

## **Waste Management**

### **Infrastructure Rehabilitation in the U.S. Virgin Islands**

The United States Virgin Islands is a group of islands in the Caribbean that are an insular area of the United States. The islands are geographically part of the Virgin Islands archipelago and are located in the Leeward Islands of the Lesser Antilles.

The U.S. Virgin Islands consist of the main islands of Saint Croix, Saint John and Saint Thomas, along with the much smaller but historically distinct Water Island and many other surrounding minor islands. The total land area of the territory is 133.73 square miles (346.4 km<sup>2</sup>). As of the 2000 census, the population was 108,612.

Prior to the 1970's, wastewater was collected in the major cities of Christiansted and Frederiksted on St. Croix and Charlotte Amalie on St. Thomas and discharged to the ocean with little or no treatment. During the 1970's, a comprehensive program was completed under the Clean Water Act to implement primary treatment with treated effluent discharge through ocean outfalls to the Caribbean Sea for the major population centers of the two main islands of St. Croix and St. Thomas. I became involved in the project as the Resident Project Representative and oversaw construction of the first phase of the project from October 1970 to August 1973 which included the treatment plant and pumping station, sewer interceptors, and force main from Frederiksted. The Christiansted sewer interceptors and force main from Christiansted were constructed in the following three years.

As part of the project, large 18-, 24- and 30-inch diameter sewers were constructed long distances to transport sewage from the population centers to the new primary wastewater treatment facilities. On St. Thomas, wastewater from the capital Charlotte Amalie was transferred several miles through the downtown area along St. Thomas Harbor and around Crown and Lindbergh Bays to the new primary treatment plant at the St. Thomas airport. On St. Croix, wastewater from Christiansted was transported over 51,000 feet and from Frederiksted over 46,000 feet by interceptor, large centrifugal pumping stations and 12-inch force mains to the new primary plant also located adjacent to the St. Croix airport.

On St. Croix large portions of the interceptor followed along natural drainage ways called "guts" often through the bushes and vegetative overgrowth. From hydraulic and land taking viewpoints, these guts were a natural location to site gravity sewer lines. In later years, this played a major role in the difficulty of maintenance and the ability to locate and repair leaks. During large rain events, the guts often overflow, undermine and even change course also attributing to the failure of adjacent pipelines.

As PVC pipe was not yet a popular option for large diameter sewers, the original designs called for reinforced concrete pipe. Due to the cost of either fabricating the pipe on the island or shipping from the United States, the contractor who ultimately was low bidder on the most of the interceptors submitted for approval a new pipeline product by Johns Manville, a well known and respected manufacturer of the time who later had problems with asbestos pipe and other asbestos

products. The new pipe, Flextron, was a reinforced plastic mortar gravity sewer pipe which consisted of a catalyzed isophthalic polyester resin binder, a siliceous sand aggregate filler, and glass fiber reinforcement. Numerous tests were run before and during construction on tensile strength, flexibility, load bearing capacity, corrosivity, etc. One great advantage was that most of the gravity sewer pipe was designed as 18, 24, and 30 inch and due to the thinness of the pipe, the three sizes could be nested one inside the other to take up 2/3 less room on the shipping barges than the same size concrete pipe. Any damaged pipe was easily repaired and spherical fittings could be made up in the field with a two part epoxy resin.

One factor that was overlooked both for the pipe and the concrete materials was the extreme wastewater strength including very high levels of hydrogen sulfide that developed in the lines. These high strength wastewater levels have been attributed to several factors. Due to the scarcity of water for flushing toilets much of which was either rain water or brackish water which contained sulfides, flushing was done more infrequently where plumbing was connected directly to the waste pipe. A second factor was the distance the sewer was transported from the point of origin to the treatment plant which allowed the sewer to become septic and give off large quantities of very corrosive and odorous hydrogen sulfide gas.

By the 1980s, some signs of deterioration were already occurring especially in a section of the Fredriksted interceptor that accepted waste from the rum factory. In 1984, the U.S. Environmental Protection Agency (EPA), working with the USVI Department of Planning and Natural Resources, signed a federal court-ordered Consent Decree with the USVI government that required that the upgrade of primary treatment plant to secondary treatment and a maintenance program for the gravity sewers, pumping station and force mains.

By the 1990s, the 25-year old sewer system was developing aging and growing pains. The St. Thomas plant had been replaced by a temporary lagoon during the expansion of the International Airport and the St. Croix facility had deteriorated to the point that failure was eminent.

