ADVANCED ENGINEERING SOLUTIONS LTD
a trading company of SSI Services

Condition Assessment of a 450mm DI Main at Cross Road, Deal

RP8737

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Report: Condition Assessment of a 450mm DI Main at Cross Road, Deal

Report Issue Status				
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AUTHOR: ______________________

APPROVED: ______________________

EXECUTIVE SUMMARY

This report contains the results of the condition assessment of a pipe section at a residential development site at Cross Road, Deal. The pipe was inspected in-situ through ultrasonic testing and Magnetic Flux Leakage scanning.

- The pipe was determined to be manufactured of 450mm ductile iron and was laid during the 1980's. Based on the age, construction, and measured dimensions to provide input data for structural analysis, the pipe has been compared to BS4772:1980 K9 pipe.

- Wall thickness readings ranged between 9.0mm to 10.3mm with an average of 10.0mm.

- The pipe wall was inspected using AES's magnetic flux leakage tool (SmartCAT) to identify and size patterns of pit corrosion defects. External defects up to a maximum of 2.7mm in depth (27% of average wall thickness) were identified through MFL scanning, internal defects were identified up to a maximum depth of 3.2mm (32% of average wall thickness), no through wall defects were revealed originating from either the external or internal wall face.

- The stress analysis shows that, considering a uniform wall thickness and without considering the presence of pitting corrosion, the pipe currently operates at satisfactory levels of stress at the considered pressure and burial depths.

- The critical defect dimension is through-wall at a length of at least 74.6mm, the remaining life until the attainment of a such a critical defect is expected to be upwards of 200 years at the inspected site.

- The calculated minimum remaining life to through wall corrosion is 52 years at the inspected site, based on the deepest identified corrosion defect and the minimum measured wall thickness along the inspected section of pipe.

- The calculated lifetime to structural failure is predicted to occur in a minimum of 120 years, assuming the current rate of corrosion persists.

- At the inspected location, the distribution of externally oriented defects depicts a sporadic pattern of very shallow defects (typically less than 2mm), due to the size and arrangement of these defects, the risk of propagating into compound defects is low. The corrosion profile of the internal wall face shows a similarly sporadic arrangement, with only 5 defects identified up to a maximum depth of 3.2mm, these defects are likely to be inherent of steady localised attrition of the interior wall over the pipe's lifetime in service.

- The degree of external corrosion identified through visual inspection and MFL scanning was very low, and the inspected section was in generally good condition this is likely to be due to the good condition of the Stanguard wrapping.

RECOMMENDATIONS

The inspected pipe section was in good condition, as such, there is little in the way of immediate remedial action to be taken. Instead, the following recommendations are intended to ensure that the pipeline at the Cross Road development maintains this level of integrity into the future.

- As surface loading will likely increase as the state of development progresses at Cross Road, ensure that the depth of cover is sufficient (1m to 2m) in order to mitigate the concentration of surface loading on sections of pipe.

- Ensure that the main is protected from external mechanical damage during planned groundworks in the area.

- Southern Water may want to consider implementing a long-scale plan for leakage monitoring to increase the chances that through wall corrosion can be identified as and when it occurs over the coming decades.

TABLE E1 – SUMMARY OF PIPELINE INSPECTION	
Pipeline inspection	Pipe was externally protected with Stanguard wrapping and bitumen paint – wrapping was in good condition and the bitumen paint beneath the wrapping was similarly well preserved. Corrosion defects were identified ranging from 1.5mm up to 3.2mm Wall thickness ranged from 9.0mm up to 10.3mm with an average of 10.0mm
Structural Analysis	Surface Loading type = Minor Road Pipeline operates at acceptable levels of stress under typical operating pressure and surge pressure.
Likelihood of fracture initiation from defect	Low – No through wall corrosion has been identified and all identified defects fall below 32% wall thickness in depth, the extent of corrosion would have to progress significantly to pose a risk of defect propagation and subsequent fracture initiation
Life expectancy	Minimum life to leakage = 52 years Structural failure = 120 years
Inspection regime/intervention	Ensure appropriate depth of cover is maintained following development of the housing estate at Cross Road to reduce surface loading concentrations on pipe sections. Ensure that the main is protected from mechanical damage from nearby groundworks. Consider a long-scale plan for identifying leakage at Cross Road in the future.

CONTENTS

1 INTRODUCTION

Advanced Engineering Solutions Limited (AES) has been requested by Gladman to carry out a condition assessment of a section of a Ø450mm ductile iron pipe located at Cross Road in Deal, in an area currently being developed for a new housing estate. As part of the development, a new access road will be built above this main, the purpose of this report is therefore to determine the structural integrity of the pipe under increased future loading conditions and to assess the main's current condition.

2 SCOPE OF REPORT

This report includes a description of the pipe installation and inspection results, including pipe wall thickness measurements, a visual coating assessment and a pipe wall corrosion assessment. Inspection was undertaken at selected locations along the pipeline route.

The structural analysis involves applying the appropriate external and pressure loading regimes to calculate the pipe wall stresses with the current level of pipe wall deterioration. Structural failure predictions are based on the calculated localised pitting and general corrosion rates.

Statistical analysis of the identified and measured pitting corrosion patterns and depths to estimate those in the uninspected sections of pipeline has been carried out, allowing general conclusions on the potential for fracture initiation along the pipelines.

