CDM Camp Dresser & McKee

Report

DRAFT

Plant Performance Evaluation

Algiers and Carrollton Water Purification Plants
New Orleans, Louisiana

December 1999

Prepared for:
Sewerage & Water Board of New Orleans

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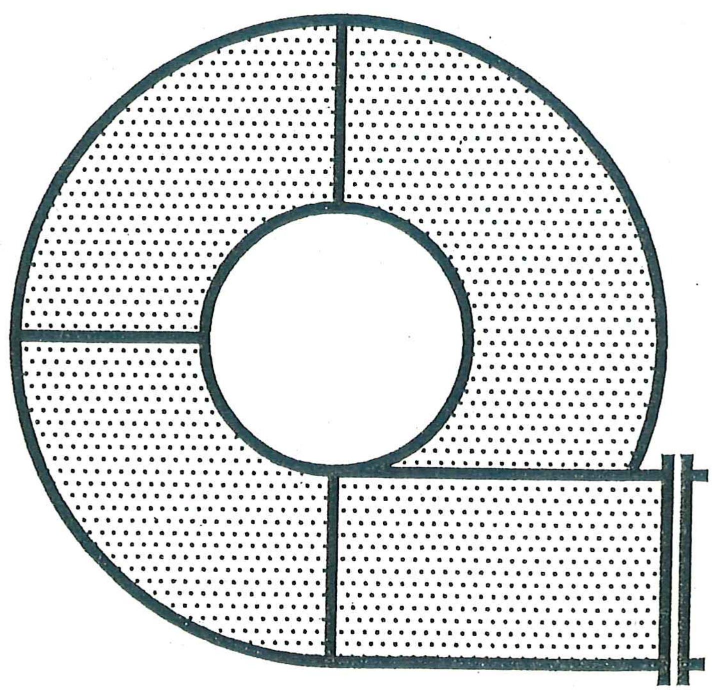

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Section 1
Introduction

1.1 General

On December 17, 1998 the Sewerage & Water Board of New Orleans (S&WB) retained Camp Dresser & McKee, Inc (CDM) with subconsultants Burk-Kleinpeter, Inc. and C&S Consultants to provide evaluation and design engineering services for improvements to the Algiers and Carrollton Water Treatment Plants (WTPs). Under this contract the CDM team provided services to assure the Algiers and Carrollton WTPs remain in compliance with current and proposed Safe Drinking Water Act regulations and maintain their current peak capacities of 40 million gallons per day (MGD) and 240 MGD, respectively. This included general assessments of the plant's treatment practices and performance to optimize current operations. These assessments included a review of current chemical feed operations and current instrumentation and control features. CDM prepared Risk Management Plans at both plants to address recent regulatory requirements governing the use of gaseous chlorine and ammonia at both facilities. Services to be provided also included completion of the design of several projects scheduled for implementation; the Oak Street Pump Station Intake Piping Improvements for the Carrollton WTP, Improvements to the Carrollton WTP G&L Basins, and Improvements to the Carrollton WTP Sycamore Filters.

1.2 Scope of Services

This report summarizes the results of activities provided under Task A1 - Plant Evaluations of CDM's contract with the S&WB. A summary of the services completed is presented below:

Task A1 - Plant Evaluations

Task Objectives: Develop an implementation plan for improvements and modifications at both the Algiers WTP and Carrollton WTP that will result in providing. Implementing the plan will provide the desired performance to meet water quality goals and regulatory requirements; maintain future capacity requirements; and improve the ease of facility operations and plant process control.

Subtask A1.1 - Review of Existing Studies and Reports. Review all relevant documents, including the existing plans and specifications, and such reports as the Water Master Plan Update, and the pilot scale ozonation study. Reviewing this information allowed the project team to develop a working knowledge of the existing WTP facilities and recent plans for improvements.

Subtask A1.2 - Review of Preliminary Designs. Provide a detailed review of the preliminary design plans and specifications for two projects, the Carrollton WTP Intake Piping Modifications and the Carrollton WTP G&L Basin Modifications. This allowed CDM to accept responsibility for the final design to be provided for both projects. Recommended changes were provided upon completion of the review.

Subtask A1.3 - Perform Process & Hydraulic Evaluations. Conduct an audit of the Algiers WTP and the Carrollton WTP to evaluate the process and hydraulic systems. These evaluations are necessary to ascertain current capabilities and vulnerabilities in light of current and proposed regulations; desired capacities; reliability and redundancy concerns; safety; and operational and maintenance ease and flexibility. The audit addressed the following:

1. Raw water supply and chemical feed
2. Coagulation and sedimentation systems, including sludge collection
3. Filtration systems, including backwash
4. Disinfection systems,
5. Clearwell storage and pumping
6. Waste backwash water disposal
7. Sludge handling and disposal
8. Chemical storage, handling and application systems
9. Electrical distribution and control systems
10. Instrumentation monitoring and control systems
11. In-plant hydraulic conveyance systems
12. Ancillary support systems, including plant drainage, plumbing, and HVAC

Audit determinations were based on physical inspections; plan and specification review conducted in Subtask A1.1; engineering calculation; field measurements (flows, pressures, levels, etc.) operations and maintenance staff interviews; engineering report review conducted in Subtask A1.1; and raw, process unit, and finished water quality report reviews.

This report serves as the status paper that documents the results of the process and hydraulic audit and describes the condition and capabilities of each of the WTPs' systems and delineates system vulnerabilities with respect to capacity, regulatory compliance, reliability and redundancy, safety, operational flexibility, and maintenance ease. All identified vulnerabilities will be substantiated with appropriate rationale. This document also includes process and instrumentation diagrams and supporting graphics as necessary to establish the status of the existing WTPs.

Subtask A1.4 - Regulatory Update. The purpose of this subtask was to review the both WTPs capabilities of meeting the current and proposed federal regulatory requirements, while maintaining desired water quality goals. The proposed Disinfectants/Disinfection Byproducts Rule (D/DBPR) and Enhanced Surface Water Treatment Rule (ESWTR), to be finalized in November 1998, have been revised since completion of the Water Quality Master Plan Update. These changes impacted previously anticipated disinfection and/or filtration requirements. For example, the implementation of ozonation may not be required for the plants to meet the Stage 1 requirements of the D/DBPR while complying with the ESWTR.

This document serves as the status paper prepared to discuss the capabilities of each of the plants in meeting the requirements of these rules; the process changes and facility modifications or additions required; impacts of modifications on other facilities; operational and cost impacts. This document also recommends the need for future studies, should such studies be required.

Subtask A1.5 - Develop Implementation Plan for Improvements. The results of subtasks A1.1, A1.2, and A1.3 were used to develop an Implementation Plan for recommended improvements to both the Algiers WTP and Carrollton WTP. This implementation plan presents phased improvements required for each plant. The scheduling of these improvements were based upon current condition of facilities, regulatory compliance requirements, operational cost implications, and other factors. The implementation plan presents estimated construction costs associated with each of the improvements.

The implementation plan also includes potential long-term improvements that may be required in the future depending upon such things as potential water quality changes or longer term regulatory requirements.

1.3 Plant Evaluation and Implementation Plan Outline

A brief outline of the plant evaluation and implementation plan report is as follows:

Section 1: Introduction

Section 2: Existing Water Treatment Operations

Section 3: Review of Existing Studies and Reports

Section 4: Review of Preliminary Designs

Section 5: Plant Evaluations – Process/Mechanical

Section 6: Plant Evaluations – Electrical/Instrumentation

Section 7: Regulatory Update

Section 8: Conclusions and Recommendations

Section 9: Implementation Plan

Appendix A: Detailed Scope of Services

Appendix B: Review Comments for Carrollton Intake Piping Project

Appendix C: May 21, 1999 Memorandum on Leak at Oak Street and Public Belt Railroad Track

Appendix D: Review Comments for PAC Feed Facilities - Carrollton WTP

Appendix E: June 17, 1999 Memorandum - Carrollton G and L Basins - Preliminary Design Review

Appendix F: April 15, 1999 Technical Memorandum - Carrollton Water Treatment Plant Filter Improvements Implementation Plan.

Appendix G: Carrollton WTP Recycle Backwash Pump System Curves

Section 2
Existing Water Treatment Plant Operations

2.1 Algiers WTP

2.1.1 Existing Operations

The original water treatment facilities at Algiers were constructed in the early 1900s. Several phases of modifications and additions have resulted in the existing Algiers WTP shown in **Figure 2.1**. Eight dual-media, constant rate filters were added to the facility in 1972. In 1982, two, circular, Eimco HRC Clarifiers were constructed to yield a treatment capacity of 16 MGD. The most recent expansion of the Algiers facility was completed in 1994. This expansion included the addition of two, rectangular, Eimco HRC Clarifiers, twelve dual-media, constant-rate filters, a Bailey control system, and effluent pump station. The 1994 expansion added 24 MGD of treatment capacity expanding the total capacity of the facility to 40 MGD.

The overall process flow at the Algiers WPP is illustrated in Figure 2-2. Each of the identified processes was evaluated and is described in Section 5.0. These descriptions include existing systems, identified problems, and alternatives for process improvement. The Algiers WTP treats raw water directly from two intake structures on the West Bank of the Mississippi River. Three separate raw water supply lines (20-inch, 30-inch, and 36-inch diameters) enter the Algiers WTP site. Currently the 36-inch diameter raw water pipeline is used to supply the treatment system.

Liquid ferric sulfate (ferric) the primary coagulant is added at the river intake pump stations and powdered activated carbon (PAC) is intermittently added at the river intake pump station for taste and odor control. Chlorine, ammonia, and fluoride are added at the plant just prior to the Eimco treatment units. Chlorine varies seasonally. If the water temperature is in excess of 15°C, chlorine is added in conjunction with ammonia prior to the Eimco units. Thus chloramines prove primary disinfection in warm water. However, if the water temperature is below 15°C, free chlorine is used for disinfection. This includes addition of chlorine down-stream of the Eimco units with the addition of ammonia following filtration. This disinfection strategy is utilized to meet regulatory requirements. Fluoride is applied before the Eimco units for dental health benefits.

The Eimco HRC units incorporate flocculation/coagulation and sedimentation into a common basin. As mentioned previously, four Eimco units are located at the Algiers WTP; however, only three are currently operational, units Nos. 2, 3, and 4. The centerwell of each unit serves as the chemical addition and mixing area. Lime and cationic polymer are added into the centerwell mixing areas. Lime addition is utilized for two beneficial reasons, pH adjustment and softening. Raising the pH of the raw water aids coagulation with ferric sulfate and enhances settling of suspended particles. Softening removes divalent cationic species such as calcium and magnesium, which is responsible for water hardness. A cationic polymer is fed at each clarification unit as a coagulant aid, increasing floc size and strength and improving

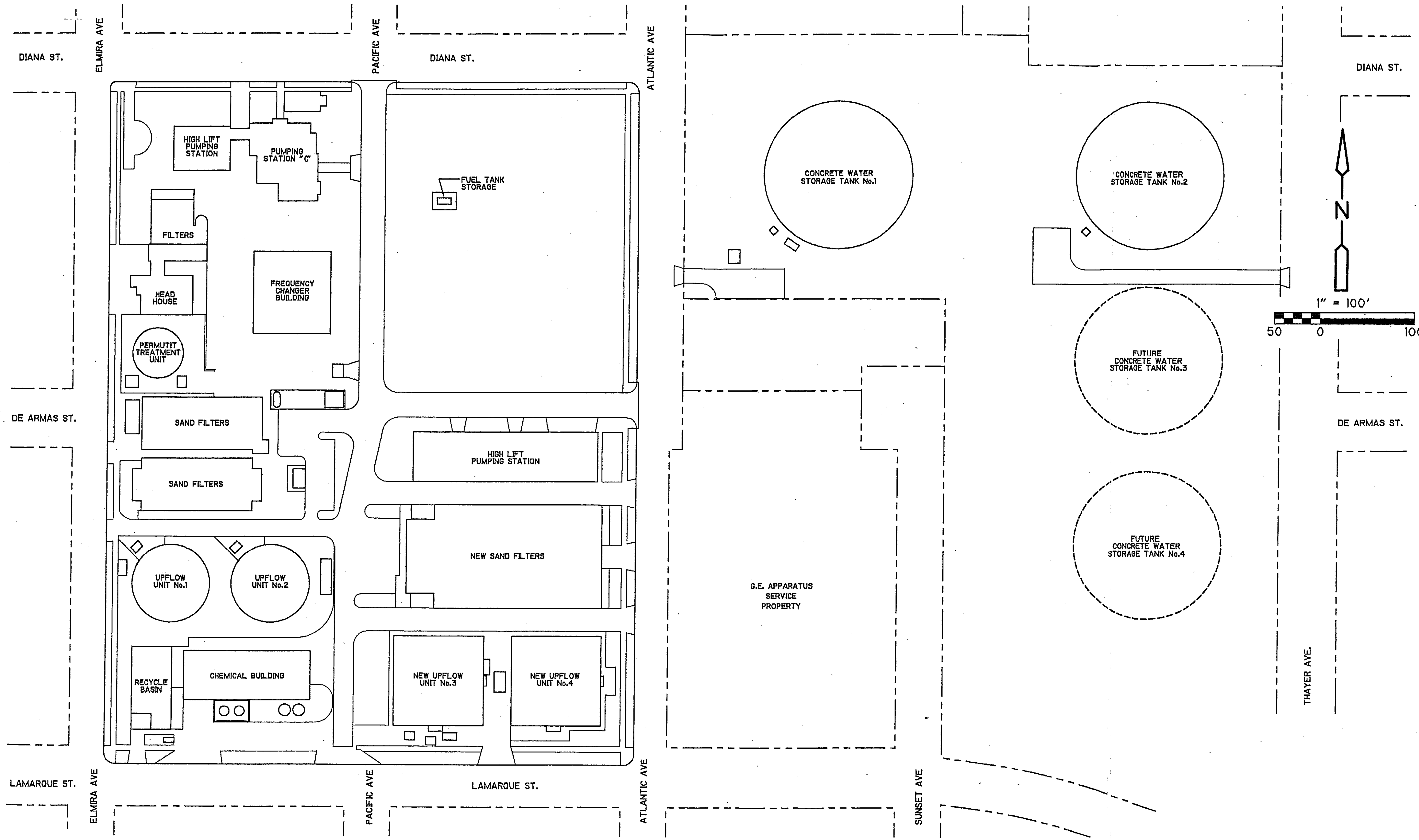

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Figure No. 2-1
ALGIERS WATER TREATMENT PLANT
SITE PLAN

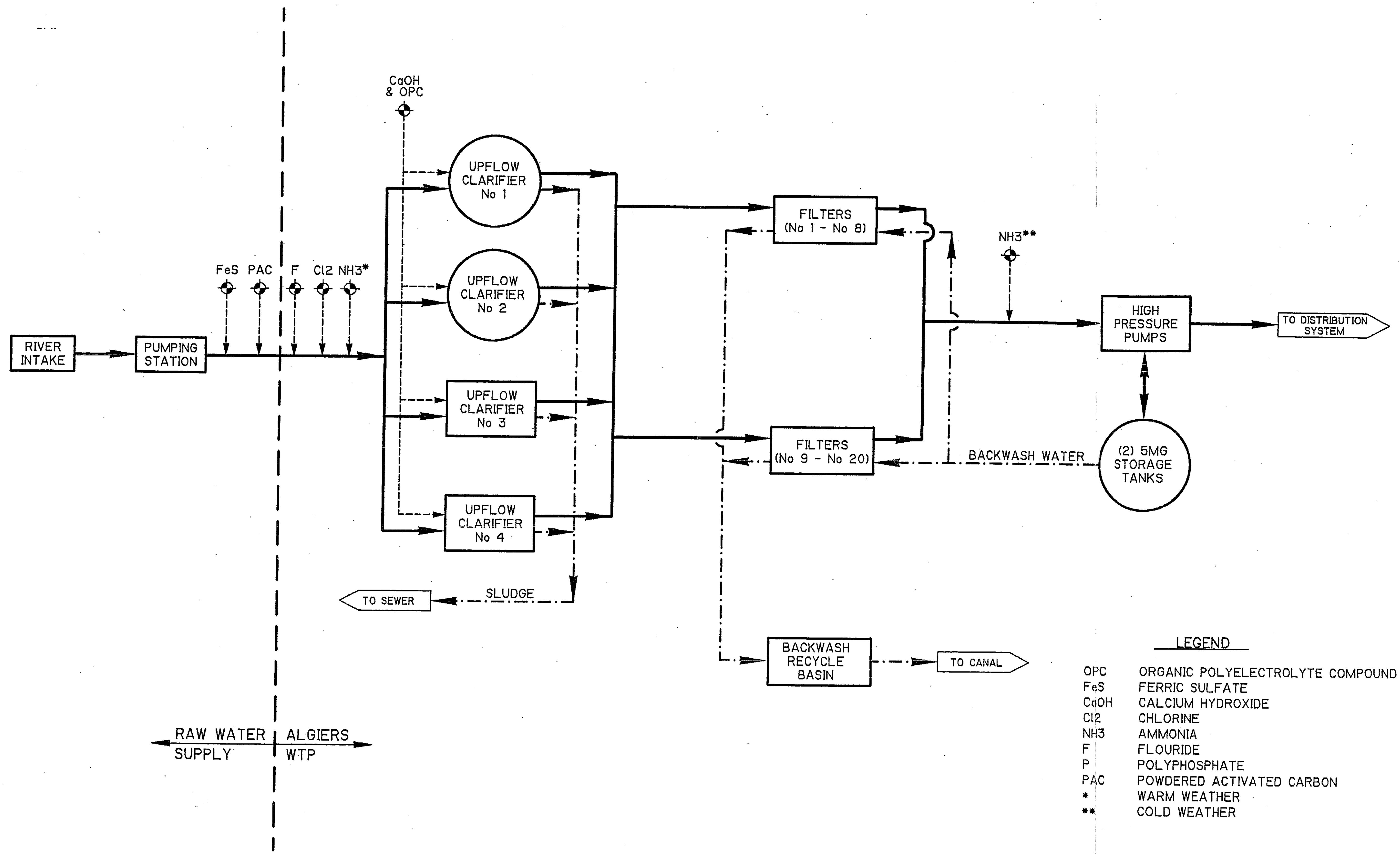

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Figure No. 2-2
ALGIERS WATER TREATMENT PLANT PROCESS SCHEMATIC

settling and filterability. This destabilization results in enhanced coagulation of particles and produces a more easily settleable floc.

Following flocculation and sedimentation, the settled waters from the upflow clarifiers are fed to the filtration system. The existing filtration system includes twenty dual-media, constant-rate filters. Currently, only Filters No. 9 - 20 are intermittently in use. All of the filters are rated for a filtration capacity of 3 gpm/sf. This yields a maximum treatment capacity of approximately 70 MGD with all filters in operation. Following filtration, water is combined and distributed to the off-line, clearwell storage system or directly to either of the distribution pump stations. Backwash water is supplied to both sets of filters from the off-line, ground storage tanks. Filters No. 1 - 8 are equipped for hydraulic wash only with auxiliary surface scour systems. Air/water backwash underdrain systems are installed in Filters No. 9 – 20.

The existing storage system includes two structures each with a five million-gallon capacity. These structures are located on the northeast quadrant of the WPP site. Filtered water is pumped from the high-service pump pit to the storage structures through a 36-inch diameter pipeline.

A variety of chemicals are added at the facility to aid softening, flocculation/ coagulation, disinfection, filtration, and aesthetics. Table 2-1 identifies all chemicals incorporated into the treatment process at the Algiers WPP, the respective uses, and the approximate doses. Each of these chemical systems is described further in Section 5.0.

Table 2-1: Algiers WTP Chemical Addition Summary

Chemical Additive	Additive Form	Chemical Use	Dose (mg/L)
Ferric Sulfate	50% Solution	Coagulation	5 – 20
PAC	Powder	Taste and Odor	3 – 30
Lime	Slaked	Softening	Not Available
Polymer	Cationic / Solution	Coagulation Aid	3 – 5
Chlorine	Solution, Vacuum Feed	Disinfection	Not Available
Ammonia	Gas, Direct Feed	Disinfection	Not Available
Fluoride	Hydrofluosilicic Acid	Dental Hygiene	Not Available
Phosphate	Solution	Sequestering Agent	2 – 5

Wastewater generated from the treatment processes includes settled sludge and filter washwater. Currently, settled sludge is discharged to the Mississippi River. Washwater generated from filter backwashing flows by gravity to the on-site recycle basin. However, the basin does not function as designed and the backwash water is pumped to the Lamarque Canal. The Louisiana Department of Environmental Quality (LDEQ) has raised concerns regarding the backwash discharge into this canal. This is further discussed in Section 7.

2.1.2 Raw Water Quality

Surface water is supplied to the Algiers WTP from the Mississippi River and is susceptible to seasonal events and climatic variation. Data (1993 to 1995) from the Water Quality Master Plan Update (WQMPU, 1997), indicate that fluctuations in turbidity are common. Considering the large source watershed and various discharges which feeds the Mississippi River, variation of water quality must be expected. Turbidity measurements have exhibited fluctuations within the last twenty years. In the mid to late 1980s, the turbidity averaged approximately 170 NTU. In contrast, during the years of 1993 to 1995, the turbidity averaged 70 NTU. Other parameters, such as alkalinity and hardness have been relatively constant (1994 and 1995 data). These three raw water parameters were compared for the Algiers and Carrollton WTPs, and as expected, minimal differences were noted. As summarized in the WQMPU, the raw water characteristics have had the following averages and ranges:

Constituent	Daily Average*	Typical Range*
Hardness**	160 mg/L	125 mg/L to 200 mg/L
Alkalinity	112 mg/L	90 mg/L to 150 mg/L
Turbidity	70 NTU	25 NTU to 150 NTU

*All measurements of hardness and alkalinity are mg/L as $CaCO_3$.
**Carrollton WTP raw water data

2.1.3 Finished Water Quality

The Algiers WTP produces relatively consistent finished water quality. Finished water can be characterized as moderately soft with low alkalinity and turbidity. Available data from the WQMPU was examined for 1993, 1994, and 1995. General characteristics of the finished water quality are summarized below:

Constituent	Daily Average*	Typical Range*
Hardness	125 mg/L	100 mg/L to 140 mg/L
Alkalinity	62 mg/L	45 mg/L to 90 mg/L
Turbidity	0.13 NTU	0.08 NTU to 0.3 NTU

*All measurements of hardness and alkalinity are mg/L as $CaCO_3$.

The hardness of the finished water was not significantly reduced from the initial raw water values. The addition of lime at the Algiers WTP is intended for pH adjustment not for softening. Following treatment, the alkalinity of the water is reduced to approximately 60 mg/L (as $CaCO_3$). In the past, the filtration system experienced episodes of high filtered water turbidities. However, the typical filtered water quality averaged near or below the regulatory requirements. Conversations with Plant staff indicated that finished water turbidity levels currently average approximately 0.10 NTU.

2.2 Carrollton WTP

2.2.1 Existing Operations

The existing treatment system at the Carrollton WPP (Figure 2-3) was constructed and modified in several phases. The current system includes four flocculation and sedimentation basins, three contact basins, 36 dual media filters, ten ground-level storage tanks, and three on-site pump stations. The four flocculation and sedimentation basins function as two separate treatment pairs of a single system. These are designated as the G and L Basins. Settled waters from the G and L Basins are combined following sedimentation. Chlorine and ammonia are added to form chloramines for primary disinfection. Water then flows into the three contact basins (C Basins). The chloraminated water flow is then split between the Sycamore and Claiborne filtration systems. The current design capacity of the Carrollton WTP is 240 MGD.

The overall process flow at the Carrollton WPP is illustrated in Figure 2-4. Each of the identified processes was evaluated and is described in Section 5.0. The Carrollton WPP is supplied raw water directly from two intake structures on the East bank of the Mississippi River. Raw water is distributed to the G and L Basins from the River Station Building (RSB) or Old Pumphouse and the Industrial Avenue Pumphouse (IAP), respectively. Currently, the G Basins are fed primarily from the RSB and by additional raw water supplied from the IAP. The L Basins are exclusively fed by the IAP, but can be served by the RSB. A 54-inch and a 48-inch diameter line exit the RSB. The 54-inch diameter line feeds raw water to the south side of the G Basins. The 48-inch diameter line also feeds the G Basins, entering from the east. The 54-inch diameter line from the RSB is interconnected to two, parallel 48-inch diameter lines feeding raw water from the IAP to the L Basins.

