SEAVIEW WASTEWATER TREATMENT PLANT

MAIN OUTFALL PIPELINE CONDITION REPORT

Prepared for Hutt City Council

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Hutt City Council

Seaview Wastewater Treatment Plant Main Outfall Pipeline Condition Report

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1 Introduction

Wellington Water Ltd (WWL), on behalf of Hutt City Council (HCC) commissioned MWH New Zealand Ltd (MWH) to prepare a report summarising activities undertaken on the Main Outfall Pipeline over the last ten years, as well as report on its condition, inspection work and contingency measures. This report summarises condition inspection work required under condition 28 of consent WGN120142.

It is not the aim of this report to repeat previous work done. Existing reports are referenced throughout the text, and in the report history included in Appendix A.

2 Background and Pipeline History

The Seaview WWTP began operating in 1962 with preliminary treatment only, was upgraded to milliscreening in 1984 and full treatment was commissioned in March 2002. The liquid stream management consists of 1mm drum screens, primary sedimentation, contact stabilisation, and secondary clarification followed by UV disinfection.

During periods of sustained wet weather, secondary effluent flows in excess of the main outfall pipeline capacity are diverted to a 5,000 m^3 storm tank. When the storm tank is full any excess flow is disinfected as it passes through the UV system and overflows adjacent to the effluent pumping station to an outfall in the lower Waiwhetu Stream.

2.1 Main Outfall Pipeline (MOP)

The 18km long main outfall pipe (MOP) conveys secondary treated and UV disinfected wastewater from the Seaview WWTP to the beach outfall at Bluff Point approximately 500m south-east of Pencarrow Head. It was commissioned in 1962 and has now been in operation for 54 years. The pipeline consists of approximately 4,000 pipe sections of pre-stressed concrete rubber ring jointed construction, with an internal diameter of 1.295m. The pipeline is currently capable of transporting up to 1,520l/s of treated wastewater driven by variable speed pumps at the maximum operating pressure of 27 metres. The average flow of 640L/s requires about 12 metres of pressure.

The pipeline has experienced 50 rubber ring joint leaks since it came into service (refer Figure 1) and in the 54 years of operation several condition inspections have been undertaken. The most recent was completed in 2013 and inspected the condition of the pre-stressed reinforcing wires that provide structural integrity to the pipeline. As a result of this investigation two pipe sections were replaced.

The joint leaks which occur irregularly are typically in the winter higher flow periods outside the bathing season. However a control system malfunction in March 2009 lead to a major outage that took several months to repair. Since May 2009, HCC has used an innovative internal pipe joint seal system with considerable success. These seals provide flexibility at the joint, are quick to install and eliminate the considerable traffic disruption that excavation for a large concrete bandage repair can involve. They do, however, require the pipeline to be completely drained in the section of line requiring repair. This operation requires effluent to be drained to the Eastern Bays and the treatment plant to be diverted to the Seaview Outfall while the repair is made. The time to install an internal seal typically takes between 2 and 7 days.

