CLEARLINE PROFILER CASE STUDY DEFORMATION

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Location: St Michaels Ave, Auckland
Pipe Size: 525mm
Age of Pipe: 40 years approx
Pipe Type: Pre-cast Concrete (Stormwater)
Pipe Length: 54m
Date: 22 December 2003
Customer: Metrowater
Engineer: R Pullar
Contractor: CityCare

Overview

This 525mm concrete pipe had been previously CCTV surveyed for a building consent as the owner was proposing to build over the pipe. ACC Consenting officers had forwarded the survey to Metrowater for consideration as the pipe showed severe cracking and loss of ovality downstream of the proposed build-over.

The purpose of the profiler survey was to ascertain the extent of loss of ovality. An evaluation of remedial options would then be considered with the information gathered.

Method

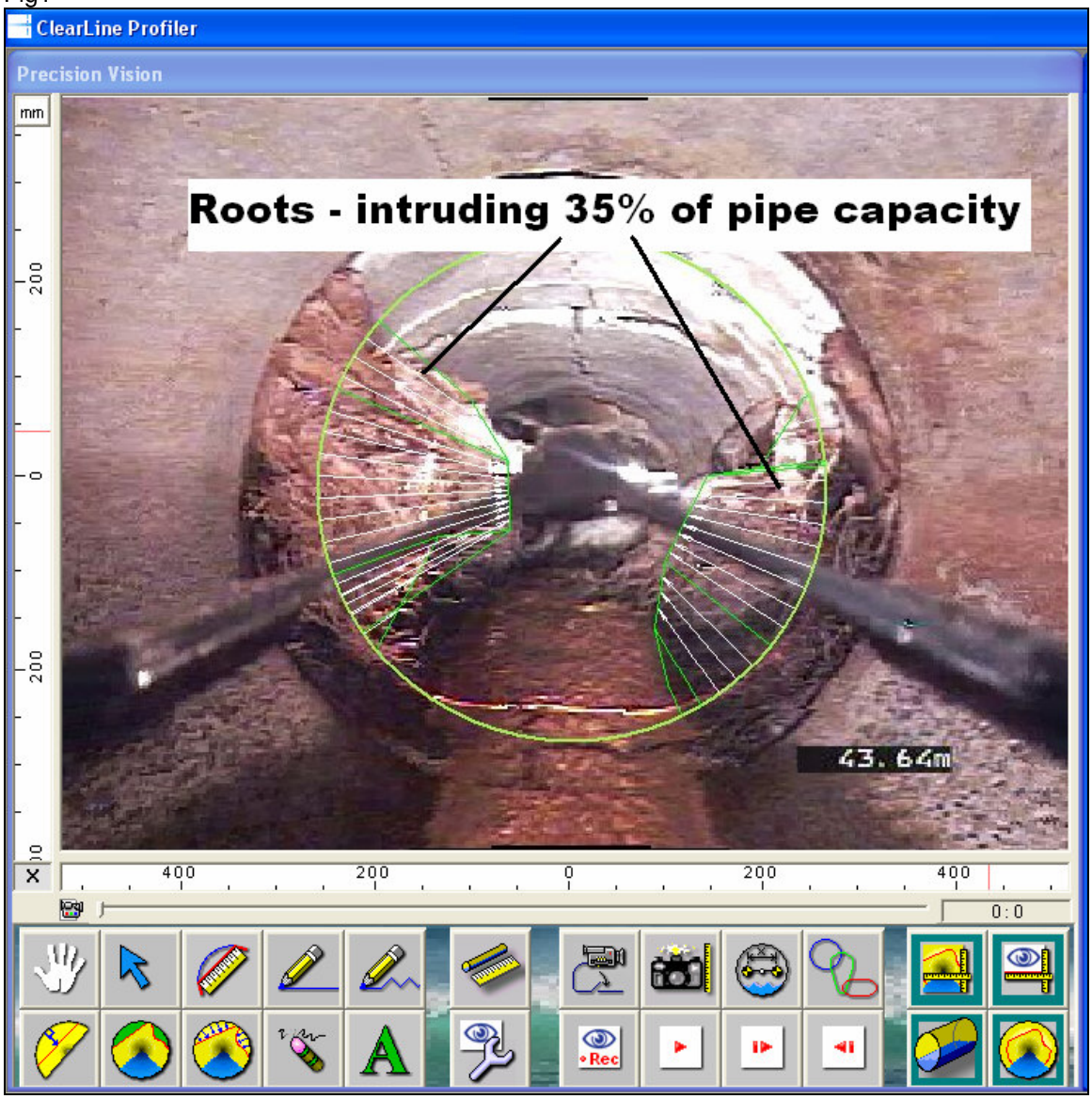
Camera Type: iPek SK80 camera, FW225 crawler configured for 525mm pipe
Profiler Type: Standard iPek ClearLine Profiler configured for a 525mm pipe
Format: mpg (digital) and VHS
Duration: 80mins approx
Lens distortion software correction: Applied
Profiling Method:
Camera lights on (recorded for visual analysis) - manhole NV4676 to manhole NV4675
Camera lights off (recorded for automated laser analysis) - NV4675 to manhole NV4676
Ovality formula:
The automated ovality calculations used by the ClearLine software are based on the American Society for Testing and Materials F1216 standards where it states;