Recommendations are made for any remedial action considered necessary to maintain the pipe's long-term integrity. The Appendices include detailed photographs, Magnetic Flux Leakage (MFL) output for the pipe wall and analysis results for the pipe.

3 DETAILS OF MAIN

3.1 General

Diameter:	450mm
Material:	Ductile Iron
Date Laid:	1980s
Duty:	Potable Water
Flow:	Unknown

4 PIPE ASSESSMENT DATA

4.1 Installation Details

Details of the pipeline route have not been provided, however, it is presumed that the pipeline runs south-west from the Deal WSW passing under an existing housing estate and through the proposed development at Cross Road.

4.1.1 Joints

No joints were identified at the inspected section of pipe.

4.1.2 Visual Coating Assessment

The pipe was protected by Stanguard wrapping and bitumen paint, both the wrap and bitumen paint displayed good overall condition and the pipe surface beneath the coating was also in good condition.

4.2 Inspection Results

4.2.1 Wall Thickness and Diametrical Measurements

The wall thickness was measured using an ultrasound technique while the integrity of the pipe wall was determined by carrying out a series of scans with the SmartCAT.

The resolution of the ultrasonic gauges is 0.01mm for the Sonatest Sitescan D20+ used to measure the wall thickness.

The full ultrasonic wall thickness measurements results are also shown in Appendix 2, with a summary provided in Table 4.1.

TABLE 4.1 – SUMMARY OF WALL THICKNESS AND DIAMETRICAL MEASUREMENTS		
External Diameter (mm)	0°-180°	477
	90°-270°	477
Total Number of Thickness Readings		144
Min. Wall Thickness (mm)		9.0
Max. Wall Thickness (mm)		10.3
Mean Wall Thickness (mm)		10.0
Standard deviation		0.2

Overall, wall thickness was found to range from 9.0mm up to 10.3mm with an average of 10.0mm.

4.2.2 Localised Corrosion

Surface corrosion defect patterns were investigated using the AES SmartCAT MFL tool and visually inspection.

The remaining wall thickness plots can be observed in Figure 4.1 below.

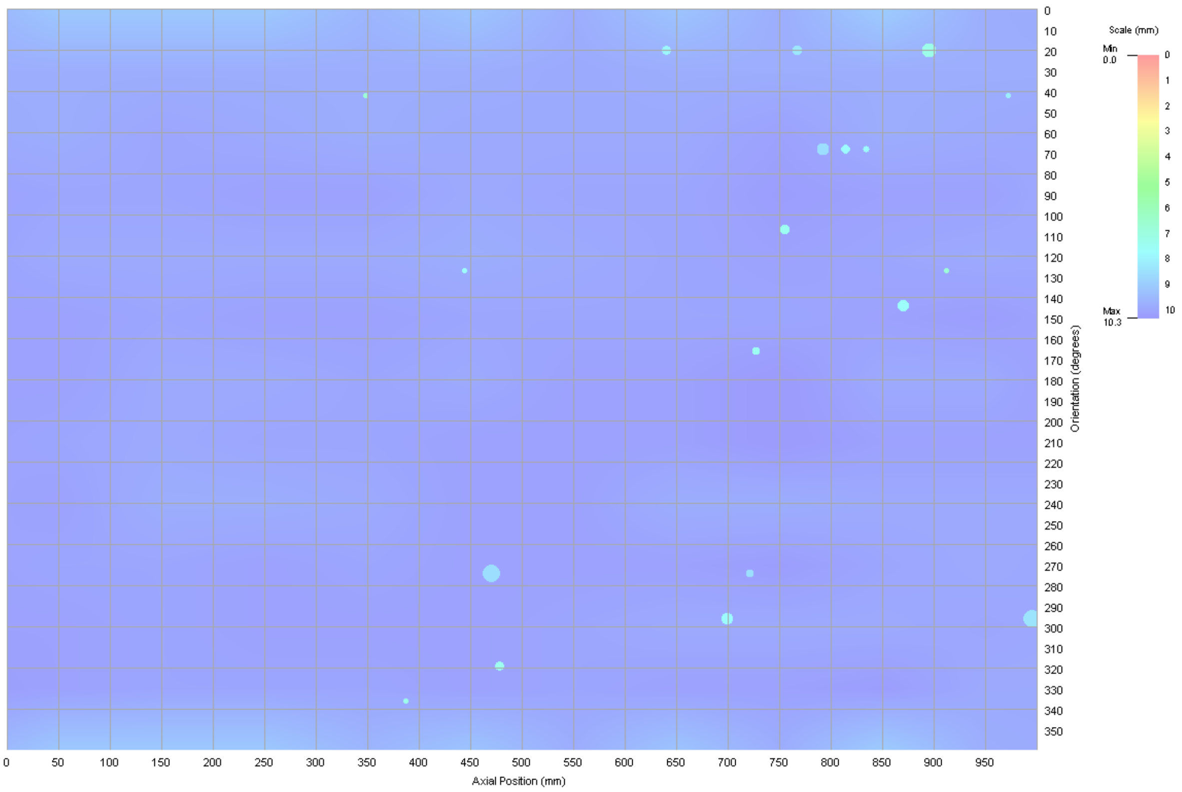

FIGURE 4.1 REMAINING WALL THICKNESS PLOT

Corrosion pitting at the inspected section was minimal with a loose cluster of shallow defects (up to around 30% of wall thickness in depth) appearing at the distal end of the scan between 20° and 150° from the pipe crown. The maximum defect was 3.2mm (32% wall thickness) in depth and originated from the internal pipe wall.

