AR0020036

Total Residual Chlorine Testing Program
Melbourne Wastewater Treatment Plan
Melbourne, Arkansas

EPA Project No. C-050588-03
November 17, 1987

Prepared by
CEI Engineering Associates
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Bentonville, Arkansas 72712
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SECTION I
Introduction

I.1 Plant History and Description

The City of Melbourne, located in Izard County in north central Arkansas, in order to be in compliance with the provisions of the Clean Water Act, (33 U.S.C. 1251 et.seq.) was required to construct new wastewater treatment facilities. These new facilities would replace the City's existing stabilization pond.

The new wastewater treatment plant, located approximately one mile west of Melbourne, beyond the end of Arkansas Highway 9 Spur, was constructed under Environmental Protection Agency (EPA) Assistance Agreement C-050588-03 and began operating in October of 1986 (Figure 1).

The treatment plant utilizes a bar rack with influent meter as preliminary treatment. Wastewater is then fed into a dual rotor, oxidation ditch, a form of the activated sludge process, as primary treatment. Secondary treatment is via a clarifier, and disinfection is achieved through chlorination in a contact chamber. The final effluent is discharged through a parshall flume and over a step aerator (Figure 2).

The receiving waters of the plant effluent is Mill Creek. Mill Creek is a tributary of Piney Creek, both of which are in the White River Basin.

I.2 Purpose of the TRC Testing

The purpose of the TRC testing program at the Melbourne Wastewater Treatment Plant was to establish whether chlorine levels in the receiving waters were within acceptable limits. The limits established by EPA have proved to pose no significant threat to aquatic life within the receiving waters. In conjunction with the aforestated purpose, the program was carried out so the City would be in compliance with Condition 21, page 5 of 7 of the EPA Assistance Agreement which provided project funding.

