From: Susan Merideth <smerideth@jonesborocwl.org>
Sent: Thursday, November 29, 2012 3:51 PM
To: Torrence, Rufus
Subject: AR0043401, AFIN 16-00936
Attachments: JB28 East Side Rerating Analysis.pdf

Rufus,

Attached please find a subsequent Engineering Analysis and Design Summary for the East WWTP. The rest of what I have is in the form of letters with our consultants. As we discussed, we plan to work with MW&Y in 2013 to develop an updated Design Summary for the Plant.

If you have any questions or require additional information, please just let me know.

Regards,

Susan

CWL

Susan Merideth, P.E.
Water & Wastewater Treatment Superintendent
City Water and Light
T 870.930.3387 | F 870.930.3304
P.O. Box 1289 | 400 E. Monroe | Jonesboro, AR 72403-1289

WATER'S WORTH IT

From: Susan Merideth <smerideth@jonesborocwl.org>
Sent: Thursday, November 29, 2012 3:41 PM
To: Torrence, Rufus
Subject: AR0043401, AFIN 16-00936
Attachments: AR0043401 1995 Engr Report.pdf

Rufus,

Attached please find a preliminary Engineering Report for the 1996 expansion. I will forward some other emails from back in the summer regarding later expansions.

Regards,

Susan

Susan Merideth, P.E.
Water & Wastewater Treatment Superintendent
City Water and Light
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P.O. Box 1289 | 400 E. Monroe | Jonesboro, AR 72403-1289

PRELIMINARY ENGINEERING REPORT

FOR

EAST SIDE WASTEWATER TREATMENT PLANT EXPANSION

CWL

JONESBORO, ARKANSAS

PROJECT NO. JB-67
DECEMBER, 1995

Prepared by
McGoodwin, Williams and Yates, Inc.
Consulting Engineers
Fayetteville, Arkansas

TABLE OF CONTENTS

1. INTRODUCTION

The Jonesboro East Side Wastewater Treatment plant has been in operation since late 1987. It was originally designed as a 6 MGD (million gallon per day) treatment facility. Current average daily flows approach 5 MGD and the possibility of a new industry locating in the City, as well as expansion of existing industries and growth in residential and commercial areas, necessitates the evaluation of treatment expansion options at this facility.

2. PURPOSE AND SCOPE OF REPORT

The purpose of this report is to evaluate wastewater treatment expansion alternatives, establish basic design criteria, and develop a proposed treatment plant site layout and cost estimates for a 4.5 MGD (million gallon per day) expansion of the East Side Wastewater Treatment Plant.

In December, 1992, engineering recommendations were made to upgrade the current 6 MGD facility to 8.8 MGD at a BOD concentration of 250 mg/l. Part of these recommendations, the installation of a third screw pump, has been implemented. The scope of this report includes developing design flows and loadings for a proposed 4.5 MGD expansion of the existing treatment facility and a future 4.5 MGD expansion resulting in an ultimate 18 MGD treatment facility.

This report is not intended to substitute for a detailed engineering design report justifying specific design recommendations, but one that will suffice to provide general treatment process recommendations, unit sizes and options, along with "opinions of probable costs" and operation scenarios to allow maximum utilization of existing facilities.

Also included as a part of this report is an attached plan sheet showing a proposed 4.5 GD treatment plant layout, and future expansion capabilities, with connections to the existing facilities, on which the estimates of probable costs are based.

3. DESIGN FLOWS AND LOADINGS

The original design pollutant loading was based on a BOD concentration of 240 mg/l. Since the plant has been in operation, BOD loadings have averaged in the range of 235 mg/l. Due to the potential of future industrial loadings, a higher influent BOD concentration of 250 mg/l is assumed for design of additional facilities. In addition, an increase in influent nitrogen concentration from 20 mg/l ammonia to 45 mg/l TKN (ammonia plus organic nitrogen) is also assumed.

The existing inlet facilities contain three enclosed screw pumps, each rated at 9.5 MGD, resulting in a total pumping capacity of approximately 28.5 MGD. Adding standby pumping with a total capacity of 9.5 MGD will increase the total pumping capacity to reach 38 MGD and will also allow the three screw pumps to be utilized as "firm capacity". The hydraulic design of the proposed additional and future treatment facilities should be sized to accept flow from two screw pumps, or 19 MGD. This would match the peak hydraulic capacity of the existing facilities, and would allow one-half of the total pumping capacity of 38 MGD to be split between each plant.

4. INLET FACILITY MODIFICATIONS

The proposed inlet facility modifications consist of providing an additional 9.5 MGD pumping capacity and utilizing the existing flow bypass channel for the new treatment facility. This can be accomplished by converting the existing manual bar screen to a mechanical bar screen and modifying the screenings conveyor to handle the additional loading.

The additional raw sewage pumping capacity can be increased by adding two submersible sewage pumps at the existing screw pump inlet facility. Each pump would be designed to pump approximately 4.75 MGD, or 3300 gpm @ 35 feet TDH. Preliminary sizing indicates a 60 Hp motor with a 12-inch discharge pipe would be required. Both pumps would discharge into a new 24-inch diameter force main which will tie into the existing screw pump discharge structure, ahead of the bar screens. The force main would also be tied into the flow division structure, which will divide the flow between the two treatment plants. This will allow a portion of the flow (up to 9.5 MGD) to bypass the bar screen building, if necessary during construction or maintenance operations.

The existing flow bypass channel can be utilized for the increased raw sewage flow by operating an existing slide gate to divert flow into the bypass channel. The manual bar screen can be replaced with a mechanical arc-type rotating bar screen by modifying the channel and lengthening or replacing the screenings conveyor. In addition, a level controller and timer will be added to control the operation of the new mechanical bar screen.

A 36-inch diameter pipeline will be installed in each channel below the floor level inside the inlet facility to divert the flow into a new flow division structure, where the flow will be split between the two treatment plants.

5. INLET FLOW DIVISION STRUCTURE

Flows in the two bar screen channels will be transported to a flow splitting structure located west of the existing Inlet Facilities Building. Two 36-inch pipes will transport these flows to the common compartment on the west side of the structure. The flow will then be split over two adjustable weirs, each approximately 18 feet in length.

By adjusting the weir heights, the flow can be split between the existing plant and the new plant in proportions determined by the operating personnel. A calibrated staff gauge will be mounted on each weir in order to give the operator an indication of the flow over each weir.

