

2018 SL-RAT Acoustic Inspection Case Study

Rialto Wastewater Collection System

EXECUTIVE SUMMARY

A pilot study was conducted to evaluate the viability of incorporating the Sewer Line Rapid Assessment Tool (SL-RAT) into the Sewer Collection System maintenance program. Outputs of the pilot included:

- Verification of the accuracy of the tool readings
- Development of an operating protocol for incorporating into the cleaning procedures
- Evaluation of the benefits of tool use
- Quantification of the financial benefits of tool use

The SL-RAT proved to be highly accurate, efficient, and provides benefits such as equipment and labor optimization, condition assessment data collection, regulatory compliance, and reduction of wear and tear on equipment, piping, and paving. Financially, use of the SL-Rat saves on fuel and maintenance cost of the vactor truck, water usage for jetting, and extension of life of equipment, piping, and paving. It is recommended that the SL-RAT be permanently adopted as a tool for use in the maintenance program and the SSMP be updated to incorporate accordingly. Veolia proposes to purchase a tool for exclusive use at the Rialto project using their O&M operating budget.

Figure 1. SL-RAT Tool in Use



CITY OF RIALTO SEWER COLLECTION SYSTEM

The Sewer Collection System consists of approximately 260 miles of sewers that collect sewage generated within the City from north to south; it flows by gravity to the wastewater treatment plant. The terrain in the City slopes from north to south with a more gentle slope from west to east so that virtually all of the system consists of gravity sewers. There is a small area in the extreme south of the city that is below the elevation of the Wastewater Treatment Plant, so the sewage must be pumped back to the Wastewater Treatment Plant with six pump stations total serving the City. The sewers range in diameter from 4 to 48 inches with approximately 80% of the pipelines being 8 inches. Most of

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the sewers installed in the system are vitrified clay pipe ("VCP"). The City has begun using polyvinyl chloride pipe ("PVC") in recent years.

CONCESSION AGREEMENT SEWER SYSTEM REQUIREMENTS

The Schedule A.9 of the Concession Agreement between Rialto Water Services and the Rialto Utility Authority governs the conditions for the operation of the City of Rialto sewer collection system and is detailed in the Sewer System Management Plan (SSMP).

Per Schedule A.9 the maintenance and inspection requirements for the Sewer Collection System are as follows:

A.9.2 Operation and Maintenance of the Sewage Collection System

- 3. Inspect by closed-circuit television ("CCTV") problem areas of the Sewage Collection System as needed.*
- 5. Operate a routine cleaning program of problem areas of the Sewage Collection System as described below (including root control).*
- 9. Maintain a library of inspection reports and videos related to the Sewage Collection System.*
- 11. Perform on an annual basis, routine line cleaning in accordance with Section A.9.4 below.*

A.9.4. Contractor shall be responsible for the following cleaning related activities:

- 1. Clean all designated high Maintenance areas within the Sewage Collection System in accordance with Prudent Industry Standards.*
- 2. Prepare and maintain an active list of known problem areas of the Sewage Collection System with proposed Maintenance schedule that will be provided to the Authority on an annual basis.*

VEOLIA SEWER SYSTEM MAINTENANCE AND INSPECTION PROGRAM

In accordance with Schedule A.9 of the Concession Agreement, Veolia has developed and implemented a compliant maintenance and inspection program detailed in the SSMP. The computerized maintenance management system (CMMS), *Innovyze InfoNet*, contains a listing of all assets utilizing a GIS mapping based system as well as all maintenance and inspection records. Key components of the preventive maintenance program include a cleaning program and a CCTV inspection program.

The pipeline maintenance cleaning program uses hydro-cleaning technology to clean the sewer system. The cleaning schedule for all pipeline segments in the entire system sets cleaning on a three year cycle per prudent industry standards. Additionally, known problem areas are managed through the "hot spot list" and are cleaned on a more frequent basis of monthly, quarterly, semi-annually, or annually depending on the analysis of each individual location.