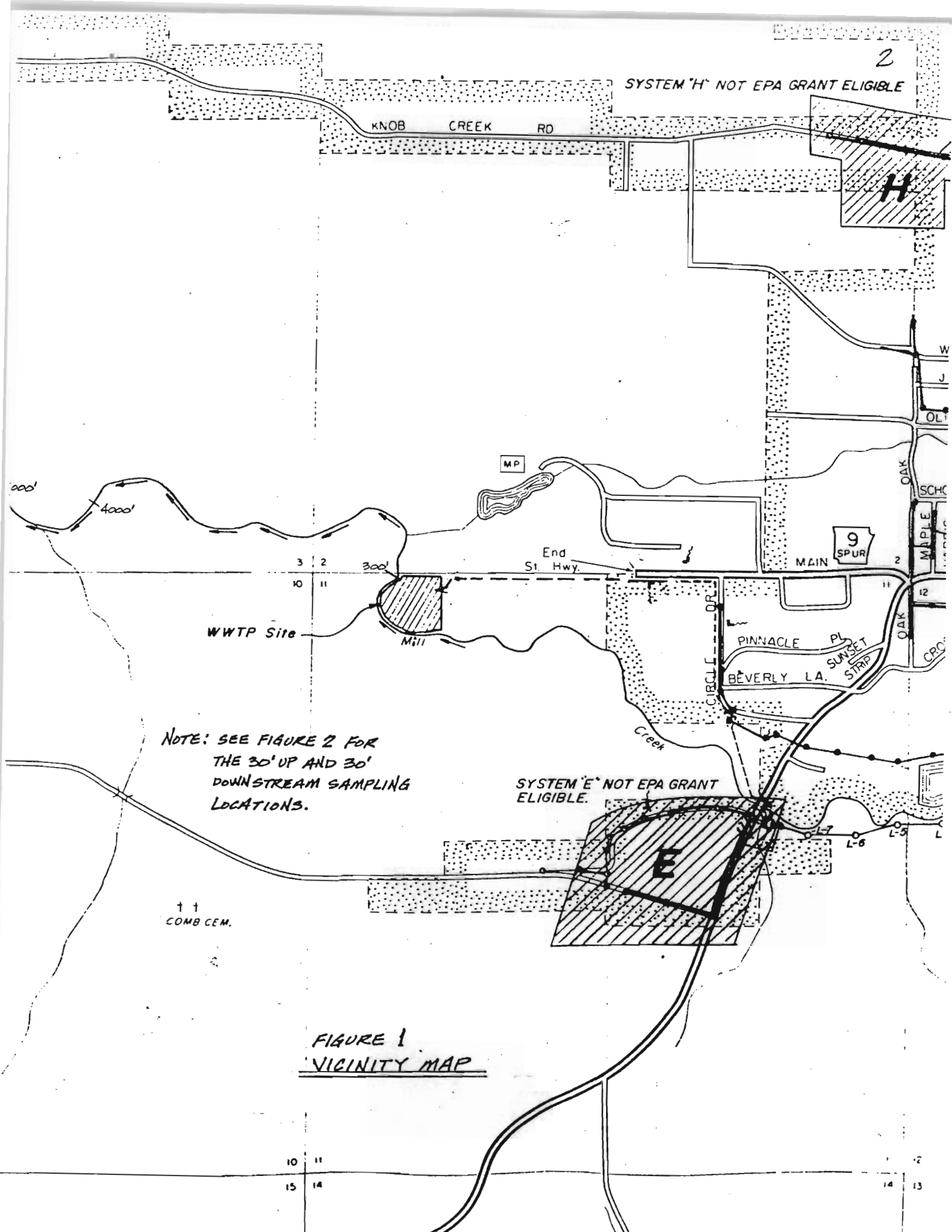
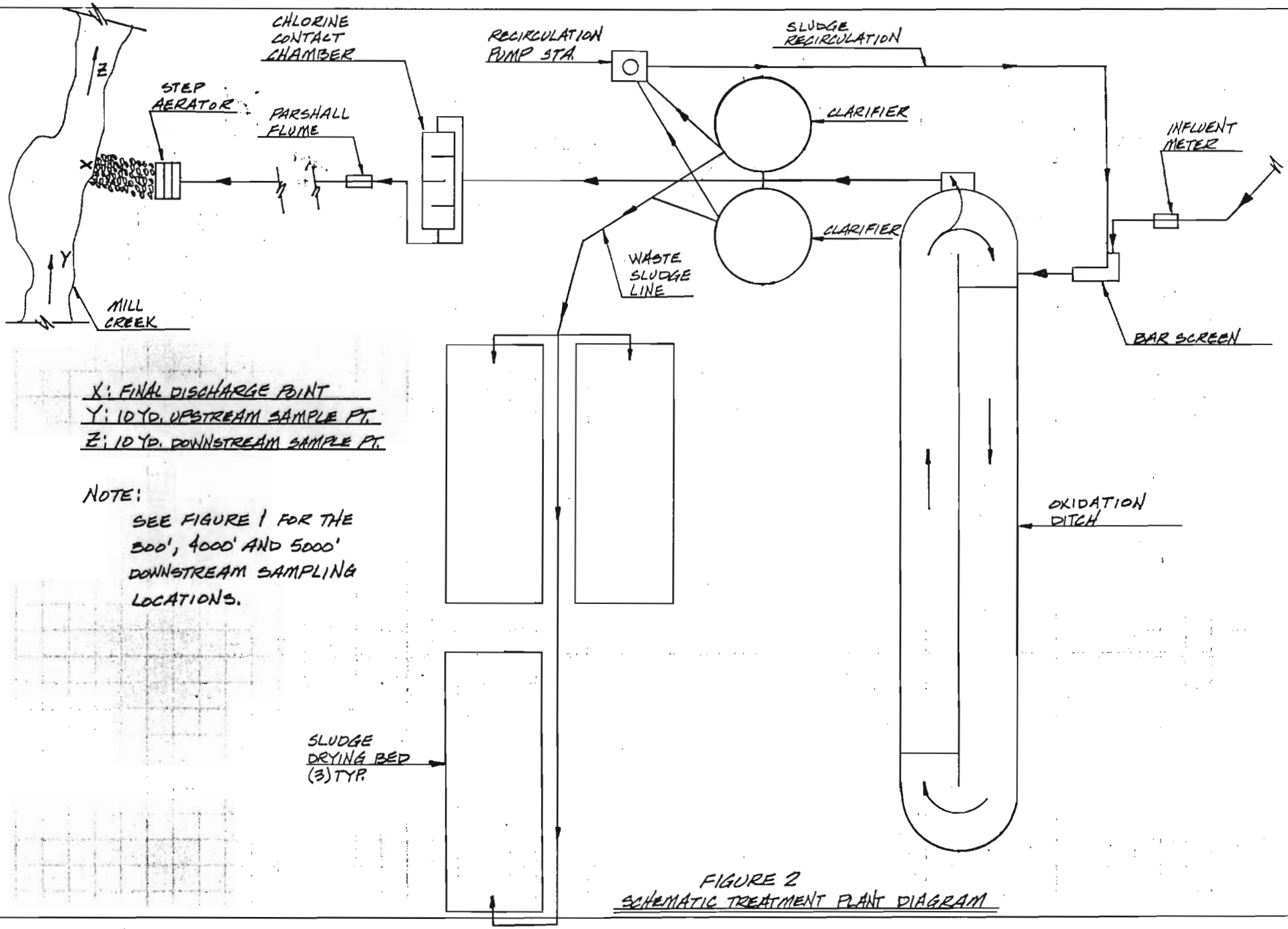