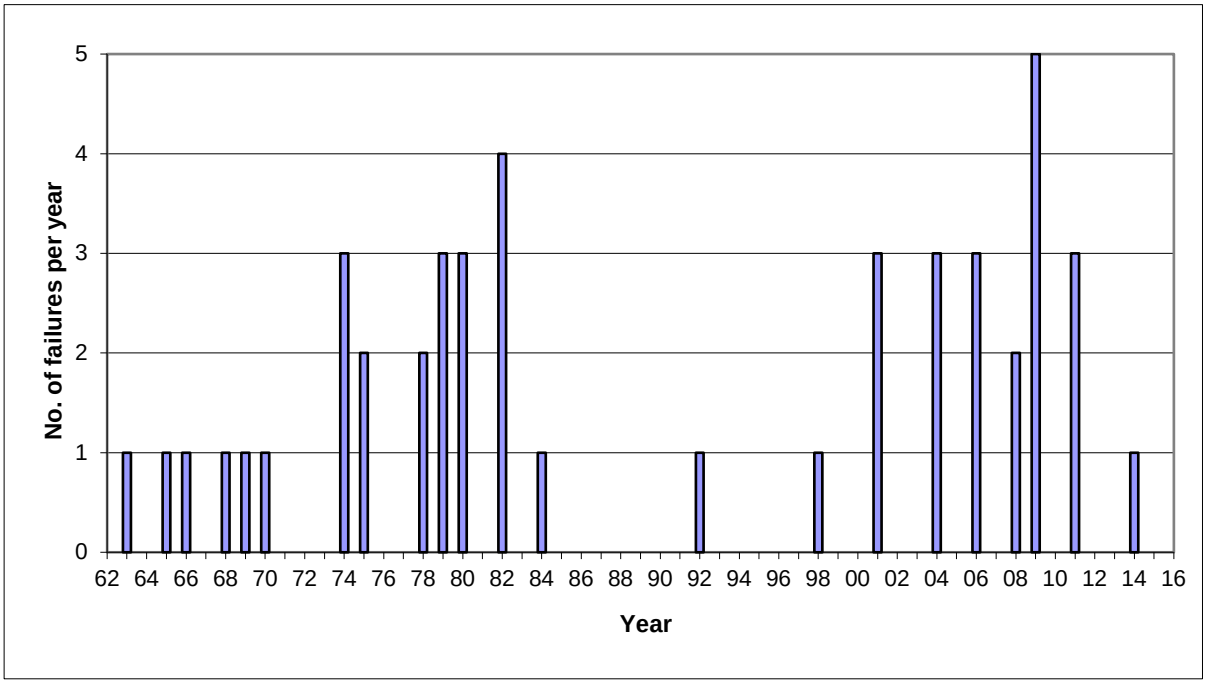

Figure 1 Rubber ring joint failures per year on the Main Outfall Pipeline

Structural pressure limitations mean that the pipeline has always had a limited hydraulic capacity during wet weather. The current pressure limitation results in approximately four overflows per year to the Seaview outfall in the lower reaches of the Waiwhetu Stream, just upstream of the Port Road bridge. The 5,000 m^3 storm tank at Seaview contains minor higher flow events but the average volume discharged when flows are higher has been about 22,000 m^3 per overflow event on average over the last 8 years. Progress is being made with the ongoing inflow and infiltration reduction programmes in HCC and Upper Hutt City Council (UHCC), however, the frequency and volume of these overflow events remains heavily weather dependent.

Following detailed consideration of alternatives and resource consent approval in 2013, HCC implemented a change in the management strategy for the pipeline in order to best overall manage the pipeline integrity, the wet weather overflows and the repair overflows. The maximum operating pressure was reduced from 35 to 27 metres to ensure less strain is placed on the pipeline and particularly the joints. This has eliminated the need for emergency joint repairs since this modification, which in turn eliminates the treated effluent discharges and major traffic disruption these repairs can cause. The reduction in flow-rate that this pressure reduction has caused is about 150 l/s. Although this change has increased the volume of treated effluent discharged through the Seaview outfall during major wet weather events from 0.5% to 0.7% of the total effluent treated at Seaview, and may have increased the number of overflow events marginally, on average joint leaks have been eliminated to date.

In the medium term an option is to install joint seals along much of the pipe and current HCC long-term planning funding allows for this to occur. The final decision on the scope and timing of this rehabilitation work is still to be determined. The performance and condition of the pipeline will be monitored and the timing of the work determined on this. If there is a clear need to bring this rehabilitation forward then that will be considered. This work will be a major operation and the environmental effects are considered to be greater than repairing the occasional joint leak as required, given that a 5 month period would be required to repair the seals, during which time the pipeline would be out of service.

Overall, the management approach which has been implemented has seen a considerable reduction in discharge of treated effluent during dry weather, with a marginal increase in wet weather discharges, when the environmental effects are minor.

2.2 Pipeline Replacement

Previous estimates for full replacement of the pipeline on the current alignment are in the order of $150M. It is essential to understand the condition of the MOP to ensure it can be fully utilised for its remaining life, and that replacement can be planned and commissioned ahead of any significant deterioration.

2.3 Previous Reports

The main outfall pipeline is a much studied asset with many reports prepared in the past addressing condition assessments, remaining expected life, improvement options and details and possible replacement scenarios.

A list of reports compiled on the MOP since 2003 is included in Appendix A for reference.

2.4 Previous Consultation

The MOP has been the subject of considerable community and special interest group consultation since the 1990's.