An inspection program using Closed circuit television (CCTV) technology is used to inspect the sewer system. The inspection schedule for all pipeline segments in the entire system sets inspection on a ten year cycle at 26 miles per year per prudent industry standards. Additionally, problem areas are

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inspected on an as-needed basis.

ACCOUSTIC INSPECTION TECHNOLOGY, THE SL-RAT

InfoSense, Inc. has developed the Sewer Line Rapid Assessment Tool (SL-RAT) using acoustic inspection technology to provide utility operators with a new capability to inspect pipe segments. The SL-RAT has been designed specifically for prioritizing maintenance operations based on rapidly assessing the degree of blockage within sewer line pipe segments for 6" to 12" pipe. The tool has proven effective in prioritizing cleaning operations within the industry and case study examples include Santa Barbara, CA and Discovery Bay, CA where use has been adopted into the SSMP Maintenance Plans. Further case study details can be found at <https://infosense.com/acoustic-inspection-case-studies/>.

The SL-RAT combines two components – a transmitter and a receiver. An operator places the transmitter in an open manhole and sends a loud sequence of tones through the airspace above the flow within the pipe. The receiver is placed in an adjacent manhole and listens for degradation in tones it hears. The resulting data is analyzed in real-time on the device using a sophisticated pattern matching algorithm. The technology exploits the fact that sound and water flow similarly through the free space within a pipe. Hence, if a known sound signal transmitted through a pipe segment is degraded, the SL-RAT analyzes the result in less than three minutes and provides a simple assessment of blockage within the pipe on a scale of 0 to 10. A score of 0 indicates a significant pipe anomaly that should be prioritized and investigated quickly. A score of 10 indicates the pipe sounds as clean as a known clear reference pipe. The scores are grouped into categories of "Red Light" for 0 to 4, "Yellow Light" for 5 to 6, or "Green Light" for 7 to 10. The inspection requires no prior preparation of the pipe other than opening the cover sufficiently to insert the speaker and microphone elements just below the plane of the manhole. The tool works in almost all gravity-fed pipe and manhole geometries, as well as with all types of pipe material.

Figure 2. SL-RAT Operating Methodology



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CITY OF RIALTO PILOT STUDY

A pilot study was proposed and completed to evaluate the viability of including the SL-RAT as a component of the Sewer Collection System maintenance program. Key outputs of the pilot study include:

- Verification of the accuracy of the tool readings
- Development of an operating protocol for incorporating into the cleaning procedures
- Evaluation of the benefits of tool use
- Quantification of any financial benefits of tool use

The SL-RAT tool to be used for the pilot study is owned by Veolia and shared across project sites throughout the year.

PILOT STUDY RESULTS

The Collections crew was introduced to the SL-RAT tool in early 2018 and provide classroom and field training on the operation of the tool and collection and analysis of the data. The crew conducted an evaluation period, then developed operating procedures over the next few months. During the month of April the tool was incorporated into the cleaning program and results documented in the summary below.

Accuracy Verification

A series of test protocols were completed to verify the accuracy of the SL-RAT scores. Utilizing the Vista Verde neighborhood, where known hot spots exist, scores were obtained on various pipe segments with the SL-RAT as well as CCTV inspections. The SL-RAT scores and the CCTV inspection results matched at 100% accuracy. Where there were blockages the SL-RAT identified those blockages and the CCTV inspection verified the blockage existed. Where there clean pipe the SL-RAT scored the pipe clean and the CCTV inspection verified the clean pipe condition. These accuracy tests provided confidence in the tool and scoring results.

Operating Protocols

After completion of the accuracy verification testing, staff established the methodology for incorporating the SL-RAT into the maintenance program.

Hot Spot Cleaning

It was determined that for the pilot project hot spots cleaning would maintained at the set cleaning frequency, and would continue to be cleaned with the vactor truck. Hot spot cleaning would occur at the beginning of each month and all hot spots would be cleaned in order before any routine cleaning occurred.