FIGURE 1
VICINITY MAP



X: FINAL DISCHARGE POINT
Y: 10 YD. UPSTREAM SAMPLE PT.
Z: 10 YD. DOWNSTREAM SAMPLE PT.

NOTE:
SEE FIGURE 1 FOR THE 300', 4000' AND 5000' DOWNSTREAM SAMPLING LOCATIONS.

FIGURE 2
SCHEMATIC TREATMENT PLANT DIAGRAM

TRC TESTING
MELBOURNE, AR WWTP
11-17-87
M.A. THOMEY
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SECTION II
TRC Testing Program

II.1 Program Outline

The testing program was begun on September 15, 1987 after CEI Engineering and Richardson Laboratories personnel visited the plant to set up the required equipment and testing and sampling criteria. During the visit, CEI personnel and the plant operator were given instruction by Richardson Lab personnel on the testing method to be used, and practice samples were collected and analyzed to assure familiarity with the procedure.

The testing method used to detect TRC was the DPD-FAS Titration Test as outlined in Standard Methods for the Examination of Water and Wastewater, 16th Edition, Method 408D, DPD Ferrous Titrimetric Method. The procedure used to analyze samples from Mill Creek can be summarized as follows:

1. Obtain a 400 ml sample and place in a clean container.
2. Place the container with the sample on a magnetic stirrer and slowly begin stirring.
3. Add 10 ml of phosphate buffer.
4. Add reagent to the sample. If a pink color develops, add more reagent until color maximizes and stabilizes at its maximum.
5. Add FAS solution a drop at a time until all color is gone.
6. Calculate TRC by the following formula:
   TRC = (ml of F.A.S. used/hundreds of ml of sample, 4.0) X 1000 micrograms/l.

The wording of the Melbourne Agreement states that TRC levels should be analyzed, "immediately downstream", from the final discharge point. Following this guideline, CEI Engineering, in a proposal to the Arkansas Department of Pollution Control and Ecology (ADPC&E) dated September 14, 1987, recommended that samples be collected at points 10 yards and 100 yards downstream from the discharge point. As a quality control device, CEI also recommended a sample be taken 10 yards upstream from the discharge point (Figure 2).

During a September 14, 1987 meeting at Melbourne City Hall, ADPC&E suggested two additional quality control measures. One of these was to run a comparative test for TRC on a sample of distilled water, and the other was to take and analyze samples from the step aerator just prior to discharge of the effluent into the creek. ADPC&E also suggested, as another quality control/assurance measure, that one weekly sampling and testing each be performed by CEI Engineering personnel and Richardson Laboratory personnel, respectively. At a later date, ADPC&E instructed the plant operator to collect samples from further downstream until a consistent point of zero TRC concentration was established.

The program was concluded on November 5, 1987, lasting seven weeks. Samples were collected once a week, except during the week

of September 28 through October 2, 1987, when two samplings were made. Stream cross-sections and flow data were taken at approximately 90 feet and 119 feet downstream from the discharge point to establish a relationship between flow and chlorine dilution in the creek (Figures 3 and 4, Table 2).

II.2 Test Results

The results of sample collection and analysis can best be summarized in the table below:

Table 1
Total Residual Chlorine Levels as Established by DPD-FAS Titration Test, microgram/liter
Location

Date	Step Aerator	30' Upstream	30' Downstream	300' Downstream	4000' Downstream	5000' Downstream
09/25/87	700.0	0.0	62.5#(1000')	37.5#(2000')	*	*
09/30/87	725.0	0.0	50.0^(1500')	25.0^(2500')	0.0	0.0
10/02/87	610.0	0.0	*	*	6.25	0.0
10/08/87	600.0	0.0	*	*	0.0	0.0
10/13/87	500.0	0.0	*	*	6.25	0.0
10/23/87	450.0	0.0	*	*	0.0	0.0
10/28/87[a]	512.5	0.0	162.5	100.0	0.0	0.0
11/05/87[b]	243.75	0.0	112.5	75.0	0.0	0.0
30-day Average	542.7	0.0	48.4	29.7	1.6	0.0

*: data not available
#: samples taken at 1000' and 2000' downstream
^: samples taken at 1500' and 2500' downstream
[a]: testing performed by Richardson Labs
[b]: testing performed by CEI Engineering

II.3 Discussion of Test Results

Section 21, page 5 of 7 of the Melbourne, EPA Assistance Agreement lists the allowable TRC levels as 8.30 micrograms/liter for a 30-day average and 14.0 micorgrams/liter for any one sample. During the September 14, 1987 meeting at Melbourne City Hall, ADPC&E informed CEI Engineering that the aforestated allowable levels would be amended to 11.0 and 19.0 mircograms/liter, respectively.