The current scheme of which key elements are the Seaview WWTP and MOP was determined by extensive consultation during the 1990's. There was wide support to build the new Seaview Treatment plant but also virtually unanimous support to retain the Main Outfall Pipeline to enable discharge of the wastewater (now fully treated) at the Pencarrow outfall. Any option which proposed a continuous discharge of treated effluent (to a suitable standard) into the harbour was not favoured at that time.

3 Update on Activities

3.1 Condition Assessments

3.1.1 Internal Inspections

A number of condition inspections have been undertaken on the Main Outfall Pipeline over the years. The historic inspections are well documented in *Pencarrow Main Outfall Sewer. Condition and Remaining Life* (J H Wood, January 2006). Corrosion of the circumferential wires emerged as a problem when two pipes in the southern tunnel catastrophically failed in 1978. Subsequent external condition survey work found some evidence of corrosion in five of 44 pipes inspected between 1989 and 2003.

3.1.2 P Wave electromagnetic inspection

Following a review of available condition inspection equipment Pure Technologies Ltd were commissioned to undertake a PureEM electromagnetic inspection of the pipeline in May 2013. Further work to validate and quantify that inspection was undertaken by Pure Technologies in November 2013. The validation report concluded that the PureEM location of distress on the prestressed concrete pipes was accurate for the eleven pipes excavated. In view of the results, the two pipes which were found to have the most broken wires were scheduled to be replaced in June 2014 during the permitted maintenance period. The pipes were adjacent to one another (#142 and #143) and located in Seaview Road.

3.1.3 SmartBall acoustic inspection

Pure Technologies were also commissioned to undertake a SmartBall assessment in November 2013 to identify leaks and gas pockets in the pipeline. During this inspection the first SmartBall launched from the Main Pump Station became stuck in the scour 9 pipe branch in Eastbourne and was unable to be retrieved as the pipe was in operation and maintenance works at that time of year were not permitted. Further attempts at retrieving this SmartBall have failed.

A second SmartBall from Point Arthur to the outfall was successful. SmartBall detected no acoustic anomalies that resembled leaks and one acoustic anomaly that indicated a pocket of trapped gas during the inspection.

3.2 Physical Works

3.2.1 Upgrades to main pump operating systems

Alterations were made in June 2013 to limit the maximum operating pressure in the MOP to reduce the risk of rubber jointing rings being dislodged.

As noted previously, adjustments to the relevant resource consent were obtained to permit the lower operating pressure.

Parts of the rationale and background to the above approach is further detailed in the report: "*Hutt Valley Wastewater System Main Outfall Pipeline Operating Strategy Discussion Paper*" by J Harding, November 2011.

3.2.2 New dedicated pipeline drain system

An issue with joint repairs has always been the need to drain the MOP to reduce the pressure at the leaking joint to permit the installation of an external reinforced concrete bandage or the fitting of an internal joint seal (AMEX seal).

Draining the line through the MOP scour lines has always been time consuming and materially affected the overall duration of joint repair times.

A permanent supplementary drain from Scour 2 which leads to the trade waste sewer in Barnes Street was installed in 2012. This is pump assisted and has significantly reduced the drain down time prior to repairs.

3.2.3 Replacement of pipes with corroded reinforcing

Following the internal condition assessment of the circumferential prestressing wire undertaken by Pure Technologies during 2013, the decision was taken to replace the two pipes showing the most significant wire corrosion. Epoxy coated welded steel was used for the pipe material and AMEX internal joint seals were installed to connect the new pipes to the existing. After re-commissioning the pipeline one of the new joints was found to be leaking. A further shutdown of the pipeline was required along with replacement of a further section of concrete pipe with steel to effect a satisfactory repair.

Confirmation of the corroded condition of the wire reinforcing was undertaken by Opus in the replaced pipes. Excellent agreement was achieved between the in-situ electromagnetic field test and the subsequent test described above.

3.2.4 Purchase of spare parts

An inventory of parts is held in stock at Seaview for future pipeline repairs. Included in the inventory are various length epoxy coated steel pipe sections, a number of internal pipe joint seals (AMEX couplings) and several other traditional pipe couplings.

3.2.5 Repair contract – contingency planning

A pipeline repair contract has been negotiated with a local drainage contractor, E Carson and Sons Ltd. This contractor has undertaken virtually all repairs and has been involved in inspections for a number of decades. E Carson and Sons Ltd have an experienced work force and a full inventory of relevant construction plant and dewatering equipment. They are also committed to a high priority response to any incidents affecting this pipeline.