Chemicals can be applied to the raw water prior to the WTP. In the past, potassium permanganate and polyelectrolyte were added at the intake pump stations. Potassium permanganate was used for taste and odor control. A preliminary design has been performed for modification of the potassium permanganate system for use with powdered activated carbon (PAC) slurry. PAC adsorbs algae based taste and odor compounds and other organic contaminants and can be settled out in traditional sedimentation processes. Currently, PAC is added upstream of the G and L basins. The system modifications were proposed so that PAC could be intermittently added at the river for taste and odor control and in case of a river spill. In addition to potential PAC addition, a cationic polymer is added at the river intakes. The polymer serves as a coagulant aid and enhances the sedimentation processes.

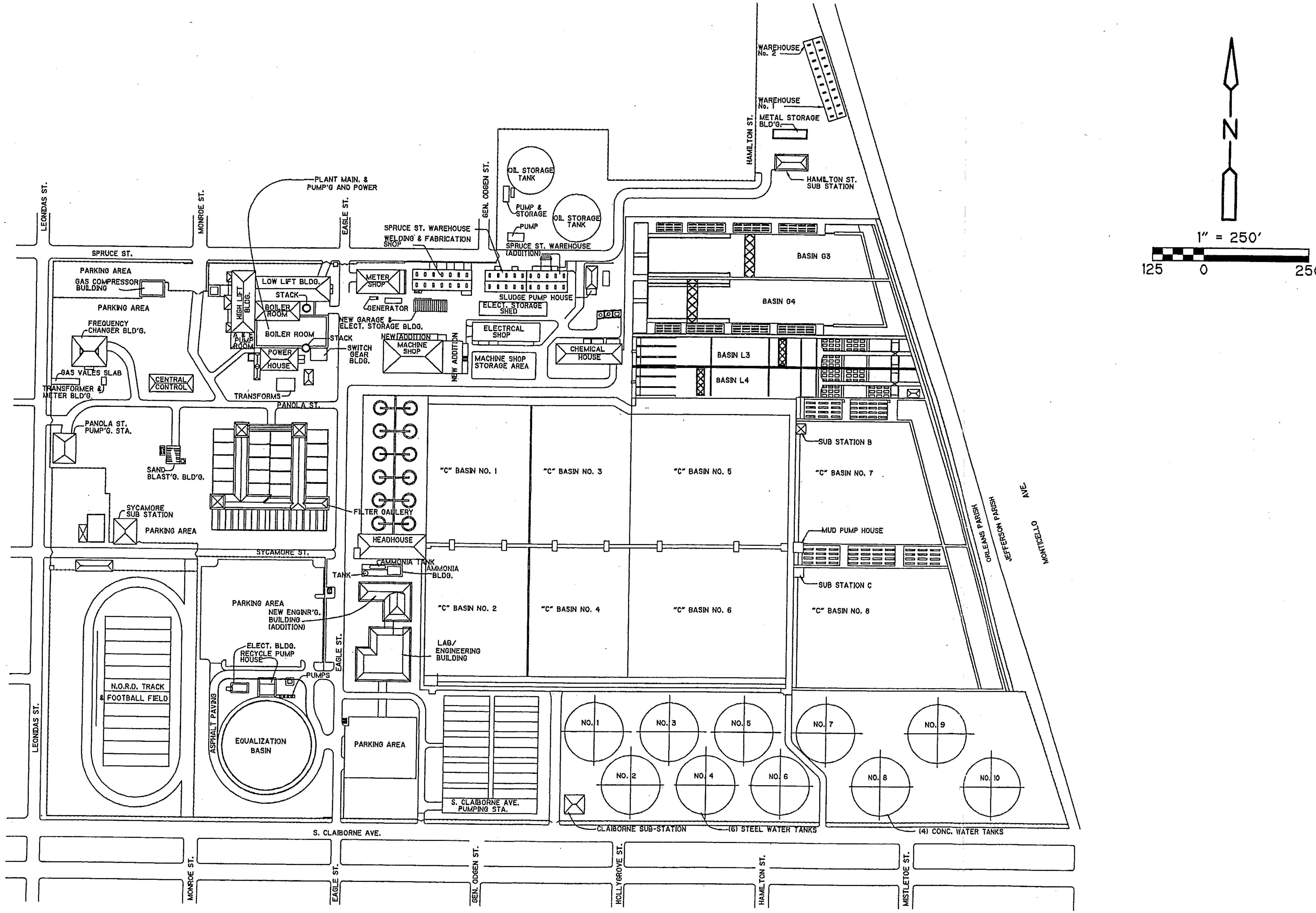

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Figure No. 2-3
CARROLLTON WATER TREATMENT PLANT
SITE PLAN

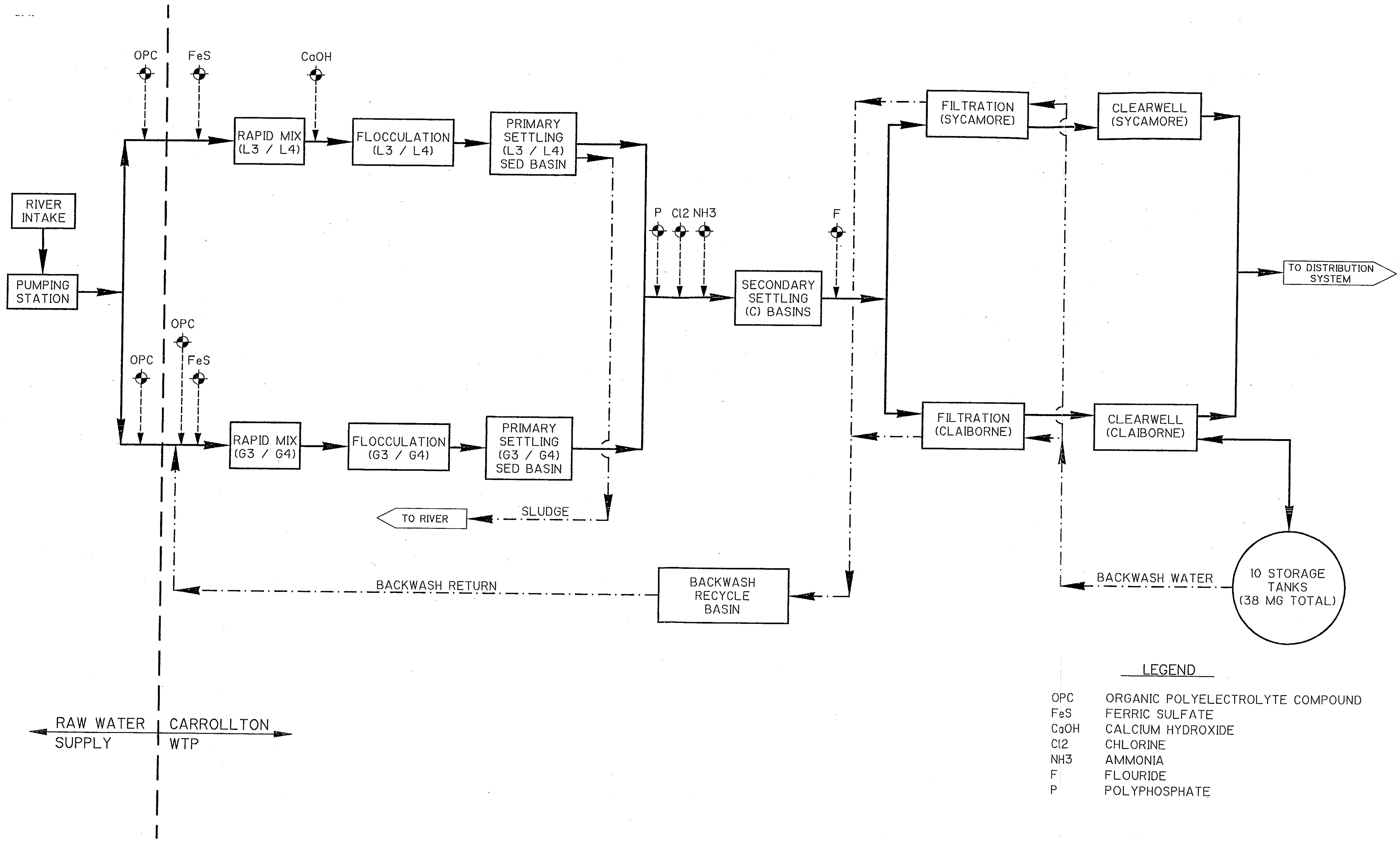

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Figure No. 2-4
CARROLLTON WATER TREATMENT PLANT
PROCESS SCHEMATIC

As stated previously, the raw water enters the G and L Basins separately. The G Basins are two similar treatment trains that include mixing, flocculation, and sedimentation basins. The mixing basins are four identical basins with no mechanical mixing. The flocculation basins include several sets of paddle mixers which are positioned parallel to the flow. The sedimentation basins are conventional designs with overflow weirs and a mono-rake system for mechanical sludge removal. The L Basin system is similar to the G Basins but smaller, and without the initial mixing chambers. Also, the flocculators of the L basins are positioned perpendicular rather than parallel to the flow. The G and L Basins are reported to hydraulic capacities of 160 MGD and 80 MGD, respectively.

Ferric is added to both of the G&L basins where as lime is only added to the L Basins. Lime is utilized for two beneficial reasons, pH adjustment and softening. Raising the pH of the raw water aids ferric coagulation and enhances settling of suspended particles. Softening removes divalent cationic species such as calcium and magnesium, which are responsible for water hardness. Polymer that is added upstream of the WTP serves as a coagulant aid by destabilizing suspended particles. This destabilization results in enhanced coagulation of particles and produces more easily settleable flocs and particles.

Following flocculation and sedimentation, the settled waters from the G and L Basins are combined into a single flow. Water then flows through distribution channels to three contact or C Basins. Chlorine and ammonia are added to the water in the distribution channels. The C Basins provide extended chloramine contact time for disinfection prior to filtration.

The existing filtration system is composed of two separate filtration facilities, the Sycamore and Claiborne Filters. The Sycamore Facility includes 28 dual-media, constant-rate filters that consist of various design configurations. These different configurations are a result of multiple renovation projects. The Claiborne facility is composed of eight dual-media, constant-rate filters. Both sets of filters have a dual-cell design. This design includes two separate filter cells separated by a center gullet. The gullet distributes settled water to the filters and removes backwash water during cleaning. Previously, plant staff determined that the loading rates for both filter systems are approximately equal. However, due to hydraulic limitations, Filters No. 1 – 10 of the Sycamore system are operated at lower rates.

Filtered water from the Sycamore and Claiborne Systems is either pumped directly to the distribution system or to the off-line storage tanks. Three distribution pump stations are located on-site. These include the Claiborne High Lift Pump Station, the Panola Street Station, and the High Lift Building (Spruce Street). Interconnections between the filter galleries provide filtered water to the three pump stations. The existing off-line storage system includes ten above ground structures. These structures are located on the northwest quadrant of the WTP site. These structures were designed to provide backwash water to the filtration operations; however, insufficient head exists. Therefore, a booster pump is required for filter backwashing. Backwash water from the Sycamore and Claiborne Filters is drained to an on-site backwash equalization basin. Suspended matter is allowed to settle from the backwash water. The settled water is then recycled from the equalization basin back to the G Basins for treatment.

Chemicals are added at the facility to provide softening, flocculation/ coagulation, disinfection, filtration, and aesthetics. Table 2-2 identifies chemicals incorporated into the treatment process at the Carrollton WPP, the respective uses, and the approximate doses. Each of these chemical systems is described further in Section 5.0.

Table 2-2: Carrollton WTP Chemical Addition Summary

Chemical Additive	Additive Form	Chemical Use	Average Dose (mg/L)
PAC	Slurry	Taste & Odor	8.0
Ferric Sulfate	50% Solution	Coagulation	10-30
Cationic Polymer	Solution	Coagulation Aid	0.5-3.0
Lime (L Basins)	Slaked	Softening	55
Chlorine	Gas, Direct Feed	Disinfection	1.9
Ammonia	Gas, Direct Feed	Disinfection	1.0
Fluoride	Hydrofluosilicic Acid	Dental Hygiene	0.8
Phosphate	Solution	Sequestering Agent	0.5-1.5

2.2.2 Raw Water Quality

Surface water is supplied to the Carrollton WTP from the Mississippi River and is susceptible to seasonal events and climatic variation. Historical data from 1993 to 1995 indicate that fluctuations in turbidity are common. Considering the large source watershed and various discharges which feed the Mississippi River, variation of water quality must be expected. Turbidity measurements have exhibited fluctuations within the last twenty years. In the mid to late 1980s it was reported that the turbidity averaged approximately 170 NTU. In contrast, during the years of 1993, 1994, and 1995, turbidity averaged between 60 and 100 NTU. Other parameters, such as alkalinity and hardness have been relatively constant. As reported in the Water Quality Master Plan Update (WQMPU, 1997), the raw water characteristics have had the following averages and ranges:

Constituent	Daily Average*	Typical Range*
Hardness	160 mg/L	125 mg/L to 200 mg/L
Alkalinity	112 mg/L	90 mg/L to 135 mg/L
Turbidity	70 NTU	25 NTU to 150 NTU

*All measurements of hardness and alkalinity are mg/L as $CaCO_3$.

2.2.3 Finished Water Quality

The Carrollton WTP has achieved relatively constant finished water quality, and can be characterized as moderately soft with low alkalinity and turbidity. Available data from the WQMPU was examined for the years of 1993, 1994, and 1995. General characteristics of the finished water quality are summarized below:

Constituent	Daily Average*	Typical Range*
Hardness	140 mg/L	120 mg/L to 160 mg/L
Alkalinity	80 mg/L	35 mg/L to 130 mg/L
Turbidity	0.13 NTU	0.1 NTU to 0.4 NTU

*All measurements of hardness and alkalinity are mg/L as $CaCO_3$.

The hardness of the finished water was not significantly reduced from the initial raw water values. The addition of lime at the Carrollton WTP is intended primarily for pH adjustment not for softening. Following treatment, the alkalinity of the water is reduced to approximately 80 mg/L (as $CaCO_3$). The filtration system has experienced episodes of high filtered water turbidities. However, the typical filtered water quality has averaged near or below the regulatory requirements.

Section 3
Review of Existing Studies and Reports

3.1 Introduction

In the evaluation of the Algiers and Carrollton WTPs a review of previous studies and reports was conducted to assess the status of work performed to date. Studies provided for review by the S&WB in chronological order were as follows:

G& L Basins Upgrade Plan, February 1997, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

Water Quality Master Plan Update, April 1997, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

Plant Performance Assessment - February, 1997, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

Zebra Mussel Control Plan - February, 1997, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

G& L Basin Preliminary Design, April 1998, Burk Kleinpeter, Inc.

Water Quality Master Plan Implementation - Carrollton PAC Facility - July 1998, Burk Kleinpeter, Inc.

Carrollton Water Treatment Plant Filter Improvements Implementation Plan, July 1998, February, 1997, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

Ozone Disinfection Implementation Plan, October, 1998, Malcolm Pirnie, Inc., Burk Kleinpeter, Inc., and C&S Consultants, Inc.

Master Plan Update Summary, December 1998, Malcolm Pirnie, Inc.

Several of these reports were reviewed as part of the preliminary design reviews as described in Section 3. The G&L Basin Upgrade Plan, Plant Performance Assessment, and G& L Basin Preliminary Design were all reviewed to develop the comments and memorandum necessary to proceed with design of the G&L Basin Improvements as described in Section 4. The Plant Performance Assessment, and Carrollton Water Treatment Plant Filter Improvements Plan were reviewed to develop comments and memorandum to proceed with design of the Carrollton WTP Filter Improvements as described in Section 3.

3.2 Zebra Mussel Control Plan

Review of the Zebra Mussel Control Plan yielded several comments. The spread of Zebra Mussels throughout the country indicates the potential for control problems at the S&WB facilities. S&WB sightings of Zebra Mussels within their intakes in December 1994 confirmed this concern. However, the immediate need to provide capital improvements to address this potential threat has not yet been proven.

The current intake piping and pump stations for both the Algiers and Carrollton WTPs provide more than sufficient backup flow capacity (>200%) even under peak demand conditions. A reduction in the effective diameter of this intake piping due to Zebra Mussel infestation can pose a threat to the consistent supply of raw water to either facility. However, since their initial sighting in December 1994, Zebra Mussels have not yet threatened the S&WB's intake structures. Thus, CDM does not believe the need for capital improvements to control Zebra Mussels is an immediate need. However, CDM concurs with the recommendations provided within this report as clarified below:

- Continue intake inspections, substrate and larval monitoring to determine the threat of infestation. Based upon interviews with operators at the plants, it appears monitoring has been discontinued. Monitoring activities should be initiated based upon plant operator availability and the appropriate monitoring frequency.

- Use mechanical cleaning as a secondary control measure to remove zebra mussels from portions of intake structures, if observed.

- Utilize the existing intake polymer feed to control zebra mussels at the Carrollton WTP. This can be accomplished through modifications to allow polymer fed to the intake suction lines. This should only be implemented if renewed monitoring procedures indicate a potential problem.

- Add a new polymer feed to Algiers Intake No. 1 to control zebra mussels. This should only be implemented if renewed monitoring procedures indicate a potential problem.

- The S&WB should seek legal counsel concerning potential patent infringement for the use of their current or proposed polymer systems for zebra mussel control.

The cost of proposed improvements provided within this report have been included in Section 9 implementation plan, as discretionary projects. The costs provided within the report for the polymer feed system improvements were $1,663,000 and $910,000, for the Carrollton WTP and Algiers WTP, respectively.

3.3 Water Quality Master Plan Update and Master Plan Update Summary

The Water Quality Master Plan and Master Plan Update Summary both provided a list of recommended improvements and suggested implementation plans as shown in Tables 3.1 and 3.2, respectively. The cost provided in **Table-3-1** are capital construction costs only, while those presented in **Table 3-2** include design and construction management costs. The need for these improvements were revised per the review of preliminary designs provided in Section 4 and review of current treatment plant operations as provided in Sections 5 and 6 of this report. The revised implementation plan based upon this review is provided in Section 9 of this report. Major revisions to the Master Plan Update Summary include phasing of G&L Basin Improvements and Filter Improvements at the Carrollton WTP, potential elimination of backwash recycle improvements at Carrollton WTP, elimination of a chlorine contact basin at the Algiers WTP, and reassessment of the use of ozonation to meet future disinfection requirements. Revisions to these recommendations are discussed throughout this document and summarized in Section 9.

3.4 Ozone Implementation Plan

CDM's review of the <u>Ozonation Disinfection Implementation Plan</u> indicated the need to resolve several unanswered questions prior to proceeding with the implementation of ozonation at the Algiers WTP or the Carrollton WTP. In addition, CDM does not concur with all the recommendations as provided in this report.

The scope of work included review of settled water quality data, assessment of water quality on ozone performance; benchscale testing at the plant sites over two separate weeks to establish ozone demand and BDOC formed, selection of design dosages for future regulatory requirements and assessment of BDOC removal by existing filters; and development of proposed ozone facilities for both plants including conceptual plans, layouts, and cost estimates. The report concluded that if ozonation is implemented the lime feed point at both plants must be moved downstream of the ozone injection point to increase ozone effectiveness. At the natural pH of the raw water the ozone dosage sufficient to protect against *crytosporidium* increases the bromate concentration in the finished water to a level which exceeds of that allowed by the Stage 1 DBP Rule. The report estimated the cost of ozone facilities at the Algiers WTP and Carrollton WTP to be approximately $9,900,000 and $28,000,000, respectively. It was recommended that these improvements await the outcome of the SWDA regulations scheduled to be finalized in 2002. However, to assure plant reliability and ease of operation post-filtration chlorine contact tanks were recommended for the Algiers WTP at an estimated cost of $4,500,000.

Table 3-1: Water Quality Master Plan Update
Carrollton Water Treatment Plant
Recommended Phased Improvements

PHASE 1	
Description	**Cost**
A. Renovation of "G" and "L" Basins	$9,500,000
B. Filter Backwash Discharge Modifications	$1,675,000
C. Filter Improvement	$8,350,000
D. Intake Chemical Feed Improvements	$3,325,000
E. Chemical Feed, Instrumentation, and Operations Plan	$3000,000 (engineering fee)
TOTAL PHASE I	**$23,150,000**

PHASE II	
A. Ozonation Facilities	$48,000,000
B. Finished Water Storage Piping Changes	$6,000,000
C. Chemical Feed, and Instrumentation Improvements (allowance)	$8,000,000
TOTAL PHASE II	**$62,000,000**
PHASE III	
A. Pretreatment Facilities	TBD

PHASE IV	
A. New Filters and GAC Adsorption System	TBD
B. Sludge Dewatering System	TBD

Table 3-1 (Cont): Water Quality Master Plan Update
Algiers Water Quality Master Plan Update
Recommended Phased Improvements

PHASE I	
Description	**Cost**
A. Ozonation Disinfection Facilities	$11,250,000
B. Filter Backwash Discharge Modifications	$990,000
C Chemical Feed Modifications	$910,000
D. Chemical Feed, Instrumentation, and Operations Plan	(Included under costs for Carrollton WTP)
TOTAL PHASE I	**$13,150,000**

PHASE II	
A. Chemical Feed, and Instrumentation Improvements (allowance)	$3,000,000
TOTAL PHASE II	**$3,000,000**

PHASE III	
A. Pretreatment Facilities	TBD

PHASE IV	
A. New Filters and GAC Adsorption System	TBD
B. Sludge Dewatering System	TBD

**Table 3-2: Master Plan Update Summary
Recommended Phased Improvements**

PHASE I	
Item	**Cost**
A. Carrollton Water Treatment Plant G & L Basin Improvements	$12,860,000
B. Carrollton Water Treatment Plant Filter Backwash Discharge Modifications	$1,825,000
C. Carrollton PAC Feed Facilities	$1,504,000
D. Carrollton Polymer Feed Facilities	$1,187,000
E. Carrollton Filter Improvements	$12,528,000
F. Carrollton WTP Intake Piping Modifications	$1,291,000
G Algiers Filter Backwash Discharge Modifications	$1,136,000
H. Algiers Chemical Feed Modifications	$1,178,000
I. Algiers Disinfection Contact Facilities	$4,741,000
J. Algiers and Carrollton Chemical Feed Instrumentation and Operations Plan	$300,000
TOTAL PHASE I	**$38,550,000.00**

PHASE II	
Item	**Cost**
A. Ozonation Facilities (Both Plants)	$59,250,000*
B. Finished Water Storage Piping Changes (Carrollton only)	$6,000,000*
B. Chemical Feed and Instrumentation Improvements (Both Plants)	$300,000 (Engineering Fee)*
TOTAL PHASE II	**$65,550,000.00**

PHASE III	
Item	**Cost**
A. Pretreatment Facilities (Both Plants)	TBD

**Table 3-2: (Cont):
Master Plan Update Summary
Recommended Phased Improvements**

PHASE IV	
Item	**Cost**
A. New Filter Units (Both Plants)	TBD
B. GAC Absorption System (in existing filter units at both plants)	TBD
C. Sludge Dewatering System (Both Plants)	TBD

*Costs from previous Water Quality Master Plan Update

CDM's comments are as follows:

a. *Future Cryptospordium Control*

The system improvements recommended by Malcolm Pirnie were not feasible for *crytospordium* inactivation since they provided no provisions for pH adjustment through acid feed. Thus, if greater *cryptospordium* inactivation is required in the future other options such as membranes or ultraviolet disinfection may be required. The impact of providing these additional systems needs to be addressed. Engineering and economic comparison of the available technologies would be prudent.

If ozone is to be utilized for future *Cryptoporidium* control the following issues need to be resolved.