4.3 Soils Analysis

The soils are assessed according to the AFNOR scheme that takes account of several variables measured during inspection. Based on the measured soil properties detailed in table 4.2, the French 'AFNOR' standard A05-250 considers the ground surrounding the main to be only "slightly corrosive", due to the permeability and basic nature of the chalky soil surrounding the pipe, combined with the low water content of the soil. It was also noted a small amount of ground immediately surrounding the pipe wall appeared to be an imported pea-gravel backfill.

TABLE 4.2 - SOIL CORROSIVITY DATA	
Variable	**Site Readings**
	Cross Road, Deal
Miller Box Resistivity (Ωcm)	26,000
pH	9.0
RedOx potential (mV)	258
Water Content (%)	18.2
Vertical Heterogeneity	Single
Water Table	Below Pipe
AFNOR Score	0
Nature of Ground	Slightly Corrosive
Type of Ground	Light, Permeable, Granular (Chalk)

5 CONSTRUCTION

The main has been taken to be manufactured between during the 1980s, to BS4772:1980, based on the wall thickness measurements and external pipe diameter. The main is constructed of ductile iron and most closely conforms to K9 pipe.

The principal structural details specified by this Standard are given in Table 5.1.

TABLE 5.1 – PRINCIPAL STRUCTURAL DETAILS OF MAIN	
Standard and Class	BS4772:1980 K9
Nominal Diameter (mm)	450
Nominal Wall Thickness (mm)	11.4
Maximum Wall Thickness (mm)	-
Minimum Wall Thickness (mm)	9.6
Maximum Working Pressure (bar)	20
Specified Minimum Yield Strength (N/mm^2)	300
Maximum Allowable Stress (N/mm^2)	150
Factor of Safety on UTS	2

The maximum working pressure is derived from 50% of the test pressure specified in the appropriate British Standard for the pipe. The maximum allowable stress is derived from the minimum tensile stress with a factor of safety of 2.

6 STRESS ANALYSIS

6.1 Structural Failure

Structural failure of the pipe is likely to occur in one of three ways:

- Loading of the pipe in excess of design and/or material limits.
- Uniform wall thinning to the point where the pipe wall thickness is not sufficient to support the applied loading.
- Growth of a corrosion pitting defect leading to a fracture, under the combined pressure and external loading.

Further details on the stress analysis methods used can be found in Appendix 6.

6.2 Internal Pressure and External Loading

The inspected section of pipeline was located at the side of Cross Road in Deal at a burial depth of 0.8m, in an area currently being developed into a new housing estate, the degree of loading via traffic was predicted to increase following the upcoming development and it was surmised through aerial imagery that the pipe runs under several roads in a nearby residential area. A minor road external loading regime was therefore adopted for the purpose of stress analysis calculations.

The operating pressure at the inspected location 1 was supplied to AES as 7.5 bar.

6.3 Stress Analysis Results

6.3.1 Circumferential Bending and Membrane Stress

The soil has been identified as firm chalk. A soil density of 2000kg/m^3 has been applied in the calculations, and the average measured pipe wall thickness and the measured depth of cover at each site are used. A summary of stress analysis results, for the operating pressure, are provided in Table 6.1, with the complete data provided in Appendix A3.

TABLE 6.1– SUMMARISED STRESS ANALYSIS RESULTS

Surface Loading	Operating Pressure (bar)	Max. Stress N/mm^2	Percentage of Maximum Allowable Stress
Minor Road	7.5	102.4	68.3

The stress analysis shows that, considering a uniform wall thickness and without considering the presence of pitting corrosion, the pipe currently operates at satisfactory levels of stress at the considered pressures, burial depths and loading conditions.

6.3.2 Wall Thickness Critical Stress Attained

The pipe wall thickness used in the model is progressively reduced until the maximum allowable stress and ultimate tensile stress are achieved for operating pressures under the relevant loading conditions. A summary of the results under the current operating pressure are shown in Table 6.2, with the complete data provided in Appendix A3.

TABLE 6.2– WALL THICKNESS AT ATTAINMENT OF CRITICAL STRESS			
Surface Loading	**Operating Pressure (bar)**	**Wall thickness Maximum Allowable Stress Attained (mm)**	**Wall thickness Ultimate Tensile Stress Attained (mm)**
Field	7.5	6.1	2.2

7 DEFECT ANALYSIS

The presence of pitting defects in the pipe wall results in local stress concentrations and increases the likelihood of failure. AES have developed software based on BS 7910:2013, Guide to Methods for Assessing the Acceptability of Flaws in Metallic Structures. This allows a prediction of the critical defect depth that may initiate failure to be made, taking the influence of individual defects identified in the inspection on the pipeline integrity into consideration.

Assessment of the acceptability of a defect is made by means of a failure assessment diagram (FAD) based on the principles of fracture mechanics. Appendix A4 shows the FAD for each load case. The vertical axis of the FAD is a ratio of the applied conditions to the conditions required to cause brittle fracture; the horizontal axis is the ratio of the applied load to that required to cause plastic collapse. Calculations for a flaw provide the coordinates for an assessment point. Defects that fall within the assessment lines are considered acceptable.