Their response and performance to date has been excellent.

3.3 Benefits of Activities

In the three years since the upgrades to the main pump station control systems there have been no further joint leaks. As well as the obvious environmental benefits, this also provides the benefit of reduced pump wear by only operating one pump at a time and the consequent minor saving in electric power use. The receiving environment has benefited through reduced overflows into the harbour and the Waiwhetu Stream.

Although it has not needed to be operated for more than three years the newly constructed pipeline drain down system will still enable a repair to be completed in a considerably shorter duration than was the case before this facility was provided.

The understanding gained of the condition of the circumferential pre-stressed pipe barrel reinforcement is the first time this information has been available to allow smart repairs or pipe replacement. It is intended that the electromagnetic survey be repeated at regular intervals to ascertain a deterioration rate pattern (noting there are a number of variables involved). This is a very significant and useful tool to assist estimating the remaining life of the pipe barrels into the future. The fact that, with the exception of the condition of this aspect of the pipes condition, most of the pipes appear to be sound is reassuring. The combination of this factor together with the apparent benefit of the reduced pressure eliminating further joint failures over the last three years is useful for the asset planning for this very expensive to replace or renovate outfall pipeline.

However, when the past history of the pipeline is taken into account there are obviously still inherent risks. Some of the foreseeable risks remaining are due to natural hazards such as seismic activity, tsunami or vibration due to overweight vehicles traversing the road over the pipe alignment between Seaview and Burdan's Gate.

The pipeline should still be treated as a valuable but fragile asset. However with prudent future management and lack of seismic events, a remaining useful life of several more decades is envisaged.

4 Proposed Activities

4.1 Inspections and monitoring

As discussed above it is envisaged that regular monitoring of the pipeline condition is carried out, to minimise the risk of emergency repairs, and allow management of the pipeline.

A number of emergency repair items are held in stock.

4.2 Review remaining life forecast and risks

The first attempt at determining a useful remaining life was reported by John Wood in a 1989 report. The life expectancy was estimated at 2005 for the section of the pipeline constructed in tunnels in the vicinity of Pencarrow outfall and 2015 for the remainder of the pipeline.

Clearly these estimates, with the benefit of hindsight, have proven to be quite conservative. This is largely due to three key factors:

- Previous estimates were based on the condition assessment forecasting tools available then, the history of failures, particularly joint leaks, and the methods used to repair them. The wastewater, although milliscreened, did not receive any other treatment at this time.
- The new secondary treatment plus UV disinfection facility commissioned in 2002 means the adverse environmental and public health effects of any overflows are now minimal compared to untreated overflows.
- The operating regime of the pipeline has since been made less onerous by reducing the maximum operating pressure from 35 metres lead to 27 metres. As explained earlier, this results in only a minor reduction in pipeline capacity and also has the benefit this pressure and flow rate can be achieved with one only pump at the main effluent pump station. One pump operation eliminates the pressure blip caused by the second duty pump start up.

The combination of the above factors combined with the overall positive results from the P-Wave electromagnetic survey results, and the ability to install AMEX rubber seals on leaky joints much faster raises the expectation of the remaining life of this asset.

It is also proposed to schedule further condition assessment tasks and monitor what advancements worldwide are emerging to gain more accurate remaining life expectancy forecasts, including alternative assessment and renewal techniques.

4.3 Planning for Renewal or Replacement

Over the last 16 years there have been studies completed on options for renewal or replacement of the pipeline. In 2005 tenders were sought from contractors on the upgrade of the pipeline. There is currently $38M allocated in the Long Term Plan for renewal or replacement (between 2030-2034), and this work should be reviewed periodically to ensure relevance. It is also expected that planning for the renewal or replacement of the main should be commenced within ten years.

5 Resource Consent Aspects

A number of resource consents with various expiry dates are relevant to the operation of the MOP. These are:

Table 5-1: Resource Consents

Consent No	Type	Expiry Date	Description
WGN 050359	Effluent	August 2031	Treated effluent discharge at Pencarrow
WGN 12014 (33406)	Overflow	February 2018	Treated effluent discharge to Waiwhetu Stream during wet weather
WGN 12014 (33407)	Overflow	August 2031	Treated effluent discharge to coastal marine area during MOP repairs
WGN 12014 (33408)	Overflow	February 2018	Treated effluent discharge to Waiwhetu Stream during MOP repairs
WGN 12014 (33408)	Overflow	August 2031	Treated effluent discharge through MOP scour valves

A technical report outlining the options for feasible new outfalls to either replace and or supplement the existing Waiwhetu Outfall is also under preparation.