New tie-ins will be made from the Inlet Flow Division Structure to the existing plant. Sluice gates will be used to route flow to the existing grit and scum unit or to the existing grit and scum bypass line.

Two other flows will be pumped to this structure: the two new influent submersible pumps will have the capability to bypass the Inlet Facilities Building directly to this structure, and the underflow from the new Gravity Table Thickener facilities will also be pumped to this structure. These flows will then be split and routed to the existing and new plants.

6. GRIT AND SCUM REMOVAL FACILITIES

The grit and scum removal facilities will consist of a flow splitter box, one 45-foot diameter grit and scum tank, and a Grit and Scum Building. The flow splitter box will have two weirs to equally split the flow in the future when a second grit and scum tank will be constructed. Sluice gates will be provided to route flows to either or both tanks in the future. The future tank's influent line will be extended and used as a bypass line until the future tank is constructed.

Equipment in the grit and scum building will consist of a grit pump, grit cyclone, grit washer/classifier, grit conveyor belt, and scum pump. The settled solids in the grit and scum tank will be pumped by the grit pump through the grit cyclone and classifier. Grit will be deposited on a conveyor and transported to a trailer for disposal. Underflow from the grit cyclone will flow back to the plant by gravity flow. Scum from the grit and scum tank will be pumped to the aerobic digesters.

The future expansion of the proposed new plant from 4.5 MGD to 9 MGD will require the construction of the second grit and scum tank. Additional grit and scum pumps and grit cyclone would be added at the Grit and Scum Building at that time.

Effluent from the grit and scum tank will flow to the flow division box. This flow will split over two 8-foot weirs and will mix with the R.A.S. flow from the two final clarifiers before flowing to the aeration basin(s).

7. AERATION BASINS

One "Carrousel" aeration basin will be constructed initially, with provisions for adding a second basin in the future. Each basin would have a liquid volume of approximately 4 MG for a hydraulic retention time of about 21 hours at the design flow. Each basin will have three 125 HP, 2 speed aerators which will increase the operator's flexibility to control dissolved oxygen levels and velocities in the basins.

Effluent from the aeration basin will flow over an adjustable weir which will allow the operator to raise or lower the water level in the basin in order to increase or decrease aeration power by the three aerators. The effluent will be routed to the Flow Division Box where it will be split to the two final clarifiers.

8. FINAL CLARIFIERS

Two 100-foot diameter units are proposed for initial construction. These two units will allow peak flows up to 19 MGD to be handled without upset, and will provide the sedimentation area required for the ultimate 9 MGD future expansion. These units will be the same diameter and depth (14 feet) as the two existing units.

The units will have center feeds and peripheral weirs. Two sludge pockets will be constructed in each clarifier; one for R.A.S. pumping and one for W.A.S. pumping. Clarifier drain lines will also be provided.

9. RETURN ACTIVATED SLUDGE PUMPING

Two submersible R.A.S. pumps per clarifier will be located at the Flow Division Box. Each pump will be two-speed in order to provide up to eight R.A.S. flow rates per clarifier. The R.A.S. pumps' discharges will be to a compartment in the Flow Division Box where the flow will split, mix while the raw influent (grit and scum tank effluent), and flow by gravity to the aeration basin(s).

A chlorine solution line will be run from the existing Chlorine Building to the R.A.S. pumps location. This chlorine solution will be used to control filamentous organisms, if required, and will be supplied by a new chlorinator located in the existing chlorine building.

10. SLUDGE HANDLING FACILITIES

In developing the sludge handling options set out in this report, the following sludge production quantities were utilized. These quantities are based upon a sludge production rate of 0.52 pounds of dry sludge per pound of BOD removed. This is the calculated current sludge production rate at Jonesboro and is lower than the sludge production rate of 0.77 pounds of sludge per pound of BOD removed anticipated by the Carrousel equipment manufacturer. An average influent BOD of 250 mg/l and an average effluent BOD at 10 mg/l was presumed.

ANTICIPATED SLUDGE YIELD					
Period	Flow (MGD)	Removed BOD mg/l	Sludge Yield Coefficient	Pounds of Dry Sludge Produced	Sludge Produced % of Current Sludge Production
July '94 to July '95	4.9	240	0.52	5,100	100%
Future	6.0	240	0.52	6,245	122%
Future	13.5	240	0.52	14,053	276%
Future	18.0	240	0.52	18,735	367%

Existing Sludge Handling Equipment. Currently waste activated sludge (WAS) is drawn from the clarifiers and is thickened through the use of gravity thickeners. The thickened sludge is then pumped into existing aerated sludge storage units. Currently there are three aerated sludge storage facilities: two 70 foot diameter x 20′ SWD and one 77 foot diameter x 22′ SWD units. These tanks have a combined volume of approximately 1.94 million gallons. These units stabilize the sludge prior to land application. Land application is by truck onto nearby, permitted sludge application fields.

New Facilities Requirements. Alternative 1 - Construction of gravity thickeners and digesters.

As set out above, the pounds of sludge produced at the existing treatment facility are projected to increase in direct proportion to the flow. If no additional thickening is provided for the sludge prior to pumping to the digesters, then the volume required for aerated sludge storage would vary in direct proportion to the load. Assuming

2-1/2% solids concentration and a 45 day retention time in the digesters, the following volumes would be required. An operating allowance of 15 days is also included when sludge cannot be applied due to inclement weather conditions, for a total storage time of 60 days.

AERATED SLUDGE STORAGE VOLUME REQUIRED 2-1/2% SOLIDS						
Period	Flow (MGD)	45 Day Digestion (MG)	15 Day Operational (MG)	Total (MG)	Existing Volume Available (MG)	Additional Required Storage (MG)
July '94 to July '95	4.9	1.10	0.37	1.47	1.94	Adequate
Future	6.0	1.35	0.45	1.80	1.94	Adequate
Future	10.5	2.36	0.79	3.15	1.94	1.21 MG Add'l.
Future	13.5	3.03	1.02	4.05	1.94	2.11 MG Add'l.
Future	18.0	4.05	1.35	5.40	1.94	3.46 MG Add'l.