For the critical defect to cause an unacceptable likelihood of failure initiation it is assumed to be coincident with a point of maximum pipe wall stress in each case.

7.1 Results

The results of the analysis are shown in Table 7.1. The analysis showed that a through-wall defect of hemispherical geometry would be acceptable in terms of the risk of structural failure resulting from its presence.

TABLE 7.1 – DEFECT ANALYSIS RESULTS				
Loading Regime	**Primary Membrane Stress (MPa)**	**Primary Bending Stress (MPa)**	**Maximum Measured Defect Depth (mm)**	**Through-wall Critical Defect Length (mm)**
Minor Road	17.1	85.3	3.2	74.6

Further analysis was then carried out to determine the length of a through-wall corrosion defect that would be required to put the pipe at risk of structural failure. It was shown that a single defect of 74.6mm, coincident with the maximum point of stress would put the pipe at an unacceptable risk of structural failure.

8 REMAINING LIFE

Based on the results of the NDT inspection at Cross Road, AES have calculated both a general and localised corrosion rate using their own procedures to be able to provide an estimated life until structural failure due to both general wall thinning and the presence of a critical defect.

8.1 General Corrosion Rate

Taking the wall thickness at the time of installation to be equal to the maximum specified wall thickness and assuming a constant linear corrosion rate between the installation and inspection dates (no initial coating life), gives a calculated general corrosion rate. These figures are shown in Table 8.1. This approach is conservative in ascribing all wall thickness variation to corrosion and none to manufacture.

TABLE 8.1 – GENERAL CORROSION RATE CALCULATION

Age of pipe (years)	Max. Measured wall thickness (mm)	Min. General wall thickness (mm)	Estimated general wall thickness loss (mm)	General Corrosion rate (mm/year)
40	10.3	9.0	1.3	0.033

8.2 Localised Corrosion Rate

Taking the wall thickness at the time of installation to be equal to the maximum specified wall thickness and a constant corrosion rate between the installation and inspection dates (no initial coating life), gives a calculated localised corrosion rate. These figures are shown in Table 8.2. This approach is conservative in ascribing all wall thickness variation to corrosion and none to manufacture.

TABLE 8.2 – LOCALISED CORROSION RATE CALCULATION

Age of pipe (years)	Max. Measured wall thickness (mm)	Min. General wall thickness (mm)	Max. pit depth (mm)	Estimated localised wall thickness loss (mm)	Localised Corrosion rate (mm/year)
40	10.3	9.0	3.2	4.5	0.113

8.3 Life to Structural Failure

8.3.1 General Wall Thinning

The projected remaining life to structural failure of the pipe due to wall thinning uses a conservative approach based on the calculated general corrosion rate in Section 8.1, the average measured wall thickness, and the wall thicknesses at which key stresses are attained.

Table 8.4 shows the projected remaining life to the attainment of maximum allowable stress for the pipe, at which point the pipe is at an increased risk of structural failure and the projected remaining life to the attainment of the yield stress, at which point structural failure of the pipe can be expected.

TABLE 8.4 – ESTIMATED REMAINING LIFE				
Failure mechanism	To maximum allowable stress		To Ultimate tensile Stress	
	Future corrosion to attainment* (mm)	Estimated remaining life (years)	Future corrosion to attainment* (mm)	Estimated remaining life (years)
Structural failure – If run at current operating pressure	6.1	120	2.2	>200
Structural failure – At surge pressure (1.5x OP)	6.1	120	2.2	>200

8.3.2 Life to Attainment of Critical Defect

The critical defect dimensions have been calculated in Section 7.1.

The measured defect dimensions and calculated localised corrosion rate may be used to calculate the life until the attainment of a critical defect, it is assumed that the length of a through-wall defect increases at twice the rate of the depth, and that the length of the maximum idealised defect is 2x its depth. These lives are reported in Table 8.5.

TABLE 8.5 – LIFE TO CRITICAL DEFECT			
Load Case	Localised Corrosion Rate (mm/year)	Critical Defect Length (mm)	Life to Critical Defect (years)
Minor Road	0.113	74.6	>200

8.4 Minimum Life to Leakage

The measured pipe wall thicknesses and defect depths are used to estimate the life to through wall corrosion. Based upon the localised corrosion rate and a minimum likely localised wall thickness (minimum localised wall thickness equal to minimum measured wall thickness minus deepest pit depth), the projected remaining life to through wall corrosion for the pipe has been calculated. These figures are shown in Table 8.6.

TABLE 8.6 –LIFE TO LEAKAGE CALCULATION		
Max. Localised Corrosion Rate (mm/year)	Minimum Likely Localised Wall Thickness (mm)	Minimum Life to Leakage (years)
0.113	5.8	52

9 CONCLUSIONS

- The pipe was determined to be manufactured of 450mm ductile iron and was laid during the 1980's. Based on the age, construction, and measured dimensions to provide input data for structural analysis, the pipe has been compared to BS4772:1980 K9 pipe.

- Wall thickness readings ranged between 9.0mm to 10.3mm with an average of 10.0mm.

- The pipe wall was inspected using AES's magnetic flux leakage tool (SmartCAT) to identify and size patterns of pit corrosion defects. External defects up to a maximum of 2.7mm in depth (27% of average wall thickness) were identified through MFL scanning, internal defects were identified up to a maximum depth of 3.2mm (32% of average wall thickness), no through wall defects were revealed originating from either the external or internal wall face.