$$q = \text{percentage of ovality of original pipe} = 100 \times \frac{(\text{Mean Inside Diameter} - \text{Minimum Inside Diameter})}{\text{Mean Inside Diameter}}$$

Notes:
The camera and profiler were obstructed from further inspection 43m from manholeNV4675 as serious roots were intruding into the pipe. Fig1 shows the roots obstructing what appears to be

35% of the pipe cross-section. It was decided to profile from this point back to the entry manhole NV4676

Fig1



Results and Discussion

Ovality

Severe deformation can be seen from 33m to 42m in the Pipe Ovality Analysis Graph in fig2. Whilst the ovality varies in this section, the deformation can clearly be seen to exceed 10% at times. The mean pipe ovality reduces to less than 2% from 33m to the entry manhole.

Fig2

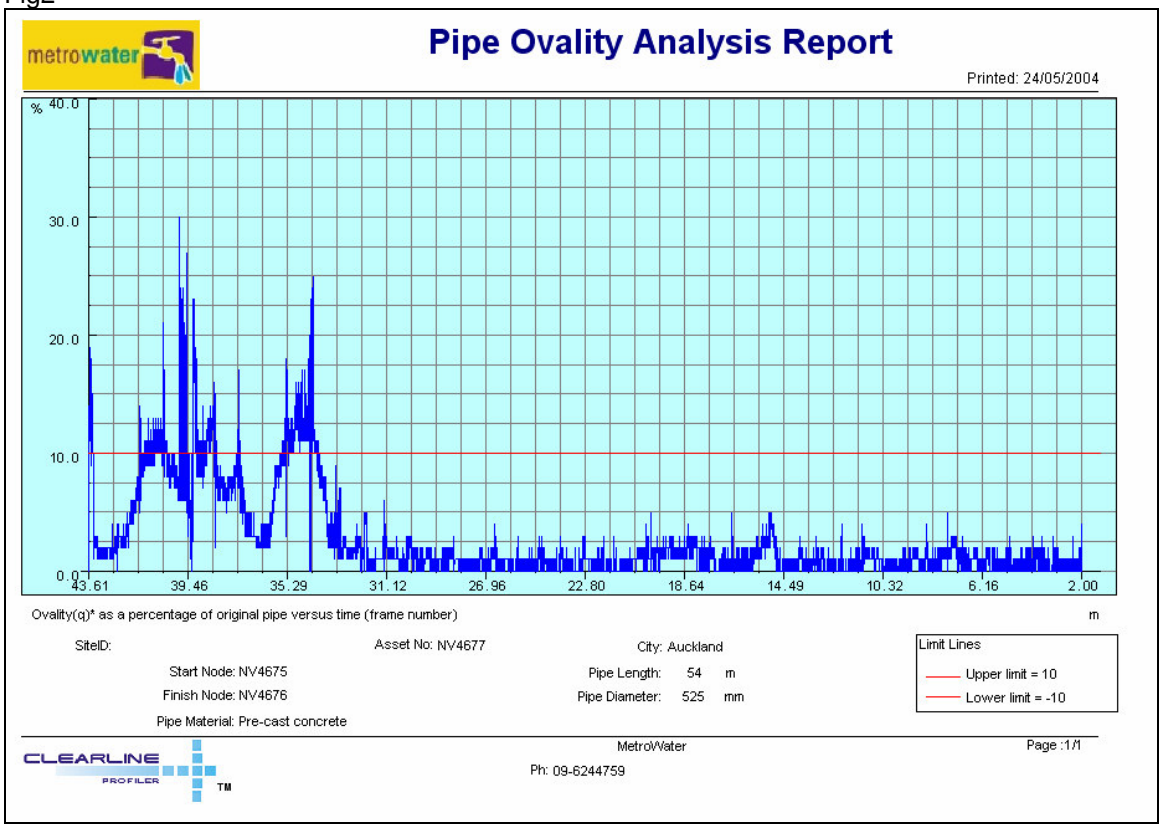
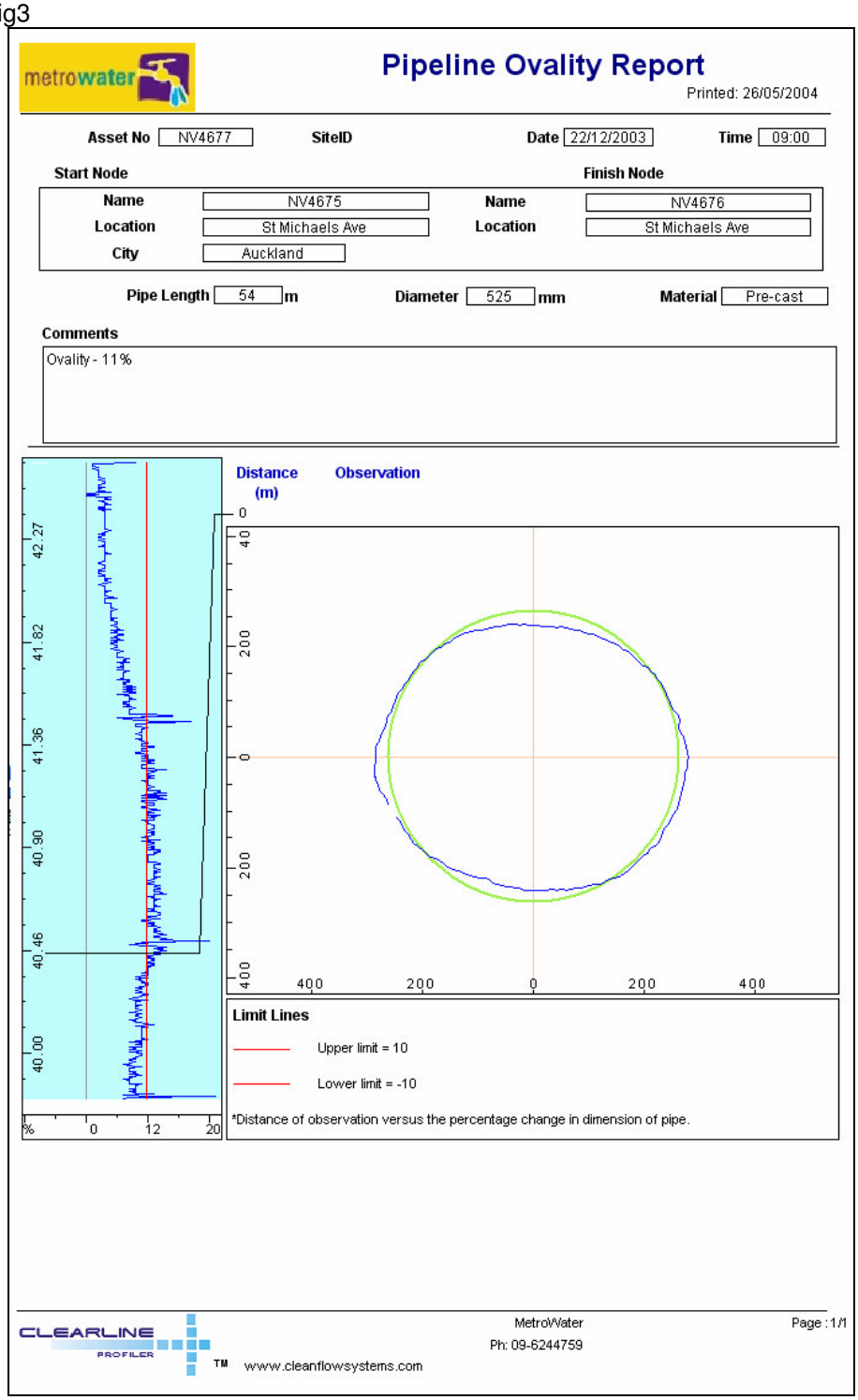