As set out above, the amount of digester capacity required by the ultimate expansion would be 3.46 million gallons. This option consists of initially constructing one 54 foot diameter gravity thickener and one 82 foot diameter aerated sludge storage tank. Future demands would require the construction of three additional 82 foot diameter tanks for the 18 MGD flow rate. These would need to be phased as follows:

DIGESTER CONSTRUCTION PHASING		
FLOW	CONSTRUCT THICKENER	CONSTRUCT DIGESTERS
Initial	1-56 Ft. Dia.	1-82 Ft. Dia. x 22' SWD
Approx. Flow = 9 MGD	No Additional Construction	1-82 Ft. Dia. x 22' SWD
Approx. Flow = 12.0 MGD	No Additional Construction	1-82 Ft. Dia. x 22' SWD
Approx. Flow = 15.0 MGD	No Additional Construction	1-82 Ft. Dia. x 22' SWD

We recommend that future digesters be equipped with fine bubble, non-clog type diffused air systems in lieu of the coarse bubble systems now in use. These units are slightly less expensive and theoretically utilize less air.

Alternative 2 - Construction of Gravity Table Thickeners and Aerated Sludge Storage Tanks.

An option to utilizing conventional gravity thickeners is to use gravity table thickeners (GTT) prior to digestion. The percent solids these machines produce is usually greater than that achieved by conventional gravity thickeners. This directly impacts the amount of digester volume required. For example, by thickening sludge to 5% prior to digestion instead of 2-1/2% as with conventional thickeners, the digestion volume requirements are cut in half. Gravity table thickeners are generally capable of achieving a 5% or more solids concentration but require the use of polymers and require operation of the equipment.

Anticipated digester volumes required utilizing gravity table thickeners are set out below.

ANTICIPATED DIGESTER VOLUMES REQUIRED 5% SOLIDS						
Period	Flow (MGD)	45 Day Digestion (MG)	15 Day Operational (MG)	Total (MG)	Exist Volume Available (MG)	Additional Required Storage (MG)
July '94 to July '95	4.9	0.55	.19	.74	1.94	Adequate
Future	6.0	0.68	.23	.91	1.94	Adequate
Future	10.5	1.18	.40	1.58	1.94	Adequate
Future	13.5	1.52	0.51	2.03	1.94	Need .05
Future	18.0	2.03	0.68	2.71	1.94	Need 0.77

As shown above, no additional digester volume would be required until flows reached approximately 13.5 MGD, at which time one additional digester 77 feet in diameter x 22 ft. SWD would be required.

It must be noted that this alternative has been preliminarily selected as a basis for estimating capital costs for the proposed 4.5 MGD expansion. Pilot testing should be performed prior to preparation of construction plans and specifications so that a cost effective analysis may be performed. This analysis would reflect the capital costs and the cost of operation, maintenance, chemicals, electricity, sludge haul costs, and other variables between the two alternatives.

Alternative Wasting Schemes Utilizing the Table Thickeners.

As set out above, Alternative 2 is the recommended alternative pending the results of pilot testing. Three options have been designed into the proposed plant expansion for thickening the sludge. Each option is set out below and should provide flexibility in operation. Each option impacts the amount of time required to waste sludge. The gravity table thickener viewed by CWL staff Friday, December 1 at Springdale, was wasting sludge at a rate of 660 gallons per minute with a MLSS concentration of approximately 2500 mg/l or 0.25%.

Manufacturer literature recommends operation at a 500 gpm maximum rate which is the basis for the calculations below. These numbers will be revised based upon pilot tests and are estimates only.

Option 1. Waste activated sludge directly from the aeration basins to the table thickener.

MLSS FROM AERATION BASINS AT BOTH EXISTING PLANT AND EXPANSION					
Period	Flow (MGD)	Sludge Concentration mg/l	Sludge Concentration %	Pounds (Dry) to Waste	Time Required* at 500 gpm 1 Machine
July '94 to July '95	4.9	2,500	.25	5,100 Lbs.	8.2 hrs/day
Future	6.0	2,500	.25	6,245 Lbs.	10.0 hrs/day
Future	13.5	2,500	.25	14,053 Lbs.	22.5 hrs/day
Future	18.0	2,500	.25	18,735 Lbs.	2 Machines 15.0 hrs/day

*Add 0.5 Hrs. for cleanup.

Option 2. Waste activated sludge from clarifiers at new plant and old plant. Estimated concentration is 10,000 mg/l or 1%.

WAS FROM FINAL CLARIFIERS AT EXISTING PLANT AND EXPANSION				
Flow (MGD)	Sludge Concentration mg/l	Sludge Concentration %	Pounds (Dry) to Waste	Time Required* at 500 gpm 1 Machine
4.9	10,000	1%	5,100 Lbs.	2.04 hrs/day
6.0	10,000	1%	6,245 Lbs.	2.50 hrs/day
13.5	10,000	1%	14,053 Lbs.	5.6 hrs/day
18.0	10,000	1%	18,735 Lbs.	7.5 hrs/day

*Add 0.5 Hrs. for cleanup.

Option 3. Waste activated sludge from the gravity thickeners at the existing plant combined with waste activated sludge from the clarifiers at the new plant. Estimated combined concentration = 1.75%.

SLUDGE FROM GRAVITY THICKENERS AT EXISTING PLANT AND CLARIFIERS AT NEW PLANT				
Flow (MGD)	Sludge Concentration		Pounds (Dry) to Waste	Time Required* at 500 gpm 1 Machine
	mg/l	%		
4.9	17,500	1.75%	5,100 Lbs.	1.2 hrs/day
6.0	17,500	1.75%	6,245 Lbs	1.4 hrs/day
13.5	17,500	1.75%	14,053 Lbs.	3.2 hrs/day
18.0	17,500	1.75%	18,735 Lbs	4.3 hrs/day

*Add 30 minutes cleanup time.

As shown above, one gravity table thickener should provide the capacity required for all of the options except number 1 during the design year. Sludge blending should give the best results as set out under options 2 and 3. Additionally, an option to run the digested sludge over the table thickener prior to application to land has been included in the costs presented in other sections of this report.

11. CHLORINE CONTACT BASIN

A new chlorine contact chamber similar to the existing unit is proposed. A Parshall flume will be located ahead of the chamber in order to measure effluent flows. Chlorine solution from the existing Chlorine Building will be supplied by a new chlorinator paced by the effluent flow. Drain lines will be provided for the two chlorine contact compartments, and either compartment can be taken out of service for cleaning while the other compartment remains in service.

