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Injection Grouts and CIPP Lining Revitalize Buried Assets on Treasure Island

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1. ABSTRACT

Living and working on a Florida barrier island has its advantages, unless you are the Public Works Director. Treasure Island was born in 1951. This 5.3 square mile, mostly man-made island was created by dredging the Boca Ciega Bay—no clays, no loamy soils—just granular sands and residual from aquatic ecosystem. What does this mean for 17 miles of mainline sewers and laterals serving 6,800 residents and 15,000 seasonal residents? A challenge, but Michael Helfrich (Public Works Director) and Joyce T. Velitschkowski (President of J.T.V., Inc.) gained insight on this project that can be applied anywhere for anyone responsible for trenchless solutions:

1. CIPP Lining and Injection Grouting are not only complementary, but very necessary in this case.
2. Due to severe infiltration, *Grout First* makes CIPP mainline possible.
3. Grouting joints and lateral connections are most cost-effective.
4. Together, Grouting and Lining provide a more durable, longer-lasting solution.

Small communities with limited budgets have to prioritize problems and choose remedies wisely. Treasure Island is a wholesale customer of a large, neighboring municipality and experiences an extremely high surcharge for excessive chlorides. To Helfrich, this could only mean high infiltration of saltwater, and through monitoring pump station data, discovered a gaping hole in a mainline located between a building structure and seawall. Trenchless was the only answer. Injection grouting stopped the active leaks, followed by CIPP Lining and grouting lateral connections. Result? 30% reduction in infiltration and with benefits compounded daily - this was the single best rehab investment Treasure Island could make.

2. INTRODUCTION

The motivation for conducting this study was due to the excessive chlorides found in our sanitary sewer that created a "Strong Waste" surcharge that was charged by the wholesaler (St. Petersburg) to treat the wastewater. The purpose of the Inflow and Infiltration (I&I) study of the City of Treasure Island wastewater collection system was to determine where the significant areas of the city that were exhibiting a large amount of chlorides. The City of Treasure is located in Pinellas County Florida on several barrier islands. Its 1.6 square miles of land is mostly man-made and was created by dredging of Boca Ciega Bay. The soil is made of granular sands and residual aquatic materials (shell). The basis of the I&I study was to use the natural chlorides in the ground water as the indicator of infiltration into our wastewater collection system. With the majority of the collection system constructed below a tidal influenced groundwater, the analysis of chlorides made the detection of high infiltration areas easy to identify. The study focused on five Study Areas (See Figure 1).

Figure 1. City of Treasure Island Study Areas

Sampling was performed during high tide and the same time of day. To identify the areas that are high contributors of chlorides in the sanitary sewer system, the Public Works Department developed a sampling plan based on collecting sewage from the lift station receiving manholes and analyzing the chloride concentrations. The results of the chloride sampling identified several areas with excessively high concentration of chlorides. In addition, a mass balance was performed on the system to determine the areas that are contributing an excessive amount of chlorides to the wastewater stream.

As illustrated in Figure 2 to Figure 4, the Sunset Beach area that is serviced by Lift Stations #1, #2, and #3 contribute 81.8% of the total mass of chlorides, and 25.7% of the total sewage flow. Currently, Lift Station #3 (LS #3) contributes 69.0% of the total mass of chlorides verses only 15.8% of the total flow.

