

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

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Introduction

The Fountain Sanitation District (District) has had a corrosion problem in manholes downstream of the location where the Colorado Centre force main discharges into the District wastewater collection system. The District performed some manhole rehabilitation work on manholes downstream of this discharge location even though the manholes are relatively new.

Task 500 was to perform an analysis to determine the advantages and disadvantages of shortening the Colorado Centre force main and allowing it to discharge into the Fountain Sanitation District wastewater collection system further upstream of its current discharge location. The current discharge location is at Ohio Street and Jimmy Camp Road. The analyzed discharge location is at C and S Road approximately ½ mile west of Link Road. Figure 3-1 shows the general location of the Colorado Centre force main with the current discharge location and the analyzed discharge location.

The Investigation

In discussions with the District, GMS, Inc. and Colorado Centre personnel there are several items that were discussed:

- The wastewater flows pumped from the Colorado Centre force main have high concentrations of waste products. Just three years ago, before much of the residential development occurred in the Colorado Centre area the BOD level in the flow averaged approximately 900 mg/l. The current levels of BOD in the flow are remarkably lower; however, they still run relatively high with an average of approximately 300 mg/l.

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

- The level of hydrogen sulfide in solution at the existing discharge location will exceed 35 ppm if chemicals are not added to the wastewater flows to reduce the concentrations.
- Colorado Centre originally added ferric chloride to the wastewater flows at the pump station to reduce the release of hydrogen sulfide in the force main and at the discharge location.
- The Colorado Centre wastewater collection system has one structure with very turbulent flow. This location has produced high levels of hydrogen sulfide.
- The introduction of the ferric chloride was moved approximately 2.5 miles upstream of the pump station to reduce the amount of hydrogen sulfide in the tributary wastewater collection system pipes. Colorado Centre is trying to keep the hydrogen sulfide in solution below 0.3 ppm.
- The potato chip factory usually runs from 7:00am to 11:00pm and generally discharges between 0.02 and 0.04 mgd with an average discharge of 0.021 mgd.
- The potato chip factory has a packaged treatment facility that is designed for an average day flow of 0.028 mgd and frequently runs overloaded and apparently often works incorrectly.
- The Colorado Centre force main was experiencing restrictions a few years ago and about one mile of it was jet cleaned downstream of C and S Road. During the cleaning, a white coating as much as 1 inch thick was observed on much of the interior of the pipe.
- The total Colorado Centre discharge into the District's wastewater collection system averages 0.125 to 0.130 mgd.
- Low flow conditions into the Colorado Centre pump station can be as low as 0.025 mgd.
- The cost of electricity for running the Colorado Centre pump station is approximately \$850 per month. This cost has increased an additional \$700 per month during periods of high flow levels.
- The cost of maintaining the pump station and force main is approximately \$250 per month.

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
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**B&V Project 137033
November 22, 2004**

- The cost of treating the wastewater flows with ferric chloride is approximately \$15,000 per year.

Additional information collected:

- The corrosive environment observed in the manholes in the District system is caused by hydrogen sulfide being converted to sulfuric acid on the manhole walls. The sulfuric acid reacts with the calcium carbonate in the concrete and mortar of the manholes and reduces the strength of the concrete and mortar.
- The strength of wastes in the wastewater flow is directly related to the amount of sulfides that can be generated. The higher the waste strength the higher the sulfide generation.
- The more time the wastewater flows spend in the collection system the more sulfides that can be generated in solution. The higher concentration of sulfides in solution causes more hydrogen sulfide to be released into the air in the pipes and manholes. Increased turbulence in the pipes and manholes allows more hydrogen sulfide to be released into the air.
- Hydrogen sulfide in the air in the manholes and pipes is a major safety concern for personnel maintaining the collection system. High enough levels of hydrogen sulfide or long periods of exposure can cause death.
- The estimated volume of the force main is 0.037 mg. The estimated travel time in the force main can be over 12 hours during low flow and as little as 2.4 hours during high flows. This is in addition to time spent in the wet well as the wet well is filling to turn the pumps on.
- Since the flows upstream of the pump station are experiencing problems with hydrogen sulfide then the addition of ferric chloride or other chemicals will need to be continued.
- There appears to be enough elevation decrease from the existing pump station to the analyzed discharge location to allow for a gravity sewer to be constructed to replace the existing pump station and force main. An 8 inch diameter pipe

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

- installed at a constant slope will have estimated travel times that range from 7.3 hours during low flow conditions to 1.3 hours during high flow conditions. The estimated travel time during average daily dry weather flow (ADDF) is 2.2 hours.
- The 2003 Master Plan shows the ADDF in the pipe from JC-030 to JC-029 (the current discharge location) as 0.154 mgd. This flow is projected to increase to 0.622 mgd in year 2010.
 - The 2003 Master Plan shows the ADDF in the pipe from JC-063 to JC-062 (the analyzed discharge location) as 0.021 mgd. This flow is projected to increase to 0.245 mgd in year 2010.
 - The 2003 Master Plan modeling results shows the estimated travel time in the system from JC-063 to JC-030 during ADDF at approximately 2.0 hours.

Alternatives

Alternatives were reviewed to try to determine the advantages and disadvantages to the District's wastewater collection system to try to decrease the hydrogen sulfide problem.

The first alternative reviewed considered abandoning both the pump station and force main and constructing an 8-inch gravity sewer from the pump station closely following the route of the force main to existing manhole JC-063.