12. DECHLORINATION AND POST-AERATION FACILITIES

Existing chlorine storage and handling facilities, with minimal modifications, can be utilized for disinfection by chlorination at the peak flow of 19 MGD from the existing WWTP and 19.0 MGD from the proposed parallel WWTP facility. An additional chlorine contact basin, designed for 15 minutes retention at a peak flow rate of 19 MGD, will be required for the proposed new 4.5 MGD treatment facility. An additional chlorinator can be installed in the existing chlorination building to take chlorine from a common cylinder and make a chlorine solution which can be transported to the effluent stream from the proposed treatment facility before it is introduced to the new chlorine contact basin. The effluent from the new chlorine contact basin can be transported to a common dechlorination facility for dechlorination and post-aeration before discharge at the existing discharge point on Whiteman's Creek. Therefore, we believe that it is cost effective to provide disinfection by chlorination of effluent flow from the proposed parallel WWTP facility and to transport the chlorinated effluent to a facility adequately designed to properly dechlorinate a peak combined effluent flow of 28.5 MGD (peak flow which can be pumped by three screw pumps in the primary lift station), utilizing sulfur dioxide for dechlorination.

Sulfonation dechlorination reduces the dissolved oxygen of effluent to near zero. Therefore, the sulfonated effluent must be post-aerated to meet the NPDES seasonal minimum D.O. requirements of May - October - 5 mg/l and November to April - 7 mg/l.

13. ELECTRICAL, INSTRUMENTATION AND CONTROL

The expansion of the East Side Wastewater Treatment Facility will include four major areas of new electrical systems. New electrical equipment will be required at the existing Plant Inlet Facilities, at the new expanded treatment facilities, at the new sludge handling facilities, and at the new dechlorination and post-aeration facilities.

At the existing Plant Inlet Facilities a new small three phase pad mounted transformer will be required to provide power for the new lift pumps control panel. Preliminary sizing for this transformer is 225 KVA. A new branch circuit will be added to the existing MCC #2 to provide power for the new bar screen control panel.

At the new expanded treatment facilities a new motor control building, a new three phase pad mounted transformer, and a new motor control center will be added to provide power and control for all of the new treatment equipment. Preliminary sizing for this transformer is 1500 KVA. The new transformer and motor control center will be sized to re-feed the four existing 100 horsepower aerators on the existing Carrousel units. This is necessary to remove the load from the existing motor control center in the maintenance facility which is experiencing some overloading conditions. The primary power for this new transformer can be pulled into the existing empty 4 inch conduit that was installed along the west side of the plant site during the last expansion. These new facilities will also be provided with a 600 KW standby generator and an automatic transfer switch.

At the new sludge handling facilities a new motor control center will be added to provide power and control for all of the new sludge handling equipment. The motor control center will be served through a branch circuit breaker in the new motor control building.

At the new dechlorination and post-aeration facilities a new motor control center will be added to provide power and control for all of the new dechlorination and post-aeration equipment. The motor control center will be served through a branch circuit breaker in the new motor control building.

New instrumentation devices (i.e., flow meters, level controllers, and analytical process monitors) will be provided to replace or augment existing plant instrumentation with new units.

A new programmable logic controller/computer control system will be designed to replace the existing graphic panel. The system will have multiple work stations which will let the operators monitor virtually the entire plant and remotely control selected portions of the plant's processes from the operations building. The control system will be built on a fiber optic network backbone to reduce the occurrences of electrical interference caused by lightning. The man-machine-interface will be designed around the Wonderware monitoring and control software package. "Pentium" computer systems running under Microsoft Windows "NT" will be utilized to accomplish the monitoring, control, and reporting the operation of your facility. Programmable logic controllers will be provided at the new motor control building, at the new sludge handling building, at the new dechlorination and post-aeration facilities, and at the existing graphic panel location. The programmable logic controllers will be provided with the necessary input/output modules to log the analog process parameters, monitor the status of running equipment, and log and monitor abnormal conditions in the equipment and the plant processes.

14. SLUDGE APPLICATION SYSTEM

The present net area contiguous to the wastewater treatment plant and available for land application disposal of sludge is 347 acres. This available application area is adequate for sludges produced by average flows up to about 13.0 MGD with a BOD removal of 240 mg/l.

The following is a tabulation of areas required at various plant flows and loadings based on: 1) 1.52 pounds of sludge produced per 1.0 pound of BOD removed by the wastewater treatment plant; 2) Plant Available Nitrogen (PAN) as the limiting pollutant with sludges having an average concentration of PAN of 41.77 pounds per dry ton; and 3) an application rate of 300 pounds of PAN per acre per year.

Average Flow MGD	Acres Required
6	159
10.5	278
13.5	358
18	477

A "traveling gun" application system would make possible the application of sludges during periods of inclement weather when haul units could not be operated. Furthermore, we believe that such a system would be far more cost effective than providing and operating existing and additional vacuum assisted dewatering beds.