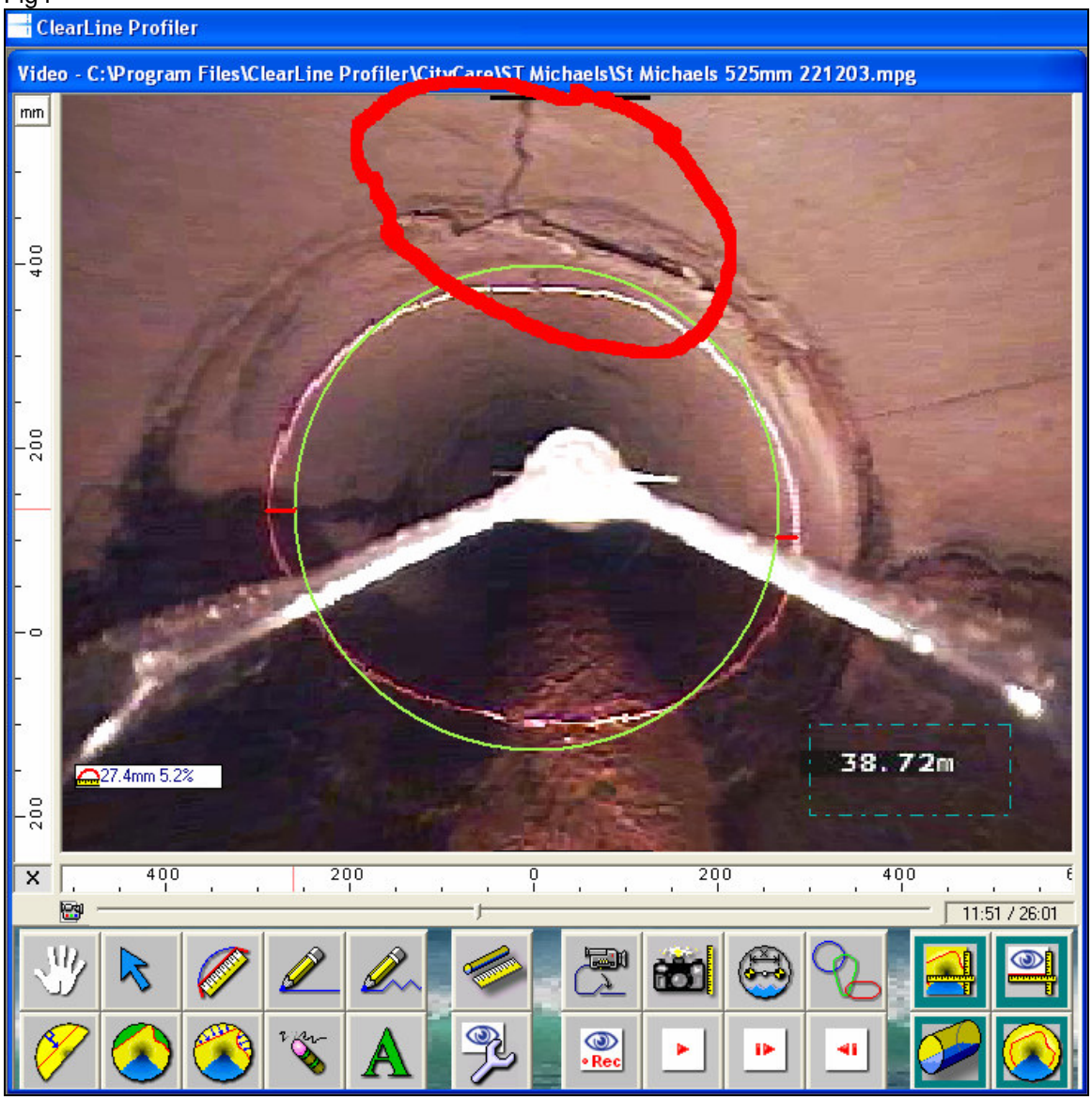
Fig3 shows the a cross-sectional digital profile 40m from NV4676. The ovality graph to the left was used to locate this particularly deformed section of pipe. The green ring represents the expected internal pipe diameter whilst the blue oval shape is the digital profile of the pipe derived from the laser image. Ovality is 11% at this point.