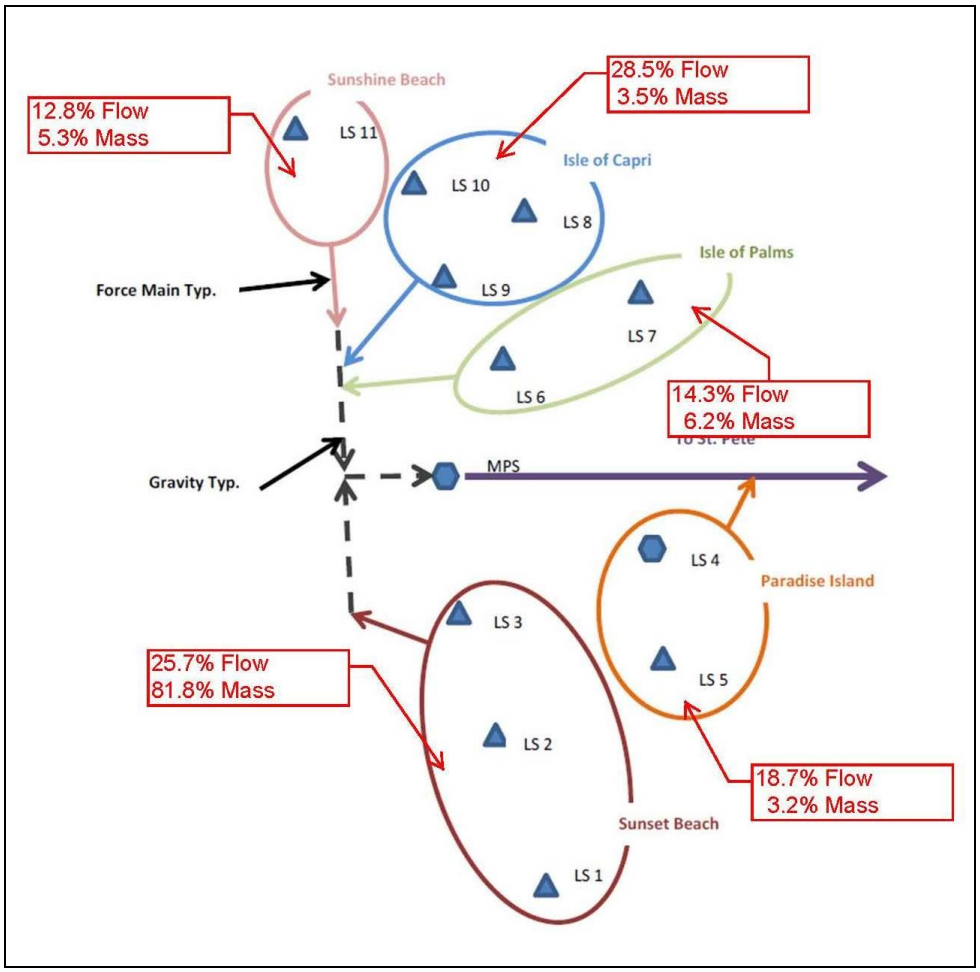

Figure 2. Results of Mass Balance and Flow Area

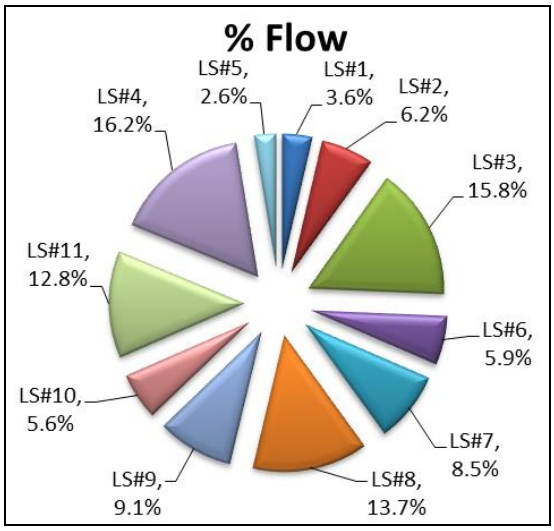

Figure 3. Percentage of Flow by Lift Station

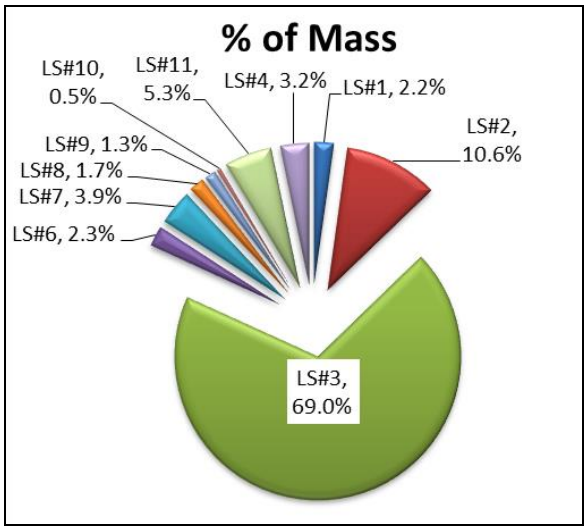

Figure 4. Percentage of Mass by Lift Station

3. IDENTIFICATION OF PRIORITY AREAS BY VIDEO SURVEILLANCE

Armed with the information collected from the chloride sampling and performing a mass balance on the system, Public Works determined that the Sunset Beach area was our highest priority and LS #3 Basin (Study Area 1) was our main area of infiltration. The Public Works Department has a state of the art Cues digital sewer video surveillance truck. The video equipment and computer tracking system allows our technicians to quickly and effectively grade the condition of the sewer line in real-time. The identification of the high chloride areas provided the Public Works Department vital information to direct the Cues digital sewer video surveillance operator to document and grade the condition of the gravity sewer lines. During the video surveillance, the camera operator documents and assesses the condition of the sewer line in order to set priorities.