- The optimal pH for CT and bromate control.
- Capacity of acid systems required.
- Ozone doses (system capacities) required for 1- and 2-log *Cryptosporidium* inactivation.
- Contact time (volume) recommended for the contractors for *Cryptosporidium* inactivation (residuals at pH 7 or below typically lasted greater than 10 minutes).

b. *Future Giardia Control*

More bromide and bromate data would be desired if the S&WB plan on implementing ozone for *Giardia* inactivation.

c. *Impact on Other Plant Processes*

If ozone is going to be implemented, why spend money on interim improvements such as the post-filter chlorine contact basin at Algiers. If chlorine addition to the raw water at the Algiers WTP is discontinued, an alternative oxidant (ozone or potassium permanganate) should be added to improve coagulation and particle removal. Also, the fluoride feed point should be moved to after the filters. A fraction of the fluoride typically reacts with metal salts and is lost through coagulation-sedimentation-filtration. With the implementation of ozone prior to the existing C Basins at the Carrollton WTP, the benefit of these basins for disinfection is reduced. Also, the potential for algae growth in these basins will greatly increase. Upon completion of improvements to the G & L Basins the use of these basins as secondary sedimentation should also be diminished. Chloraminated water will impact bacteria population on biologically active filters. Although, the impacts on GAC will not be as dramatic as with anthracite or sand. CDM often provides flexibility at ozone plants to backwash with disinfectant free water, chlorinated water, or chloraminated water. This should be considered at both the Algiers and Carrollton WTP.

d. *Cost Estimates*

Overall the cost estimates appear low. No costs for acid feed system and relocation of lime addition points or chlorine addition points appear to be included. Engineering costs (Design, CA, Inspection) may be 20% or higher, particularly with the long construction periods. GAC costs for the Algiers ($1.15M for 40 MGD) and Carrolton ($2.15M for 240 MGD) do not appear to be consistent if the filtration rates are similar.

e. *Proposed Ozone System*

The off-gas ozone concentration goal of <0.1 ppm may not be low enough when considering that some operators and other plant personnel or visitors may be more sensitive to ozone and experience discomfort at lower concentrations. There is no actual data that reports the transfer efficiency measurements for the various investigations (i.e., feed gas and off gas concentrations). This is a major concern because all the dose requirements are based on transferred ozone doses. The single column (6.0′ H x 2.5′ Dia.) arrangement with 1% ozone by weight may not be the most reliable system for achieving reasonably good transfer efficiency (>85%). The method and accuracy of the feed gas and off gas measurements then becomes critical in determining the transfer efficiency and transferred dose. In many CDM projects, we used multiple columns 9.0′ H or taller to develop ozone dose residual relationships based on the total (applied) ozone dose rather than the transferred dose. Measuring off gas concentration can be difficult and inaccuracies can lead to significant errors in the calculation of transferred dose. Will the recommended 2 mg/L ozone dose for *Giardia* inactivation and control of tastes and odors? No data was provide to support this statement. Also, will the 2 mg/L dose meet the requirements under all anticipated water quality conditions? The testing did not specifically address high turbidity, high TOC runoff events. With low pH, chemical systems to quench the ozone residuals in water may be necessary. Is this necessary and cost effective?

f. Overall Recommendations

It generally appears that the need and details of an ozone system for both the Algiers and Carrollton WTP were not completely resolved by this report. The overall costs to the Algiers and Carrollton WTP for an ozone system including ancillary systems such as acid feed systems and the costs of impacts of other systems such as lime addition feed points were not firmly established. In addition, the sizing of required ancillary systems such as acid feed systems were not established. Further refinement, including additional piloting as necessary, should be performed. Upon refining the costs of the potential ozone systems should be compared to other potential technologies such as ultraviolet disinfection and microfiltration. Interim improvements such as the chlorine contact basin should be postponed until decisions on the need and scope of an ozonation system is determined.

Section 4
Review of Preliminary Design

4.1 Introduction

Upon initiation of this project preliminary designs had been completed by the S&WB for several critical projects from previous five-year capital improvement plans. As one of its priorities, CDM reviewed the preliminary design of completed for three projects. These projects included the Carrollton WTP Intake Piping Modifications, Powdered Activated Carbon (PAC) Feed Facilities at the Jefferson Parish Intake Pumping Station for the Carrollton WTP, and Carrollton WTP G&L Basin Modifications. A description of the status and recommended implementation of each of these projects is provided below.

4.2 Carrollton Intake Piping

The review of the preliminary design for this project was completed and summarized in the February 19, 1999 correspondence to Mr. G. Joseph Sullivan as provided in **Appendix B** of this report. This review recommended proceeding with final design and construction of this project based upon the comments provided. Although this project is not critical to meeting current or proposed water quality treatment requirements, it is an essential project for both the Corps of Engineers and the City of New Orleans.

The two existing 48-inch diameter intake lines to the Oak Street pumping station currently pass beneath the current base of the Mississippi River levee in this area. The condition of the line is questionable due to its age and sagging problems which have occurred. Any leakage of this line would threaten this critical flood protection levee. If leakage is observed, the Corps of Engineers would most likely require immediate plugging and discontinued use of these two lines. If the use of these lines is lost, adequate water supply to meet peak demands could be provided to the Carrollton WTP through the remaining 72 inch diameter intake line at the Oak Street pumping station and the Jefferson Parish pumping station. For these reasons the final design and construction of this project has been recommended to proceed based upon the schedule provided in Section 9 of this report. The estimated construction cost of this project upon completion of the preliminary design phase is provided as **Table 4.1**.

In addition to the replacement of the 48 inch diameter intake lines to the Oak Street Pumping Station, a portion of the two 48 inch diameter discharge lines for this facility have been added to this project for replacement. Both these lines have historically experienced leaks beneath the New Orleans Public Belt Railroad (NOPBR) tracks immediately to the north of the station. To resolve this problem replacement of the lines to 20 feet of either side of the NOPBR tracks has been recommended. Replacement of these lines on an emergency basis has been initiated from pressure from the NOPBR concerning the impact of this leak on their tracks and the potential liability to the S&WB if a train derailment would occur in the vicinity of this leak. This is documented in the May 21, 1999 Memorandum to the S&WB as provided in **Appendix C**. It is anticipated that this project will be completed by approximately January 2000. The estimated cost of replacing these lines is included in the cost estimate shown in **Table 4.1**.

Table 4-1: Estimated Construction Cost
Carrollton WTP Intake Piping Improvements

Description	Quantity	Unit	Unit Cost	Cost
A. Site Improvements				
1. Sewer Line and Manhole	1	LS	-	$10,000.00
2. New Fire Hydrant	1	EA	$2,000.00	$2,000.00
3. Water Main	750	LF	$80.00	$60,000.00
4. Seeding and Fertilizer	530	LB	$9.00	$4,770.00
B. Material and Equipment				
1. 48" Diameter Raw Water	1600	LF	$350.00	$560,000.00
2. Concrete	250	SY	$300.00	$75,000.00
3. Piles	1500	LF	$10.00	$15,000.00
4. Vacuum Pumps	1	LS	-	$30,000.00
5. River Sand Fill	6200	CY	$10.00	$62,000.00
6. Jack and Bore (2-48" Pipe)	360	LF	$500.00	$180,000.00
C. Electrical				
1. Electrical & Instrumentation	1	LS	-	60,000.00
			Subtotal Installed Cost	**$1,058,770.00**
			Contractor's OH&P 15%	**$158,816.00**
			Subtotal	**$1,217,586.00**
			Contingency 10%	**$121,759.00**
			Total Cost	**$1,339,345.00**

4.3 PAC Feed Facilities - Carrollton WTP

The review of the preliminary design for this project was completed and summarized in the March 4, 1999 correspondence to Mr. G. Joseph Sullivan as provided in **Appendix D** of this report. This review recommended installation of the facilities based upon the comments provided. The S&WB has indicated that this project is not to budgeted until the year 2001. Since the use of PAC to date has not been required to assure the water supply to the Carrollton WTP remains free of contaminants during spill conditions at the River, this has not been recommended as a priority project. In addition, the use of the proposed PAC facility for taste and odor control would also experience limited use at the Carrollton WTP. The existing PAC facilities are typically utilized for taste and odor control in August when algae blooms in the Mississippi River. The existing PAC addition facility immediately prior to the G&L Basins is inadequate and less effective than the facility proposed at the River. Replacement of this facility is recommended, however, based upon the S&WB's request this facility can remain in place to meet most needs of the system until 2001. Based upon the S&WB recommendations the proposed schedule for this project is provided in Section 9 of this report. The cost estimate for this project upon completion of the preliminary design phase is provided as **Table 4.2.**

Table 4-2: Estimated Construction Cost
Carrollton WTP PAC Facility

Item	Quantity	Unit Cost	Cost
1. PAC Dry Feed System	1 LS	$775,000.00	$775,000.00
2. Motive Water Pumps 200 GPM, 40 HP	3 EA	$5,000.00	$15,000.00
3. 14" Diam. Steel Pipe Piles	2240 LF	$30.00	$67,200.00
4. Reinforced Concrete	90 CY	$400.00	$36,000.00
5. Miscellaneous Metal Structures	1 LS	$20,000.00	$20,000.00
6. 3" Welded Steel Pipe	1200 LF	$45.00	$54,000.00
7. 2" Polyethylene Feeder	6800 LF	$5.00	$34,000.00
8. 2" Stainless Steel Feeder Pipe	1500 LF	$40.00	$60,000.00
9. Demolition	1 LF	$10,000.00	$10,000.00
10. Electrical	1 LS	$40,000.00	$40,000.00
11. Mobilization	1 LS	$75,000.00	$75,000.00
		Subtotal	**$1,186,200.00**
		10% Contingencies	**$118,600.00**
		Total	**$1,304,800.00**

4.4 Carrollton WTP G&L Basin Modifications

The review of the preliminary design for this project resulted in serious concerns about the project as proposed. The preliminary design indicated the addition of lime prior to these sedimentation basins and the retrofit of the basins with inclined tube settlers. It was strongly recommended that the lime addition point be moved, or the use of tube settlers be eliminated. Modeling of lime addition indicated the potential for calcium carbonate precipitation was high regardless of the lime addition point. The results of this review and lime addition modeling was documented in CDMs June 17, 1999 Memorandum to the S&WB as provided in **Appendix F**. Discussion of this memorandum with S&WB resulted in agreement that the lime addition point be moved to a location between the G & L Basins and the C Basins. It was agreed any calcium carbonate precipitation would be addressed within the C Basins through the periodic cleaning of solids.

Based upon this discussion, the conceptual design of a new lime addition location was developed and the June 17, 1999 Memorandum was revised to recommend the improvements and changes to be included in the final design of this project. This revision will be incorporated in a separate memorandum update to be provided to the S&WB shortly. As will be indicated within this memorandum, its is recommended the design proceed with this project according to the schedule provided in Section 9. The cost estimate for this project upon completion of the preliminary design phase is $12.1 million as shown in **Table 4.3**.

Table 4-3: Estimated Construction Cost
Carrollton WTP G&L Basin Improvements

Item	Unit	Quantity	Unit Cost	Cost
MOBILIZATION	Lump	1	$712,000.00	$712,000.00
BASIN DEMOLITION				$210,800.00
FOUNDATION PILES				$74,400.00
STRUCTURAL MODIFICATIONS				
NEW SLUDGE TROUGHS	CY	350	$350.00	$122,500.00
Scraper Leveling Slab G Basin	CY	400	$250.00	$100,000.00
Scraper Leveling Slab L Basin	CY	500	$250.00	$125,000.00
Concrete Walkways (Precast)	CY	190	$500.00	$95,000.00
Concrete Column Cost. W/Embeds for Al. Struct. Framing.	CY	375	$500.00	$187,000.00
Underflow Walls G & L Basin	CY	100	$500.00	$50,000.00
Scraper Drive Platform, G & L Basin	CY	150	$375.00	$56,250.00
New Concrete Walls in G-3 and G-4 (former baffle walls)	CY	263	$500.00	$131,500.00
Misc. Slabs, columns, walkways, etc.				$204,900.00
METALS AND FABRICATIONS				
Structural Aluminum	LB	125,000	$5.00	$625,000.00
Aluminum Handrails & Toe Boards	LF	5,300	$75.00	$397,500.00
Misc. Aluminum & Fiberglass	LB	500	$5.00	$26,050.00
Fiberglass Baffle Wall	SF	1,400	$32.00	$44,800.00
MECHANICAL PIPING				$408,450.00
EQUIPMENT				
Mixer Bronze Bearing Replacement	EACH	144	$400.00	$57,600.00
Tube Settlers	SF	70,300	$32.00	$2,249,600.00
G and L Basin Chain and Flight Collectors	EACH	14	$75,000.00	$1,050,000.00
G and L Basin Launder Troughs	LF	8,420	$300.00	$2,526,000.00
Static Mixers	EACH	4	$55,000.00	$220,000.00
G Basin Sludge Pump Replacement	EACH	3	$30,000.00	$90,000.00
ELECTRICAL	LUMP	1	$440,000.00	$440,000.00
			Subtotal	**$10,211,750.00**
			Contingencies 10%	**$1,021,000.00**
			Total For: Civil/Structural/Mechanical/Equipment/Electrical	**$11,232,750.00**
			Basic Engineering and Construction Administration Fee	**$893,400.00**
			TOTAL ESTIMATED PROJECT COST	**$12,126,150.00**

Shaded items indicate construction items that may be delayed.

Due to recent budgetary concerns the potential elimination scope reduction of this project has been raised by the S&WB. Upon review of recent data as provided in Section 7 of this report, it appears the Carrollton WTP ability to meet Stage 1 ESWTR turbidity limits of 0.3 NTU is marginal. Insufficient information about individual filter performance at the time of the report was available to indicate whether the plant was in compliance. Thus, there is a need for this project to meet current regulatory requirements. If the Stage 2 ESWTR requires turbidity limits of 0.10 NTU the degree of improvements required at the plant will be increased. In addition, the current reliability and performance of the G&L Basins remains questionable.

The effluent turbidity levels from the G&L Basins is fairly high with frequent spikes as indicated in Section 7 of this report. Even with the secondary settling provided by the C Basins, the loading and performance of the filters appear to be impacted by these spikes. The resultant deposition of solids in the C Basins also provides maintenance problems. The G&L Basins are out of service frequently due to maintenance problems. To eliminate current maintenance and performance problems it is recommended all the improvements to the G&L Basins be designed and constructed as indicated within the June 17, 1999 Memorandum. However, the construction of tube settlers, flight collectors, and launder troughs may be staged until a later date dependent on Stage 2 ESWTR requirements. As shown in Table 4.3, this would substantially reduce the initial costs of this project. As described in the June 17, 1999 Memorandum, without these improvements the capacity of the G&L Basins will be adequate for most flow conditions, up to 167 MGD. The degradation of performance at the current infrequent exceedance of 167 MGD, should still be buffered due to the C Basins. The initial improvements would reduce maintenance costs associated with the current needs to manually drain and clean each basin to remove accumulated sludge and maintain submerged equipment, improve water quality applied to filters improving the ability to maintain high filtered water quality, and allow staff to optimize coagulation and pH adjustment chemicals.

The use of high rate clarification within the existing G&L Basin may present an opportunity to achieve improved performance at or less than currently estimated construction costs. The use of this approach should be considered prior to finalizing the G&L Basin design. A memorandum on the performance of the high rate clarifiers will be issued detailing its potential applicability.

4.5 Carrollton WTP Filter Improvements Implementation Plan

Upon review of the Plant Performance Assessment, and Carrollton Water Treatment Plant Filter Improvements Implementation Plan (FIIP) a technical memorandum was issued on April 15, 1999 detailing the outcome of this review. This technical memorandum is provided as **Appendix F**. As discussed in this memorandum, CDM agreed with the majority of the FIIPs recommendations and recommended the initiation of preliminary design for this project. **Table 4.4** details the estimated construction cost for the filter improvements. However, upon discussion of CDM's April 15, 1999 technical memorandum the project team determined a large portion of the costs included within this cost estimate were for items the S&WB might not consider necessary for the project. The primary item was a HVAC system recommended to control the environment for the existing filter pipe gallery (at an estimated cost of $1.million). Initial discussions indicated the cost of such measures did not justify their need. At this time the preliminary design for this project is proceeding within HVAC improvements for the existing pipe gallery. The proposed implementation schedule for this project is provided in Section 9.

Table 4-4: Estimated Construction Cost
Carrollton WTP Sycamore Filters Improvements

Description	Costs
Filter Media Removal	$115,000.00
Underdrain Removal	$115,000.00
New Underdrains	$3,618,000.00
New Media	$719,000.00
Air Scour Facilities (including blowers)	$431,000.00
Blower Building	$90,000.00
New Filter Piping and Valves	$1,822,000.00
Backwash Pumps and Appurtenances	$322,000.00
Instrumentation and Controls	$794,000.00
Renovation of Support Facilities (allowance)	$1,000,000.00
Subtotal	$9,026,000.00
Construction Contingency @ 20%	$1,805,000.00
Construction Cost	$10,831,000.00
Engineering/CA/Inspection @ 15%	$1,625,000.00
TOTAL PROJECT COST	$12,456,000.00

Due to recent budgetary concerns the potential elimination or scope reduction of this project have been raised by the S&WB. Upon review of recent data as provided in Section 7 of this report, it appears the Carrollton WTP ability to meet Stage 1 ESWTR turbidity limits of 0.3 NTU is marginal. Thus, there is a need for this project to meet current regulatory requirements. In addition insufficient information about individual filter performance at the time of this report was available to indicate whether the plant was in compliance. The need for these improvements will increase if the Stage 2 ESWTR requires turbidity limits of/1.0 NTU. In addition, the current reliability and performance of the Sycamore Filters remain should be improved. Improvements to the Sycamore Filters are still strongly recommended to reduce maintenance costs and assure dependable operation. Prior to the Stage 2 ESWTR it is recommended that improvements proceed as proposed. However, the implementation may be phased by retrofitting several filters at a time to distribute capital expenditures over several years.

Section 5
Plant Evaluations - Process and Mechanical

5.1 Carrollton WTP

This evaluation examined the individual treatment processes, rapid mix, flocculation, sedimentation and filtration, at the Carrollton WTP. Each was examined to determine system adequacy and performance. Each of the following sections present a discussion regarding the existing processes and potential methods for process improvement. The rapid mix, flocculation, and sedimentation processes are each described separately for the G and L Basin systems. Discussion regarding the filtration operations examines the Sycamore and Claiborne Filters separately.

The G and L Basins are two different conventional treatment train systems that include mixing, flocculation, and sedimentation processes. Both sets of basins include two treatment paths with mirrored components. Therefore, the following discussions describe a single treatment path from each basin system. The evaluation of each process assumes a maximum flow rate of 240 MGD through the facility with the G and L Basins having hydraulic capacities of 160 MGD and 80 MGD, respectively. The capacities are based on a maximum flow rate previously treated at the Carrollton Facility.

5.1.1 Rapid Mixing

G Basins

Raw water enters the G Basins from a common raw water influent channel. This channel is supplied water from three connections. These connections include two 48-inch diameter pipelines and an 84-inch diameter connection served by a 54-inch diameter pipeline. Raw water enters a G Basin through a set of three (4 ft by 4 ft) sluice gates. The water then flows through four openings (4 ft by 4 ft), into four mixing basins. Currently, mechanical mixing equipment is not installed in any of these basins. Therefore, the mixing basins are not used for any chemical addition or mixing operations. A summary of the existing basin design criteria is presented below.

Mixing Basins	
Number of Basins	Eight (Four/Treatment Train)
Dimensions	20′ W x 120′ L x 18′ D
Volume	1,510 cf
Theoretical Hyd. Residence Time*	49 sec/basin

*At hydraulic capacity flow rate of 160 MGD

The incorporation of efficient and proven mixing methods will enhance flocculation and coagulation. One such method is mechanical mixing utilizing vertical-turbine mixers. Given the existing structural design of the mixing basins, vertical-turbine mixers can be installed. These mixers have been proven effective and are common to numerous water treatment facilities. The primary design variables examined prior to design of a flash mixing basin are the hydraulic residence time (HRT) and the mixing or velocity gradient (G). At a maximum flow rate of 80 MGD per treatment train, the hydraulic residence time (HRT) of each mixing basin is approximately 49 seconds. This HRT is in excess of typical design criteria for mechanical flash mixing systems. Therefore, implementation of vertical-turbine mixers would not require use of all four basins. The use of two mixing basins yields a HRT of approximately 25 seconds per basin at a maximum flow rate of 80 MGD/basin. The velocity gradient is determined based upon the power of the mixing unit, volume of the basin, and the viscosity of the mixed fluid. In this case, power is the primary factor for mixer selection. Vertical turbine mixers should be sized to yield a G value ranging from 300 to 500 sec^{1}.

Installation of two mixing units would require minimal modifications to the existing system. The mixing basins were originally designed for use with similar rapid mixers and can be fitted to accommodate vertical-turbine units. In addition to mixer installation, this modification would require reconfiguration of the chemical feed lines. The ferric sulfate application point should be placed in close proximity to the upstream side of the mixers. Also, the inlets to the mixing basins should be retrofitted with sluice gates or stop planks so that each mixing basin can be isolated and taken out of service.

Currently, lime is not added to the G Basins. If future use of lime in the G Basins is to be considered, the vertical-turbine mixers and chemical application piping should be designed accordingly. This will allow for possible lime application prior to the flocculation process. The existing method for lime addition is addressed further in Section 3.3.

L Basins

A single 48-inch diameter pipeline supplies raw water to each L Basin. The influent passage into each basin is an eight-foot wide channel. Downstream of the influent channel, the raw water flows over an inlet weir and splits between either of two flocculation basins. No form of mechanical or hydraulic mixing is employed in conjunction with the L Basins.

As with the G Basins, incorporating an efficient and proven mixing method will enhance the flocculation and coagulation process. Given the existing structural design, installation of a mechanical mixing alternative is not plausible. Therefore, alternative forms of mixing must be considered. A primary option is the installation of a static mixer. Static mixers effectively disperse chemicals and require minimum maintenance. The selection of a static mixer requires that minimum flow velocities be maintained while headloss due to turbulence is limited. Typically, a flow velocity in excess of 1.5 ft/sec is required for effective use of a static mixer. The 48-inch diameter influent piping into the L Basins creates flow velocities in excess of 1.5 ft/sec at a flow rate greater than 12 MGD. Therefore, a static mixer of the same diameter as the influent piping may be sufficient. However, the headlosses and lay length associated with a static mixer of this diameter should be considered prior to design.

Installation of a static mixer would include modification and or reconfiguration of the chemical feed lines. Static mixers can be fitted with multiple chemical injection ports; however, chemical characteristics should be considered prior to injection. For example, lime should not be injected into a static mixer system. The potential exists for extensive calcium carbonate precipitation on the mixing elements. This will eventually reduce mixer efficiency. Other chemicals such as ferric sulfate, polymer, or disinfection chemicals would not adversely affect the performance of the mixer. However, the compatibility of any injected chemical and the material of mixer construction must be considered.

5.1.2 Flocculation

G Basins

Following ferric addition, water enters the flocculation basins. Each flocculation basin is a single train with two rows of flocculators positioned parallel to the water flow. Both rows are paddle-type flocculators mounted on horizontal drive shafts. The motors are constant speed and connected to the flocculator shafts by a drive chain. The general design data of each basin is summarized below:

Flocculation Basin	
Number of Basins	Two
Dimensions	32′ W x 480′ L x 17′-6″ D
Volume	268,800 cf
Theoretical Hyd Residence Time*	36 min
Flocculation Equipment	
Flocculator Type	Paddle
Number of Flocculators	2 rows, 35 mixers per row
Drive Type	Constant speed

*At hydraulic capacity flow rate of 160 MGD

As with rapid mixing, a primary design variable for flocculation processes is the mixing gradient (G). The mixing gradient is dependent on the speed of the mixer and the viscosity of the mixed solution (temperature dependent). Mixer speed is the only variable that can be easily controlled. The existing constant speed motors used with the G Basins do not allow for such speed variation. The inability to manipulate mixer speed may inhibit optimization of the flocculation process.

The flocculation process can be enhanced by implementing alternative flocculation methods such as tapered flocculation. Tapered flocculation is the reduction of mixing speed as the water progresses through the process. As particles agglomerate during the slow mixing process, floc size and settling efficiency increases. Therefore, it is advantageous to have a gentle mixing as the flocs near the end of the mixing basin. Variable speed drives can facilitate this process. The ability to manipulate the mixer speed allows the operator to increase mixing efficiency and enhance the flocculation process.

The existing flocculation basins require improvements to enhance performance. The wall separating the flocculation channel from the sedimentation basins needs modification in some areas. During the site visit, it was noted that the wall integrity was questionable and failing in several locations. Following an inspection, reconstruction of the damaged walls is recommended to prevent short-circuiting of water between the flocculation and the sedimentation basins.

L Basins

Following lime and ferric addition, water enters the flocculation basins. Each flocculation basin is divided into two parallel trains with ten rows of flocculators positioned perpendicular to the water flow. The individual rows include three, paddle-type flocculators mounted on a horizontal drive shaft. A single motor located between the two parallel basins operates two adjacent drive shafts. The general design data of each basin is summarized below:

Flocculation Basin	
Number of Basins	Four
Dimensions	32′ W x 150′ L x 17′-6″ D
Volume	84,000 cf
Theoretical Hyd Residence Time*	45 min
Flocculation Equipment	
Flocculator Type	Paddle (4 paddles per mixer)
Number of Flocculators	10 rows, 3 mixers per row
Drive Type	Constant speed

*At hydraulic capacity flow rate of 80 MGD

The L Basin flocculators are driven by constant speed motors. Therefore, manipulation of the flocculation process is limited. This may inhibit optimization of the flocculation and coagulation process. Incorporation of tapered flocculation, as described previously, can enhance the existing flocculation process.