The advantages and disadvantages to this approach are as follows:

Advantages

1. Eliminate the time wastewater flows have to remain in the pump station wet well before being pumped into the force main. This is a major concern during low flow periods.
2. Eliminate the turbulence caused by the collection of the flows in the pump station wet well and the pumping of the wastewater flows through the pumps and the force main.
3. Reduces the amount of time the wastewater flows spend in the wastewater collection system. During ADDF the time from the pump station to the existing

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

- discharge location is estimated to be reduced from 7.1 hours to 4.2 hours. The time reduction will most likely be more because the wastewater will not have to accumulate in the pump station wet well before being pumped.
4. If the concentration of waste flows in the receiving sewer is less than the Colorado Centre waste flows then this will allow the relatively high concentration of waste flows from the Colorado Centre area to be mixed with the lower concentration of waste flows from the rest of the collection system sooner which will help reduce the possibility of hydrogen sulfide buildup.
 5. Eliminates the pump station and force main operation and maintenance costs estimated to be approximately \$14,700 per year. Using an interest rate of 6% and a 20 year analysis, the present value of those payments is \$168,600.

Disadvantages

1. Cost to construct the gravity sewer and to abandon the pump station and force main. Estimated capital cost to construct approximately 13,300 ft of 8-inch diameter gravity pipe is \$1,441,000.
2. Cost to abandon the pump station and force main.
3. If the wastewater flows are not continually treated with the addition of chemicals then fewer of the Districts pipes and manholes will be exposed to the corrosive powers of the sulfuric acid.
4. Larger CIP pipes will most likely be needed between JC-063 and JC-030 to allow the additional flows to be transported.

The second alternative reviewed considered leaving the pump station in operation but to shorten the force main. The force main would empty into a proposed gravity sewer at the existing 90 degree elbow at C and S Road. The gravity sewer would be constructed along C and S road approximately ½ mile towards the west and discharge into existing manhole JC-063.

The advantages and disadvantages to this approach are as follows:

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

Advantages

1. Reduce the length of the force main from the original 23,950 feet to 10,720 feet, thereby:
 - Reducing the amount of time the wastewater flows spend in the force main by more than half.
 - Reducing the amount of turbulence caused by pumping the wastewater flows through a shorter force main.
2. Removing the lower portion of the force main will allow the force main to drain empty into the new gravity sewer during periods when the pumps are not running. The force main flows downhill from the pump station to the proposed beginning of the gravity sewer. This will further reduce the overall amount of time the flows spend in the collection system. During periods of low flow, this time reduction can be several hours.
3. Reduces the amount of time the wastewater flows spend in the wastewater collection system. During ADDF the time from the pump station to the existing discharge location is estimated to be reduced from 7.1 hours to 5.4 hours. The reduction will most likely be more because the wastewater will not have to accumulate in the pump station wet well before being pumped.
4. If the concentration of waste flows in the receiving sewer is less than the Colorado Centre waste flows then this will allow the relatively high concentration of waste flows from the Colorado Centre area to be mixed with the lower concentration of waste flows from the rest of the collection system sooner which will help reduce the possibility of hydrogen sulfide buildup.
5. Reduces the pump station and force main operation and maintenance costs.

Disadvantages

1. Cost to construct the gravity sewer and to abandon the southern portion of force main. Estimated capital cost to construct approximately 2,600 ft of 8-inch diameter gravity pipe is \$282,000.
2. Cost to abandon part of the force main.

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

3. If the wastewater flows are not continually treated with the addition of chemicals then fewer of the Districts pipes and manholes will be exposed to the corrosive powers of the sulfuric acid.
4. Larger CIP pipes will most likely be needed between JC-063 and JC-030 to allow the additional flows to be transported.

The third alternative involved doing nothing to the pump station or force main and leaving the system as it is.

The advantages and disadvantages to this approach are as follows:

Advantages

1. Funds are not needed to construct the gravity sewer required to replace the pump station and force main or the partial abandonment of the force main. Estimated capital cost to construct the 8-inch diameter gravity pipe is \$1,441,000 for total abandonment and \$282,000 for the partial abandonment.
2. If the wastewater flows are not continually treated with the addition of chemicals then fewer of the Districts pipes and manholes will be exposed to the corrosive powers of the sulfuric acid.
3. Larger CIP pipes will not be needed between JC-063 and JC-030 to allow the additional flows to be transported.

Disadvantages

1. The time the wastewater flows are kept in the wastewater collection system does not change.
2. The turbulence caused by the pump station and force main will still exist.
3. The pump station and force main operation and maintenance costs will still be incurred by Colorado Centre.

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 500 - Colorado Centre Analysis**

**B&V Project 137033
November 22, 2004**

Conclusion and Recommendations

Currently Colorado Centre is using ferric chloride treatments to keep the amount of sulfides in solution at a minimum. Other issues that can be addressed to try to help the problem are:

- Consider constructing a pretreatment facility to treat the flows, which will reduce the sulfides in solution.
- Perform an analysis of the existing treatment facility at the potato chip factory to determine if the plant is operating correctly and or if the process can be improved to help reduce the concentration of the wastewater flows. This may eliminate the need for constructing a pretreatment facility.
- Continue with the chemical treatments in the wastewater flows.

Based on the limited work performed by this analysis it appears that the second alternative allows for the greatest reduction in the amount of time the wastewater flows spend in the collection system for the cost. The time is reduced because the force main flows downhill from the pump station, which allows it to drain during times the pumps are not pumping. The shorter force main will lead to cost savings for the operation of the pump station and maintenance on the pump station and force main. The less time the flows spend in the collection system the easier it is to keep the development of hydrogen sulfide at bay. This leads to less corrosion for the manholes and pipes and safer working conditions for maintenance personnel. Even with the reduced time the wastewater flows spend in the collection system it will most likely not eliminate the need for chemical treatment of the wastewater flows.