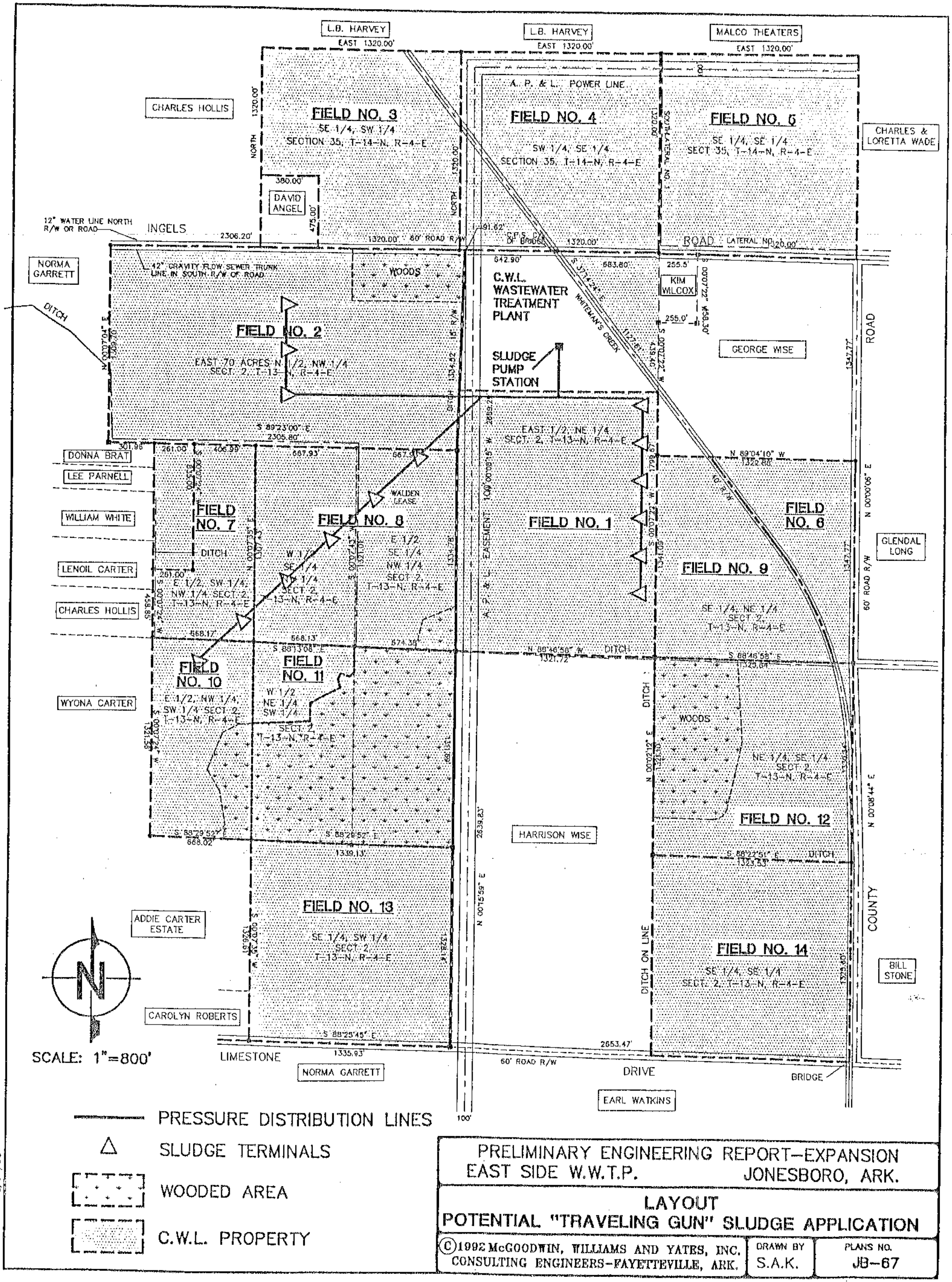
In order for a "traveling gun" application to be feasible, the terminals for supplying and controlling the irrigators (guns) should allow for application in opposing directions from the same terminal. For maximum efficiency the application areas should be approximately 1,100 feet long by 240 feet wide.

The areas shown by the attached preliminary drawing generally meet this criteria. With runs of 1,100 feet, the system would operate on each run for about six hours with minimal attention required. The 80 acre Harrison Wise tract, if available, would also be ideal for "traveling gun" application.

A system of land application of sludges via "traveling guns" could be developed as shown on attached preliminary layout. This system would allow application by this method on 178 acres, about equal to that required for an average daily flow of 6.0 MGD at a BOD reduction of 240 mg/l.

15. PROJECT COSTS AND SCHEDULE

Based on the best available information, a preliminary estimate of probable cost has been developed for the recommended 4.5 MGD treatment plant expansion and sludge application system at a location immediately adjacent to and south of the existing East Side treatment facilities. These estimates of probable costs, set out in the Table below, are based on recently received construction bids for similar type public works facilities and are based on 1995 dollars.


L.B. HARVEY
L.B. HARVEY
MALCO THEATERS
CHARLES HOLLIS
FIELD NO. 3
SE 1/4, SW 1/4
SECTION 35, T-14-N, R-4-E
FIELD NO. 4
SW 1/4, SE 1/4
SECTION 35, T-14-N, R-4-E
A. P. & L. POWER LINE
FIELD NO. 5
SE 1/4, SE 1/4
SECT 35, T-14-N, R-4-E
CHARLES & LORETTA WADE
DAVID ANGEL
12" WATER LINE NORTH R/W OF ROAD
INGELS
ROAD
NORMA GARRETT
12" GRAVITY FLOW SEWER TRUNK LINE IN SOUTH R/W OF ROAD
WOODS
DITCH
FIELD NO. 2
EAST 70 ACRES N 1/2, NW 1/4
SECT. 2, T-13-N, R-4-E
C.W.L. WASTEWATER TREATMENT PLANT
WHITEMAN'S CREEK
KIM WILCOX
GEORGE WISE
SLUDGE PUMP STATION
EAST 1/2, NE 1/4
SECT. 2, T-13-N, R-4-E
DONNA BRAT
LEE PARNELL
WILLIAM WHITE
LENOIL CARTER
CHARLES HOLLIS
WYONA CARTER
FIELD NO. 7
FIELD NO. 8
WALDEN LEASE
FIELD NO. 1
FIELD NO. 6
FIELD NO. 9
GLENDAL LONG
E 1/2, SW 1/4, NW 1/4 SECT. 2, T-13-N, R-4-E
W 1/2 SE 1/4 NW 1/4 SECT. 2, T-13-N, R-4-E
E 1/2 SE 1/4 NW 1/4 SECT. 2 T-13-N, R-4-E
SE 1/4, NE 1/4 SECT. 2 T-13-N, R-4-E
A. P. & L. EASEMENT
60' ROAD R/W
FIELD NO. 10
E 1/2, NW 1/4, SW 1/4 SECT. 2, T-13-N, R-4-E
FIELD NO. 11
W 1/2 NE 1/4 SW 1/4 SECT. 2, T-13-N, R-4-E
NE 1/4, SE 1/4 SECT. 2, T-13-N, R-4-E
FIELD NO. 12
HARRISON WISE
ADDIE CARTER ESTATE
FIELD NO. 13
SE 1/4, SW 1/4 SECT. 2, T-13-N, R-4-E
DITCH ON LINE
FIELD NO. 14
SE 1/4, SE 1/4 SECT. 2, T-13-N, R-4-E
COUNTY
BILL STONE
CAROLYN ROBERTS
SCALE: 1"=800'
LIMESTONE
DRIVE
NORMA GARRETT
EARL WATKINS
BRIDGE
PRESSURE DISTRIBUTION LINES
SLUDGE TERMINALS
WOODED AREA
C.W.L. PROPERTY
PRELIMINARY ENGINEERING REPORT–EXPANSION
EAST SIDE W.W.T.P. JONESBORO, ARK.
LAYOUT
POTENTIAL "TRAVELING GUN" SLUDGE APPLICATION
©1992 McGOODWIN, WILLIAMS AND YATES, INC. CONSULTING ENGINEERS–FAYETTEVILLE, ARK.
DRAWN BY S.A.K.
PLANS NO. JB-67

These estimates should be treated as "budget estimates" suitable for developing project funding, with contingencies. These costs should be reestimated during the preparation of the detailed engineering design report, and at the completion of final construction plans and specifications.