- The stress analysis shows that, considering a uniform wall thickness and without considering the presence of pitting corrosion, the pipe currently operates at satisfactory levels of stress at the considered pressure and burial depths.

- The critical defect dimension is through-wall at a length of at least 74.6mm, the remaining life until the attainment of a such a critical defect is expected to be upwards of 200 years at the inspected site.

- The calculated minimum remaining life to through wall corrosion is 52 years at the inspected site, based on the deepest identified corrosion defect and the minimum measured wall thickness along the inspected section of pipe.

- The calculated lifetime to structural failure is predicted to occur in a minimum of 120 years, assuming the current rate of corrosion persists.

- At the inspected location, the distribution of externally oriented defects depicts a sporadic pattern of very shallow defects (typically less than 2mm), due to the size and arrangement of these defects, the risk of propagating into compound defects is low. The corrosion profile of the internal wall face shows a similarly sporadic arrangement, with only 5 defects identified up to a maximum depth of 3.2mm, these defects are likely to be inherent of steady localised attrition of the interior wall over the pipe's lifetime in service.

- The degree of external corrosion identified through visual inspection and MFL scanning was very low, and the inspected section was in generally good condition this is likely to be due to the good condition of the Stanguard wrapping.

RECOMMENDATIONS

The inspected pipe section was in good condition, as such, there is little in the way of immediate remedial action to be taken. Instead, the following recommendations are intended to ensure that the pipeline at the Cross Road development maintains this level of integrity into the future.

- As surface loading will likely increase as the state of development progresses at Cross Road, ensure that the depth of cover is sufficient (1m to 2m) in order to mitigate the concentration of surface loading on sections of pipe.

- Ensure that the main is protected from external mechanical damage during planned groundworks in the area.

- Southern Water may want to consider implementing a long-scale plan for leakage monitoring to increase the chances that through wall corrosion can be identified as and when it occurs over the coming decades.

Appendix 1 Photographs

FIGURE A1.1 – INSPECTION LOCATION AND PROXIMITY TO THE DEAL WSW

FIGURE A1.2 – INSPECTION SITE

FIGURE A1.3 – EXCAVATION AT INSPECTION SITE, STANGUARD WRAPPING IN GOOD CONDITION

FIGURE A1.4 – PIPE SURFACE BENEATH STANGUARD, GOOD CONDITION

FIGURE A1.5 – PEA GRAVEL BACKFILL IMMEDIATELY SURROUNDING PIPE

FIGURE A1.6 – CLOSE UP OF PIPE SURFACE, SUPERFICIAL EXTERNAL DEFECTS NOTED

FIGURE A1.7 – UT PERFORMED ON MAIN

FIGURE A1.8 – MFL CARRIED OUT ON MAIN WITH SMARTCAT TOOL

Appendix 2 Wall Thickness Results and MFL Pipe Wall Scan Plots

TABLE A2.1– MEASURED WALL THICKNESS RESULTS										
Orientation from TDC (º)	Axial Distance from Start (mm)									
	100	200	300	400	500	600	700	800	900	1000
0	9.8	9.1	9.1	9.1	9.6	9.2	9.8	9.2	9.8	9.0
30	9.8	9.8	9.8	9.8	9.8	9.8	9.9	9.8	9.8	9.8
60	9.9	9.8	10.0	9.9	9.8	9.9	9.9	9.9	10.1	9.8
90	10.1	10.0	10.0	10.1	10.1	9.9	10.0	10.0	10.2	10.1
120	10.1	9.9	9.9	9.9	9.9	9.8	9.9	10.0	10.1	10.0
150	10.1	10.1	10.0	10.1	10.1	10.0	10.0	10.0	10.0	10.1
180	10.1	10.1	9.9	9.9	10.0	9.9	10.1	10.1	10.3	9.9
210	10.1	10.0	9.9	10.0	10.0	10.1	10.1	10.1	10.3	10.1
240	10.0	10.1	9.8	9.8	9.9	10.1	10.1	9.8	9.8	9.9
270	10.1	10.0	10.0	10.1	10.0	10.1	10.1	10.1	10.2	10.0
300	10.1	10.1	10.0	10.1	10.1	10.1	10.0	9.9	9.9	9.9
330	10.2	10.1	10.0	10.0	10.0	10.1	10.0	10.1	10.1	10.2