Fig3



The following (fig4) is a view of the same section of pipe, as seen during the pre-profiling (lights on). The expected internal pipe diameter is once again the green ring whilst the red ring is the actual pipe shape. Note the longitudinal and circumferential cracking in the invert.

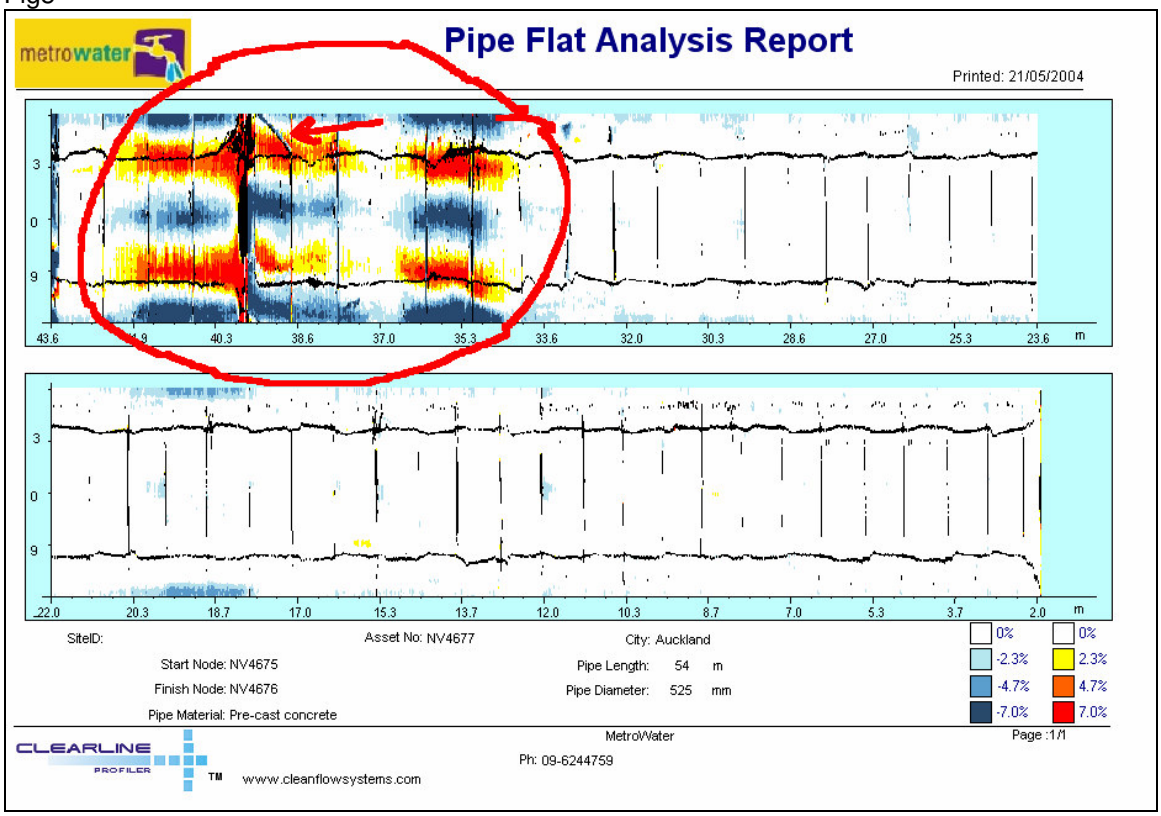
Fig4



Flat

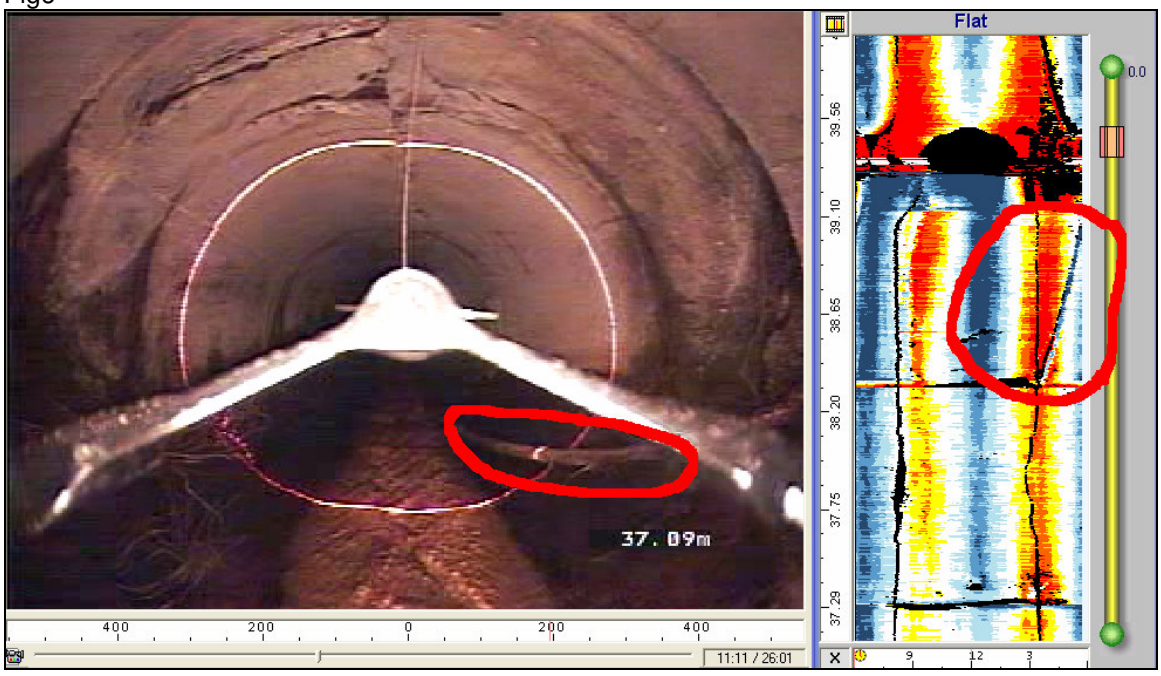
The ‘flat graph’ in fig5 shows a topographical view of pipe radius when flattened. Once again the deformation between 42m and 33m is clearly seen, whilst minimal deformation is evident throughout the reminder of the pipe. In this case the red colouring shows an increase in pipe radius of 7.0% (39.3mm) while the blue is the equivalent radius decrease. The black vertical lines show the joints of the concrete pipe.

Fig5



There appears to be a large root or possibly a cable running along the length of pipe between the 37 to 38m point in the pipe as highlighted by the straight line in the flat topography. This is seen in fig5 and fig6.