OPINION OF PROBABLE COSTS FOR PROPOSED 4.5 MGD WWTP EXPANSION

ITEM	COST
Sitework	$ 325,000
Pavement	205,000
Outside Piping	830,000
Inlet Facility Modifications	205,000
Inlet Flow Division Structure	115,000
Grit and Scum Division Box	60,000
Grit and Scum Removal Unit	130,000
Grit and Scum Building	225,000
Aeration Basin	1,845,000
R.A.S. Pumping and Flow Division	215,000
Final Clarifiers	715,000
Sludge Handling Facilities	525,000
Chlorine Contact Basin	150,000
Dechlorination and Post-Aeration Facilities	305,000
Electrical Facilities	700,000
Sludge Application System	$ 745,000
Total Estimated Construction Costs	7,295,000
Engineering and Contingencies (20%)	$1,460,000
Total Estimated Project Costs	$8,754,000

16. PROJECT SCHEDULE

A project of this size and complexity would normally take between 180 to 270 days to complete preliminary and detailed design, depending on pilot testing required and state agency reviews (ADPCE and AHD). Construction of facilities would also normally run from 480 to 600 days, depending on equipment delivery times, as well as local weather and labor force availability. Construction time frames affect total costs, generally the shorter the time frame, the higher the construction costs.

Total project completion from start of detailed design to operation of facilities, would therefore range from 660 to 870 days, or 22 to 29 months. Based on knowledge of existing facilities and treatment processes, it is reasonable to assume 24 to 26 months would be required to complete the proposed facilities.

ENGINEERING ANALYSIS
AND DESIGN SUMMARY

RERATING OF EAST SIDE WASTEWATER TREATMENT FACILITY

JONESBORO, ARKANSAS

NPDES Permit No. AR0043401

Project No. Jb-28
October, 1996

McGoodwin, Williams and Yates, Inc.
Consulting Engineers
Fayetteville, Arkansas

TABLE OF CONTENTS

I. INTRODUCTION

The Jonesboro East Side Wastewater Treatment plant was placed into operation in December, 1987. The plant uses an extended aeration "oxidation ditch" treatment process to produce a consistently high-quality effluent which is discharged into Whiteman's Ditch, a consecutive tributary of Little Bay Ditch, Ditch No. 10, and St. Francis Bay. Designed for a dry weather flow of 6 MGD, the treatment plant is currently treating an average flow of about 5.3 MGD.

Due to anticipated growth in the Jonesboro area, Jonesboro City Water and Light (CWL) has begun planning and construction for the rerating of the existing East Side facility while adequate reserve capacity exists. Additions made to the plant since its startup include a 77-foot diameter aerated sludge storage tank, a second blower building, 90 HP additional aeration capacity, and a dewatered sludge storage pad. In addition, CWL has rerouted the R.A.S. force main as described in Section V.B.

This engineering report presents past performance data and engineering calculations for improvements which have been constructed for the East Side facility which will allow an increase in treatment capacity from 6 MGD to 9 MGD. The purpose of this report is to provide documentation for rerating the flow basis for the facility's NPDES permit from 6 MGD to 9 MGD.

II. DESIGN HYDRAULIC LOADING

The average influent flow is approximately 5.3 MGD. The highest average daily flow of record was 15.1 MGD on January 18, 1995.

As shown in the analyses of the aeration basin design (Section V.C.2), the average daily flow capacity of the two existing basins is at least 9 MGD based on historical operating parameters and the given influent/effluent design criteria. Based on this analysis, it is the aeration capacity of the aeration basins which is limiting, and which therefore limits the design average daily flow of the system.

For the purpose of estimating future maximum daily flows, the difference between current design flow (6.0 MGD) and the revised design flow (9 MGD) was added to the highest daily flow of record (15.1 MGD) to yield a future maximum daily flow of 18.1 MGD. The design peak instantaneous flow rate is the capacity of two screw pumps, or 19 MGD. A hydraulic analysis of the treatment units indicates that the facility has the capability to pass in excess of 24 MGD.

	Existing (MGD)	Previous Design (MGD)	New Design (MGD)
Average Daily Flow	5.3	6.0	9.0
Maximum Daily Flow	15.1	12.0	18.1
Design Peak Instantaneous Flow Rate	19.0	19.0	19.0

III. DESIGN POLLUTANT LOADING

Recent BOD concentrations in the raw wastewater have averaged about 235 mg/l. Due to future industrial growth, a higher influent BOD concentration of 250 mg/l is assumed. Likewise, some increase in influent ammonia concentration is assumed in order to conservatively estimate the design aeration requirements for the two oxidation ditches. Higher design suspended solids concentrations reflect recent average influent concentrations.

	Existing (mg/l)	Previous Design (mg/l)	New Design (mg/l)
Influent BOD	235	240	250
Influent TSS	260	202	260
Influent Ammonia	20	19	25

IV. EFFLUENT LIMITS

Current NPDES effluent concentration limits are given below.

Parameter	30-Day Average Concentration (mg/l)
Carbonaceous BOD	20
Total Suspended Solids	30
Ammonia (May-Oct.)	7
Ammonia (Nov.-April)	12
Dissolved Oxygen (May-Oct.)	5
Dissolved Oxygen (Nov.-April)	7
Fecal Coliform Bacteria	1000/100 ml

V. UNIT PROCESS EVALUATION

A. Inlet Facilities

The inlet facilities consist of three screw pumps, each having a capacity of 9.5 MGD, a mechanical bar screen, and a standby manual bar screen. The screw pumps lift all influent flows to the bar screen channels. The remainder of the plant is gravity flow.

With a firm capacity of 19 MGD, plus one standby pump, two screw pumps provide adequate capability for projected peak flows.

The mechanical bar screen appears to be performing properly for the proposed upgrade. No problems have been noted with bar screen operations during peak flow periods.

B. Grit and Scum Removal Unit

This unit consists of a 50-foot diameter by 8-foot side water depth tank. Floating scum is removed and pumped to the aerated sludge digesters for treatment. Settled solids are pumped through a grit separator located in the Inlet Building, with the underflow being returned to the waste stream for treatment.

This unit was originally sized for 30 minutes retention time at a design flow of 6 MGD to allow floating solids to rise to the water surface. At the proposed rerating to 9 MGD, the retention time would theoretically be 20 minutes. While this could marginally affect scum removal, it is believed that the skimmers on the final clarifiers will capture most floatable solids which might pass through the grit and scum unit and aeration basins.