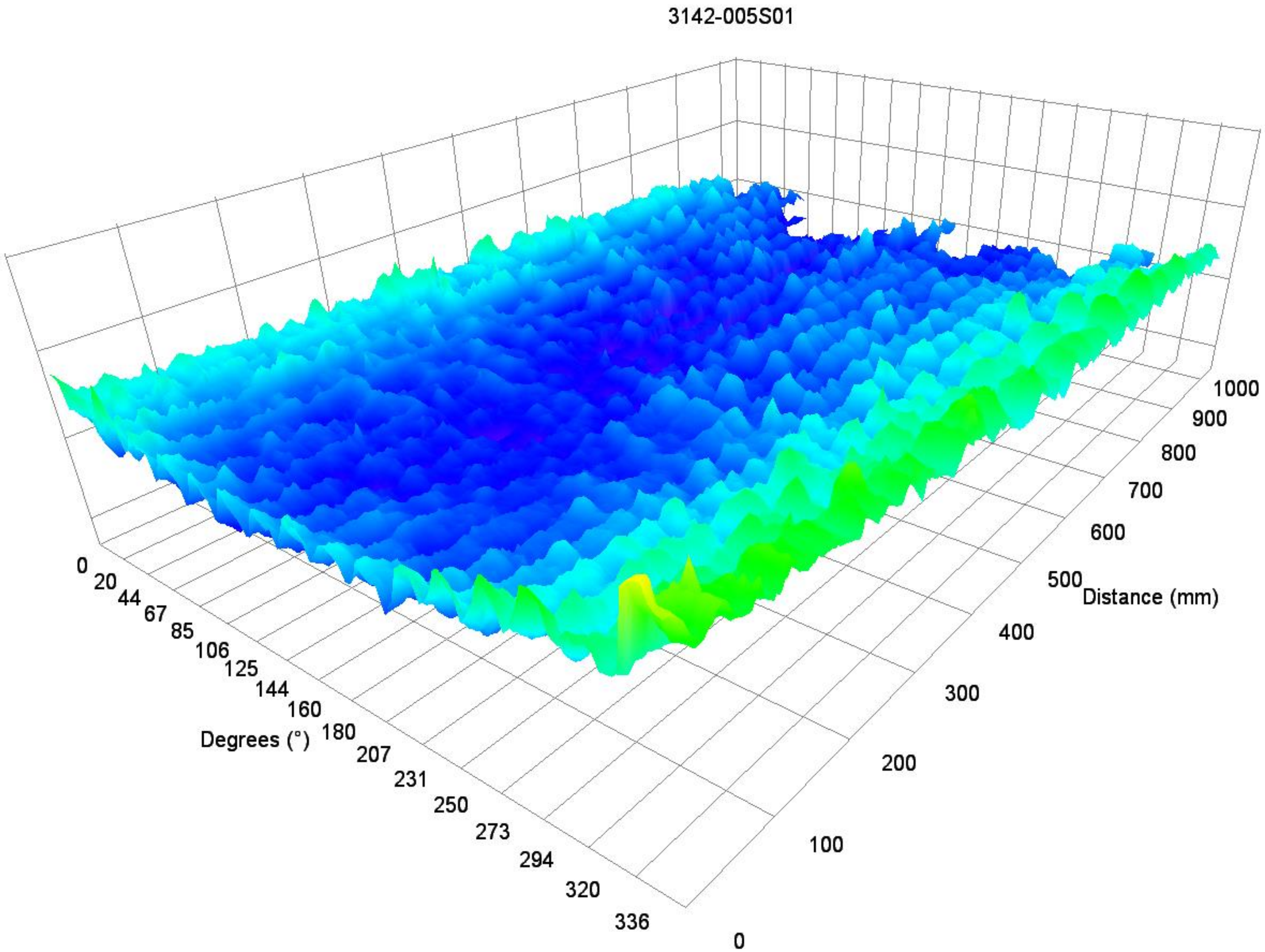

FIGURE A2.1 – MFL PIPE WALL SCAN PLOT

Appendix 3 Stress Analysis

A3.1 Stress Analysis

A3.1.1 Internal Pressure and Overburden

The stress analysis requires an understanding of the loading regimes on the pipeline.

The operating pressure at the inspection location was provided to be 7.5 bar.

A3.2 Stress Analysis Results

The stress analysis considers a soil density figure of 2000kg/m^3 together with the average measured pipe wall thickness and the measured depth of cover at each site. The results of the analysis are provided in Table A3.1.

TABLE A3.1 - SUMMARISED STRESS ANALYSIS RESULTS

Field Loading			
	Operating Pressure (7.5bar)	**Surge Pressure (11.25bar)**	**Zero Pressure (0.0bar)**
Maximum Circumferential Bending Stress (MPa)	85.3	83.8	88.3
Membrane Stress* (MPa)	17.1	25.8	0.0
Maximum Allowable Stress (MPa)	150	150	150
Max Stress as a % of Maximum Allowable Stress	68.3	73.1	58.9

*Membrane stress is essentially the hoop stress.

This circumferential bending stress analysis considers a uniform wall thickness and does not consider the additional localised stresses caused by corrosion pits.

The stress analysis shows that, considering a uniform wall thickness and without considering the presence of pitting corrosion, the pipe currently operates at satisfactory levels of stress at the considered pressures, and burial depths.

Appendix 4 Defect Analysis

4.1 Defect Analysis

The presence of pipe wall defects results in stress concentrations in the pipe wall around the defect and thus, increases the likelihood of failure.

The stress analysis for the pipeline has been carried out using the minimum material properties specified in the British Standards, to which the pipes in the system are considered to be manufactured to.

The assumed material properties for the defect analysis were as follows:

Material Properties:

Fracture Toughness of material: – 30 MPa/m$^{1/2}$

Yield Strength of material: – 300 N/mm^2

Ultimate tensile Strength of material: – 420 N/mm^2

FAD Diagrams

The FAD diagrams show the critical defect size based upon the minimum material properties from the assumed standard and the results of the stress analysis.

