC

Issued to: ☐ Carnazzo ☐ Wilson ☒ Thoendel ☐ Mackin ☐ Ross ☐ Vetter ☐ ☐

Commented [MC01]: Double-click on grey box to insert check mark

Referenced Contract Spec: N/A

Referenced Drawing Number: D102, D201

Location of Nonconformance: Drain Line 31-507-B

NB I-25 or I-225 Stationing: 506+92 & 507+67 (show nearest 500')

Description of NCR: Mandrel failed 24 feet North of structure 506V1 and 12 feet South of the same structure on Drain Line 31-507-B. MSE wall, concrete barrier, moment slab, and permanent asphalt have been constructed in this area of conflict.

Superintendent: Gary Palmer
Subcontractor: None
Supplier: None

Part II: Review by Construction QA Management

This NCR request has been reviewed by:

☐ Terry Constable
☐ Tim Nelson
☐ Anthony Crockett
☒ Brian Bullen
☐ Glen Tonak
☐ John Lee
☐ Pat McCready
☐ Kevin Segrue
☐ Other QA Management:

Part III: Distribution

The NCR/NCE form will be distributed to the appropriate parties via e-mail after each step where action is required or a change in status has taken place. The person making the distribution at these occurrences must update the status column of the NCR Log.

TO:
✓ SECC Document Control (NCR File)
✓ SECC QA Manager – Constable

SECC Design and Construction
✓ Post Design – Klemz, Uyematsu, Field Design Coord
____ Highways – Doug Brannan
____ Structures – 1 Don Muns, 2/3 Rich Westerheid
✓ Grading – 1 Tim Driver, 2/3 Scott Cromack
____ Paving – Dave Ross
____ Survey – Jim Bodi
____ ITS/Elec – Bruce Wilson
____ LRT– Tim Mackin, Wilson, Larson
____ Stations – JD Vetter, Mackin, Larson
____ MHT – Lloyd Maier, Luke Connelley
____ Segment 1 – Carnazzo, Sato
✓ Segment 2/3 – Thoendel, Deml
____ Dynalectric – Vecchione, Wright

SECC Construction Quality Assurance
____ Structures – Tim Nelson
✓ Grading/Drainage – Anthony Crockett, Brian Bullen
____ Paving – Pat McCready
____ ITS – John Lee
____ LRT – Kevin Segrue
____ Procurement – Glen Tonak
____

T-REX Oversight and Other
✓ Oversight – Basner, Walker, Stevenson
____ Segment 1 – Jeff Clevenger, Danielle Smith
✓ Segment 2/3 – Al Eastwood, David Wieder
____ LRT –Starling, Bacus, Reitter, (Shrestha if Systems)
____ ITS – Gonzales, Lipp
____ Design Oversight –
____ Utility Company (DW-McQuade, DWWM-Gaines)
____

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number: 709 **Date Issued:** 9/12/03
Area: 3.1 **Contractor:** SECC
Discipline: Drainage **Subcontractor:** None
Activity Number: 30001.20 **Supplier:** None

Part IV: Identify Need for Nonconformance Evaluation

Note: **NCE is not needed if the work is to be removed and replaced, or reworked to Contract Specification Compliance.**

NCE Needed?
- ☐ May be requested but requires Project Manager approval
- ☒ Yes, by QA Discipline Manager approval
- ☐ No (skip to Part VII)

QA or PM Approved: Joe Jensen Date: 9/12/03

Proposed Resolution: Evaluate remove/replace Drain Line 31-507-B at location of damaged pipe or NCE alternative.

Date Sent to Post Design: _____

Response Requested by: _____

Part V: Post Design Response

Response:

Revised Plans needed before this change can be Implemented: Yes ☐ No ☐

If Yes, Plans to be Reissued by: _____

Plans or Specs to be changed:

Design Work Charged to WBS: _____ Hours: _____

Responded by: _____ Date: _____
Post Design Services

Checked by: _____

Attachments: Yes ☐ No ☐

SOUTHEAST CORRIDOR CONSTRUCTORS

NONCONFORMANCE REPORT and EVALUATION (NCR/NCE)

NCR Number:	709	**Date Issued:**	9/12/03
Area:	3.1	**Contractor:**	SECC
Discipline:	Drainage	**Subcontractor:**	None
Activity Number:	30001.20	**Supplier:**	None

Part VI: Public Utility NCEs

Response from Utility Company: _____ Date: _____
Name of Utility Company Representative

Attached utility company response or indicate location of response on FileNET.

Part VII: Resolution of NCR

Type of Resolution:
- ☐ Remove and Replace (skip to Part IX)
- ☐ Repair/Rework to Contract Specification Compliance (skip to Part IX)
- ☐ Repair/Rework to acceptable standards
- ☐ Leave As Is (Use As Is) does not require QA reinspection

Description of Resolution:

Expected Closure Date: _____

Part VIII: T-REX Technical Closure

Closure by: _____ Date: _____
(Segment Oversight or Segment Design Oversight)

Part IX: SECC QA Disposition

Action:
- ☐ Reinspected verifying Contract Specification Compliance
- ☐ Reinspected and Accepted based on T-REX Technical Closure

Comments or Verification of Reinspection:

QA Manager: _____ Date: _____

Part X: Compliance with Contractual Requirements

Note: This disposition results in the work being in full contract compliance.

T-REX Signature: **Submit Change Order: YES NO (circle one)**

Print or Type Name	Signature	Date

To be signed by Jeff Clevenger, Al Eastwood, Del Walker, Jim Starling, Gary Gonzales, Pranaya Shrestha, or Jerry Nery as appropriate.

T-REX accepts the effected elements of the work described by this NCR. This acceptance does not change SECC's responsibilities for the Work pursuant to the Contract, nor does it create any additional liabilities for CDOT or RTD, nor does it change any rights SECC has under the Contract. SECC agrees to submit a Request for Change Order (RCO) if acceptance requires concessions pursuant to Section 10.1.2 of the Contract.