5.1.3 Sedimentation

The following paragraphs outline the existing design characteristics of the G&L sedimentation basins. The discussion also summarizes potential modifications to be presented in revision of the preliminary design review provided in **Appendix E**.

G Basins

The sedimentation portion of the G treatment train are identified as the G-3 and G-4 basins. Flocculated water flows from the flocculation basins, around a sharp cornered turning area, through directional butterfly gates, and into the G-3 and G-4 basins. Approximate general design data for each settling basin is summarized below:

<u>Sedimentation Basins</u>	
Number of Basins	Two
Basin Volume	938,875 cf (G-3) 970,200 cf (G-4)
Average Depth	17.5 ft
Surface Overflow Rate*	1,490 gpd/sf (G-3) 1,440 gpd/sf (G-4)
Theoretical Detention Time*	126 min (G-3) 130 min (G-4)
Horizontal Velocity*	4.0 ft/min
Weir Loading Rate*	120 gpm/ft

*At hydraulic capacity flow rate of 160 MGD

The recommended range for the surface overflow rate (SOR) of a conventional settling basin is 700 to 1,000 gpd/sf with a typical value of approximately 850 gpd/sf. A SOR of 1,000 gpd/sf gives a maximum combined treatment capacity for the G-3 and G-4 basins of approximately 109 MGD. At the previously mentioned hydraulic capacity, the existing design configuration of the G 3 and G 4 basins yields SORs in excess of 1,440 gpd/sf. These SORs combined with the existing outlet configuration inhibit the sedimentation process.

The effectiveness of the outlet launder configuration in each of the G-3 and G-4 basins is questionable. The existing launders extend from the overflow weir wall to a point approximately 185 feet upstream in the basins. Effluent is collected over the entire length of the launders. The use of launders positioned parallel to the direction of flow reduces the effective settling area of the basins. In effect, the surface area of the G-3 and G-4 basins from the overflow weir wall to the upstream end of the launders can be considered inefficient for settling.

Performance of the G Basins can be enhanced through design modifications. Two potential alternatives are the replacement of the existing overflow launders with a ported outlet baffle wall or the installation of tube settlers. A baffle wall would improve basin hydraulics and may enhance basin performance. Also, installation of a ported baffle wall would eliminate concern regarding the existing weir loading rate. Typically, design weir loading rates range from 12 – 18 gpm/sf. The G-3 and G-4 basins each have a weir length of approximately 460 feet. At a flow rate of 80 MGD per basin, this equates to a loading rate of 120 gpm/ft. Alternatively, the installation of tube settlers would increase the capacity of each basin and enhance the sedimentation process. Tube settlers increase the effective settling area of sedimentation system. Typical design SORs for tube settlers range from 2,880 gpd/sf to

4,300 gpd/sf. At these SORs and assuming two-thirds of each G Basin covered by tubes, the combined capacity of the G 3 and G 4 basins would increase to between 206 to 307 MGD. This would allow for operational flexibility in the instance that a basin was taken out-of-service. Tube settlers would require installation of launder troughs evenly spaced between the tube settler modules.

The inlet butterfly gates of the G Basins are largely inoperable due to calcification and corrosion. The gates are positioned at various angles with some completely open and others completely closed. Therefore, influent flow is preferentially channeled through the open gates. This was observed to result in an uneven flow distribution into the basins. The preferential flow patterns also contribute to the reduction of the effective settling area of each basin by the formation of dead spots. Modification of both basin inlets is needed to properly distribute flow across the basins. Installation of ported baffle walls similar to that identified for the basin outlets would improve inlet conditions.

The existing sludge collection equipment in each G Basin is a mono-rake. The mono-rakes move along a rail system scraping sludge to collection sumps. The rake mechanisms do not contact the bottom of the basins and therefore a layer of sludge deposits in the basins. This sludge must be periodically removed. Currently, the G basins are operated with one off-line. This enables plant staff to periodically remove the deposited sludge. An alternative that has been proposed is the installation of chain-and-flight sludge collectors. A single chain-and-flight sludge collector includes two drive chains, supporting drive sprockets, and multiple horizontal scraping beams. The length of the G Basins restricts application of the chain-and-flight. Therefore, these collectors may be installed over a portion of the basin length. The incorporation of chain-and-flight collectors requires level basin floors for efficient cleaning. Therefore, the existing floors in the G Basins would need to be leveled prior to installation.

L Basins

The sedimentation portion of the L treatment train are identified as the L-3 and L-4 basins. Flocculated water enters each sedimentation basin through a fiberglass, ported baffle wall. Approximate general design data for each settling basin is summarized below:

Sedimentation Basins	
Number of Basins	Two (L 3 & 4)
Basin Volume	402,000 cf
Average Depth	14 ft
Surface Overflow Rate*	1,390 gpd/sf
Theoretical Detention Time*	108 min
Horizontal Velocity*	3.8 ft/min
Weir Loading Rate*	43 gpm/ft

*At hydraulic capacity flow rate of 80 MGD

Assuming a SOR of 1,000 gpd/sf, the combined treatment capacity of L-3 and L-4 is approximately 57.4 MGD. At a flow rate of 40 MGD/basin, the SOR of L-3 and L-4 is approximately 1,390 gpd/sf. This overflow rate combined with the existing outlet configuration inhibits the sedimentation process. The weir loading rates of the L-3 and L-4 basins is not excessive, but should be reduced to enhance sedimentation. Each basin has approximately 650 linear feet of overflow troughs, and at a flow rate of 40 MGD per basin, this equates to a weir loading rate of 43 gpm/sf.

The existing design of the L Basins can be modified to increase efficiency and accommodate increased flow rates. Potential modifications include removal of the outlet launders and replacement with a ported baffle wall or installation of tube settlers. As described previously, the use of launders parallel to the direction of flow may reduce the effective surface area of a basin. Therefore, replacement of the existing launders with a ported baffle wall can enhance basin efficiency, and allow for operation at higher SORs. Alternatively, the installation of tube settlers would increase the effective settling area of the basins. Tube settlers would incorporate a launder trough configuration similar to the existing structures. Assuming two-thirds of L-3 and L-4 were covered with tubes, the combined capacity of the L Basins would range from 110 MGD to 165 MGD.

Similar to the G-3 and G-4 basins, the existing sludge collection equipment in each L Basin a mono-rake. Currently, the L-3 and L-4 basins are operated with one basin off-line. This enables plant staff to periodically remove the deposited sludge. Chain-and-flight collectors have been proposed for the L-Basins. Similar to the G-3 and G-4 basins, the length of the L basins is in excess of standard chain-and-flight lengths. Therefore, these may be installed over a portion of the basin length. The incorporation of chain-and-flight collectors requires level floors for efficient cleaning. Therefore, the existing floors in the L Basins would need to be leveled prior to installation.

5.1.4 Filtration

The filtration system at the Carrollton WTP has been constructed and modified in several phases. It is composed of two separate filter systems as identified below:

- Sycamore Filters - Twenty-eight (28) dual-media filters
- Claiborne Filters - Eight (8) dual-media-filters

Previous memoranda and preliminary design documents have outlined inefficiencies of the existing filters and needs for improvements. The primary summary of these documents is the "Review of the Carrollton Water Treatment Plant Filter Improvements Implementation Plan (FIIP)" (CDM, 1999) provided as **Appendix F**. This document should be referred to regarding all recommended filter improvements and proposed modifications. The following sections summary provide a description of the existing filtration system and outlines recommendations presented and reviewed in the FIIP.

A. *Claiborne Filters*

The Claiborne filter bank, built in 1950, is a dual-cell, constant-rate design composed of eight filters or 16 cells. Each filter is separated into two cells by a center gullet. The gullet distributes settled water to the filters and during cleaning removes backwash water. Each filter cell is 24' 3" wide by 108' long. These dimensions yield a surface area of 5,240 ft^2 per filter or 41,920 ft^2 combined. Further characteristics of the existing media is provided in **Appendix F**. The filters are operated at loading rates up to 2.2 gpm/sf. The filtration rate of the Claiborne Filters is controlled by the wet-well water level. This rate fluctuates throughout the operational day.

Overall, the Claiborne Filters were determined to be in good operating condition, and capable of meeting present and future regulatory requirements. This determination was made dependent on routine maintenance and periodic, as-needed upgrades. The following list is an outline of improvements and modifications recommended in the FIIP.

- Replacement of existing filter valve operators with electric actuators as needed.
- Continuation of current media replacement program.
- Installation of a new rate-of-flow controller for the backwash pump.
- Completion of trubidimeter and data logger installation.

B. *Sycamore Filters*

The Sycamore filter gallery includes 28 dual-media, constant rate filters. As with the Claiborne gallery, a center gullet divides each filter into two equally sized cells. The center gullet provides for distribution of settled water and removal of backwash water. Filters 1-10 were installed in 1906. This was followed by the addition of filters 11-28 in 1932. Each filter cell is 13' 6" wide by 53' in length. This equates to a filtration area of 1,432 square feet per filter, or combined, 40,096 square feet. The Sycamore Filters are operated at loading rates up to 2.2 gpm/sf. However, due to hydraulic limitations, Sycamore filters 1-10 operate at lower loading rates. Further characteristics of the existing media is provided in **Appendix F**. Plant operators manually set the Sycamore effluent filter rate by adjusting the effluent control valve. The differential measured across this valve is used to monitor flow rate.

The Sycamore filters were determined to possess several deficiencies. The following list is an outline of improvements and modifications recommended in the FIIP.

- Determination to be made regarding removal of Filters 1-10 from service.
- Replacement of all piping with ductile iron or steel pipe.
- Installation of new electric, motor-operated (possibly pneumatic operators) butterfly valves.
- New PLC to regulate valve operation.
- Replacement of all underdrains and gravel with low-profile underdrains and integrated media cap. Inclusion of air scour system.

- Installation of two, new backwash pumps with new rate-of-flow controllers and motor-operated butterfly valves.
- Installation of filter-to-waste connections.
- Installation of electronic controls and monitoring equipment.
  - PLC for automatic control of operation.
  - Turbidimeters, elapsed time meters, and head loss indicators for monitoring.
  - Manual/automatic control switches for manual operator control.
  - Local/remote and open/close push-buttons for testing and operation.

5.1.5 Chemical Storage and Feed

The Carrollton WTP system is equipped to apply nine different chemicals for water treatment, which include the following:

- Powdered Activated Carbon
- Ferric Sulfate
- Polymer (Cationic)
- Lime (L-3 and L-4 Only)
- Chlorine
- Ammonia
- Fluoride
- Phosphate

Each chemical system was examined to determine the adequacy of the on-site storage capacity and chemical feed system. Storage volume is a primary concern. A minimum of 30-days on-site storage is dictated by regulatory requirements unless the chemical is readily available. All chemicals, except PAC, are added in conjunction with the specific treatment processes identified in Section 2.0. Lime is applied only to raw water entering the L-3 and L-4 basins. Each chemical application system is summarized in the following sections. **During plant interviews average or typical dosages of all chemicals were requested, however, only dosage ranges were provided. Average dosages were estimated to calculate storage quantities required.**

A. Powdered Activated Carbon

The primary use of powdered activated carbon (PAC) is for taste and odor control. Tastes and odors are typically caused by algae and other naturally occurring organic compounds. Activated carbon adsorbs many organic taste and odor compounds from the raw water. Following adsorption, the activated carbon can either be settled or filtered from the process flow.

Aside from taste and odor concerns, the Sewerage and Water Board uses PAC to address chemical spills into the Mississippi River. Typically, a harmful chemical spill includes organic compounds that PAC can adsorb. PAC can be used as a precautionary measure to prevent potentially harmful organics from entering the treatment system. If required, (PAC) may be periodically applied to the raw water prior to treatment.

A preliminary design review (**Appendix D**) has been performed for relocation of the existing PAC addition system to the river intakes. It was proposed to utilize the existing potassium permanganate system located at the Industrial Avenue Pump Station for PAC application. The reader should refer to the (**Appendix D**) regarding potential modifications. Components of the existing PAC system utilized for the Carrollton facility are summarized below.

<u>Existing PAC System</u>	
Storage Tank	One
Capacity	5,000 gallons
Feed Pumps	Two, Waukesha-Burrell (One Hp)
Dose	< 8.0 mg/L

The PAC is combined with water at a ratio of 1.0 lb/gallon to from a slurry. The typical application rate of the PAC is less than 8.0 mg/L. The PAC is added to the raw water prior to the inlets to the G and L-Basins. Since, PAC is used on an intermittent and inconsistent basis, storage and pump capacity was not determined.

B. Ferric Sulfate

Ferric sulfate (ferric) is the primary coagulant used at the Carrollton WTP. The ferric system includes two 8,000-gallon bulk storage tanks, and five metering pumps. Ferric is applied at the influents of the G and L treatment trains. A summary of the existing ferric feed system is summarized below.

Ferric Sulfate System	
Type of Storage	Cross-linked Polyethylene Bulk Storage Tank (2)
Capacity	8,000 gallons (Bulk)
Number of Feed Pumps	Four
Type/Capacity	LMI @ 106 gph (2) LMI @ 53 gph (1) Waukesha-Burrell @ 150 gph (1)
Dose	10 to 30 mg/L

Calculations were performed to determine if the existing storage capacity is sufficient for the current dosages. Assuming a maximum flow of 240 MGD and an equivalent dose of 20 mg/L in all basins, the existing 16,000-gallons of bulk storage gives two and one-half days storage. However, at the current operating conditions (one G and one L basin on-line) with a flow of 120 MGD, approximately five days of storage is available. If the ferric dose is reduced to 10 mg/L, there is sufficient storage for 10 days. If production rates are anticipated to increase, the installation of additional storage will be required.

Three new pumps were recently installed for ferric application. These units, in combination with the older units, provide adequate capacity to meet maximum daily demands.

No flow pacing or automatic adjustment of ferric sulfate feed based upon water quality is provided for this system. Automation of this system based upon flow and water quality could result in significant chemical savings. In addition, optimization of ferric sulfate dosing should be performed to assure enhanced coagulation requirements are met.

C. Polymer

Cationic polymer is added to the raw water upstream of the WTP. Polymer addition enhances floc coagulation and produces settleable flocs by particle destabilization. The cationic polymer is supplied in solution form to the Carrollton WTP. The feed system includes the following equipment:

Polymer Feed System	
Type of Storage	(2) Bulk storage
Storage Volume	3,000 & 1,500-gallon
Number of Pumps	Three (One as backup)
Feed Pump Capacity	10 gph (each)
Dose	0.5 to 3.0 mg/L

Polymer can be fed to either the raw water entering the G or L basins. Therefore, to determine the required storage capacity and pump requirements it is assumed that polymer is fed to both basin systems. Assuming a dosage of 3.0 mg/L and a maximum flow rate of 240 MGD, the existing 4,500-gallon capacity provides approximately six days of storage. The polymer application demand at these conditions is approximately 700 gal/day. Therefore, all three of the existing pumps must be operated to meet this demand. Additional metering pumps would be required if the polymer addition were to include all of the supplied raw water.

At current operating conditions (assume 120 MGD and 1.5 mg/L polymer dose), the existing system provides 25 days of storage. Also, the metering pumps need to supply only 175 gal/day of polymer to the treatment system. Therefore, the existing system is sufficient for operation at these conditions.

No flow pacing or automatic adjustment of polymer feed based upon water quality is provided for this system. Automation of this system based upon flow and water quality could result in significant chemical savings. In addition, optimization of polymer dosing should be performed to assure enhanced coagulation requirements are met.

D. Lime

Lime feed is employed at the Carrollton WTP to adjust the pH and to reduce the raw water hardness. Currently, lime is only added to the L Basins. The lime storage and feed system is summarized below:

<u>Lime Slakers</u>	
Number	Three (Wallace & Tiernen)
Type	Weighbelt feeder w/ grit removal
Capacity	4,000 lb/hr (each)
<u>Lime Pumps</u>	
Number	Five
Type	Horizontal
Capacity	100 gal/min (each)
Dose	55 mg/L

Quicklime is fed from the day bins to the slakers. The slaked lime slurry is gravity fed to a holding tank. The hydrated lime is then pumped from the holding tank to the L Basins for application. The lime is fed at a rate of 55 mg/L.

Assuming a constant application rate of 55 mg/L and a maximum flow rate of 80 MGD through the L Basins, the maximum daily demand of lime is approximately 36,700 pounds (lb). The three existing slakers provide adequate capacity to meet this maximum day demand. The five horizontal pumps available for lime feed provide sufficient capacity. At maximum capacities of 100 gpm, there is a total pumping capacity of 30,000 gph. Assuming a lime slurry with 3.0 lb lime/gallon solution, the pump system will need to provide approximately 12,250 gallons of lime slurry/day based on the assumed dosage and raw water flow rate.

CDM proposes to move the lime application system to a point down-stream of the L Basins located in the C Basin influent channel. Therefore, the capacity of the lime system must be examined with regard to a total flow rate of 240 MGD. Assuming the same dose of 55 mg/L, the maximum day demand would be approximately 110,000 pounds per day (ppd) of dry lime. The existing slakers are each capable of providing a total capacity of 96,000 ppd of dry lime. Therefore, no additional slaker capacity would be required. Again assuming a lime slurry with 3.0 lb lime/gal solution, the required pumping capacity must be in excess of 36,000 gal slurry/day. The existing pumps are capable of meeting this demand.

Presently, a new lime handling system is under design. The current lime handling system is a combination of belt, screw, and bucket conveyors. The new system will utilize pneumatic transfer systems for lime handling. This modification will facilitate the transfer of dry lime from transport to the storage containers.

No flow pacing or automatic adjustment of lime feed based upon water quality is provided for this system. Automation of this system based upon flow and water quality could result in significant chemical savings.

E. Chlorine

The chlorine system, in combination with the ammonia feed provides, provides the primary disinfection at the Carrollton WTP. Following sedimentation, waters from the G and L Basins are combined into a single channel which feeds the C Basin influent passage. Chlorine is applied at a single location in the G and L Basin effluent channel.

The existing chlorine feed system includes two 4,000 ppd (approximately) evaporators, two 55-ton railcars, and three remote injection points. The average chlorine dose is approximately 1.9 mg/L. A summary of the existing chlorine system is given below.

<u>Chlorine System</u>	
Type of Storage	Railcar tankers
Capacity	55-ton/tanker
Number On-Site	Two tankers
Number of Evaporators	Two
Type	Direct-feed
Capacity	4,000-ppd (total)
Dose	1.9 mg/L

Based on a flow of 240 MGD and a 1.9-mg/L dose, 3,800 ppd of chlorine must be supplied. Based on conversations with plant staff, the existing evaporators can supply approximately 4,000 ppd of chlorine. Therefore, the existing units are sufficient for the current requirements. The S&WB maintains two 55-ton, chlorine railcar tankers on-site. Based on current feed rates, a total dosage of 1.9 mg/L, a max flow rate of 240 MGD, and two 55-ton railcars on-site, the S&WB has in excess of 57 days storage.

The operators at the Carrollton facility manually control the chlorine feed based on the influent flow signal. The rotameters are adjusted based on the influent flow signal to produce the desired chloramine residual. Grab samples are manually taken every hour to determine residual concentrations. Automation of the chlorine feed system would facilitate chemical application and increase efficiency. Automation should be based upon residual chlorine measurement.

CDM completed the Risk Management Program for the Carrollton WTP in July, 1999. As a part of this program CDM provided a Hazard Review of the existing chlorination facilities and provided operational and capital improvement recommendations to further assure safe operation of the system. The major capital improvement recommendations were to construct a sheltered area with monorail for the one-ton container storage area and to consider enclosure and emergency scrubber systems for the rail car chlorination system. In addition, operational and capital costs to convert the rail car and one ton container chlorine system to a sodium hypochlorite system should be further evaluated and weighed against the risk of operating a chlorine gas system provided with a container structure and emergency scrubber system.

F. *Ammonia*

The ammonia system at the Carrollton WTP operates in conjunction with the chlorine system provide chloramination of the settled water. Chloramination is not as strong a disinfectant as free chlorine and therefore, longer contact times and/or higher doses are required. However, the use of chloramines reduces the formation of chlorinated disinfection byproducts and provides a more persistent residual than chlorine for the distribution system.

Ammonia can be applied at three locations in the C Basin influent passage. The ammonia system includes a single, direct feed ammoniator (additional under construction), a 10,000-gallon storage tank, and three remote injection points. The average dose of ammonia is 1.0 mg/L. A summary of the existing system is given below.

<u>Ammonia System</u>	
Type of Storage	Fixed Steel, Pressure Tank
Capacity	10,000 gallons
Number On-Site	One
Number of Ammoniators	One (additional under construction)
Type	Direct Feed
Capacity	3,000-ppd
Dose	1.0 mg/L

No operational problems with the existing ammonia feed system have been identified. Three existing ammoniators are to be removed and replaced by an additional 3,000-ppd ammonia feed unit. The existing and proposed 3,000-ppd units are custom made and include a pressure reducing valve and a flow meter. The typical application ratio of ammonia to chlorine during chloramination ranges from 1:3 to 1:5. The current dosage rate employed at the Carrollton WTP was calculated to be approximately one to two. Therefore, excess ammonia is present in the system. It is recommended that ammonia dosing be controlled through chlorine residual readings with a recommended chlorine to ammonia ratio of 5:1.

The existing 3,000-ppd feed unit is capable of meeting daily demands at a flow rate of 240 MGD and dose of 1.0 mg/L. However, additional equipment is needed to provide redundancy in case of equipment failure. The construction of the additional 3,000-ppd unit will guarantee ammonia feed capabilities.

The existing on-site ammonia storage capacity includes a 10,000-gallon steel, pressure tank. Calculations indicate that at a dosage of 1.0 mg/L, the S&WB has in excess of 25 days storage capacity.

The Risk Management Program for the Carrollton WTP was completed by CDM in July, 1999. As a part of this program CDM provided a Hazard Review of the existing ammonia facilities and provided operational and capital improvement recommendations to further assure safe operation of the system. The major capital improvement recommendations were to conduct a feasibility study for enclosing the ammonia facilities and providing emergency scrubber systems for the ammonia system.

G. Fluoride

Fluoride is commonly added to water treatment processes for dental health reasons. The recommended dose for fluoride concentration in potable water ranges from 0.8 mg/Lto 1.2 mg/L. The recommended dose is inversely proportional to the water temperature; higher temperatures require a lower dose and vice versa.

Hydrofluosilicic acid (fluoride) is added to the process water prior to filtration in the C Basin effluent channel. On-site storage consists of a 12,000-gallon bulk storage tank. Three metering pumps are fed from the bulk storage tank. The fluoride feed system is summarized below.

Fluoride Feed System	
Type of Storage	Double-wall Tank
Storage Volume	12,000 gallons
Number of Feed Pump	Three
Feed Pump Capacity	(1) 18 gph (2) 26 gph
Dose	0.75 to 0.8 mg/L

Fluoride is not vital to the treatment process; however, the feed system should have the capacity to meet production demands. Assuming a flow rate of 240 MGD and an application rate of 0.8 mg/L, the 12,000-gallon storage tank provides in excess of 75 days storage capacity. Under these same conditions, the feed pumps must be able to supply approximately 160 gal/day. The existing pumps can easily meet this demand.

No flow pacing or automatic adjustment of fluoride feed system is provided. Automation of this system based upon flow could result in significant chemical savings.

H. Sodium Hexametaphosphate

Sodium hexametaphosphate (SHMP) is added to the treatment process following the C Basins. SHMP is a common additive at WTPs and serves as a sequestering agent. Sequestering agents inhibit the formation of metal precipitation. The addition of SHMP inhibits the precipitation of calcium carbonates and hydroxides following lime addition. This reduces effect of calcification on the filter media. The SHMP application system at the Carrollton WTP includes a bulk mixing tank and one Milton Roy metering pump. The

SHMP feed system is controlled by a magnetic flow meter. A summary of the existing system is as follows.

SHMP Feed System	
Type of Storage	Mixing Tank
Storage Capacity	4,000 gal (new 6,000 gal designed)
Feed Method	Metering Pumps
Number of Pumps	One (to be replaced with two new pumps)
Dose	0.5 to 1.5 mg/L

As identified above, the existing 4,000-gallon tank is to be replaced by a 6,000-gallon structure and the single metering pump by two new pumps. This new equipment will facilitate the addition of the SHMP prior to filtration. Assuming a flow rate of 240 MGD and a dose of 1.5 mg/L, 3,000 ppd of SHMP will be required. Alternatively, at a dose of 0.5 mg/L and 240 MGD of flow, 1,000 ppd is required. Storage must be available to house sufficient chemical to meet current and future production rates. A 36 percent solution equates to 4.69 lb dry SHMP/gal water. Therefore, with a demand of 1,000 ppd of SHMP, 4,700 gallons of water is required. The mixing tank should be sized to handle the combined volume of 4,700 gallons of water and 1,000 lb of dry SHMP.