After many years of slow progress and several amended decrees, the waste water system continued to fail frequently and discharged untreated waste water through outfalls and bypasses. Under threat of criminal enforcement action for waste water violations and mounting EPA Administrative Orders on Consent for landfill and solid waste regulatory compliance issues, the Government of the Virgin Islands established the Virgin Islands Waste Management Authority (VIWMA) in 2004 to focus more attention and funding to address longstanding problems with waste water and solid waste management in the territory.

With funding from Corrective Action Trust Funds and general and special operating funds, the operations staff was hired to improve the operations and maintenance of the waste water system and solid waste facilities. Additionally, with federal grants and bond proceeds, the engineering staff and consulting companies were hired to plan, design, and manage capital projects and major maintenance and facility upgrades.

Several initiatives were immediately undertaken and significant milestones have been met. Emergency Task Order Contracts were established to reduce emergency response and repair time for sewer system failures and bypasses. Numerous manhole rehabilitation projects were

completed in this emergency response mode. One major force main replacement project is currently underway and another will be advertised for bids this fiscal year. New upgraded pumps were installed at all of the major pump stations on St. Croix. Upgrade work on the major pump station on St. Thomas and the replacement of the Cruz Bay, St. John main pump station are also scheduled to begin this fiscal year.

A Request for Proposals was developed for the design, construction, and operation of the two new secondary wastewater treatment plants. In 2006 and 2007, Veolia Water North America (VWNA) completed the construction of the two new secondary wastewater treatment facilities in St. Croix and St. Thomas, respectively.

The Authority utilized state-of-the-art zoom camera technology and global positioning system (GPS) equipment to map and assess the condition of the gravity sewers and manholes on St. Croix. Prior to this evaluation, the sewer pipes had to be cleaned and flushed; therefore, vacuum and flushing vehicles and equipment were procured and engineering and waste water operations staff were trained to use this equipment during the systematic cleaning of the sewer lines.

Pipe Assessment and Condition Program (PACP) training was also provided to the WMA staff. This two-day program included identifying and rating defects found in both pipelines and manholes in four main categories: Structural Defects; Operational (O&M) Defects; Construction Features; and, Miscellaneous Features. Cataloguing these defects and identifying their severity has led to an easily understood process for prioritizing the Authority's Capital Improvement Program and Operation and Maintenance Program.

During the field assessments, at several locations along the guts, storm water erosion and flooding had exposed the pipe and manhole causing sewage to bypass and storm or surface water to inflow. In one notable case, a large shark was found in the bar screen and several small parrot fish were found in the clarifier at the treatment plant resulted from an inlet crossing adjacent to the ocean where a large vortex and subsequent pipe failure was found and repaired.

In some cases, due to the extreme levels of the very corrosive hydrogen sulfide, portions of manholes and pipe were nonexistent. Point repairs commenced immediately using both no dig and dig replacement methods. Technologies used included cured-in-place liners, spiral-wounded PVC, slip linings, epoxy coatings, pipe bursting, sealing grouting and others. To fully evaluate these repair options and build local capacity in these new technologies for manhole and pipe repairs, several specialty manufacturers of these repair products and technologies from the mainland were invited to participate in a two-day seminar on St. Croix to explain and demonstrate the benefits and applications of their products and establish licensing agreements with the local contractors who would use these repair products and technologies.

Presently, the Authority continues to prepare bid specification packages for the manholes and sewer lines that were rated as imminent failure condition by prioritizing locations, recommending types of repairs, and developing a maintenance program. This sewer system evaluation and pipe condition rating will be duplicated on the St. Thomas and St. John islands in upcoming years. A value-added asset management system for these underground assets is also being reviewed to achieve the long-term goals for Capacity Management and Operation and

Maintenance standards. This asset management system will assist in the implementation of a systematic maintenance programs, the execution of sewer system rehabilitation and replacement projects, and the planning of future infrastructure upgrades and improvements.

## Problem



*Sewer Manhole Corroded by Hydrogen Sulfide Gas, St. Croix*



*Manhole Concrete Deteriorated by Hydrogen Sulfide Gas, St. Thomas*

## Evaluation



*Hoyle, Tanner's Dick Perez Investigates Sinkhole by Sewer Manhole, St. Croix*



*Smoke Testing to Locate Deteriorating Sewer Line, St. Thomas*

**Solutions**



*Epoxy-Lining Manhole Repair,  
St. Thomas*



*Pipe Bursting Repair, St. Croix*



*Slip Lining Repair, St. Croix*

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