

Manhole Rehabilitation

Plays Key Role in North Carolina City's I&I Program By Dan Cook

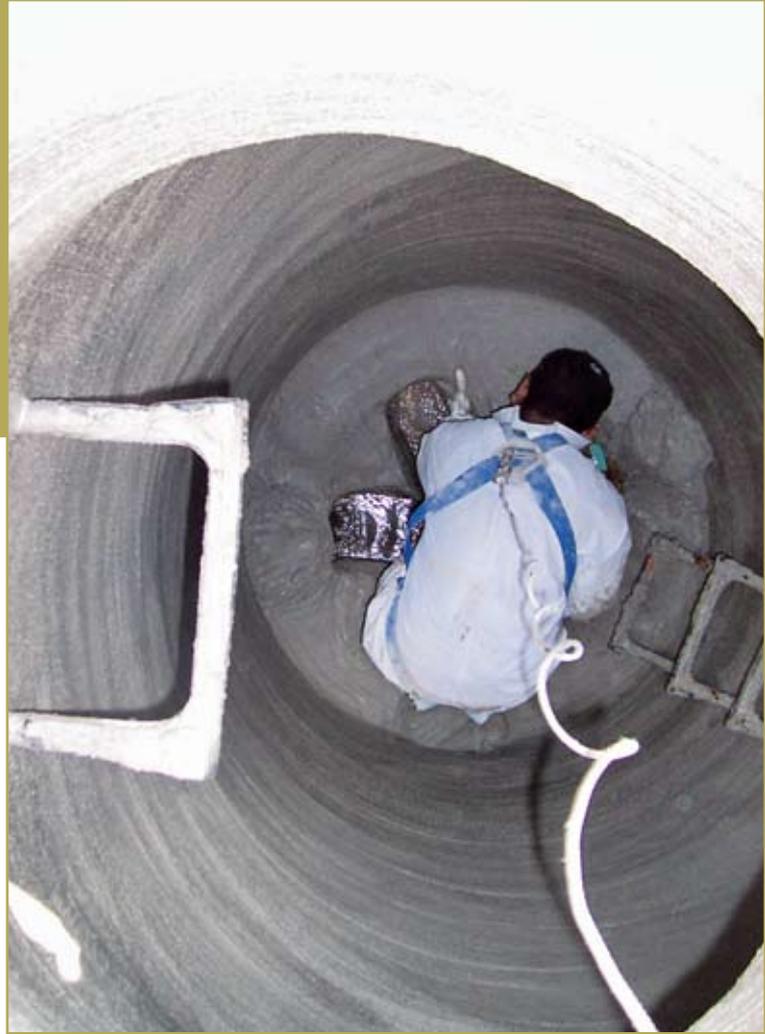
The Charlotte-Mecklenburg Utilities (CMU) has established an aggressive, long-term plan to significantly reduce inflow and infiltration (I&I) in the sewer system of Mecklenburg County, N.C.

CMU's sewer collection system is comprised of approximately 4,075 miles of sewer collection lines serving more than 230,000 households residing throughout Mecklenburg County and the City of Charlotte — North Carolina's most populous city. CMU operates five wastewater treatment plants with a total capacity of 123 million gallons/day, with an average daily flow of 76 million gallons/day. The total number of manholes in the CMU system exceeds 100,000.

CMU spends millions of dollars annually on the discovery and repair of sewer collection system defects. Using a systematic, basin-by-basin "find it and fix it" methodology, CMU delivers a thorough and cost-effective approach to discovering and decreasing I&I, thus improving the collection systems' efficiency and reducing the hydraulic load on the treatment plants.

Reducing the load on these plants helps maximize efficiency, thus delaying or eliminating the need for costly upsizing of CMU's treatment capacity.

The inspection, evaluation, and rehabilitation of manholes play a significant role in CMU's sewer rehabilitation program. CMU and its engineering consultant, Frazier Engineering, identify and document any entry points for unwanted rain water and ground water to enter the manholes. Manholes are often large sources of I&I, and they can often be repaired and strengthened relatively easily and inexpensively. A properly designed



manhole repair can lead to substantial reductions in the amounts of unwanted groundwater and runoff that enter the system.

CMU has inspected and evaluated more than 50,000 manholes to date in its system. Each inspector gathers information using hand-held digital devices purposefully built for the task. Information collected includes:

- GPS coordinates for each manhole
- Diameter of manhole and cover
- Manhole depth
- Description of manhole structural material (brick, block, pre-cast)
- Number of connections within the manhole
- Pipe diameters of incoming/outgoing lines
- Condition of all manhole components
- Evidence of structural defects, infiltration, surcharge and/or overflow

The information gathered at each manhole site is reviewed by engineering staff, defects are identified and the most cost-effective solution to correct the discovered defects is determined. Many manhole defects (such as leaking manhole covers) can be repaired simply and at relatively little cost. Some manholes, however, are found to have extensive deterioration and leakage, and require solutions that go well beyond the simplest techniques. In such instances, CMU typically rehabilitates these manholes using a specialized cementitious mortar that is installed on the manhole walls from top to bottom. CMU uses Portland-based mortar, blend-

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ed calcium aluminate mortars and 100 percent calcium aluminate mortars, depending on the location of the manhole and the susceptibility of the manhole to hydrogen sulfide (H₂S) corrosion. Where H₂S corrosion is severe, CMU will typically use an epoxy coating over the cementitious mortar product.

The procedure for relining each manhole follows specific requirements set forth by CMU, and every manhole is thoroughly inspected after rehabilitation to ensure compliance with those requirements. Manhole relining begins with a thorough preparation of all internal manhole surfaces. Field crews use high-pressure washing (greater than 3,500 psi) to remove loose particles, dirt, sludge, grease and other contaminants from the manhole interior. This step is extremely important in order to ensure that the cementitious mortar, when applied, will properly bond to the substrate. If any leaks are found after the manhole has been cleaned, they must be repaired using fast-setting hydraulic cement prior to the application of the mortar.

Once the manhole has been properly prepared for lining, the cementitious mortar is then applied, usually by a low pressure spray technique or via centrifugal casting. The CMU requirement specifies that the entire manhole surface be coated with a 1-in. thick layer of the cementitious mortar. Upon completion of the cementitious liner, the manhole is allowed to cure and then the manhole is vacuum-tested to verify that the manhole is leak-tight (minimum 1 minute for the vacuum test). A properly relined manhole is virtually impervious to extraneous water sources, and provides the intended reduction in inflow and infiltration at that site.

CMU has successfully re-lined more than 7,000 manholes using cementitious mortar products since the early 1990s. Cementitious mortar lining is the standard manhole rehabilitation technique employed by CMU based on its long-term record of success with the various products. By using a pro-active, cost effective approach to manhole rehabilitation, the Charlotte-Mecklenburg Utilities has improved system capacity, reduced inflow and infiltration, and improved the structural integrity and reliability of their sewer system for residents throughout Mecklenburg County.

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