No flow pacing or automatic adjustment of polyphosphate feed is provided for this system. Automation of this system based upon flow could result in significant chemical savings.

5.1.6 Filter Backwash Recycle

The Filter Backwash Recycle Basin at the Carrollton Water Treatment Plant is utilized as a holding basin prior to pumping the filter backwash to the G&L basins, or the river. This basin is approximately 105 feet in diameter and 17.5 feet deep. The backwash is pumped via four vertical turbine pumps in parallel. Two 75-hp and two 150-hp motors drive the four pumps. When the backwash is pumped to the G&L basins, it is pumped through a 24-inch force main. When the backwash is pumped to the river, only one of the smaller pumps is utilized. Currently, pumping backwash to the river can only be accomplished via the 20-inch mud line. The system curves for all three current conditions are in illustrated in figures 5.1, 5.2, and 5.3. Table 5.2 below summarizes the current conditions. These figures represent a 15% factor of safety for system aging.

Table-5.1: Current Recycle Backwash Pumping Conditions
Carrollton WTP

Receiving Basin	Average Flow (MGD)
L Basin	15.4
G Basin	15.2
River	4.9

Backwashing at the Claiborne filters requires 375,000 gallons per filter and 210,000 gallons per filter at the Sycamore filters. From S&MB records, it was determine that the average rate of filter backwash is three filters per day. This represents a peak loading of approximately 13.5 MGD. As indicated by pumps curves provided in **Appendix G**, current pump configuration for pumping to the G&L basins is appropriate for peak loading. Whereas pumping to the river can only be achieved at a maximum rate of 4.9 MGD. This is less than the peak filter backwash rate required for adequate drainage of the filter backwash basin.

As indicated in Section 7 of this report the anticipated Filter Backwash Rule will likely allow, discharge of backwash to the headworks of the plant. Thus, the current discharge point prior to the G&L Basins will remain adequate. The need to relocate the discharge to the Mississippi River to provide further protection of the water supply should be discussed with the S&WB staff. The cost of relocating the discharge to the Mississippi River was previously estimated as $1,575,000 by Malcolm Pirnie. The details of this project were not determined, however, based upon initial investigation by CDM replacing of the existing backwash pumps and installation of approximately 5,000 of 36 inch diameter pipe to the Mississippi River may be required.

5.1.7 Sludge Handling

The sludge handling systems at the Carrollton WTP were reviewed primarily to assess the need to eliminate the current practice of discharging sludge to the Mississippi River. Review of current EPA regulations and contact with the Louisiana Department of Environmental Quality (LDEQ), did not reveal any current or pending regulations which would prevent the current practice of discharging sludge to the Mississippi River. The discharge at the Mississippi River is currently permitted with LDEQ. The permit requires monitoring and reporting only for TSS and flows. Thus, no violations of this permit have occurred. Based upon review of current regulations the need to alter the current sludge handling practice is not necessary at this time.

5.2 Algiers WTP

This evaluation examined the individual treatment processes at the Algiers WTP. These unit processes include the flocculation/sedimentation and filtration systems. These systems were examined to determine system adequacy and performance. Each of the following sections is a discussion regarding the existing processes and potential methods for process improvement.

5.2.1 Flocculation/Sedimentation

As stated previously, the Algiers WTP incorporates four Eimco HRC Upflow Clarification units. These are configured such that raw water flows separately to No. 1 and No. 2 and also to No. 3 and No. 4. The raw water inlet pipeline is split at a location between Units No. 1 and No. 2 next to the chemical building. From this location raw water is transported to Units

No. 1 and 2 and to No. 3 and 4. Raw water then enters the centerwell of each unit where lime and polymer are added and mixed using a rotor-impeller type mixer. The raw water flows up through the mixing unit and exits the centerwell and into an area surrounded by a conical skirt. Within the conical skirt, excess settled solids are mixed with the raw water to enhance flocculation. The water then flows down and out from under the skirt into the clarification zone. The settled water exits the clarification zone through radial, ported, outlet launders. Settled sludge is deposited in the base of the unit and either discharged or recycled to the centerwell. Design and operational characteristics of the Eimco Unit are summarized below.

Upflow Clarification

Number of Units	Two (No. 1 & No. 2)
Dimensions	85 ft O.D. w/ 32 ft I.D.
Depth	16 ft
Effective Settling Surface Area	4,870 sf
Surface Overflow Rate*	1,640 gpd/sf (1.1 gpm/sf)
Outlet Type	(No. 2) Radial, Launder (No. 1) Perimeter, Launder

* At design flow rate of 8 MGD

Number of Units	Two (No. 3 & No. 4)
Dimensions	92 ft square w/ 32 ft I.D.
Depth	18 ft
Effective Settling Surface Area	7,660 sf
Surface Overflow Rate**	1,567 gpd/sf(1.1 gpm/sf)
Outlet Type	Radial, Launders

** At design flow rate of 12 MGD

Currently, the Algiers WTP is operating using only Units No. 2, 3, and 4. This yields a maximum treatment capacity of approximately 32 MGD. Unit No. 1 is out-of-service and requires minor rehabilitation to insure proper operation. Existing water demands do not require that the facility operate at or near the rated treatment capacity. However, it is advantageous to complete the rehabilitation of Unit No. 1. This will allow operational flexibility and ease the burden on the remaining units during high demand periods. Based on conversations with Algiers staff, other than the Unit No. 1 rehabilitation, no operational difficulties exist that require immediate attention.

5.2.2 Filtration

The existing filtration system at the Algiers WTP was constructed in two phases:

- Filters No. 1 - No. 8 in 1972 (approx. 827sf/filter)
- Filters No. 9 - No. 20 in 1994 (approx. 743 sf/filter)

The basic operational and design premises for both sets of filters are the same, but minor variations exist. All filters are a dual-media (sand/anthracite) design laid upon a supporting gravel layer, but the thickness of each layer varies. Filter operation is controlled using a venturi flowmeter and a throttling valve. However, Filters No. 1 – 8 are manually controlled and Filters No. 9 – 20 are automatically controlled. Also, the underdrain design and backwash operations vary between the two filter galleries.

The two filtration systems are interconnected by three independent pipelines that link the settled water influent, filtered effluent, and backwash water flows respectively. Butterfly valves permit independent operation or isolation of the two filtration systems. If the Algiers facility was operated at or near capacity, effluent from Eimco units No. 1 and No. 2 and No. 3 and No.4 would primarily flow to Filters No. 1 – No. 8 and No. 9 – No. 20, respectively. This scenario would equate to loading rates of approximately 1.9 gpm/sf and 2.0 gpm/sf for Filters No. 1 – No. 8 and No. 9 – No. 20, respectively. These loading rates include the assumption that one filter is out-or-service in each system. Each of the existing filter systems is described in subsequent sections.

Filters No. 1 through No. 8

Filters No. 1 – No. 8 are a dual-cell configuration separated by a center gullet. Each filter is approximately 24 feet wide by 34 feet long yielding a total effective surface area of 827 square feet. At a rated capacity of 3.0 gpm/sf, each filter is capable of treating approximately 3.6 MGD, but has been typically operated at approximately 1.1 gpm/sf. This equates to a maximum treatment capacity of 25 MGD assuming a single filter out of service. Existing water demands do not require use of these filters, and therefore, they are not in-service but are operational.

As depicted in design drawings, the filter media is a combination anthracite/sand (6 inches anthracite and 22 inches sand) dual-media system with 8 inches of supporting gravel. The underdrains of Filters No. 1 – 8 are dual-lateral, 10-inch ceramic blocks for water backwash only. The water only backwash can limit the ability to effectively clean the filter media. Typically, the minimum recommended backwash rate for dual-media filters is approximately 18 gpm/sf. This rate is required so that the media can properly restratify following expansion. Restratification of the dual media system is needed to insure proper filter operation. For example, if the sand layer is intermixed with anthracite as the top media layer, filter runs and capacity can be reduced due to excessive particle and precipitate build-up. This can result in formation of mudballs and require early media replacement. Surface wash or air/water backwash can reduce mudball formation and enhance media cleaning during backwash cycles. A secondary scour system exists for surface wash of the filter media in Filters No. 1 – 8. Based on design drawings, the existing elevation from the media to the bottom of the washwater troughs allows for approximately 36 percent media expansion. To ensure proper media stratification following backwash, the minimum recommended media expansion for dual-media filters is 30 percent. The effectiveness of the existing media backwash capabilities is questionable due to the minimal capacity for media expansion and the water only backwash system.

Filters No. 1 – No. 8 each have existing filter-to-waste connections. A manual valve actuator operates each connection. Filter-to-waste connections allow for direct wasting of filtered water. This permits plant operators to discharge or waste the initial turbidity spike associated with filter start-up following backwash cycles. These spikes will be regulated by the Interim Enhanced Surface Water Treatment Rule. If Filters No. 1 – No. 8 are intended to be used to meet future water demands, it would be advantageous to install electric valve actuators to enable automatic control of the filter-to-waste connections. At present, four turbidimeters are operated in conjunction with Filters No. 1 – 8. These units are rotated between the eight filters depending on those in operation. This method of operation is sufficient for current demand conditions.

Filters No. 9 through No. 20

Similar to Filters No. 1 – No. 8, Filters No. 9 – No. 20 are a dual-cell configuration separated by a center gullet. Each filter is approximately 22.5 feet wide by 33 feet long yielding a total effective surface area of 743 square feet. Each filter is rated to treat approximately 3.2 MGD (3.0 gpm/sf), but are currently operated at approximately 2.0 MGD (1.9 gpm/sf). Filters No. 9 – 20 typically remain in service, with Filters No. 1 – 8 exercised periodically to assure backup capacity is available if necessary. This equates to a maximum and average treatment capacity of 35.3 MGD and 23.5 MGD, respectively, assuming a single filter out of service and only Filters No. 9 – 20 in service.

The filter media configuration for Filters No. 9 – No. 20 is a combination anthracite/sand (6 inches anthracite and 24 inches sand) dual-media system with twelve inches of supporting gravel. The underdrains of Filters No. 9 – 20 are dual-lateral, air/water filter blocks. The air/water combination underdrain is more effective than the water only system used in Filters No. 1 – No. 8 for media cleaning. Air adds turbulence to the backwash cycle during media expansion. This turbulence causes media interaction and contact that removes precipitates and particles attached to the filter media. The bottom elevations of the backwash troughs in Filters No. 9 – No. 20 were designed to be 21 inches above the filter media. This allows for approximately 65 percent bed expansion during backwash cycles. At a backwash rate of at least 18 gpm/sf in conjunction with the air scour system, a 65 percent bed is effective for media cleaning.

Filters No. 9 – No. 20 each have existing filter-to-waste connections. These connections are used to waste the initial two minutes of filtered water following a backwash cycle. Therefore, plant staff is able to eliminate turbidity spikes associated with initial filter start-up. Turbidity meters for monitoring the filter effluent have been installed on each filter.

Filtered water from both filter banks (Nos. 1 – 8 and Nos. 9 – 20) is combined and fed to the high service pump station pump pit. Water from the pump pit is used for distribution and to fill off-line storage tanks. Treated water is pumped from the pump pit to the two ground-level storage tanks. During filter backwash, washwater is gravity fed to the filter galleries. At or near tank capacity, approximately 35 feet of head is available for filter backwash.

S&WB staff did not indicate that any problems exist with the backwash system. For additional monitoring purposes, each storage tank is equipped with a turbidimeter.

The state department of environmental quality (DEQ) has raised issues concerning backwash discharge and canal flow into intercoastal waterways. This issue is currently being examined by CDM.

5.2.3 Chemical Storage and Feed

The Algiers WTP is equipped to apply nine different chemicals for water treatment, and include the following:

- Ferric Sulfate
- Powdered Activated Carbon (PAC)
- Lime
- Chlorine
- Ammonia
- Sodium Hexametaphosphate (SHMP)
- Polymer (Cationic)
- Fluoride
- Sodium Hydroxide (caustic)

Each chemical system was examined to determine the adequacy of the on-site storage capacity and of the chemical feed system. Storage volume is a primary concern. A minimum of 30-days on-site storage is dictated by regulatory requirements unless the chemical is readily available. The following subsections summarize each chemical feed system and the associated ancillary equipment. **During plant interviews average or typical dosages of all chemicals were requested, however, only dosage ranges were provided. Average dosages were estimated to calculate storage quantities required.**

A. Ferric Sulfate

Ferric sulfate (ferric) is the primary coagulant used for the Algiers WTP. The ferric system includes 5,000 and 3,000-gallon bulk storage tanks and two 26-gph metering pumps. One pump is designated as the feed pump at each raw water intake pump station. A summary of the existing ferric feed system is summarized below.

<u>Ferric Sulfate System</u>	
Type of Storage	(2) Fiberglass Bulk Storage Tanks
Capacity	(1) 5,000 gallons
	(1) 3,000 gallons
Feed Pumps	Two
Type	Chemical Metering Pumps
Capacity	26 gph (each)

The addition of ferric varies and is dependent on the raw water turbidities. The typical range of ferric addition is 5 – 20 mg/L. Calculations were performed to determine if the existing storage capacity is sufficient for the current doses. Assuming a maximum total flow of 40 MGD and a dose of 20 mg/L, the total 8,000-gallons of bulk storage provides approximately 8 days of storage capacity. At a 20 MGD flow and 10 mg/L dose, there is sufficient ferric storage for 26 days of chemical application. Regulations stipulate that a minimum chemical storage capacity of 30 days is required. However, if the chemical is readily available this requirement can be avoided.

The existing metering pumps are capable of meeting the current daily demands. However, dependent on the exact flow split between the two pump stations and the ferric application rate, the pumps may not be able to meet maximum demands. The addition of two additional pumps to increase capacity and to serve as backup units would insure adequate system operation.

No flow pacing or automatic adjustment of ferric sulfate feed based upon water quality is provided for this system. Automation of this system based upon flow and water quality could result in chemical savings. In addition, movement of the ferric sulfate system from the raw water intake to prior to the upflow clarifiers should be provided. This will maximize the effectiveness of PAC addition.

B. Powdered Activated Carbon

The primary use of powdered activated carbon (PAC) is for taste and odor control. Tastes and odors are typically caused by algae and other naturally occurring organic compounds. Activated carbon adsorbs many organic taste and odor compounds from the raw water. Following adsorption, the activated carbon can either be settled or filtered from the process flow.

Aside from taste and odor concerns, the S&WB uses PAC to address chemical spills into the Mississippi River. Typically, a harmful chemical spill includes organic compounds that PAC can adsorb. PAC can be used as a precautionary measure to prevent potentially harmful chemicals from entering the treatment system. If required, (PAC) may be periodically applied to the raw water prior to treatment at the Algiers WTP.

The existing PAC system includes a total slurry tank volume of 60,000 gallons, and six hose pumps. Below is a summary of the PAC system.

Existing PAC System

Storage Tank	One
Capacity	60,000 gallons
Feed Pumps	Six
Capacity	(4) 95 gph (2) 170 gph

Dose	3 – 30 ppm

The PAC is combined with water at a ratio of 0.6 lb/gallon to form the slurry solution. The PAC is added to the raw water prior to the Eimco Units. Since, PAC is used on an intermittent basis, storage and pump capacity is not a major concern. The existing slurry tank has the storage capacity for 10 days or continuous PAC addition at a concentration of 30 ppm and flow rate of 40 MGD. The pump system allows for application of approximately 13,200 gal/day with one pump out-of-service. The existing PAC system is adequate for the current treatment operations.

C. Lime

Lime feed is employed at the Algiers WTP to reduce the raw water hardness and to adjust the treatment process pH. The lime storage and feed system consists of two main storage silos, three day bins, and three slaker units and are summarized below:

<u>Lime Storage Facilities</u>	
Type	Steel welded silo
Number	Two
Capacity	100 tons/silo
Type	Day bins
Number	Three
Capacity	20 tons/day bin

<u>Lime Slakers</u>	
Number	Three (Chempac)
Type	Weighbelt feeder w/ grit removal
Capacity	500 lb/hr (each)

<u>Lime Pumps</u>	
Number	Seven
Type	Durco (1-1/2")
Capacity	160 gal/min (each)
Feed Rate	Not available

The existing silos are not used for storage due to operational problems. Therefore, the pebble quicklime is off loaded from transport trucks directly to the lime slaker day bins. Each day bin has a capacity of approximately 20 tons. Weighbelts regulate the quicklime feed from the day bins to the slakers. The slaked lime is pumped to the application points, the center mixers of the Eimco HRC Clarifiers.

The three existing slakers provide adequate capacity to meet daily treatment requirements. An exact lime dosage was not available; therefore, assumptions were made to determine storage and pumping capacity. Assuming a flow rate of 40 MGD and an application rate of 55 ppm (Carrollton WTP), approximately three days of storage is available. At a dose of 55 ppm and flow of 20 MGD, the storage capacity is enough for nearly seven days. The seven Durco pumps available for lime feed provide sufficient capacity. At a maximum flow rate of 160 gpm, there is a total pumping capacity of 48,000 gph with two pumps off-line.

No flow pacing or automatic adjustment of lime feed based upon water quality is provided for this system. Automation of this system based upon flow and water quality could result in chemical savings.

D. Chlorine

Chlorine, in combination with ammonia, provides primary disinfection at the Algiers WTP. The chlorine system includes six, 2,000-lb/day and one, 1,000 lb/day vacuum feed chlorinators, two application areas, and storage capacity for 12 one-ton containers. The different components of the application system are as follows.

Chlorine System	
Type of Storage	One-ton Containers
Capacity	2,000 lb/container
Number On-Site	12 containers
Chlorinator No. & Capacity	(6) 2,000-lb/day (1) 1,000-lb/day
Type	Vacuum Feed

Chlorine is fed differently at the Algiers WTP depending on the water temperature. If the water temperature is in excess of 15 degrees C, then chlorine is added prior to the Eimco Units in combination with ammonia. When the raw water temperature is below 15 degrees C, free chlorine is added following treatment in the Eimco Units with post-filtration, ammonia addition. These two different methodologies are used to meet regulatory disinfection requirements. The primary concerns regarding free chlorine disinfection is disinfection byproduct (DBP) formation. Organic materials have been identified as precursors to DBP formation. The majority of organic materials can be removed during flocculation/sedimentation processes. Therefore, free chlorine addition following these processes reduces DBP formation.

Disinfection capacity is determined by calculating the product of concentration and contact time (CT). The Algiers WTP is capable of meeting their CT requirements using chloramination through the entire plant when the water temperature is in excess of 15 degrees C. Chloramination does not form significant amounts of (DBP) in the presence of organic matter. Therefore, this procedure allows the facility to meet DBP and CT regulatory requirements.

When the water temperature drops below 15 degrees C, the alternative free chlorine disinfection strategy is utilized. Free chlorine is a significantly stronger disinfectant than chloramines; therefore, a reduced contact time is needed to meet CT requirements. The short period of free chlorine disinfection down stream of the Eimco Units through the filters, followed by chloramination, permits the Algiers facility to meet CT requirements while minimizing DBP formation in cooler months. Calculations of CT times through the plant are provided in Table 5.1. Calculations of CT times appear to confirm the ability to meet disinfection requirements during the cooler months. However, interviews with plant operators indicate there are operational problems with disinfection during cold weather months. Addition of ammonia following the new filters does not assure adequate mixing prior to high service pumping. If flows can be rerouted through piping to the old pumping station, adequate mixing should be obtained. However, if flows are routed from the new filters directly to the new pumping station, equal mixing of ammonia prior to pumping is in question.

To resolve operational problems Malcolm Pirnie recommended installing a chlorine contact chamber. CDM's believes the installation of a static mixer should be considered prior to implementing a chlorine contact chamber. This could relieve current operational problems during cooler weather. It may also eliminate the need for the chlorine contact chamber. With the implementation of future disinfection requirements, this static mixer may serve as an interim measure until the direction of future requirements is better determined.

Table 5.2: CT Calculations – Algiers WTP
Disinfection Through Clarifiers and New Filters

Flow Rate (mgd)	Water Temp (C)	Ph	Free Chlorine Residual (mg/l)	Chloramine Residual (mg/l)	Giardia Inactivation (ratio)	Virus Inactiva tion (ratio)
40	10	8.5	0.5	-----	1.0	10.7
40	24	-----	-----	3.8	1.8	1.0
20	14	-----	-----	3.8	1.9	1.0
12	10	-----	-----	3.0	2.1	1.0

The existing seven (7) chlorinators provide sufficient capacity for chlorine application. In case of equipment failure, this number of units effectively guarantees operation. A maximum of twelve one-ton, chlorine containers are kept on-site at all times. A current feed rate or dose was not available; however, based on a total dosage of 3.0 mg/L, a maximum flow rate of 40 MGD, and twelve one-ton containers on-site, the City has approximately 24 days of storage. At current flow rates, storage in excess of the regulatory required 30 days is available.

CDM completed Risk Management Program for the Algiers WTP in July, 1999. As a part of this program CDM provided a Hazard Review of the existing chlorination facilities and provided operational and capital improvement recommendations to further assure safe operation of the system. The major capital improvement recommendation was to upgrade the existing closed-loop chlorine scrubber system to a once through negative pressure system. In addition, operational and capital costs to convert the chlorine system a sodium hypochlorite system should be further evaluated and weighed against the risk of operating a chlorine gas system with an upgraded scrubbing system.

No flow pacing or automatic adjustment of chlorine feed based upon water quality is provided. Automation of this system based upon flow and water quality could result in chemical savings. Automating should be based upon residual chlorine measurements.

E. *Ammonia*

The ammonia system at the Algiers WTP operates in conjunction with the chlorine system. These combined systems provide for chloramination of the raw and treated water. Chloramination is not as strong a disinfectant as free chlorine, and therefore, free chlorine is utilized in instances as previously described. However, the use of chloramines reduces the formation of disinfection byproducts and provides a longer lasting residual through the distribution system.

Ammonia can be applied at two different locations depending on the disinfection strategy. These locations include prior to the Eimco Units and following filtration. The ammonia system includes four, direct feed ammoniators and a 1,000-gallon storage tank. A summary of the existing system is given below.

<u>Ammonia System</u>	
Type of Storage	Fixed Steel, Pressure Tank
Capacity	1,000 gallons
Number On-Site	One
Number of Ammoniators	Four
Type	Direct Feed
Capacity	200 lb/day (each)

No operational problems with the existing ammonia feed system have been identified. The standard chlorine to ammonia dosage for chloramination corresponds to a ratio ranging from 3:1 to 5:1. The current dosage rate was not available; therefore, assumptions were made. It is recommended ammonia dosing be controlled based on residual measurements at a ratio of 5:1, chlorine to ammonia.

The existing four ammoniators provide sufficient capacity for ammonia application. In case of equipment failure, and assuming a dose of 1.0 mg/L, these four units effectively guarantee operation.

The existing on-site ammonia storage capacity includes a 1,000-gallon steel, pressure tank. Calculations were performed to estimate on-site storage capacity. Assuming a dosage of 1.0 mg/L and maximum flow rate of 40 MGD, the facility would have approximately 15 days of storage. At a flow rate corresponding to current production (20 MGD), the Algiers WTP would have at least 30 days storage capacity. This meets regulatory requirements. As future demands require increased production, storage capacity will need to be expanded.

CDM completed the Risk Management Program for the Algiers WTP July, 1999. Due to the limited quantities of ammonia stored at Algiers, a Hazard Review of the existing ammonia facilities was not provided. However, a feasibility study for enclosing and providing emergency scrubber systems for the ammonia facilities should be considered.

F. Polymer

Cationic polymer is added to the raw water in conjunction with lime to the centerwell of each Eimco Unit at the Algiers WTP. Polymer addition enhances particle coagulation and sedimentation. The cationic polymer is supplied in solution form to the Algiers WTP and stored in two 5,000-gallon fiberglass tanks. The polymer feed system includes the following equipment:

<u>Polymer Feed System</u>	
Type of Storage	(2) Fiberglass tanks
Storage Volume	5,000-gallons/tank
Number of Pumps	Four
Feed Pump Capacity	190 gpd @ 100 psi max. (each)
Feed Rate	3.0 – 5.0 mg/L

The typical dose applied to the raw water is 3.0 - 5.0 mg/L. At a 5.0 mg/L dosage, a maximum flow rate of 40 MGD, and a solution density of 8.5 lb/gal, approximately 195 gpd of polymer are used. This equates to an on-site storage capacity in excess of 50 days. The current storage capacity does not require improvements.