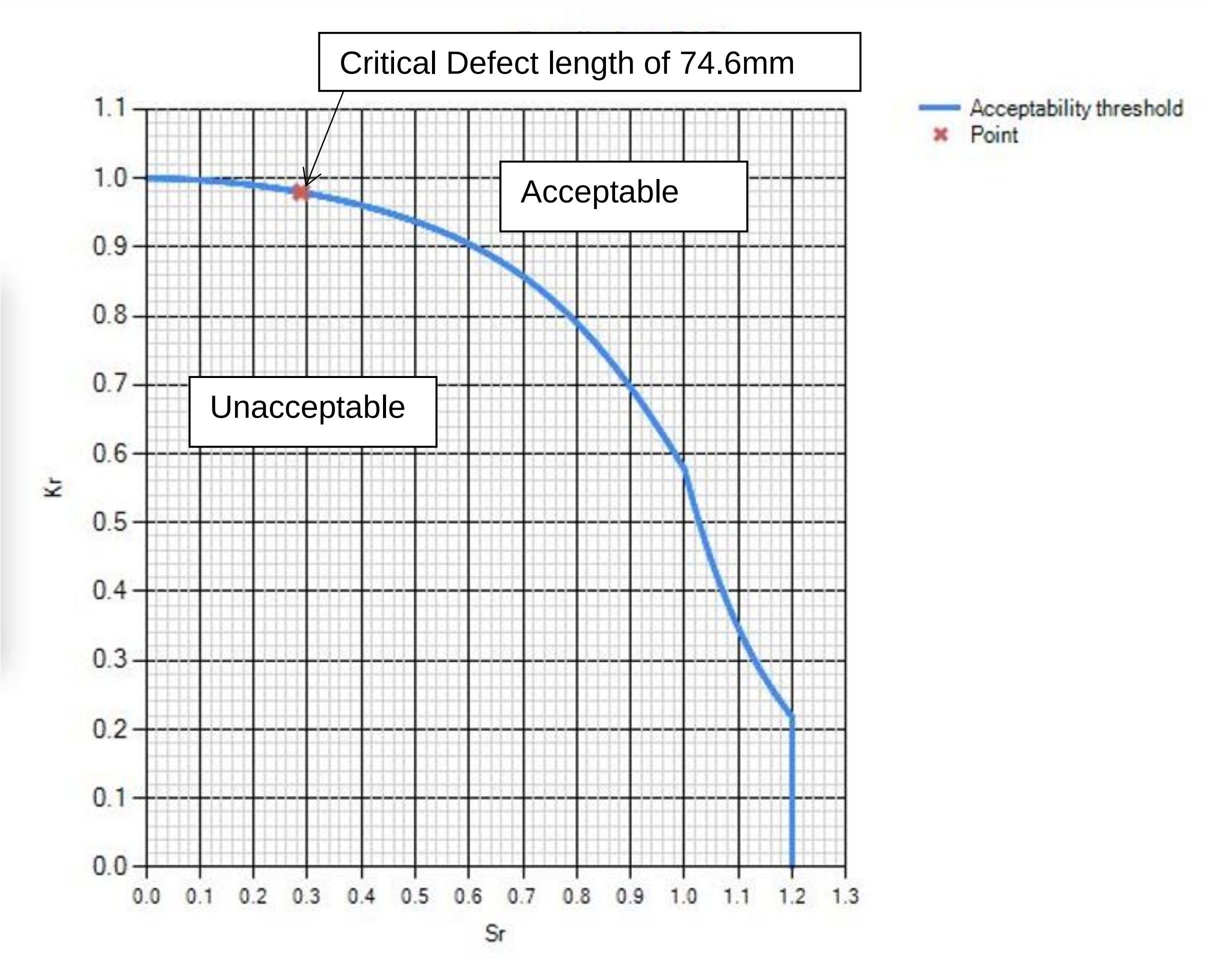

FIGURE A4.1 – FAD AT OPERATING PRESSURE WITH FIELD LOADING– CRITICAL LENGTH 74.6MM

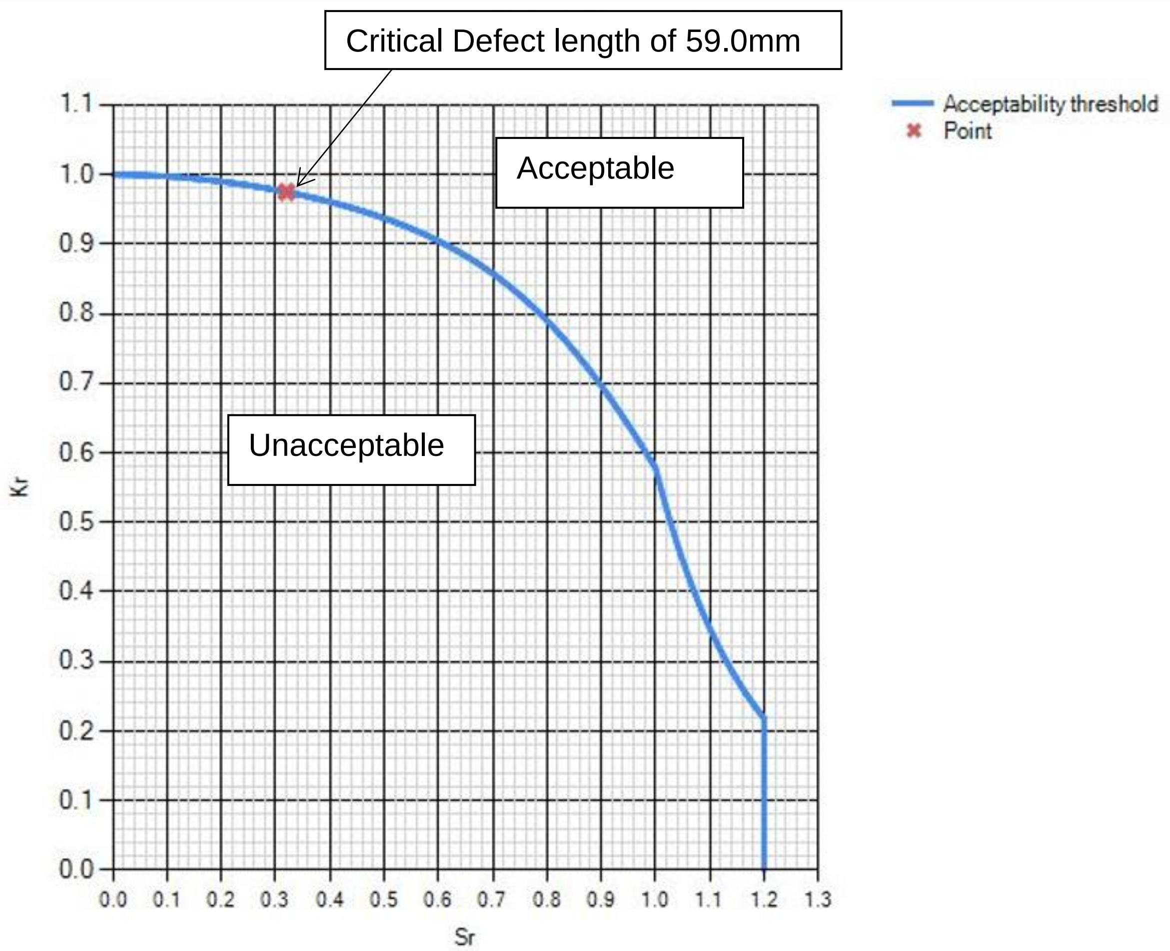

FIGURE A4.2 – FAD AT SURGE PRESSURE WITH FIELD LOADING – CRITICAL LENGTH 59.0MM

Appendix 5 Coating Assessment Methodology

A5.1 Visual Coating Assessment

A visual assessment of the pipe coating was carried out in order to identify the coating type and assess its general condition.

To quantify the level of coating failure present on the pipelines, the following model has been created. The pipe's external surface area has been separated into grids and the coating failure identified within these grids reported as a percentage. Each row (1, 