Grit removal should continue to be very good due to the large surface area of the tank. Based on an upflow rate of 2.5 fpm for removal of 100 mesh particles, and assuming a safety factor of 2 for localized turbulence in the tank, the calculated maximum flow rate for removal of 100 mesh particles is:

$$\frac{2.5 \text{ ft/min}}{2} \times 1{,}963 \text{ ft}^2 = 2{,}454 \text{ ft}^3/\text{min} = 26.4 \text{ MGD}$$

The only problem previously identified with the grit and scum removal unit was submergence of the weirs during high flow conditions.

This problem was related to the discharge of return activated sludge (R.A.S.) into the grit and scum removal tank's effluent launder. During extreme high influent flows, the flow over the tank's effluent weir plus the R.A.S. flow resulted in submergence of the weir. This problem has been corrected by changing the discharge location of the return activated sludge (R.A.S.) pumps from the grit and scum unit's effluent trough to the aeration basin flow division box.

C. <u>Aeration Basins</u>

1. <u>Historical Plant Performance</u>

Historical data demonstrate that the aeration basins are capable of treating well above the original design basis of 6 MGD. Successful operations using one aeration basin from plant startup through August, 1991, demonstrate that routine treatment of flows in excess of 5 MGD are feasible using half the existing aeration basin capacity.

Based on this past performance, routine treatment of flows as high as 10 MGD could be feasible with both aeration basins on line. However, due to the possibility of changing influent characteristics in future years, a more conservative design flow of 9 MGD has been recommended, based on estimates of aeration capability and basin capacity as set out below. This analysis indicates that the additional aeration capacity which has been installed (three 15 HP aerators per basin) will meet the oxygen requirements under the design loading condition.

2. <u>Aeration Basin Design Basis</u>

Current influent BOD concentrations average about 235 mg/l. However, due to future industrial growth, a higher influent BOD concentration of 250 mg/l is assumed. Historically, SRT's have typically been in the range of 15 to 17 days. For the purpose of this design a SRT of 18 days is assumed.

AERATION BASIN DESIGN BASIS:

Basin Volume V	=	6 MG
Influent BOD	=	250 mg/l
Effluent BOD	=	10 mg/l
Influent NH_3	=	25 mg/l New Plant TKN = 45 mg/l
Effluent NH_3	=	5 mg/l
Effluent NO_3	=	5 mg/l
$N_{synthesis}$	=	0.05 (250-10)(.55) = 6.6 mg/l
based on historical data → Sludge Yield Y	=	0.52 lb/sludge/lb BOD removal (.77)
MLSS	=	3,500 mg/l
SRT	=	18 days
T_{max}	=	28° C
C_{sw}	=	7.8 mg/l
C_o	=	2.0 mg/l
α	=	0.92
β	=	0.97

BASIN CAPACITY:

$$MGD = \frac{V \text{ X } MLSS}{SRT \times BOD_R \times Y}$$

$$= \frac{6 \times 3,500}{18 \times (250 - 10) \times 0.52} \quad .77 \quad = 6.3$$

$$= 9.3 \quad \text{(Use 9.0)}$$

OXYGEN REQUIREMENTS:

$$AOR = 1.2(8.34 \times MGD \times BOD_R) + 4.6(8.34 \times MGD \times NH3_R) - 2.86(8.34 \times MGD \times NO3_R)$$

$$= 1.2(8.34 \times 9.0 \times 240) + 4.6(8.34 \times 9.0 \times (25 - 5 - 6.9)) - 2.86\ (8.34 \times 9.0 \times (13.4 - 5))$$

$$= 24,440 \text{ lb/day}$$

$$SOR = AOR \left(\frac{9.2 \times 1.024^{20-T}}{\alpha\ (\beta\ C_{sw} - C_o)} \right)$$

$$= 24,440 \left(\frac{9.2 \times 1.024^{-8}}{0.92(0.97 \times 7.8 - 2.0)} \right)$$

$$= 36,322 \text{ lb/day}$$

Existing Aeration Equipment SOR:

400 HP (3.5 lb/HP - hr)(24 hr/day)

= 33,600 lb/day

Additional SOR required = 36,322 - 33,600

= 2,722 lb/day

Use high-speed aerators rated at 1.25 lb O_2/HP-hr

$$\frac{2,722}{1.25 \times 24} = 90 \text{ HP}$$

Aerators are available in 15 HP and 20 HP sizes. Use three 15 HP aerators per basin (90 HP, total).

D. <u>Final Clarifiers</u>

To verify adequate clarifier performance at higher design flows, one clarifier was taken out of service from June, 1991 through March, 1992. No operational problems or NPDES violations occurred as a result of single clarifier operations. A summary of flows during this period is given in Table I.

TABLE I

SINGLE CLARIFIER PERFORMANCE

Mo/Yr	Avg. Flow, MGD	Avg. Surface Loading Rate gpd/ft^2	Max. Daily Flow, MGD	Max. Surface Loading Rate gpd/ft^2	Effluent BOD mg/l	Effluent TSS mg/l	Effluent NH_3 mg/l
06/91	3.74	476	5.61	714	3.6	5.5	0.8
07/91	3.60	458	4.46	568	1.9	5.0	1.2
08/91	3.84	489	7.22	919	2.2	5.7	0.4
09/91	3.83	488	5.02	639	2.1	7.9	0.2
10/91	4.56	581	11.68	1487	3.8	10.3	0.2
11/91	4.49	571	12.04	1533	5.1	15.0	0.3
12/91	5.51	702	10.85	1381	4.1	9.4	0.1
01/92	4.78	609	8.64	1100	4.8	11.1	0.1
02/92	4.87	620	10.15	1292	4.3	9.9	0.3
03/92	5.64	718	12.50	1591	6.4	13.9	0.4

FINAL CLARIFIER DESIGN BASIS

Design Flow Rate	=	9.0 MGD
Peak Flow Rate	=	16.8 MGD
Number Units	=	2
Diameter	=	100 Feet
Surface Loading Rate (Design)	=	573 gpd/ft^2
Surface Loading Rate (Peak)	=	1,210 gpd/ft^2
Weir Loading (Design)	=	14,324 gpd/ft.
Weir Loading (Peak)	=	30,200 gpd/ft.

E. Chlorine Contact Tank

Volume = 26,880 ft^3 = 201,000 gal.