The existing pump capacity is sufficient for the current production rates. A single pump is dedicated to an individual Eimco Unit. However, the pump configuration allows each of the pumps to feed any of the Eimco Units. At current production rates, these four pumps provide sufficient capacity, and serve as supporting equipment in case of failure. However, as demand increases it would be advantageous to purchase additional back-up pumps in case of equipment failure.

No flow pacing or automatic adjustment of polymer feed based upon water quality is provided. Automation of this system based upon flow and water quality could result in chemical savings.

G. Fluoride

Hydrofluosilicic acid (fluoride) is added prior to the Eimco Units. Fluoride is commonly added at WTPs for dental health reasons. The fluoride application system at the Algiers

WTP includes a 2,000-gallon bulk storage tank and four, metering pumps. A summary of the existing system is as follows.

Fluoride Feed System	
Type of Storage	Cross-linked Polyethylene Tank
Storage Volume	2,000 gallons
Number of Feed Pumps	Four
Feed Pump Capacity	30 gpd(each)
Feed Rate	Not available

A maximum concentration of fluoride allowed in water distribution systems is approximately 0.8 mg/L. Assuming this dose and a maximum flow rate of 40 MGD, the existing storage tank provides in excess of 75 days of storage. A single pump is dedicated to feed each Eimco Unit. This configuration is sufficient for fluoride application at flow rates in excess of 40 MGD. Fluoride is not required as a primary treatment chemical; however, as demand increases, the installation of back-up pumps would be advantageous. Currently, the fluoride system does not require modifications and no improvements are recommended.

No flow pacing or automatic adjustment of polymer feed based upon water quality is provided. Automation of this system based upon flow and water quality could result in significant chemical savings.

H. Sodium Hexametaphosphate

Sodium hexametaphosphate (SHMP) is added to the treatment process following sedimentation. SHMP is a common additive at WTPs and serves as a sequestering agent. Sequestering agents inhibit the formation of metal precipitation. The addition of SHMP inhibits the precipitation of calcium carbonates and hydroxides following lime addition in the Eimco Units. This reduces effect of calcification on the filter media. The SHMP application system at the Algiers WTP includes a bulk mixing tank and four, metering pumps. A summary of the existing system is as follows.

SHMP Feed System	
Type of Storage	Mixing Tank
Feed Method	Siphon and gravity system w/ rotameters
Number of Rotameters	Four
Rotameter Capacity	0 to 11 gph (each)
Feed Rate	2.5 – 4.5 ppm

The SHMP solution is prepared by addition of 50 pounds of the solid to 200 – 400 gallons of water. The solution is gravity fed to the application points and controlled by individual rotameters. An individual rotameter controls the feed of solution to each of the effluent line application points. No operational difficulties or problems were identified with this system.

No flow pacing or automatic adjustment of polymer feed based upon water quality is provided. Automation of this system based upon flow and water quality could result in chemical savings.

5.2.4 Filter Backwash Recycle

The filter backwash water can currently be pumped to two locations the Lamarque Canal and the headworks of the plant.

The filter backwash water is not currently pumped to the headworks of the plant due to operational concerns and concerns about potential impacts on water quality. The discharge to the Lamarque Canal was previously permitted by LDEQ. However, the permit limits for TSS could not be achieved. The current permit has not been renewed since it expired over six months ago. LDEQ also considers the permit for review under its enforcement section. Thus, the continued practice of discharging to the Lamarque Canal may have to be discontinued in the near term.

Discharge to the headworks of the plant has resulted in significant changes in the characteristics of the sludge. This has resulted in more frequent needs to empty and clean the settling basins.

As indicated in Section 7 of this report the anticipated Filter Backwash Rule will likely allow discharge of backwash to the headworks of the plant. However, due to maintenance concerns this may not be acceptable. Thus, the discharge point prior to the settling basins will remain adequate. The need to relocate the discharge to the Mississippi River to provide further protection of the water supply should be discussed with the S&WB staff. The cost of relocating the discharge to the Mississippi River was previously estimated as $1,575,000 by Malcolm Pirnie.

5.2.5 Sludge Handling

The sludge handling systems at the Algiers WTP were reviewed primarily to assess the need to eliminate the current practice of discharging sludge to the Mississippi River. Review of current EPA regulations and contact with LDEQ did not reveal any current or pending regulations which would prevent the current practice of discharging sludge to the Mississippi River. The discharge at the Mississippi River is currently permitted with LDEQ. The requirements of the permit require monitoring and <u>reporting only</u> for TSS and flows. Thus, no violations at this permit have occurred. Based upon a review of current regulations the need to alter the current sludge handling practice is not necessary at this time.

Section 6
Plant Evaluations - Electrical/Instrumentation

6.1 Electrical System Audit

6.1.1 Carrollton Water Treatment Plant

The existing electrical distribution system at Carrollton WTP is fed from three Entergy substations, which are Priority classified. The three substations are listed below:

- Claiborne Substation
- Hamilton Substation
- Sycamore Substation

Each Substation is fed from a primary and secondary/backup feeder. The primary feeder is provided by Entergy at 5KV and feeds 5KV switchgear arranged in a main-tie-main configuration. The nominal voltage for the system is 4160 VAC throughout the plant. The secondary/backup feeder is provided from the in plant powerhouse.

The backup source of power is generated by the plant at the Power House and owned and operated by the S&WB. The plant has two fuel sources available for generation of power, natural gas and diesel fuel oil. The power generated is 6600 VAC at 25 Hz, than converted to 4160 VAC at 60 Hz by rotating machinery type frequency changers for use throughout the plant. The power house has three of these frequency changers which have the capability to simultaneously support Carrollton WTP, Algiers WTP, remote pump stations, and ancillary facilities loads. Originally the whole plant operated at 25 Hz but through a series of renovations the only remaining parts of the plant that operate at 25 Hz are the conveyors and bucket elevators at the Chemical House and the Old River Pump Station.

In the main-tie-main configuration the tie breaker is closed, the secondary/backup main breaker is open and the primary feeder breaker is closed under normal power conditions. Under abnormal or emergency power conditions the tie breaker is open, the secondary/backup main breaker is closed and the primary feeder breaker is open.

Main circuit breakers on the 4160 VAC, 60 Hz equipment and 6600 VAC, 25 Hz equipment are opened and closed with solenoids. These trip and close solenoids are Direct Current (DC) operated and powered from station batteries.

The in-plant electrical distribution system is underground and the feeder conductors for the 4160 VAC, 60 Hz circuits are 5 KVAC, 133 percent insulation rated and is lead encased multiconductor cables. The feeder conductors for the 6600 VAC, 25 Hz circuits are 15 KVAC, 133 percent insulated rated and are lead encased multiconductor cables.

Feeder and branch circuit instantaneous and overcurrent protection is provided by fuses down to the panelboard level.

6.1.2 Hamilton Substation

Refer to one line diagram **Figure 6-1**. Hamilton substation feeds the following buildings in the plant:

- Chemical House
- Machine Shop
- Jefferson Intake Station
- Oak Street Station
- Hamilton Warehouse
- Steel Warehouse
- Basins C,G and L

Jefferson Parish Pumping Station, Oak Street Pumping Station, Hamilton Warehouse, and Steel Warehouse are radially fed from the substation. The chemical house, and machine shop are configured using a secondary selective style system where the electrical equipment is fed from either side of a cable or bus type of tie using circuit breakers or switches at strategic locations. Transformers downstream of the main tie are sized for the combined peak capacity requirement of either side of the tie.

Hamilton substation is single fed by Entergy at 4160 VAC, 60 Hz. The Hamilton substation consists of 5KV switchgear configured in a main-tie-main arrangement which is fed from two separate sources of power i.e. the Entergy feeder and the inplant power generation feeder at 4160 VAC, 3 phase, 60 HZ.

6.1.3 Sycamore Substation

Refer to one line diagram **Figure 6-2**. Sycamore substation feeds he following buildings in the plant:

- Filter Backwash Pumping Station
- Engineering Laboratory Building
- Filter Gallery Building
- Spruce St. Warehouse/Welding Shop
- Main Engineering Building
- Engineering Building Addition
- Headhouse
- Panola Pump Station

Sycamore substation is single fed by Entergy by feeder 2016 at 4160 VAC, 60 Hz. The Engineering Laboratory Complex is configured using a secondary selective style system; one side of the tie is located in the Sycamore substation and the other side of the tie is located in the Claiborne substation. All other loads are radially fed from the substation.

6.1.4 Claiborne Substation

Refer to one line diagram **Figure 6-3**. Claiborne substation feeds he following buildings in the plant:

- Claiborne High Lift Pump Station
- Filters
- Main Engineering Building
- Engineering Building. Addition

Claiborne substation is dual fed by Entergy by feeder 2022 or714 with automatic switchover at 4160 VAC, 60 Hz. The Claiborne substation consists of 5KVAC switchgear which is fed from two separate sources of power the Entergy feeder and the in plant power generation feeder at 4160 VAC, 3 phase, 60 HZ.

6.1.5 Algiers Water Treatment Plant

The existing electrical distribution system at Algiers WTP is dual fed from an Entergy substation with automatic transfer and is priority classified. The Entergy substation is dual fed at 4160 VAC, 60 Hz.

In addition the plant can be served from any of the three frequency changers located at the Carrolton WTP Power House.

Refer to one line diagram **Figure 6-4**. Algiers substation feeds the following buildings in the plant:

- Chemical Building
- Filter Galleries
- River Station No.1

The main electrical distribution equipment that feeds all the plant equipment is a ring bus type of configuration permitting any electrical feeder to be fed from any of the electrical sources. In addition, portions of the electrical bus can be isolated for repairs or maintenance.

Downstream of the ring bus the plant electrical distribution system is configured using a secondary selective style system where the electrical equipment is fed from either side of a cable or bus type of tie using circuit breakers or switches at strategic locations. Transformers

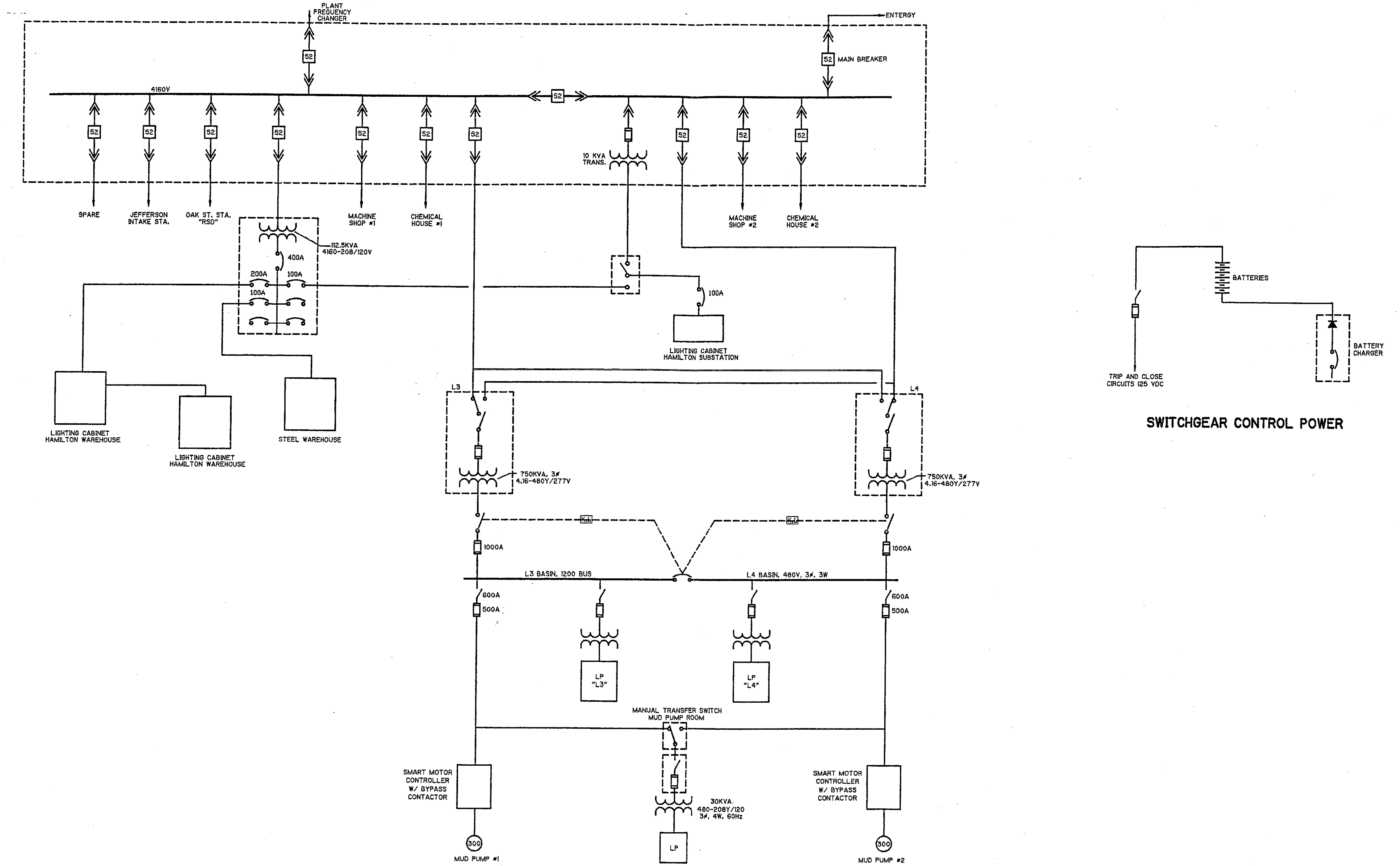

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Figure No. 6-1
CARROLLTON WATER TREATMENT PLANT
ONE LINE DIAGRAM - HAMILTON SUBSTATION

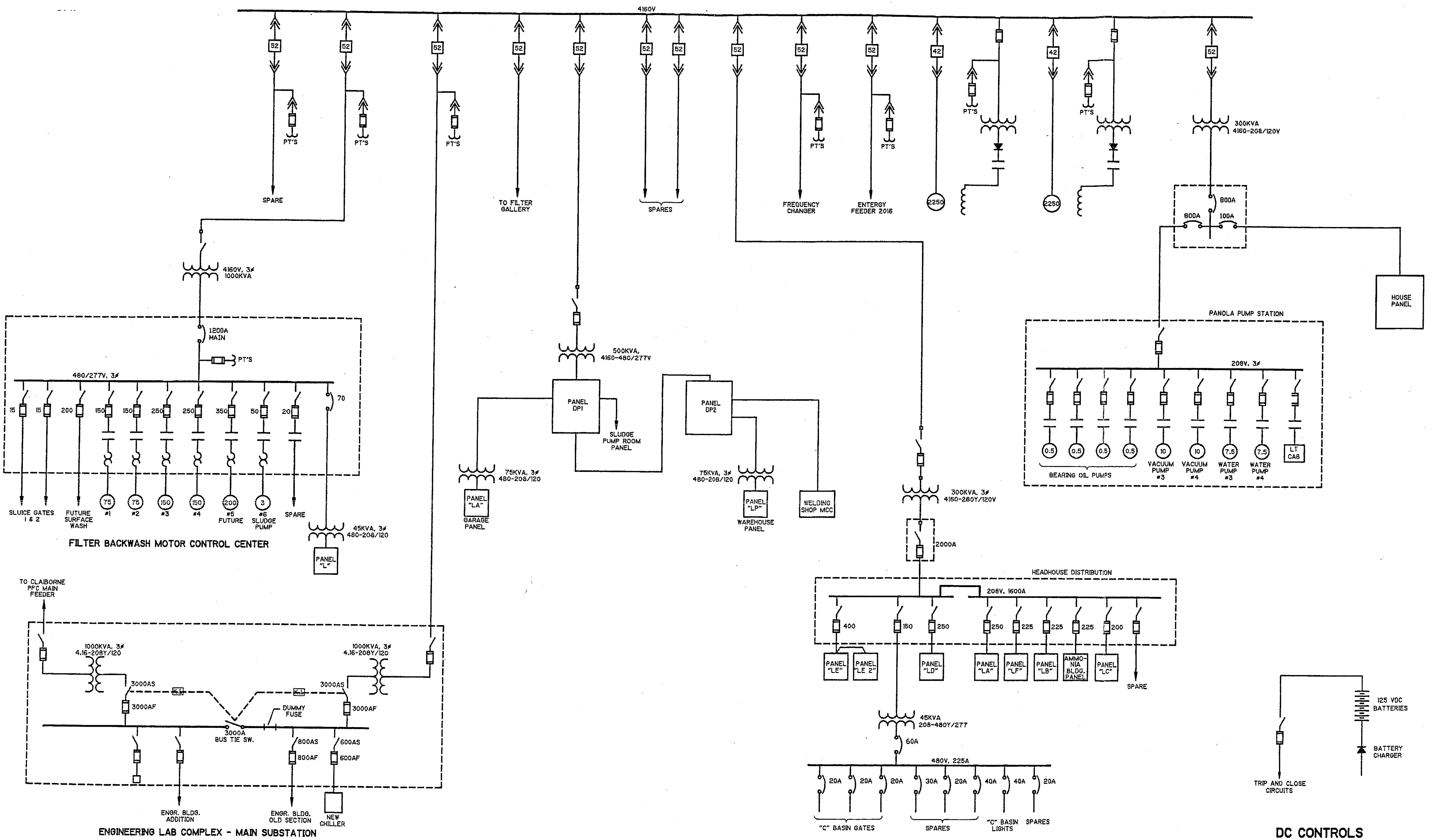

Figure No. 6-2
CARROLLTON WATER TREATMENT PLANT
ONE LINE DIAGRAM - SYCAMORE SUBSTATION

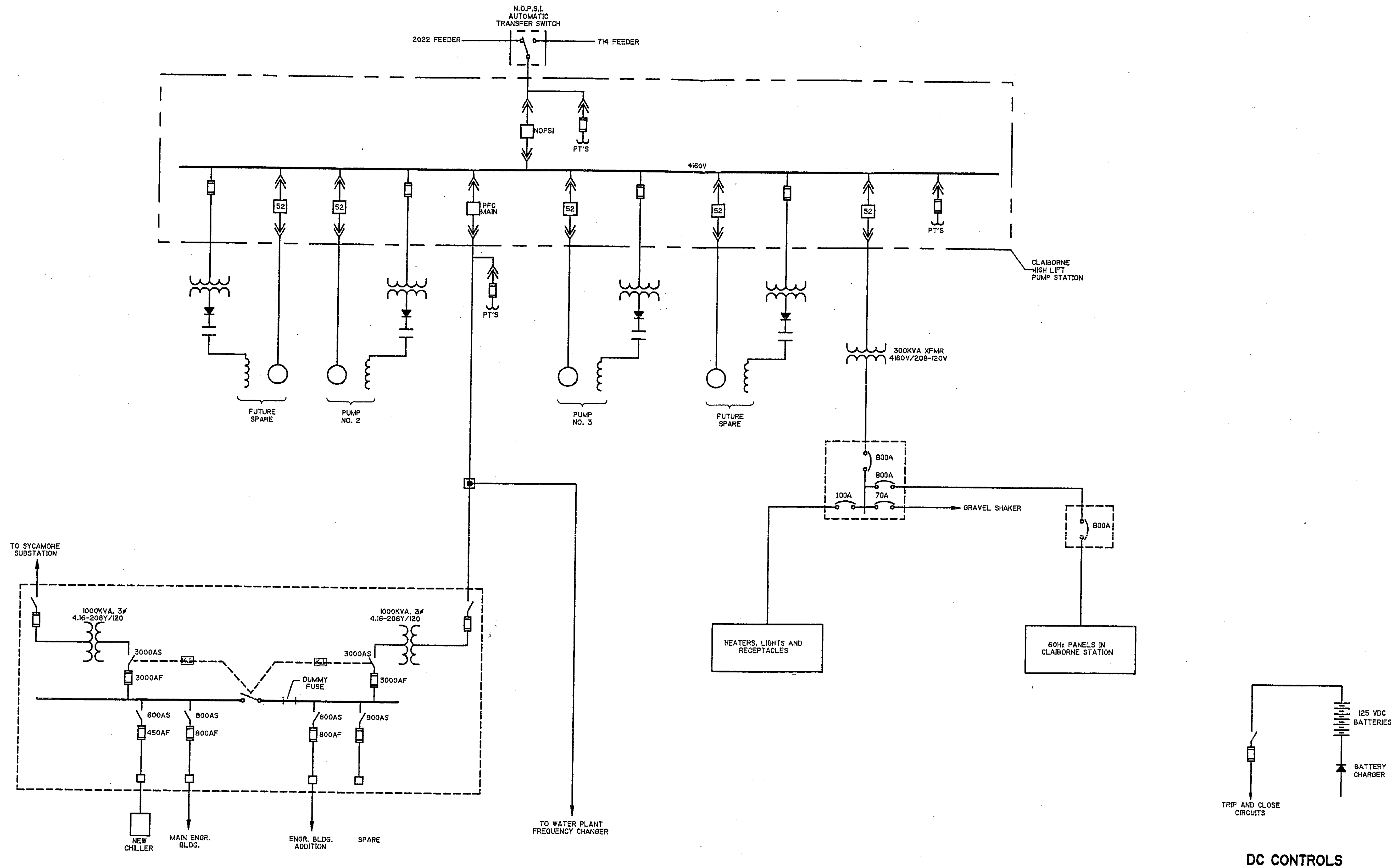

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Figure No. 6-3
CARROLLTON WATER TREATMENT PLANT
ONE LINE DIAGRAM - CLAIBORNE SUBSTATION

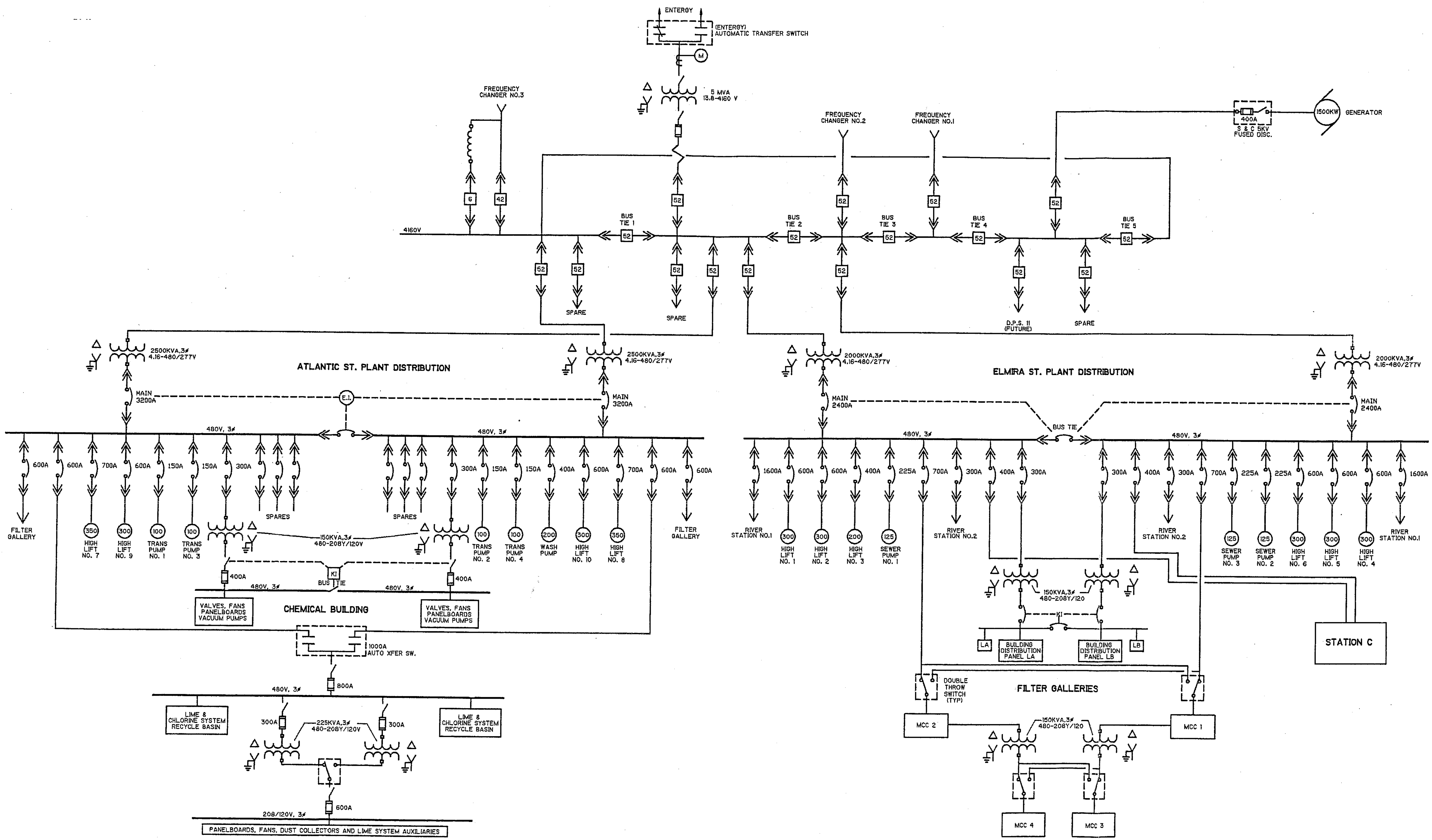


Figure No. 6-4
ALGIERS WATER TREATMENT PLANT
ONE LINE DIAGRAM

CDM Camp Dresser & McKee

downstream of the main tie are sized for the combined peak capacity requirement of either side of the tie.