2, 3…n) in the grid is representative of one scanned length of the pipe up to the number of scans completed in total (n) – see Figure A5.1.

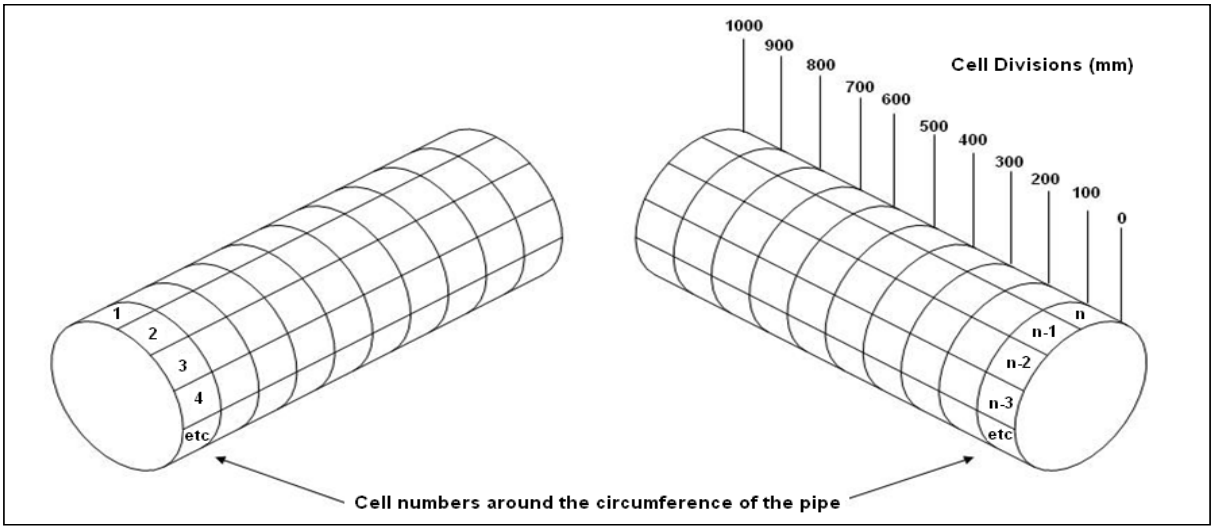

FIGURE A5.1 – PIPE GRID DIAGRAM

Appendix 6 Inspection Equipment Record Form

Inspection Equipment Record Form

Project Number	3142-005
Inspected Item	450mm Ductile Iron Main
Site Name	Cross Road, Deal
Completed By	G Warwick

Site Name	Site Inspection Date	AES Operative
Cross road	17/01/2024	G Warwick, J Green

Equipment	Asset No	Serial No	Calibration Expiry Date
Sitescan D20	1189	1106621	08/01/2025
SmartCAT 5	1595	-	19/01/2024
GEM 5 Probe	1328	T042262	-
Megger Meter	942	080108/1434	14/12/2023
Fluke	1595	35632264WS	15/01/2024