It can be seen from a review of Table 1 that all allowable levels of TRC were exceeded by the downstream samples of 30, 300, 1000, 1500, 2000 and 2500 feet. At the 4000 and 5000 feet downstream locations, samples showed acceptable or zero levels of TRC for both the individual sample and 30-day average cases.

The receiving waters of the plant's effluent, Mill Creek, is a very small stream. The stream cross sections and depth data of Figures 3 and 4 and Table 2, respectively indicate average conditions for most of the tested length of the creek. The accompanying calculations show that the average flow in the creek is an extremely low 1.05 cubic feet

per second or 0.68 million gallons per day. Since this data was taken from downstream of the discharge point, it is inclusive of the plant's average daily discharge flow of 0.13 million gallons per day; therefore, the net stream flow averages 0.55 million gallons per day.

The TRC levels shown at the step aerator are extremely high - a 542.7 micrograms/liter 30-day average. By comparison, a sample of distilled water tested at a zero level of TRC, as would be expected. For the sake of argument, a TRC test was run on a sample of the City's drinking water. This sample, fit for human consumption according to the State Health Department, contained 800.0 micrograms/liter of TRC.

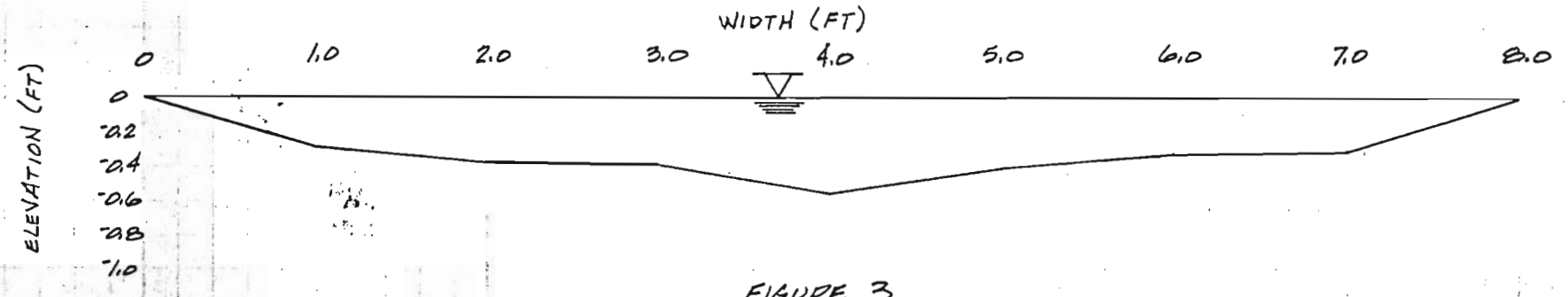

FIGURE 3
STREAM CROSS-SECTION @ APPROXIMATELY
90 FT. DOWNSTREAM FROM DISCHARGE POINT
SCALE: 1" = 1.0'

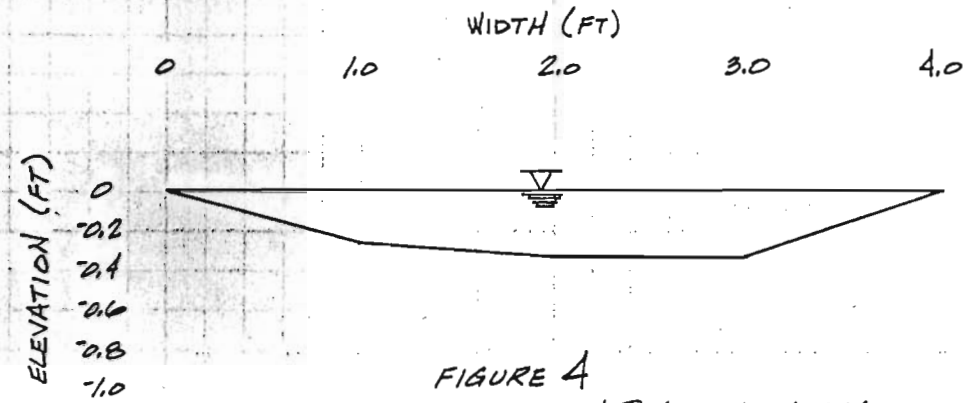

FIGURE 4
STREAM CROSS-SECTION @ APPROXIMATELY
119 FT. DOWNSTREAM FROM DISCHARGE POINT
SCALE: 1" = 1.0'