Main circuit breakers on the 4160 VAC, 60 Hz ring bus equipment trip and close solenoids are direct current (DC) operated and powered from station batteries.

The in-plant electrical distribution system is underground and the feeder conductors for the 4160 VAC, 60 Hz circuits are 5 KVAC, 133 percent insulation rated and is lead encased multiconductor cables.

Feeder and branch circuit instantaneous and overcurrent protection is provided by fuses down to the panelboard level.

6.2 Electrical Audit Results

Both the Carrolton and Algiers WTP have extremely reliable, redundant and flexible electrical distribution systems.

An externally generated power source and an internally generated power source serve both plants. The priority service delivered by Entergy will ensure that the plants are one of the last facilities to be taken out of service in a city or statewide emergency. In addition some of the services are dual fed from two independent utility sources. If utility power is lost the plants are self-sufficient with their own on site generating capacity with multiple fuel source capabilities. The on-site backup power is served from the power plant located at the Carrollton WTP which also serves the other external ancillary facilities. Providing backup power to these ancillary facilities is required for a fully operational water distribution system. All feeder circuits are underground, thus reducing outages from lightning induced surges or direct lighting strikes. Even if a feeder is lost, the critical plant equipment is fed from at least two power sources providing isolation capability and resumption of service. All of these redundancy factors make for a very reliable and flexible power distribution system.

A great deal of the electrical equipment is over twenty years old. Although the equipment has been very reliable, replacement parts will be increasingly difficult and expensive to obtain. This makes maintenance and consequently operational ease more difficult unless a great deal of planning and scheduling is performed. The plants currently perform scheduled testing, inspection and maintenance, i.e. relay and breaker calibration. The use of fusing in most of the locations helps to protect equipment from damage during fault conditions but requires a large inventory of fuses to be maintained at all times.

6.3 Instrumentation and Control Audit

6.3.1 Carrolton Water Treatment Plant

Automatic or remote control and monitoring of the water treatment at the Carrolton WTP is extremely limited. Where automatic or remote control does exist it is extremely localized and limited. There is no central location for monitoring, control or data acquisition of the plant process equipment. The automatic control that does exist is operator initiated at the location. An example of this would be control of the filters, which are locally operated from the filter consoles. Operators also manually control backwash sequences at the console. The automatic control that does exist is limited to chemical pacing by PID (Proportional - Integral - Derivative controllers) located in the chemical house. Data acquisition consists of an operator manually recording data at scheduled intervals. At the chemical house real time monitoring of the chlorine rail cars is achieved by video cameras with the monitors located in the chemical house control room. In addition there is remote monitoring of chemical leak detectors in the chemical house control room.

Automatic or remote control and monitoring of the electrical distribution system at the Carrolton WTP is extensive. The plant electrical distribution system is monitored and controlled by the Westinghouse IMPACC/PowerNet Communications System and Software. This system permits metering devices, protective relays, circuit breaker trip units and motor starters to communicate information for remote monitoring, alarming, trending and control. The plant has the metering, protective relays and circuit breakers communicating over a twisted pair wire network. This network is in the process of being converted over to a fiber optic cable for greater transmission speeds and data capability. The plant currently has the capability to remotely open and close feeder breakers. The central control for the IMPACC system is located in the power house.

6.3.2 Algiers Water Treatment Plant

Automatic or remote control and monitoring of the water treatment at the Algiers WTP is provided by a Bailey Network 90® distributed control system (DCS). This system was installed at the plant in the mid 1980's. The Bailey system is functioning only in a limited control mode and is primarily being used for some data acquisition of field instrumentation. The Bailey system was originally installed for a fully automated plant and the S&WB staff reports that the system has never worked effectively in that capacity. Workstations are located in the old filter building, chemical house, power house and filter building. The Bailey system has consistently been susceptible to lightning induced damage and is not Y2K compliant.

The filters have until recently functioned in an operator initiated automatic mode. As a result of valves not seating fully, the permissives required for logic control are no longer accurate and automatic control can no longer be used and the control sequence is manually stepped through by two operators with hand held radios.

The original plant control systems and field instrumentation have been extensively modified and replaced to permit the plant to operate effectively. Currently, the ultrasonic level transmitters do not work in the chemical bulk storage tanks due to high humidity conditions. The ammonia leak detector does not have an analog signal tied into the Bailey control system.

The electrical distribution system has the same capabilities as those described for the Carrollton WTP.

6.4 Instrumentation and Control Audit Results

The existing instrumentation and controls system at both the Carrollton and Algiers WTPs are extremely limited for the process control. The electrical distribution system control system is very flexible for future additions and reliable and easy to use.

The control system at the Algiers plant is vulnerable to lightening strikes and will become obsolete at the end of the year due to being Y2K non-compliant. This system can be described as being extremely vulnerable. Since there is very little automatic control at the Algiers WTP and because most of the equipment is manually operated, there is little protection to control equipment failure.

The Algiers control system is not very reliable other than for data acquisition and then only in a limited capacity. When the operator workstation control screens were viewed most of the analog and discrete equipment indication, status and alarm signals were not functional.

The Carrollton system method of data collection can introduce the possibilities of human error when transferring information from indicators onto paper. The possibility of error is further increased due to irregular time intervals between this data recording. Therefore reliable repeatability could vary.

There is good redundancy of field instrumentation at the Algiers plant. The automatic control system was designed with redundant capability, but, along with its other functions, the system's performance has degraded over time.

Both of the water treatment plants have chemical leak monitoring and other alarm functions and are a basic safety requirements. However, there is no centralized control room for remote annunciation of these signals, which would permit a more controlled response.

The control systems at both plants make for difficult and awkward operational and maintenance. These two criteria characterized a system with little flexibility. A central control room with a fully functioning control system would permit accurate and regular data acquisition for all equipment for real time monitoring, trending and historical recording. In addition standardized control reports could be generated which could lead to the development of a Management Information System (MIS) permitting the generation of work orders and scheduled maintenance based on historical data. Changing of the control system parameters is a manual task at present requiring field adjustment and observation. A fully functional control system would permit easier adjustment, optimization and flexibility.

Section 7
Regulatory Update

7.1 Regulatory Overview

Water quality regulations have changed significantly over the last ten years. Two new regulations were recently finalized and several others are on the regulatory horizon. These include:

- Disinfectants/Disinfection Byproducts Rule (D/DBPR)
- Enhanced Surface Water Treatment Rule (ESWTR)
- Filter Backwash Water Rule
- Arsenic
- Sulfate
- Radon and Other Radionuclides

The most significant of the new rules with respect to regulatory compliance are the D/DBPR and ESWTR. These two rules, which are being promulgated in stages between 1998 and 2002, are closely related and attempt to balance the following disinfection and disinfection byproduct concerns in an integrated manner:

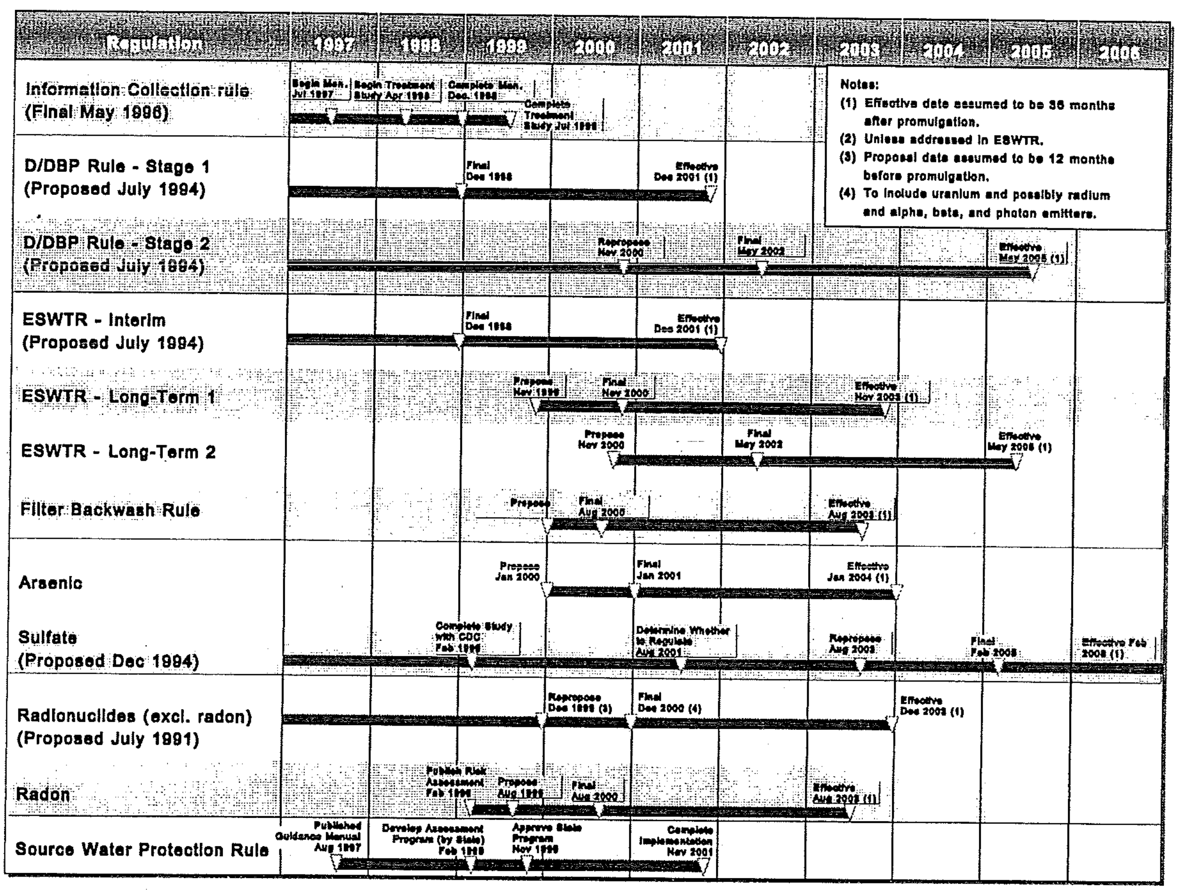
- Disinfection of drinking water is necessary to destroy pathogenic microorganisms and avoid outbreaks of waterborne diseases. Increasing the disinfectant concentration and contact time improves the microbial quality of drinking water.
- However, disinfectants react with naturally occurring precursors in the water to form disinfection byproducts (DBPs) which have been determined by the EPA to pose health risks to consumers.
- Furthermore, the disinfectants themselves (for example, chlorine, chloramines, and chlorine dioxide) also have possible deleterious health effects.
- Current knowledge about the health risks of disinfection byproducts, disinfectants, and even pathogenic microorganisms is very limited. Moreover, little is known about disinfection byproducts (less than half of all chlorinated DBPs have even been identified) or about how to remove them.

The purpose of the D/DBPR is to limit the levels of both disinfectants and DBPs in drinking water. The purpose of the ESWTR is to ensure that disinfection is sufficient to provide adequate microbial quality. The initial stages of both rules are based upon current knowledge; the final stages will be based on data furnished to the EPA by water systems throughout the country under the Information Collection Rule (ICR), as well as on other pertinent new studies and research.

The D/DBPR and ESWTR will have major impacts on the U.S. water industry and in many cases will require both capital improvements and operational changes. It is important to recognize that any treatment modifications implemented to comply with the new rules must not compromise compliance with other Safe Drinking Water Act (SDWA) regulations. When treatment changes are made to comply with one rule, the effect of those changes may negatively impact the ability to comply with other rules. For example, the current Lead and Copper Rule requires some plants to increase the pH of finished water. However, increasing the pH reduces the effectiveness of disinfectants such as chlorine and increases the formation of trihalomethanes (THMs), thereby making compliance with the D/DBPR and ESWTR more difficult.

The current regulatory compliance schedule for the new water quality standards is shown in **Figure 7-1.**

Figure 7-1
SDWA Regulations Compliance Schedule



A description of each regulation is provided below.

7.1.1 Disinfectants/Disinfection Byproducts Rule

The two-staged D/DBPR was proposed in July 1994. The proposed rule included maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) for trihalomethanes, haloacetic acids, bromate, and chlorite; maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for chlorine, chloramines, and chlorine dioxide; requirements for enhanced coagulation and enhanced softening; and changes in disinfection credit.

After review and consideration of comments received on the proposed D/DBPR; of the most recent epidemiology and toxicity studies; of research on enhanced coagulation, enhanced softening, and disinfection issues; and of the results of a predisinfection survey conducted under the ICR, the EPA published Stage 1 of the D/DBPR in the *Federal Register* on December 16, 1998. At present, Stage 2 of the D/DBPR is expected to be finalized by May 2002. EPA will require affected water systems to comply within 36 months unless capital improvements are required for compliance. An additional 24 months may be allowed for systems requiring capital improvements.

7.1.2 Maximum Contaminant Level Goals and Maximum Contaminant Levels for DBPs

Currently, trihalomethanes (THMs) are the only DBPs regulated under the SDWA. The MCL for total trihalomethanes (TTHMs) is 100 ug/L, based on a running annual average of quarterly samples in the distribution system. The D/DBPR will revise the current TTHM standard and will regulate haloacetic acids another class of disinfection byproducts formed by chlorination. In addition, the D/DBPR will regulate two inorganic DBPs bromate and chlorite, which are byproducts of ozone and chlorine dioxide, respectively. Decomposition of sodium hypochlorite can also produce chlorite in treated waters. Table 7.1 summarizes the MCLGs and MCLs for DBPs.

The monitoring and compliance requirements for DBPs are summarized in Table 7.2 for water systems serving 10,000 or more persons and using surface water or groundwater under the direct influence of surface water.

Table 7-1
MCGLs and MCLs for DBPs
in Stage 1 of D/DBPR

DBP	MCLG (mg/L)	MCL (mg/L)
Total Trihalomethanes (TTHM[a])		0.08
Chloroform	0	
Bromodichloromethane	0	
Bromoform	0	
Dibromochloromethane	0.06	
Haloacetic Acids (Five)(HAA5[b])		0.06
Dichloroacetic acid	0	
Trichloroacetic acid	0.3	
Bromate	0	0.01
Chlorite	0.8	1.0

[a]Sum of concentrations for chloroform, bromodichloromethane, bromoform, and dibromochloromethane.

[b]Sum of concentrations for monobromoacetic acid, dibromoacetic acid, monochloroacetic acid, dichloroacetic acid, and trichloroacetic acid.

Table 7-2
Monitoring and Compliance Requirements for DBPs

DBP	Monitoring	Compliance
TTHMs HAA5	4 samples/quarter/plant[a]	Running annual arithmetic average, computed quarterly, of quarterly arithmetic averages of all samples
Bromate	1 sample/month/plant[b]	Running annual arithmetic average of monthly samples, computed quarterly
Chlorite (monthly)	3 samples/month/plant[c]	Monthly arithmetic average of samples
Chlorite (daily)	1 sample/day/plant[d]	Violation of MCL triggers additional distribution system monitoring

[a]One sample taken at location representative of maximum residence time in distribution system; three samples taken at locations representative of system variability.

[b]Applicable only for plants using ozone; sample taken at entrance to distribution system while ozone system is operating under normal conditions.

[c]Applicable only for plants using chlorine dioxide; one sample taken near first customer; one sample taken at location representative of average residence time in distribution system; one sample taken at location representative of maximum residence time in distribution system. Samples must be collected on the same day.

[d]Applicable only for plants using chlorine dioxide; sample taken at entrance to the distribution system.

The proposed stage 2 D/DBPR included MCLs for TTHMs (0.04 mg/L) and HAA5 (0.03 mg/L). The final Stage 2 MCLs will be set after review of data furnished under the ICR, new health-effect studies, and cost-benefit evaluations.

7.1.3 Maximum Residual Disinfectant Level Goals and Maximum Residual Disinfectant Levels

Stage 1 of the D/DBPR includes levels for MRDLGs and MRDLs. These levels are summarized in **Table 7.3.**

Table 7-3
MRDLGs and MRDLs in Stage 1 of D/DBPR

Disinfectant	MRDLG (mg/L)	MRDL (mg/L)
Chlorine	4	4
Chloramines	4	4
Chlorine Dioxide	0.8	0.8

Short-term increases for chlorine and chloramines will be permitted in order to control specific microbiological problems.

The monitoring and compliance requirements for disinfectants are summarized in Table 7.4 for water systems using surface water or groundwater under the direct influence of surface water.

Table 7-4
Monitoring and Compliance Requirements for Disinfectants

Disinfectant	Monitoring	Compliance
Chlorine Chloramines	Same locations and time in distribution system as total coliforms	Running annual arithmetic average, computed quarterly, of monthly averages of all samples
Chlorine Dioxide	1 sample/day/plant at entrance to distribution system [a]	Consecutive daily samples

[a]If daily sample exceeds MRDL, additional samples are required in distribution system on following day.

7.1.4 Enhanced Coagulation and Enhanced Softening

Stage 1 of the D/DBPR requires surface water systems using conventional treatment or precipitative softening to remove DBP precursors, and thereby reduce DBPs, by enhanced coagulation or enhanced softening. Total organic carbon (TOC), a surrogate of DBP precursors, is used to measure DBP precursor removal performance. Systems failing to meet one of four specified exemption criteria are required to provide from 20 to 50 percent TOC removal, depending on the raw water TOC and alkalinity. The D/DBPR also includes alternate performance criteria for systems that can not reasonably meet the specified TOC removal.

The final D/DBPR Stage 1 will require water systems to meet the TOC removals shown in Table 7.5 by enhanced coagulation or enhanced softening unless:

- TOC concentration in the raw water is less than 2.0 mg/L; or
- TOC concentration in treated water, is less than 2.0 mg/L; or
- TOC concentration in raw water, prior to any treatment, is less than 4.0 mg/L, alkalinity is greater than 60 mg/L, and TTHMs and HAA5 in the treated water are less than 40 g/L and 30 g/L, respectively, with any disinfectant, or the water system has made irrevocable financial commitments to technologies that will meet these limits; or
- TTHMs and HAA5 in treated water are less than or equal to 40 g/L and 30 g/L, respectively, with disinfection by chlorine only; or
- Specific ultraviolet absorbance at 254 nm (SUVA) in the raw water is less than 2.0 L/mg-m; or
- SUVA in the treated water is less than 2 L/mg-m; or

- Magnesium hardness removal is greater than or equal to 10 mg/L as $CaCO_3$ for softening systems; or

- Treated water alkalinity lowered to less than 60 mg/L as $CaCO_3$ for softening systems.

Table 7-5
Requirements for Removal of TOC by
Enhanced Coagulation or Enhanced Softening

Raw Water TOC (mg/L)	Raw Water Alkalinity (mg/L as $CaCO_3$)		
	0 - 60	> 60 - 120	> 120[a]
> 2-4	35%	25%	15%
> 4-8	45%	35%	25%
> 8	50%	40%	30%

[a]Systems practicing precipitative softening must meet TOC removal requirements in this column.

The final D/DBPR Stage 1 will allow non-softening systems that cannot reasonably meet the required TOC removal to establish a required coagulant dose through jar testing. In general, the required coagulant dose will be the dose at which additional coagulant reduces:

- TOC removal to a rate less than 0.3 mg/L per 10 mg/L alum addition (as active chemical prior to dilution) or 9.5 mg/L ferric sulfate addition (as active chemical prior to dilution) (this is termed "point of diminishing returns"); or

- pH below the limits shown in **Table 7.6.**

Jar tests must be conducted on at least a quarterly basis for one year to determine the coagulant dose and the corresponding alternate TOC removal percentage.

Table 7.6
Enhanced Coagulation Target pH

Raw Water Alkalinity (mg/L as $CaCO_3$)	Maximum pH
0 - 60	5.5
> 60 - 120	6.3

Compliance with the enhanced coagulation and enhanced softening requirements will be based on the running annual arithmetic average of monthly samples, computed quarterly. Monitoring will include raw water TOC and alkalinity and TOC after enhanced coagulation or softening.

7.1.5 Disinfection Credit

With a few exceptions, the proposed D/DBPR eliminated credit for disinfection prior to meeting the enhanced coagulation or enhanced softening requirements. However, research subsequent to the proposed D/DBPR showed that significant precursor removal and DBP reduction could be achieved by enhanced coagulation and enhanced softening with a disinfectant residual carried through all or part of the process. Therefore, the final D/DBPR Stage 1 will allow water systems to continue to receive disinfection credit at any point prior to the first customer.

7.1.6 Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) was proposed in July 1994 and finalized on December 16, 1998. It affects public water systems serving 10,000 or more people. The final interim rule includes the following revisions to the Surface Water Treatment Rule: a new definition for groundwater under the direct influence of surface water, an MCLG for *Cryptosporidium*, stricter requirements for systems wishing to avoid filtration, periodic sanitary survey requirements, and several alternative treatment methods to provide additional protection against pathogens in drinking water.

The EPA requires affected systems to comply within 36 months unless capital improvements are required for compliance. An additional 24 months may be allowed for systems requiring capital improvements.

In December 1997, the EPA announced that the Long-Term ESWTR would be split into two parts Long-Term 1 and Long-Term 2. The first part will ensure that microbial protection is not compromised as small systems (<10,000 people) come into compliance. Long-Term 1 of the ESWTR is scheduled to be promulgated by November 2000.

The second part of the Long-Term ESWTR will require greater control of microbial pathogens as water systems comply with Stage 2 of the D/DBPR. Long-Term 2 of the ESWTR will be promulgated by May 2002, paralleling the schedule for Stage 2 of the D/DBPR.

7.1.7 Groundwater Under the Direct Influence of Surface Water

The Interim ESWTR revised the definition of "groundwater under the direct influence of surface water" to include *Cryptosporidium* making groundwater systems considered vulnerable to *Cryptosporidium* subject to the ESWTR.

7.1.8 Maximum Contaminant Level Goal for Cryptosporidium

The Interim ESWTR includes an MCLG of zero for *Cryptosporidium*. The MCLG is set at the genus level (i.e., *Cryptosporidium*), rather than species level (i.e., C. *Parvum*).

7.1.9 Stricter Requirements for Systems Wishing to Avoid Filtration

The Interim ESWTR requires the control of *Cryptosporidium* as part of the watershed protection program for unfiltered systems.

7.1.10 Sanitary Survey Requirements

The Interim ESWTR requires periodic sanitary surveys for all public water systems that use surface water, or groundwater under the direct influence of surface water. Sanitary surveys must be conducted a minimum of every three years for community systems and a minimum of every five years for non-community systems.

7.1.11 Covered Finished Water Reservoirs

The Interim ESWTR will require all new facilities holding finished water, for which construction begins after the effective date of the rule, to be covered. The Interim ESWTR does not require existing uncovered finished water reservoirs to be covered.

7.1.12 Treatment Methods

The Interim ESWTR includes several alternative treatment methods to provide additional treatment against pathogens in drinking water. In general, these methods recognize the variations in raw water quality in setting a required reduction level for protozoa (*Giardia* and *Cryptosporidium*) and viruses by the treatment plant. The final Interim ESWTR will require water systems to meet the following turbidity requirements:

- The combined filtered water turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the monthly samples.
- The combined filtered water turbidity must never exceed 1.0 NTU.

Compliance with the above turbidity requirements will be based on sampling at 4-hour intervals.

The Interim ESWTR requires water systems to provide continuous turbidity monitoring of each individual filter and report the following events to the State on a monthly basis:

- Any individual filter with a turbidity greater than 1.0 NTU on two consecutive measurements 15 minutes apart; and
- Any individual filter with a turbidity reading greater than 0.5 NTU at the end of the first four hours of filter operation, based on two consecutive measurements 15 minutes apart.