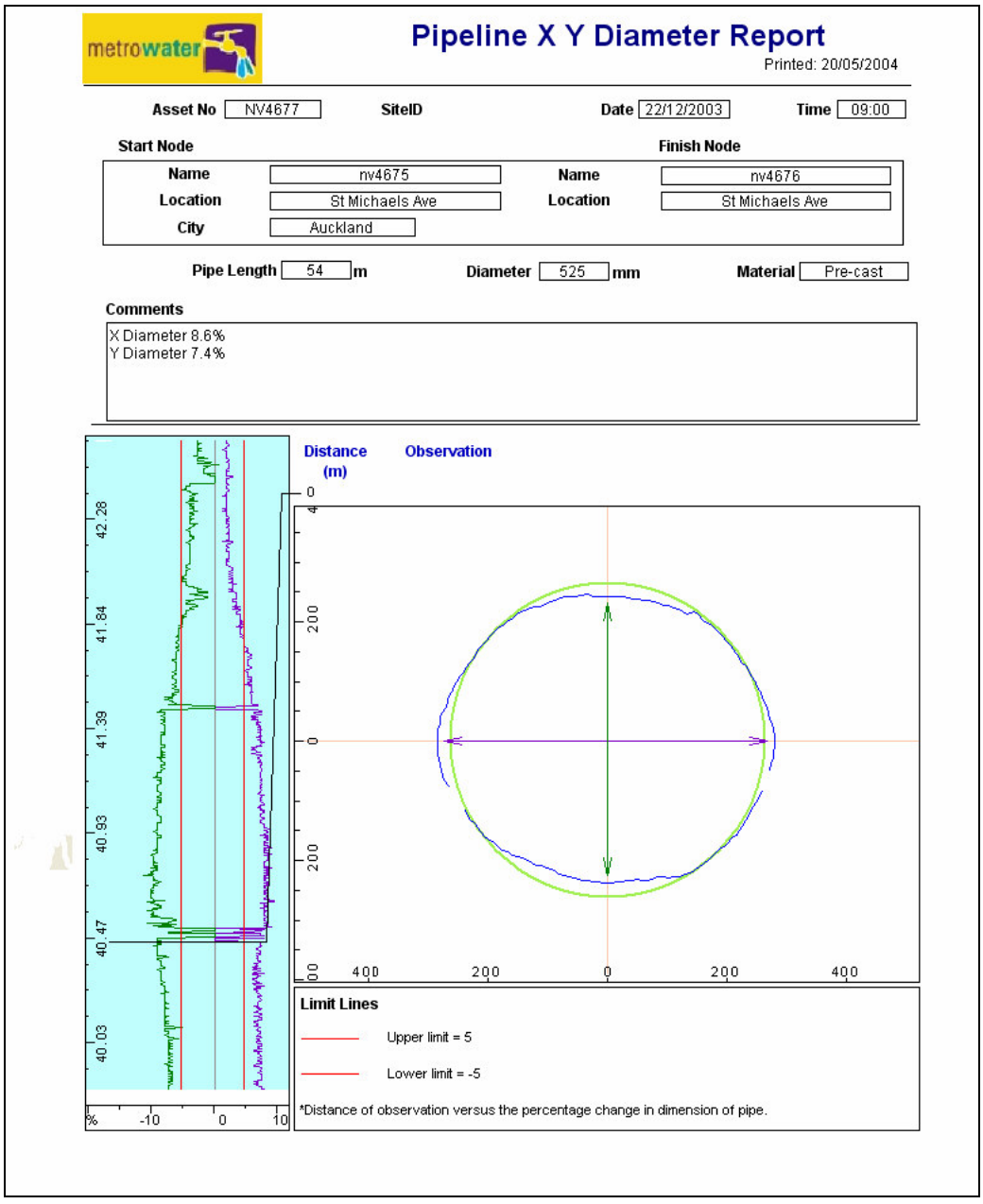
Fig6



XY Diameter

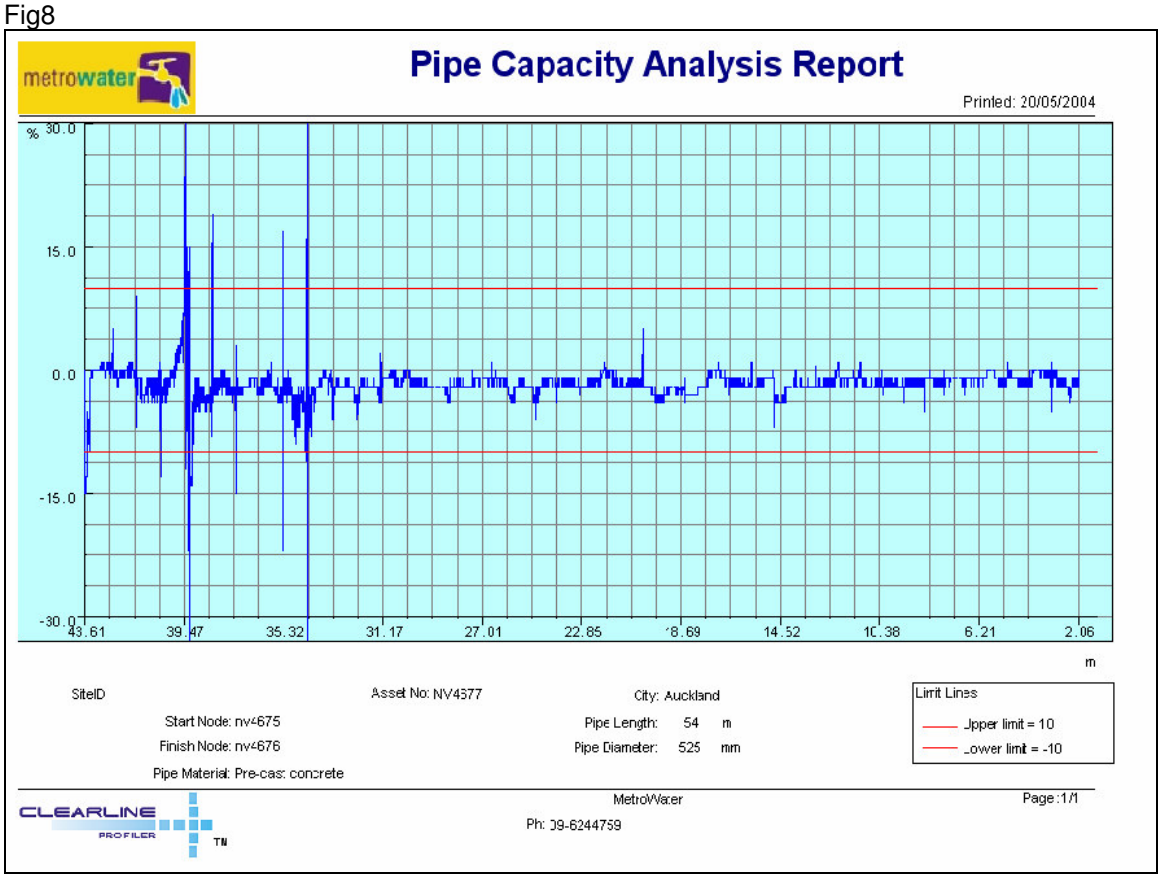
The XY graph (fig7) displays the vertical diameter and the horizontal diameter in terms of a percentage change from the expected diameter of 525mm. The digital profile shown, highlighted as severe in the XY graph to the left, is 40m from NV4676. In this case the X diameter is 39mm (7.4%) in excess of the expected Y diameter whilst the Y diameter has been reduced by 45mm (8.6%).

Fig7



Capacity
The Capacity graph in fig8 highlights a loss or gain in cross-sectional area in percentage throughout the total length profiled. The baseline (0.0) indicates the expected cross-sectional area for an unaffected new 525mm pipe. Although seriously deformed between 33m and 42m as seen in the ovality, XY and flat graphs, there is no major loss in capacity (1.6% for the section of pipe profiled). Note: The calculation of 1.6% does not include the capacity loss due to the roots intrusion at 43m.

Fig8



Conclusions
This profiling was performed in conjunction Metrowater and CityCare. Using these results, the following conclusions were ascertained;

'The Laser Profiler proved to be a useful tool to supplement CCTV surveys of drainage pipelines when the empirical measurements of physical details are required for the Drainage Asset Manager to make correct and more informed decisions.

[This] 525mm precast concrete stormwater pipe was badly cracked and likely to collapse in the future. The laser profiler was able to precisely gauge the loss of ovality ensuring correct evaluation could be made on the repair and/or rehabilitation techniques required'.

Richard Pullar
Metrowater Engineer