TABLE 2
MEASURED DEPTHS @ CROSS-SECTIONS (FT)

	WIDTH (FT)								
FIGURE	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
#3	0	0.29	0.38	0.40	0.56	0.42	0.33	0.31	0
#4	0	0.27	0.33	0.33	0				

END AREA OF STREAM CROSS-SECTION FROM FIG. 3 —

$$A = .5(1')(0.29') + \left(\frac{0.29' + 0.38'}{2}\right)(1') + \left(\frac{0.38' + 0.4'}{2}\right)(1') + \left(\frac{0.4' + 0.56'}{2}\right)(1') + \left(\frac{0.56' + 0.42'}{2}\right)(1') + \left(\frac{0.42' + 0.33'}{2}\right)(1') + \left(\frac{0.33' + 0.31'}{2}\right)(1') + .5(1')(0.31')$$

$A = 2.69\ FT^2$

END AREA OF STREAM CROSS-SECTION FROM FIG. 4 —

$$A = .5(1')(0.27') + \left(\frac{0.27' + 0.33'}{2}\right)(1') + \left(\frac{0.33' + 0.33'}{2}\right)(1') + .5(1')(0.33')$$

$A = 0.93\ FT^2$

AVERAGE END AREA OF CROSS-SECTIONS —

$$A_{AVG} = \left(\frac{2.69\ FT^2 + 0.93\ FT^2}{2}\right) = 1.81\ FT^2$$

DISTANCE BETWEEN CROSS-SECTIONS = 29'

TIME REQUIRED FOR AN ORANGE TO TRAVEL 29' = 50 SEC. ∴

STREAM VELOCITY, $V = \frac{29'}{50s} = 0.58\ FT/s$

FROM THE RELATIONSHIP: $Q = AV$ WHERE: Q = FLOW, FT^3/s
A = CROSS-SECTIONAL AREA, FT^2
V = VELOCITY, FT/s

$Q = 1.81\ FT^2 (0.58\ FT/s)$

$Q = 1.05\ FT^3/s$ (471.2 GALS/MIN OR 0.68 MIL. GALS/DAY)

SECTION III
Conclusions

III.1 Recommended Action

The facts pertinent to drawing a logical, sound engineering and common sense conclusion to this TRC Testing Report are summarized below:

1. The average plant discharge is 0.13 million gallons per day (mgd).
2. The net stream flow of Mill Creek is 0.55 mgd.
3. The allowable TRC levels are 11.0 micrograms/liter (ug/l) 30-day average and a 19.0 ug/l individual sample maximum.
4. The 30-day average TRC levels from Table 1.
5. The TRC levels of distilled water, 0.0 ug/l and City drinking water, 800.0 ug/l.

Other important facts necessary for a sound conclusion, but not discussed elsewhere in this report are:

1. Plant effluent has consistently met all NPDES discharge requirements listed in its discharge permit, AR0020036, with minor exceptions.
2. Aquatic life, minnows, game fish, plants, etc., have been observed by the plant operator and CEI personnel to be suffering no ill effects due to plant effluent discharge. Schools of minnows have been observed in the creek at the end of the rip-rap below the step aerator on several occasions. According to test results, this is an area of high TRC concentration, yet no dead minnows have ever been observed, nor has any erratic or unnatural behavior.

Based on an analysis of the facts listed above, CEI Engineering Associates does not feel dechlorination facilities are needed for the Melbourne, Arkansas Wastewater Treatment Plant.

Respectfully submitted,

Mark A. Thomey
Project Engineer

Robert E. Holmes, P.E.
CEI Principal Engineer

ATTACHMENTS

1/2

CEI Engineering Associates

A Partnership of Holmes, Inc. and Shupe Enterprises, Inc.