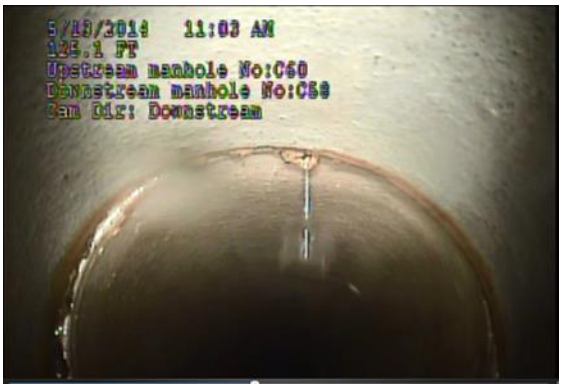

Figure 5. Gravity Sewer Line with Constant Drip from Infiltration

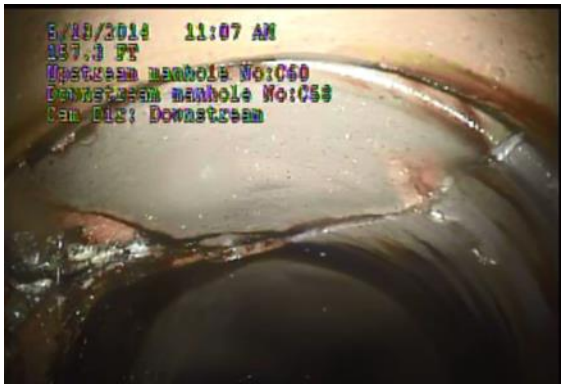

Figure 6. Typical Gravity Sewer Line Damage with Infiltration

The condition of the clay (Terracotta) pipe was cracked, allowing a large amount of groundwater to infiltrate as illustrated in Figures 5 and 6. The result of the video surveillance allowed us to identify the two areas shown in Figure 7 as the main culprits of infiltration.

Figure 7. LS #3 Area with Extreme Infiltration

4. PROJECT GOALS AND OBJECTIVES

Once the Public Works Department identified the two areas, we investigated the operation of LS #3. The City has a Supervisory Control and Data Acquisition (SCADA) system that operates with coded signals over communication channels to provide control and logging of remote equipment. In addition, the SCADA system allows us to monitor the flow rates entering and leaving the Lift Station. The goal of this project was to decrease the infiltration of groundwater thereby reducing chlorides and total flow. The reduction in both the level of chlorides and total flow reduces the cost of wastewater treatment.

Repairing these two areas cost effectively required the use of trenchless technology. Fortunately, the City of Treasure Island had recently awarded a contract with J.T.V. – a municipal contractor located in St. Petersburg, Florida. The City provided a Work Authorization to J.T.V. to provide the services to repair the pipelines utilizing Cured-in-Place Pipe (CIPP) rehabilitation.

5. APPROACH, CHALLENGES AND TIMELINE

J.T.V. was contracted by the City of Treasure Island to rehabilitate the 8-inch diameter by 436 linear feet of vitrified clay pipe (VCP) sanitary sewer line. Within the scope of services was heavy cleaning to remove mineral deposits, removal of protruding service connections, pipe joint air test and seal, CIPP lining of the sanitary sewer main, nine lateral reinstatements, and lateral grouting.

The Public Works Department determined the high chloride rates were originating within the designated pipe segments and deteriorated pipe conditions in LS #3 via CCTV inspection. The pipe segments were located off of Harrell Avenue within an easement located from Manhole 55 to Manhole 56, to terminating in a clean-out located at the edge of the Intercostal Waterway. The sanitary sewer runs were next to an apartment complex approximately three to five feet off the foundation of the building, and four to six feet deep.

Initial inspection indicated that 95% of the service connections required the removal of protruding taps. Four out of nine of the taps removed were achieved via robotic cutting, and the remaining five hammer taps were replaced due to shattered VCP at the sewer main. Once the laterals were repaired, mainline air testing and sealing proceeded for a total of 44 joints. 100% of the 8-inch sanitary sewer main joints failed their air test. J.T.V. decided to injection grout the joints via remote packer. During this process, a packer with inflatable rubber ends is centered on either side of the joint via CCTV camera, and then inflated. Once inflated, the packer releases grout, and under pressure, is forced outside the joint defect into the surrounding soils creating an impermeable water barrier. For this project, J.T.V. used Avanti's AV-100 Acrylamide Chemical Grout. The amount of grout used at each of the 44 joints averaged 3.59 gallons totaling 158 gallons of AV-100. Within the initial inspection, it was discovered that the terminal clean-out was not capped and in fact was an open pipe. Once the clean out was excavated, it was possible to watch the tide change.

Heavy mineral deposits were accumulated at each of the leaking joints and fractures. J.T.V. utilized robotic cutters to mill the mineral deposits from the VCP to minimize any additional damage to the pipe. Lining material was installed to an 8-inch diameter and 7.5 mm finish due to the shallow elevation of the pipe and overall longevity of the final product. Lateral grouting also required a higher than normal quantity of grout due to the existing voids from years of infiltration. Manhole 56 was an outside drop manhole, and it was determined that the last joint of the drop was severely separated allowing approximately 30 gallons per minute of groundwater to infiltrate into the system. J.T.V. plugged the bottom of the drop, pumped AV-100 into the drop, and sealed the section of pipe. The CIPP liner was extended into the manhole and a PVC inside drop was constructed to replace the defective drop. The finished product achieved a 91% reduction in chlorides and a 30% reduction in flow.

6. SUMMARY, CONCLUSION AND BENEFITS GAINED

The cost to rehabilitate these two areas using trenchless technology was $51,273. In return, the City saw a chloride concentration reduction in this area from 10,700 ppm to 965 ppm, and a reduction in average flow from 188 gallons per minute to 128 gallons per minute. This reduction in flow from these two areas equates to approximately 31 million gallons per year at a reduction of over $90,000 per year for the life of the structure.