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Should formal adoption of the SL-RAT into the maintenance program occur, the SL-RAT could be used to evaluate the frequency of each hot spot and determine the rate at which cleaning is required to maintain clean pipe segments.

Cleaning Program

There are three types of approaches for a cleaning program:

- Reactive Cleaning – cleaning only when issues are found
- Routine Cleaning – cleaning on a set routine, without advance knowledge of whether it requires cleaning.
- Directed Cleaning – cleaning only targeted areas using advance knowledge of condition, optimizing staff and equipment use.

It was determined that the incorporation of the SL-RAT into the development of the cleaning schedule would move the program from a routine cleaning methodology to a directed cleaning methodology resulting in enhanced resource optimization. A Standard Operating Procedure (SOP) was developed on the use of the SL-RAT tool and incorporation of the work order and scoring data into the CMMS InfoNet system.

As described above, the SL-RAT develops a score ranking from 0 to 10. The scores were grouped into the following categories:

Score	Color	Response Time
0	Red	Action Same Day
1 to 4	Red	Action Same Day
5 to 6	Yellow	Add to List, Action with Full Day of Work
7 to 10	Green	No Further Action

The process for the cleaning evaluation would proceed in the following steps:

- Step 1. Evaluate a pipe segment with the SL-RAT and obtain a score. If score is Green (7 to 10) no further action required. If score is Yellow or Red (0 to 6) continue to Step 2.
- Step 2. Complete a CCTV inspection of the pipe segment. Determine why a poor reading was received to understand the cause of the blockage.
- Step 3. Clear the blockage with the vactor truck or initiate CIP project if due to pipeline failure.
- Step 4. Complete a second CCTV inspection of the pipe segment to ensure the blockage has been

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removed.

Step 5. Re-evaluate the pipe segment with the SL-RAT for an updated quick condition score. (Note, this step was identified post pilot study as quick queries could be run on the system using the snapshot score from the SL-RAT while the CCTV inspections are being completed over a longer period of time).

This methodology allowed for the set of network piping identified for cleaning during the month to be completed more quickly than had the set of piping been cleaned during the current procedure with the vactor truck. The rest of the month the cleaning crew completed manhole inspections.

CCTV Inspections

It was determined that CCTV inspections should continue and remain on the 26 mile per year basis. Detailed evaluations of the pipe segments are necessary for condition assessment purposes in order to properly identify capital improvement projects. Though the SL-RAT can provide quick identification of blockages, other issues not identified with the SL-RAT can be identified with the CCTV inspections. Therefore, a full assessment of the entire system in the identified 10 year cycle should be completed with the CCTV equipment.

Benefits of Use

Numerous benefits of the SL-RAT were identified through the course of the pilot study such as equipment and labor optimization, condition assessment data collection, regulatory compliance, and reduction of wear and tear on equipment, piping, and paving.

Equipment and Labor Optimization

The SL-RAT scoring data by category and footage is summarized in the tables below for March and April. March testing was a partial test month and April followed the proposed protocols for the entire month. Specifically in April, the crew achieved 80,673 ft per month with SL-RAT versus 60,000 ft per month target with jetting process. Only 2% of pipe footage required immediate cleaning, and only 5% required scheduled follow-up cleaning, with the vactor truck. The remaining 93% of pipe footage required no cleaning.

Tables 1. and 2. SL-RAT Pilot Study Footage and Percent by Score Category in March and April

SL-RAT Score	March, ft	April, ft
0-4	286	1,651
5-6	1,646	3,805
7-10	38,081	75,217
Total Ft	40,013	80,673

SL-RAT Score	March	April
0-4	1%	2%
5-6	4%	5%
7-10	95%	93%

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It was determined that the transition to a directed based cleaning program using the SL-RAT increased the productivity of the collection crew. The rapid deployment capability of the SL-RAT resulted in being able to monitor/clean more footage of pipe in a month with additional time remaining for other duties such as manhole inspections. For a given pipe segment the SL-RAT assessment takes approximately 3 to 5 minutes to set-up, gather reading, and break-down. Jetting with the vactor truck adds an additional 10 minutes to each segment.