CEI Engineering Associates
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Bentonville, Arkansas 72712
(501) 273-9472

ATTACHMENT IV.1

September 14, 1987

Mr. Mike Hood
Arkansas Department of Pollution
Control and Ecology
P.O. Box 9583
Little Rock, AR 72219

Re: Total Residual Chlorine Testing
Wastewater Treatment Plant
Melbourne, AR

Dear Mr. Hood:

Please find attached a copy of our proposal for performing Total Residual Chlorine (TRC) testing at the wastewater treatment plant in Melbuorne, Arkansas.

The proposal contains a brief description of our intended sampling, testing and reporting proceedure.

Respectfully submitted,

Mark A. Thomey

Mark A. Thomey
Project Engineer

Copy: Mr. Bob Holmes
The Honorable Shannon Womack, Mayor of the City of Melbourne
File
attachments as stated

Total Residual Chlorine Testing
Wastewater Treatment Plant
Melbourne, Arkansas

Introduction

As required by Grant Assistance Agreement C-050588-03-0, Section 21, page 5 of 7 for the wastewater treatment plant in Melbourne, Arkansas, CEI Engineering Associates will conduct and/or supervise the conduction of testing for Total Residual Chlorine (TRC) in the plant's effluent.

Outline of Testing

Assistance: CEI and plant personnel will be instructed in the proper sampling and testing proceedure by Mr. Eric Scholl of Richardson Testing Lab of Searcy, Arkansas.

Test Type: A DPD-FAS titration test will be utilized. The required equipment will be supplied by Richardson Testing Lab.

Sampling Locations: Samples will be taken at 10 yards above, 10 yards and 100 yards below the plant discharge point.

Sampling Frequency: One sample will be collected per week for four weeks.

Sample Analysis: Samples will be collected and analyzed immediately at the plant site by CEI and/or plant personnel.

Allowable TRC Concentrations: As required by the grant agreement, for any one sample, TRC must be less than or equal to 14.0 micrograms/liter. For a 30 day average, TRC must be less than or equal to 8.30 micrograms/liter. Per a conversation with ADPC&E on September 9, 1987, these allowable concentrations have been modified to 19.0 and 11.0 micrograms/liter, respectively. With approval from ADPC&E, CEI will test for these higher levels of TRC.

Conclusion

As required by the above referenced grant agreement, CEI will submit a report to ADPC&E and EPA outlining the testing program and its results. Based on those results, the report will state whether dechlorination facilities are required.

CEI ENGINEERING ASSOCIATES
110 WEST CENTRAL, SUITE 300
BENTONVILLE, ARKANSAS 72712
(501)273-9472

September 15, 1987

Honorable Shannon Womack, Mayor
City of Melbourne
PO Box 278
Melbourne, AR 72556

DISTRIBUTION:
Mr. Mike Hood, ADPC&E
Mrs. Connie Wheeler, City
Mr. Coy Dale, WWTP
Mr. Eric Schol, Richardson Labs
Mr. Bob Holmes
FILE

Re: Laboratory Testing
Melbourne Wastewater Treatment Plant

Introduction

On Monday, September 14, 1987 I (Mark A. Thomey) attended a meeting at Melbourne City Hall concerning the wastewater treatment plant in Melbourne, Arkansas. Also present were Mr. Mike Hood of the Department of Pollution Control and Ecology, Mayor Shannon Womack, Mrs. Connie Wheeler, Recorder-Treasurer, and Mr. Coy Dale, Plant Operator.

Also that day, Mr. Dale and myself met with with Mr. Eric Schol of Richardson Testing Lab of Searcy, Arkansas. Mr. Schol helped us set up for, and instructed us in, the proper procedures to run a DPD-FAS titration test for total residual chlorine (TRC) at the plant.

The details of these meetings are as documented into the following paragraphs.

Conclusions

1. Mike Hood said I needed to remind Bob Holmes that the quarterly performance report for the plant is overdue and needs to be turned in as soon as possible.

2. Mike Hood also told us that testing for higher TRC levels than specified in the grant would be fine. He will confirm this to CEI in writing after confering with Mr. Nial O'Shaughenesy at the Department of Pollution Control & Ecology.

3. Mike Hood gave me some general guidelines to follow for our report to ADPC&E and EPA. He said these will be important points to cover so our report will be more readily accepted.

4. After a quick tour and inspection of the plant, Mike determined that it was performing well, but he showed some concern over two slightly high fecal coliform levels.

5. Upon arriving, Mr. Schol helped us set up our lab equipment, take creek water samples and run a trial test to insure that Mr. Dale and I were familiar with the test procedure.

Discussion

1. Mike Hood needs our quarterly performance report as soon as possible. The report was due a couple of months ago and we need to get it to him.