Retention Time (Design) = $\frac{.201}{9.0} \times 24$ = 0.54 hrs.

= 32 min.

Retention Time (Peak) = $\frac{.201 \times 24}{19.0}$ = 0.25 hrs = 15 min.

F. Return Activated Sludge Pumps

Four submersible pumps are provided to return activated sludge from the final clarifiers to the aeration basins. Each pump is two-speed with pumping rates of 600 GPM and 1,525 GPM, for a maximum pumping capacity of 8.8 MGD.

These pumps should provide adequate R.A.S. capacity up to the new design flow of 9.0 MGD. If operating experience indicates that higher R.A.S. capacity is needed, Jonesboro CWL can replace two or more of the existing pumps with larger pumps at the existing installation.

G. Sludge Thickeners

Two 30-foot diameter units.

Sludge Production = 8.34 x MGD x BOD_R x Y
= 8.34 x 9.0 (250 - 10) x 0.52
= 9,367 lb/day

Unthickened Volume (1% solids) = 112,000 gpd

Thickened Volume (3% solids) = 37,400 gpd

Solids Loading = 6.6 lb/ft^2 - day

The two existing waste activated sludge pumps have a capacity of 200 gpm each, and are adequate to pump the unthickened sludge volume. The two thickener sludge pumps have a capacity of 100 gpm each, and are adequate to pump the thickened sludge volume.

H. Sludge Digestion and Land Application

Currently, waste activated sludge (W.A.S.) is drawn from the clarifiers and is thickened through the use of gravity thickeners. The thickened sludge is then pumped into existing aerated sludge storage units. There are three aerated sludge storage tanks: two 70-foot diameter x 20-foot SWD and one 77-foot diameter x 22-foot SWD units. These tanks have a combined volume of approximately 1.94 million gallons. These units stabilize the sludge sufficiently to meet the 40 CFR 503 pathogen reduction criteria for Class "B" sludge and to meet the requirements of 40 CFR 503.33 (3 & 4) for Vector Attraction Reduction.

Land application is by truck onto nearby, permitted sludge application fields. In addition, Jonesboro CWL has installed fixed-header spray irrigation for application to 90 acres of the total 347 acres presently permitted.

Gravity table thickeners (GTT) are also being constructed to thicken waste activated sludge prior to digestion. The percent solids these machines produce is usually greater than that achieved by conventional gravity thickeners. This directly impacts the amount of digester volume required. For example, by thickening sludge to 5 percent prior to digestion instead of 2-1/2 percent as with conventional thickeners, the digestion volume requirements are cut in half.

Anticipated digester volumes required utilizing gravity table thickeners are set out below:

ANTICIPATED SLUDGE STORAGE REQUIREMENTS

Period	Flow (MGD)	45-Day Digestion (MG)	15-Day Operational (MG)	Total (MG)	Existing Volume Avail. (MG)	Add'l. Required Storage (MG)
July '94 to July '95	4.9	0.55	.19	.74	1.94	Adequate
Future	6.0	0.68	.23	.91	1.94	Adequate
Future	10.5	1.18	.40	1.58	1.94	Adequate
Future	13.5	1.52	.51	2.03	1.94	Need .05
Future	18.0	2.03	.68	2.71	1.94	Need 0.77

As shown above, no additional digester volume would be required until flows reached approximately 13.5 MGD, at which time one additional digester 77 feet in diameter x 22-foot SWD would be required.

The present net area contiguous to the wastewater treatment plant and available for land application disposal of sludge is 347 acres. This available application area is adequate for sludges produced by average flows up to about 13.0 MGD with a BOD removal of 240 mg/l, based on: 1) 0.52 pounds of sludge produced per 1.0 pound of BOD removed by the wastewater treatment plant; 2) Plant Available Nitrogen (PAN) as the limiting pollutant with sludges having an average concentration of PAN of 41.77 pounds per dry ton; and 3) an application rate of 300 pounds of PAN per acre per year.

M E M O R A N D U M

To: Jb-35A, Jb-59, and Jb-67 Project Files, NPDES File AR 0043401, Chuck and Johnny

From: Jimmy

Subject: Construction Permits and NPDES Permit Modification

Date: March 28, 1996

This is to document procedure implemented in application for Construction Permit for the Project Jb-35A & Jb-59 which may also apply to the application for a Construction Permit for Project Jb-67 and application for NPDES Permit Modification necessary to raise the permitted flow above the present 6.0 MGD.

Nelson & I (Jimmy) made the decision to apply for a Construction Permit only for Project Jb-35A & Jb-59 and to delay the application for NPDES Permit Modification. The following are reasons for this decision:

1. Construction Permit can be acquired in about 60 days, (sometimes as little as 45 days). Construction Permits, if no public comment is received during the initial 30 day public notice period, may then be issued without further delay.

2. Construction Permit, including NPDES Modification or NPDES Modification only, would require about 120 days. Whenever NPDES modification is being considered, two separate 30-day public notice periods are required plus the modification must be reviewed by Region VI EPA.

3. ADPC&E Regulation No. 9.7.1.1 and 9.7.5.2 set forth the following fee schedule for the Major Municipal Facilities:

Construction Permit Fee	$250.00
Modification Fee	$5,000.00
Annual Fee - 6 MGD	$2,930.00
Annual Fee - 9 MGD	$4,688.00

Since the existing 6.0 MGD permit will likely be adequate to meet CWL needs until Frito-Lay is scheduled to go on line in April 1997, it appears that the most cost effective and expeditious plan for CWL is also to apply for a Construction

Permit Only for Project No. Jb-67,(the 4.5 MGD or 9.0 MGD parallel facility,) and delay application for modification of the permit from 6.0 MGD to 9.0 MGD, or whatever flow is found to be appropriate at the time the application for modification is filed, until about October 1,1996. This should provide ample time for reviews and public notification periods to expect a modified permit to be issued by the end of January 1997.

Mark Bradley, Engineering Supervisor, NPDES Permits, ADPC&E has concurred by phone today that keeping the Permit Modification separate from the Construction Permits is acceptable to ADPC&E and likely the more expeditious procedure for all parties than including application for Permit Modification with application for Construction Permit.

Nelson Childers directed today that MWY prepare applications for Construction Permit for Jb-67 and for Permit Modification to increase the permitted capacity of the facility.

We didn't discuss the flow to which we should request modification of the permit. There will be ample time to agree on the flow before October 1, 1996.