An additional benefit is that the procedure for use of the SL-RAT is less physically intensive than the jetting process. This results in a potential for less impact on employees and a potential reduction in health and safety incidents.

Condition Data

The use of the SL-RAT provides for a quick score inspection that can be used to summarize at a high level the condition of the network more quickly than CCTV inspections. When scores of 0 through 6 are identified, a CCTV inspection is completed for investigation. This process allows for additional targeted CCTV evaluations in areas where issues have been identified. If cleaning does not solve the blockage, targeted CIP projects can be funded and implemented to resolve known issues.

Additionally, through the process of setting up the SL-RAT for use, it requires each manhole in the system to be opened, which the use of the vactor truck does not require. This allows for a quick visual manhole inspection for identification of any serious issues. Additionally, it requires opening dead-end manholes at the ends of streets, which the vactor truck does not require. This provides quick visual inspections on more of the system.

Finally, through the optimization of resources, additional time is available each month for additional services such as manhole inspections. Currently, the staff aims to complete manhole inspections each year, but currently no target rate is set as it is based on time availability. With the incorporation of the SL-RAT efficiencies the manhole inspection program could be organized and accelerated.

Environmental Compliance

By using the SL-RAT to identify quick scoring of blockages, trending over time of data can result in early identification of new hot-spots, before they develop into Sanitary Sewer Overflows (SSO's). Using the developed protocol by CCTV'ing pipe segments with low scores, issues can be identified more quickly resulting in maintenance and CIP planning to prevent SSO development.

Certain portions of the network, such as the Beachwood area are unable to be jetted at the normal operating pressure due to elevation and grade issues as the jetting causes situations such as pressure back-up in homes and toilet burping. The use of the SL-RAT tool allows these areas to be inspected for issues until a CIP project can be implemented to correct the network situations.

Wear and Tear Reduction

The use of the SL-RAT reduces the frequency of jetting with the vactor truck each month. This results in a reduction of the wear and tear of the sewer piping network, as the jetting process has

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been shown to have the potential to degrade piping over time. Additionally, this results in a reduction of the wear and tear of the vactor truck and city paving as the truck is not deployed as frequently on the city streets. Extending the life of the piping, truck, and pavement has positive financial impacts.

Cost Savings

With the reduction in use of the vactor truck for jetting operations operating cost savings were identified. These include lower maintenance costs on the vehicle, lower fuel costs, and lower water use. Fuel cost savings were estimated based on a comparison of annual data to the April data. Vactor truck maintenance assumed a 50% reduction in cost. Jet water billing has a base rate and a consumption rate. The base rate would remain constant, however consumption savings were estimated using 90% reduction of water consumption based on the percentage of green scoring that required no cleaning from the April data. Additional savings would occur in extending the life of the piping network and paving, however these costs are not simple to estimate and have not been included in the study at this time.

Table 3. Calculated Savings Through Incorporation of the SL-RAT Tool into the Cleaning Program

Category	Average Annual Cost	Estimated Savings %	Calculated Annual Savings	Responsible Party
Vactor Truck Fuel	\$ 10,800	66%	\$ 7,128	Veolia
Vactor Truck Maintenance	\$ 8,500	50%	\$ 4,250	Veolia
Jet Water (Estimated)	\$ 6,800	30%	\$ 2,040	City

Investment Evaluation

The SL-RAT tool and software has a cost of \$27,000 for purchase. The calculated Return on Investment (ROI) for Veolia through Vactor truck fuel and maintenance savings is 2.4 years. The calculated ROI for the City through utility savings is 13 years. The tool should be expected to have a minimum five year life cycle.

RECOMMENDED NEXT STEPS

Based on the pilot study results and the identified benefits to the Rialto sewer collection network program, it is recommended that the SL-RAT be permanently adopted as a tool for use in the maintenance program and the SSMP be updated to incorporate the tool into the maintenance program accordingly. Based on the ROI calculations, it is recommended Veolia purchase the tool through the O&M operating budget.