2. Testing for higher levels of TRC will be acceptable. The ADPC&E has recently amended the limiting values to 11.0 micrograms/liter for a 30-day average TRC and 19.0 micrograms/liter for an individual sample. The values in the actual Melbourne grant are 8.30 and 14.0 microgram/liter, respectively. Mike Hood said he would take the matter up with Mr. Nial O'Shaughnesy of ADPC&E after he returned to Little Rock. Mike Hood will confirm the higher values to us in a letter and would have the grant amended to show the new levels of allowable TRC.

3. Mike Hood listed some general guidelines in writing our final report to ADPC&E and EPA. He said they will make our report more complete in its scope, and therefore more readily accepted by both agencies. The guidelines are as follow:

   a) Include a site plan showing sampling locations.
   b) Estimate the stream flow each time samples are collected to obtain a correlation between stream flow and chlorine levels.
   c) Run a comparison TRC on distilled water for quality control/assurance.
   d) Take TRC samples at the step aerator to compare TRC levels there with those in the creek.
   e) He suggested that CEI personnel and Richardson Lab personnel collect samples and test them once each during the four weekly samplings and testings.
   f) Make reference to the test method and its location in a book of wastewater testing standards.

4. The general concensus of opinion was that the plant was effectively operating and producing acceptable effluent. He was pleased with the record keeping methods Mr. Dale was using to document plant operations. The only concerns he expressed were over a high fecal coliform level on two different days.

5. Mr. Schol of Richardson Labs arrived at the plant at 3:30 PM.

He set up the test equipment for us, then we collected creek water samples at the three locations CEI proposed. The samples were then tested for TRC. Mr. Schol ran the test, explaining it to Mr. Dale and me as he proceeded. The test procedure is as follows:

a) Place 400 ml of sample in a container.
b) Place the sample on a magnetic stirrer and slowly begin stirring.
c) Add 10 ml of phosphate buffer to negate the effects of suspended solids.
d) Add reagent to the sample. If a pink color develops, add more reagent until the color maximizes then stabilizes at its maximum.
e) Add F.A.S. solution a drop at a time until the color is completely gone.
f) Calculate TRC by the following formula:
(ml of F.A.S. used/4.0) x 1000 = TRC in microgram/liter

This test is referenced from Section 408D of Standard Methods for Wastewater Testing, 16th Edition.

Respectfully submitted,

Mark A. Thomey

Mark A. Thomey
Project Engineer

ATTACHMENT II.3

1/4

CEI ENGINEERING ASSOCIATES
110 WEST CENTRAL, SUITE 300
BENTONVILLE, ARKANSAS 72712

November 6, 1987

Honorable Shannon Womack, Mayor
City of Melbourne
P.O. Box 278
Melbourne, AR 72556

DISTRIBUTION:
Mr. Mike Hood, ADPC&E
Mr. Coy Dale, WWTP Operator
Mr. Bob Holmes
File

Re: Conclusion of TRC Testing

Introduction

On Thursday, November 5, 1987 I (Mark A. Thomey) visited the Melbourne, Arkansas wastewater treatment plant to conclude the testing program for total residual chlorine (TRC) in the plant's effluent. Assisting me in this task was Mr. Coy Dale, the plant operator.

While there, Mr. Dale brought to my attention two other problems that had arisen. One of these concerned the build-up of sludge on the bottom of the oxidation ditch, and the other was the improper construction, and subsequent poor performance, of a manhole near the old sewer pond.

A detailed account of the day's events is in the following paragraphs.

Conclusions

1. The TRC testing program was concluded. I retrieved samples from the creek and performed the DPD-FAS titration test myself. Stream flow data was also collected for the report on TRC to EPA and ADPC&E.

2. The plant is still producing good effluent, but a problem with sludge build-up on the bottom of the ditch has occurred. I will investigate for solutions to this problem.

3. A manhole near the old sewer pond was improperly constructed and is performing poorly. CEI recommends that the city repair the manhole.

4. Some slight problems with two pieces of lab equipment were experienced. The Hach, portable pH meter and the Mettler, AE100 scale are not calibrating properly. This is not percieved to be a significant problem.