6 Summary and conclusions

In 1989 an estimate on the remaining life of the pipeline was made. Since then improvement in the level of treatment of the wastewater, changes in operating pressures, and new assessment techniques have meant this remaining life estimate was conservative.

There is insufficient data to be able to put a timeframe on the remaining life of this asset. However the most recent assessment, completed in 2013, showed the reinforcing steel of the pipeline was in relatively good order, though some pipes were replaced. Periodically carrying out condition assessments on the pipeline will allow WWL to determine if deterioration rate is increasing, and renewal or replacement needs to be brought forward. It will also allow weakened sections of the pipeline to be replaced in a planned manner, reducing the need for emergency repairs.

Due to the age and material of the pipeline it is always at risk of failure from natural hazards, particularly seismic events. After each reasonable seismic event the pipeline route is driven and monitored to see if there are any visible leaks at the ground surface.

The speed and cost of the seal repair method currently used (AMEX seals) means that any time the pipeline is emptied for any reason, whether it is planned or emergency maintenance, more seals in the area of concern can be replaced. Also a new draindown system has been installed to allow a faster drain down of the pipeline, reducing the time the treated effluent is discharged through the emergency outfall.

It is currently believed the MOP is in good working order, and under existing conditions will remain so for the foreseeable future. There is allowance in long term budgets for replacement or renewal of the pipeline, and planning for this renewal or replacement should be commenced within ten years, to ensure it is ready when the time is needed.

Appendix A Previous Reports Regarding the Main Outfall Pipeline

Author - Agency	Date	Report Title
Hickman W E & Bruce S M Opus Central Laboratories	2003: November	External Condition Assessment of Six Sections of the Pencarrow Main Outfall Sewer, Central Laboratories Report No 03-524569.00
Wood J H John Wood Consulting	2004: January	Pencarrow Main Outfall Sewer: Condition and Remaining Life
Wood J H John Wood Consulting	2004: April	Pencarrow Main Outfall Sewer: Leaks from Pipe Joints: 76 to 82 m Downstream of MH 33 and 62 m Downstream of MH 40
Wood J H John Wood Consulting	2004: September	Pencarrow Main Outfall Pipeline: Evaluation of Structural Rehabilitation Proposals: 2004
Wood J H John Wood Consulting	2004: October	Pencarrow Main Outfall Sewer: Internal Inspection 2004
Wood J H John Wood Consulting	2005: March	Pencarrow Main Outfall Sewer: Inspection of Outfall Ramp
Wood J H John Wood Consulting	2006: June	Pencarrow Main Outfall Pipeline: Update of Ground Water Survey Information
MWH New Zealand Ltd	2006: November	Pencarrow Main Outfall Pipeline: August 2006 Joint Repairs
Wood J H John Wood Consulting	2008: June	Pencarrow Main Outfall Pipeline: Leak from Pipe Joint in Seaview Road: 40m Downstream of MH70
Wood J H John Wood Consulting	2008: June	Pencarrow Main Outfall Pipeline: Update of Ground Water Survey Information
Wood J H John Wood Consulting	2009: November	Pencarrow Main Outfall Pipeline: Repair of Pipeline Failures: March to September 2009
MWH New Zealand Ltd	2010: February	Main Outfall Pipeline: Issues and Options
Wood J H John Wood Consulting	2011: November	Main Outfall Pipeline Operating Strategy: Discussion Paper
Aqua Environmental	2013: July	PureEM® Inspection Report
MWH NZ, Aqua Environmental	2013: October	Non-Destructive Pipeline Condition Assessment – Hutt Valley Main Outfall Pipeline
Aqua Environmental	2013: November	SmartBall Inspection Report, MOP Section 2
Aqua Environmental	2013:December	PureEM™ Validation Results
MWH New Zealand Ltd	2014: September	Main Outfall Pipeline: June 2014 Maintenance and August 2014 Repair Report
Opus International Consultants Ltd	2015: April	Pencarrow Main Outfall Pipeline: Pipe breakage and condition assessment