Discussion

1. The TRC testing, which began on September 15, 1987, was concluded on November 5, 1987.

I reviewed the results of the tests on the samples collected over the previous weeks. Samples were collected at the four locations previously proposed by CEI and at two additional locations of 4000 feet and 5000 feet downstream from the discharge point. TRC levels at the step aerator ranged from a low of 400 micrograms/liter to a high of 725 micrograms/liter. The tirty feet (10 yards) upstream samples all showed no traces of TRC. Data was not shown for the thirty feet (10 yards) downstream and three hundred feet (100 yards) downstream locations on all weekly samplings, but those that were shown all excuded the 19.0 micrograms/liter limit for an individual sample. Two of the 4000 feet downstream samples showed a TRC of 6.25 micrograms/liter, but all others showed no trace of TRC. All of the 5000 feet downstream samples showed no trace of TRC.

exceeded

I then collected samples at all six locations on the creek, with the help of Mr. Dale, and returned to the plant to do the DPD-FAS titration tests. The results of the tests on the samples are listed in the table below.

Sampling Location	TRC Concentration (microgram/liter)
Step Aerator	243.75
30 feet upstream	0.0
30 feet downstream	112.5
300 feet downstream	75.0
4000 feet downstream	0.0
5000 feet downstream	0.0

The final step in data collection for the TRC testing report was to obtain stream flow data. Two stream cross-sections were taken at a point approximately midway between the thirty feet and three hundred feet downstream sampling locations. The width of the stream was measured, and depth measured at one foot intervals across the stream width. The distance between the cross-sections was measured, and an orange was dropped in the stream and timed as it floated from one to the other.

2. A problem with sludge build-up on the bottom of the oxidation ditch was reported to me while at the plant. Mr. Dale felt the problem had been slowly building over the last few months.

At a distance of approximately 40 feet downstream from each rotor, a layer of sludge has been deposited on the bottom of the ditch. It appears to increase in thicknes as the distance from the rotor increases. The maximum thickness of the sludge is approximately 9 to 12 inches at the turn in the ditch before flow reaches the next rotor. In order to resuspend the sludge, Mr. Dale lowered the rotors deeper into the ditch.

This has consequently increased the dissolved oxygen (DO) level in the ditch from its optimum of 2.0 milligrams/liter to 8.0 milligrams/liter. The 8.0 mg/l DO readings are constant through the depth of the ditch except for the final two (2) feet from the bottom. In this layer, the DO suddenly drops below 0.5 mg/l. The high DO is of concern, because it could overstress or "hyperventilate" the microorganisms in the ditch thereby reducing its efficiency and reducing effluent quality. The deeper rotor settings do not appear to be resuspending the sludge either.

CEI recommended that Mr. Dale raise the rotors back up to normal operating level to reduce the DO to its optimum level of 2.0 mg/l. Also, it was recommended that sludge be wasted more frequently to help reduce its build-up in the ditch. I will get in touch with Mr. Bob Pruitt of Van Brocklin Associates, who supplied the ditch, and discuss this problem with him. I will relay his solution to Mr. Dale. The possiblity of installing a baffle in the ditch was discussed. This apparatus would consist of an adjustable angle, steel plate extending across the ditch and immersed to a depth of four to five feet. This would force flow to the bottom of the ditch, increase velocity at the bottom, and keep the sludge suspended. I will develop a preliminary design and study the cost of implementing this option. In conjunction with the baffle option, I will contact Richardson Labs in Searcy, Arkansas and request velocity measuring equipment be sent to the plant. Mr. Dale will then establish velocity and sludge thickness data at 20 feet stations along the ditch length, and across its width, at two feet from each wall and at the center. This data will enable us to determine the best baffle location.

3. A problem is being experienced with a manhole adjacent to the city's old sewer pond. Two sewer lines feed into the manhole and one line drains it to the treatment plant. The invert of the drain line is approximately one foot above the inverts of the feed lines. Consequently, the manhole stands with this much sewer influent in its bottom. Solids in the influent settle out and plug the feed lines, eventually turning septic. This causes frequent maintenance trips to the manhole to clean it out. Mr. Dale informed me that the inspector during construction of the manhole, Mr. Charles O'Brian, approved the drain pipe location. CEI recommended that the city replace the drain line at a lower elevation so proper drainage of the manhole will occur.

4. The Hach, protable pH meter and Mettler AE100 scale are not calibrating properly. The pH meter is reading approximatley one tenth a pH point off of true value. The scale is skipping some of the steps in its automatic calibration sequence, but it reads out the weights of samples as the same when the same samples are reweighed after turning the scale off then on again. CEI recommended that someone from Richardson Labs be

asked about these problems. If they feel it's ok to use the equipment as is, then no action is required. If a problem is perceived-CEI will contact the manufacturers on the city's behalf.

Respectfully submitted,

Mark A. Thomey

Mark A. Thomey
Project Engineer