In addition, if an individual filter exceeds 1.0 NTU turbidity, based on two consecutive measurements fifteen minutes apart, the system must report the exception and conduct a self-assessment of the filter. If an individual filter turbidity exceeds 2.0 NTU, based on two consecutive measurements fifteen minutes apart, the system must report the exception and arrange for a Comprehensive Performance Evaluation (CPE) by the State or by a third party (approved by the State).

7.1.13 Disinfection Benchmarking

A fundamental concern during the EPA's development of the Stage 1 D/DBPR and Interim ESWTR was to balance the protection against DBPs provided by the D/DBPR against the microbial protection provided by the ESWTR. Therefore, the Interim ESWTR includes provisions to assure that microbial protection is maintained when water systems implement changes to comply with the D/DBPR Stage 1. Specifically, water systems will be required to prepare a "disinfection profile" if:

- TTHMs in the treated water are .064 mg/L or more; or
- HAA5 in the treated water is .048 mg/L or more.

The disinfection profile will be based on daily monitoring conducted over a one-year period or three years of acceptable grandfathered data. The disinfection profile must include historical inactivations of *Giardia* for systems using chlorine for primary disinfection, and of viruses for systems using chloramines or ozone as the primary disinfectant. Daily measurements of disinfectant residual, disinfectant contact time, water temperature, and pH (for chlorine systems) is also required. A minimum inactivation benchmark will be established from the disinfection profile and used by the State to assess any of the following changes to a system's disinfection practice:

- Disinfectant application point
- Type of disinfectant
- Disinfection process
- Any other change designated by the State

7.1.14 Current Surface Water Treatment Rule

The current SWTR applies to surface water treatment plants, and has the following stipulations:

- Plants must provide treatment to achieve 99.9% (3-log) Giardia and 99.99% (4-log) virus removal/inactivation.
- Conventional water treatment plants are given a 2.5-log Giardia and 2.0-log virus removal credit.
- 0.5-log Giardia and 2.0-log virus inactivation must be achieved through disinfection, using CT provisions.
- Filtered water turbidity must be less than 0.5 NTU 95% of the time and never exceed 5.0 NTU.
- A minimum chlorine (or chloramine) residual of 0.2 mg/L must be maintained leaving the plant and entering the distribution system.

Disinfection CT is determined by multiplying the disinfectant residual C in mg/L by the effective disinfectant contact time T in minutes. T is actually the T_{10} determined by tracer studies. Required CT values to obtain the 0.5 log *Giardia* and 2.0 log virus inactivation credit are dependent upon the water temperature and pH and the disinfectant used. Table 7.7 presents CT requirements for various disinfectants at various temperatures.

Table 7-7
Disinfection CT Requirements*

Disinfectant	0.5 Log Giardia Inactivation				2.0 Log Virus Inactivation			
	3C	5C	10C	20C	3C	5C	10C	20C
Ozone	0.40	0.32	0.23	0.12	0.75	0.6	0.5	0.25
Chlorine Dioxide	7.2	4.3	4.0	2.5	7.0	5.6	4.2	2.1
Chlorine	48	41	30	15	4	4	3	1
Chloramine	500	365	310	185	1050	857	643	321

*At pH 8.0

7.1.15 Filter Backwash Rule

The 1996 SDWA Amendments require the EPA to promulgate a regulation for recycling filter backwash water. The regulation is scheduled for proposal in late 1999 or early 2000 with the final regulation being promulgated in August 2000. Compliance with the Filter Backwash Recycle Rule is expected within 36 months after promulgation (August 2003). The Filter Backwash Rule is expected to require water treatment facilities to recycle their filter backwash either to the headworks of the plant (prior to rapid mixing) or to return it to its source (in this case, the Mississippi River). While no specific requirements for the rule have been defined at this time, likely issues to be addressed include:

- Disinfection, clarification, or other treatment requirements for used washwater.
- Rate at which reclaimed washwater is returned to the main treatment process.
- Point in the main treatment process that the reclaimed water is returned.
- Water quality standards or goals for reclaimed washwater.

7.1.16 Arsenic

The current MCL for arsenic, which was established as part of the National Interim Primary Drinking Water Regulations in 1975, is .050mg/L. A new MCL was expected in 1993. However, because of controversies with nearly all aspects of the rulemaking process health effects, occurrence data, treatment technologies, implementation costs and analytical methods a new arsenic rule is still pending.

The 1996 SDWA Amendments require the EPA to propose an arsenic rule by January 2000 and promulgate the rule by January 2001. The new arsenic MCL is expected to be in the range of 0.002 to 0.020 mg/L.

7.1.17 Sulfate Rule

Currently sulfate is regulated as a secondary contaminant that is, a contaminant which may affect the aesthetic quality of drinking water. The EPA established a secondary MCL of 250 mg/L as part of the National Interim Secondary Drinking Water Regulations in 1975. Subsequently the Texas Department of Health, acting as the primary enforcement agency in Texas for the SDWA, adopted a secondary MCL of 300 mg/L in 1977.

In December 1994, the EPA proposed a primary MCL of 500 mg/L for sulfate. The proposed regulation provided an alternate to MCL compliance by allowing water systems to comply through a public education/notification and bottled water program. In light of uncertain implementation costs, inadequate health data, and pending reauthorization of the SDWA, the final sulfate rule was not promulgated in May 1996 as originally scheduled.

The 1996 SDWA Amendments require the EPA to complete a joint study with the Centers for Disease Control to assess the health effects of sulfate by February 1999 and determine whether to regulate sulfate by August 2001. If the EPA decides to regulate sulfate, the sulfate rule must be reproposed by August 2003 and promulgated by February 2005.

7.1.18 Radon and Other Radionuclides

The EPA proposed radionuclide standards in July 1991 to revise the standards established as part of the National Interim Primary Drinking Water Regulations in 1975 and to regulate additional contaminants. In August 1997, the EPA withdrew the proposed MCL for radon, as required by the 1996 SDWA Amendments. These current and proposed radionuclide standards are summarized in **Table 7.8.**

Table 7-8
Current and Proposed MCLs for Radionuclides

Contaminant	Current MCL	Proposed MCL
Radon 222	None	None
Radium 226	5 pCi/La b	20 pCi/L
Radium 228	5 pCi/Lb	20 pCi/L
Uranium	None	20 g/L
Adjusted Gross Alpha Emitters	15 pCi/L	15 pCi/L
Gross Beta and Photon Emitters	4 mrem/yrc	4 mrem/yr

[a] pCi/L = Picocurie per liter, a measure of the disintegration of a radionuclide.
[b] MCL is combined total of Radium 226 and Radium 228.
[c] mrem/yr is a measure of the dose effect of radiation.

The 1996 SDWA Amendments address radon but none of the other radionuclides. The Amendments require the EPA to propose and promulgate a radon standard after the National Academy of Sciences has completed a risk assessment study. The risk assessment must be published by February 1999, with proposal and promulgation of the radon rule to follow by August 1999 and August 2000, respectively. The new MCL for radon is expected to be in the range of 200 to 300 pCi/L.

Although radionuclides other than radon are not addressed in the 1996 SDWA Amendments, their regulation remains subject to court-negotiated deadlines. The EPA has agreed to repropose and promulgate standards for uranium by late 2000. At the same time, the EPA must either set standards for the remaining radionuclides or publish a notice of nonregulation.

7.2 Compliance with Current and Proposed Regulations

7.2.1 Algiers WTP

Current Regulations

The Algiers WTP is in full compliance with the Stage 1 D/DBP Rule. A summary of THM data for the Algiers WTP for 3501 East Canal St. is provided in **Table 7-9**. In order to achieve proper CT times during cooler months the Algiers WTP must practice disinfection with free chlorine. THM levels during these months increase as indicated in Table 7-9, however, they remain in compliance with Stage 1 D/DBP Rule levels.

Table 7-9
Algiers WTP THM Data
(As Determined by the Louisiana Department of Health & Hospitals)

Site	Date	Total THM (mg/L)
3501 East Canal St.	2/8/96	0.04
	10/22/96	0.01
	6/3/97	0.07
	9/29/97	0.04
	12/2/97	0.05
	3/26/98	0.04
	6/3/98	0.066
	9/8/98	0.06
	12/7/98	0.04
	3/15/99	0.04
	5/17/99	0.07

The Algiers WTP is also in compliance with the Interim ESWTR. As stated previously, in order to obtain proper disinfection at the Algiers WTP, free chlorination must be practiced during cooler months. Calculation of CT times for the Algiers WTP, as provided in Section 5 of this report, indicates that the Algiers WTP is in compliance with the Interim ESWTR for disinfection. However, some operational improvements may be warranted.

The Algiers WTP has recently added turbidity meters for each individual filter at the Algiers WTP. Currently the filters at the Algiers WTP consistently produce filtered water turbidities of 0.1 NTU or less.

Given that the New Orleans river water has an average alkalinity of 115 mg/L as CaCO3, and that the raw water TOC average at the Algiers WTP is in the >4 – 8 range (actual value: 4.76 mg/L), Table 7.5 indicates that the requirements for enhanced coagulation or enhanced softening is 35% TOC removal. According to 1999 data from the Algiers plant, the average TOC value of the effluent from the EIMCO 1-4 clarifiers is 3.49 mg/L. This equates to a 27% removal and therefore does not meet the D/DBPR regulations for enhanced coagulation and enhanced softening.

Table 7-10
Algiers WTP TOC Removal Data

Year	Quarter	Raw Water TOC (mg/L)	Settled Water TOC (mg/L)	Percent Removal (%)
1999	Jan-Mar	unavailable	Unavailable	N/A
	Apr-Jun	5.44	3.37	38.05
	Jul-Sep	4.56	3.55	22.15
	Oct-Dec	4.00	3.57	10.75

Future Regulations

Algiers WTP may not likely comply with the Stage 2 D/DBP Rule as currently proposed. The WTP will particularly have difficulty in meeting THM requirements in cooler months when disinfecting with free chlorine is practiced. It has been previously been proposed that a chloramine contact chamber can be designed and constructed to eliminate the need for free chlorination. This would provide sufficient CT time without free chlorination and would reduce THM formation. However, this contact chamber may not meet the potential disinfection requirements of the Long Term ESWTR, particularly for *cryptosporidium*.

Implementing ozone or other treatment technologies may resolve both compliance with the Stage 2 D/DBP Rule and the Long Term ESWTR. However, as discussed in Section 3, further investigation of ozonation and other technologies may be warranted to determine the most feasible solution to meet these future requirements. CDM recommends that further investigation of these solutions be initiated. Budgetary provisions should be made to plan for implementation of these solutions. However, implementation closer to the finalization of the proposed regulations, if possible, will assure effective use of capital.

Used backwash is currently being pumped to the Lamarque Canal, which eventually flows into the intracoastal waterways. Currently, the DEQ is concerned with this method of recycling because of the high amount of solids found in the backwash that enter the canal and eventually travel to estuarine waterways. In order to meet anticipated Filter Backwash Rule regulations, the filter backwash must be pumped either to the headworks (prior to rapid mixing) or else back to its source, the Mississippi River. The problem with pumping filter backwash water to the headworks of the plant is that it could increase chemical demands, disinfection byproducts and pathogenic microorganisms. The changes in water quality could complicate compliance with future regulations. The previous practice of returning backwash flows to the headworks at the plant, resulted in changes in the quality of sludge settled. This in turn increased maintenance of the settling basins. It is therefore recommended that the filter backwash be returned to the river. This solution, if implemented, would meet current state and federal regulations and would increase the plant's ability to comply with future regulations.

7.2.2 Carrollton WTP

Current Regulations

Since the Carrollton WTP services over 100,000 people, it had to conform to the EPA's Information Collection Rule (ICR). Under the ICR, DBPs and disease-causing micro-organisms were analyzed in order for the EPA to determine cost-effective yet health protective levels of the previously listed parameters that all water treatment plants serving a population over 10,000 would have to meet. The DBPs were tested quarterly for 18 months.

The Carrolton WTP is in full compliance with the Stage 1 D/DBP Rule. A summary of THM data for the Carrolton WTP for 1997 and 1998 is provided in Table 7.10 (as collected for the ICR). The Carrolton WTP has more than sufficient CT time for disinfection through the use of the C Basins. This allows the use of chloramines year round and prevents the formation of THMs.

Table 7-11
Carrolton WTP THM Data

Date	Location	Total THM (mg/L)
8/5/97	SDS*	0.020
11/4/97	After Filtration	0.026
	Finished Water	0.018
	SDS	0.027
2/3/98	After Filtration	0.016
	Finished Water	0.018
	SDS	0.018
5/5/98	After Filtration	0.028
	Finished Water	0.023
	SDS	0.026
8/4/98	After Filtration	0.023
	Finished Water	0.025
	SDS	0.024
11/3/98	After Filtration	0.020
	Finished Water	0.019
	SDS	0.021

*SDS stands for Simulated Distribution System sample.

Although no samples were actually taken from the distribution system, the EPA, through the Information Collection Rule, asked the water treatment plants involved to create SDS samples by incubating water from the plant tap at the average distribution detention time and temperature of the system. Although this is not considered proof that the Carrollton WTP is meeting THM regulations within the distribution system, it is the only information available at this time.

The Carrollton WTP is also in compliance with the Interim ESWTR. As stated previously, the C Basins provide more than sufficient CT time while practicing disinfection with chloramines. However, the ability of the Carrollton WTP to consistently meet the filtered turbidity requirements of this rule may be marginal. Tables 7.11 and 7.12 indicate the performance of the G&L basins and the Sycamore and Claiborne Filters. Although this data indicates that the WTP is in compliance with the 0.3 NTU filtered water requirements of the Interim ESWTR, consistent compliance appears marginal. The requirement of the combined filtered water turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the monthly samples may be difficult to obtain. A 95% confidence interval, calculated in Table 7.12, indicates that compliance may be marginal. In addition, it appears the maximum combined filtered water turbidity of 1.0 NTU may be exceeded. Also, the filters currently do not have individual turbidity measurements as required.

Table 7.12
Carrollton WTP Settled Water Turbidity

Date	Basin ID	Average (NTU)	%>2 NTU (%)	%>4 NTU (%)	Std. Dev. (NTU)	Upper 95% (NTU)
1996	G & L Effluent	7.9	98	83	4.5	16.8
1997	G & L Effluent	6.3	98	60	6.4	18.9
1996	C Effluent	4.6	93	51	2.5	9.5
1997	C Effluent	3.5	79	27	2.0	7.4

Table 7-13
Carrollton WTP Filter Performance

Date	Filter ID	Average (NTU)	Maximum (NTU)	Std. Dev. (NTU)	Upper 95% (NTU)
1996	Sycamore Combined	0.19	1.2	0.08	0.36
1996	Claiborne Combined	0.20	1.0	0.08	0.36
1997 - 98	Sycamore Combined	0.14	0.68	0.06	0.24
1997 - 98	Claiborne Combined	0.25	1.8	0.07	0.29

As shown in **Table 7.11**, the marginal performance of the filters may be due to the quality of water prior to the filters. The G&L basins provide water, which may be difficult to consistently filter to levels less than an NTU of 0.3 NTU without operational difficulties, increased backwashing, etc. Thus, to improve filter performance the improvements to the G&L Basins and the Sycamore Filters should proceed as planned to assure compliance with the Interim ESWTR.

Given that the New Orleans river water has an average alkalinity of 115 mg/L as CaCO3, and that the raw water TOC average at the Carrollton WTP is between 4 and 8 mg/L range (average value: 4.45 mg/L), Table 7-5 indicates that the requirements for enhanced coagulation and enhanced softening is 35% TOC removal. According to 1999 data from the Carrollton plant, the average TOC value of the effluent from the L3 and L4 clarifiers is 3.49 mg/L. This equates to a 22% removal and therefore does not meet the D/DBPR regulations for enhanced coagulation and enhanced softening.

Table 7-14
Carrollton WTP TOC Removal Data

Year	Quarter	Raw Water TOC (mg/L)	Settled Water TOC (mg/L)	Percent Removal (%)
1999	**Jan-Mar**	unavailable	unavailable	N/A
	Apr-Jun	5.44	3.33	38.79
	Jul-Sep	4.56	2.44	46.49
	Oct-Dec	4.00	2.48	38.00

Future Regulations

Carrollton WTP will most likely be in compliance with the Stage 2 D/DBP Rule as currently proposed. This will largely be due to the ability to utilize chloramines to obtain sufficient CT times through the C basins. However, the C basins may not meet the additional disinfection requirements of the Long Term ESWTR, particularly for *cryptosporidium*.

Implementation of ozonation or other treatment technologies may resolve compliance with the Long Term ESWTR. However, as discussed in Section 3, further investigation of ozonation and other technologies may be warranted to determine the most feasible solution to meet these future requirements. It is recommended that further investigation of these solutions be initiated. Budgetary provisions should be made to plan for implementation of these solutions. However, implementation closer to the finalization of the proposed regulations, if possible, will assure effective use of capital improvements required.

As stated previously, the Carrolton WTP currently recycles its backwash to the headworks of the plant, before the rapid mixing stage. Although this method meets current FBR regulations, due to the possibility of concentrating disinfectants, disinfectant byproducts and pathogenic microorganisms, it is recommended that the need to pump backwash back to the river be further discussed with S&WB staff to help meet future and current regulations.

Section 8
Conclusions and Recommendations

8.1 Conclusions

1. Further evaluation of the requirements for ozonation at both the Algiers and Carrollton WTPs needs to be assessed.

   a. The design of any ozonation system should accommodate all future regulatory requires for disinfection and DBP control. If acid feed systems are required for the ozonation, comparison to other alternatives systems such as membranes and ultraviolet disinfection should be considered.

   b. Further pilot testing to determine acid feed dosages should be considered to establish the costs between alternative systems.

   c. Implementing ozone at both plants should await the outcome of pending regulations if possible.

2. The existing power system is reliable with multiple levels of redundancy. However, a large proportion of the electrical equipment is in excess of twenty years old. CDM does not recommend replacing the equipment at this time but recommends that S&WB develops a replacement schedule be developed. This replacement schedule will provide an orderly transition for replacement of electrical equipment when components are no longer supported by manufacturers and cannot be obtained on the replacement parts market or fabricated by the Sewage and Water Board (SW&B) personnel.

3. The existing process control system is rudimentary where it exists and a plan should be implemented to provide both plants and ancillary facilities with a partially automated control system. This system should include greater levels of monitoring with automatic generation of reports and historical data gathering. This would provide correlation between the process equipment and power usage. Which can aid in developing plant energy load profiles optimizing power usage and allowing more aggressive rate structure negotiations.

4. Little or no automation of chemical feed systems are provided throughout the Algiers and Carrollton WTPs based upon flow and water quality measurements. An assessment of potential cost savings through such automation measurements should be obtained. The need to implement automation should be based upon the estimated return on investment.

5. The monitoring program for zebra mussels should be reinstated at both the Algiers and Carrollton WTPs. The monitoring frequencies should be revised based upon observations of plant operators over the last several years. Capital improvements to utilize polymer for zebra mussel control should be delayed until the need is further demonstrated.

6. The purposed closed-loop chlorine scrubber system at the Algiers WTP should be upgraded to a once through negative pressure system. Operational and capital costs to convert the chlorine system to a sodium hypochlorite system should be further evaluated and weighed against the risk of operating a chlorine gas system with upgraded scrubbing systems.

7. Installation of a chlorine contact chamber at the Algiers WTP prior to installation of a future ozonation system, warrants further investigation. Although the Algiers WTP experiences some operational difficulties achieving adequate CT times in cooler months, installation of a static mixer prior at the new pumping station should be investigated to resolve these operational issues prior to proceeding with installation of a contact basin.

8. Installation of a containment area and a once through negative pressure emergency scrubber system for the both the rail car and one-ton chlorination systems at the Carrollton WTP should be further evaluated and weighed against the capital and operational costs of converting to an alternate disinfection system such as sodium hypochlorite. At a minimum a sheltered area with monorail should be provided for the one-ton storage area.

9. A feasibility study should be provided for both the Algiers and Carrollton WTPs to provide containment and emergency scrubber systems for ammonia.

10. Based upon the recent preamble for the Filter Recycle Rule, it appears discharge of filter backwash water to the headworks at each plant will be acceptable. This eliminates the need to relocate the filter backwash location for the Carrollton WTP. However, due to current discharge permit and operational problems the filter backwash discharge at the Algiers WTP may need to be relocated to the Mississippi River. The need to relocate the discharge for both WTPs to the Mississippi River should be further reviewed with the S&WB staff.

11. Rehabilitation of the EIMCO Unit #1 at the Algiers WTP should be initiated, if not already underway.

12. The ability of the Carrollton WPT and Algiers WTP to meet enhanced coagulation requirements for TOC removal may not be adequate and should be further investigated.

8.2 Recommendations

1. An ozonation/disinfection study should be authorized to further evaluate the feasibility of ozone at both Algiers and Carrollton, establish interim improvements for disinfection at the Algiers WTP, and to evaluate the need for emergency scrubbers or sodium hypochlorite systems at Algiers and Carrollton.

2. If feasible installation of ozonation facilities at both WTPs should await the outcome of pending regulations if possible.

3. The chemical feed/instrumentation study should be authorized to further evaluate the need to upgrade and automate chemical feed systems and the need to improve or provide instrumentation and controls at the Carrollton and Algiers WTP. The payback period of all improvements identified should be defined as part of this study. Enhancement of chemical addition at the Algiers and Carrollton WTP to assure compliance for enhanced coagulation for TOC removal should be established in this study.

4. The improvements to the G&L Basins and Sycamore Filters at the Carrollton WTP should proceed as planned to improve current plant performance and reliability and to assure compliance with future regulations. If funding of improvements is a concern, construction can be staged as necessary over several years. Use of high rate clarification equipment in lieu of the currently proposed improvements for the G&L Basins should be considered prior to initiation of final design.

5. Reassess and reinstitute zebra mussel monitoring efforts at both the Algiers and Carrollton WTPs.

6. Delay capital improvements (i.e. Carrollton polymer feed facilities) for zebra mussel control until the monitoring program confirms the need for these improvements.

7. Eliminate the discharge of filter backwash water to the Lamarque Canal for the Algiers WTP and reroute to the Mississippi River.

8. Reassess the need to route filter backwash water discharges from the Carrollton WTP to the Mississippi River based upon the recent preamble to the proposed Filter Recycle Rule.

9. Intake piping improvements for the Carrollton WTP should proceed as currently planned.

10. PAC feed facilities and finished water storage piping changes at the Carrollton WTP should be provided when funding becomes available in the future.

Section 9
Implementation Plan

Based upon completion of the evaluation of the Algiers and Carrollton WTPs, as provided in the previous sections, CDM recommends the implementation of several capital improvements. The recommended improvements are provided in two phases, Phase I, short term implementation and Phase II, long term implementation. Phase III and IV improvements as provided in Malcolm Pirnie's Master Plan Update summary are not included. The Phase I improvements are further delineated into required improvements and improvements which should be implemented at the discretion of the S&WB.

Phase I Immediate Improvements - Recommended

These are improvements recommended to instituted within the short term.

A. Carrollton G&L Basin Improvements
The final design of the G&L Basin improvements as described within this document should be initiated immediately. However, the improvements should allow for staged construction of mixing, flocculation, lime addition, sludge removal, and other improvements, followed by the addition of plate settlers and associated equipment as necessary. The S&WB should also consider installation of high rate clarifiers in lieu of the previously proposed improvements. The cost schedule provided in **Table 9-1** and project implementation schedule provided as **Figure 9-1** reflect this staged construction. The addition of plate settlers and associated equipment should be provided in anticipation of pending regulations.

B. Carrollton WTP Sycamore Filter Improvements
The design of the Sycamore Filter improvements as described within this document should be proceed on schedule. However, it funding of the improvements is a concern, construction of the improvements may be staged as necessary. The cost schedule provided in **Table 9-1** and project implementation schedule provided as **Figure 9-1** reflect this staged construction.

C. Carrollton Intake Piping Improvements
The design of the improvements to the intake piping at the Oak Street intake pumping station should proceed as described within this document. The cost schedule and project implementation schedule for this project are provided in **Table 9-1** and **Figure 9-1** , respectively.

D. Chemical Feed and Instrumentation Study – Both Plants
The chemical feed/instrumentation study should be authorized to further evaluate the need to upgrade and automate chemical feed systems and the need to improve or provide instrumentation and controls provided at the Carrollton and Algiers WTP. All payback of all

improvements should be identified as part of this study. The costs and schedule for this study are provided in **Table 9-1** and **Figure 9-1**, respectively.

E. Disinfection/Ozone Study – Both Plants
This study should include evaluation of sodium hypochlorite for disinfection at both plants in lieu of chlorine provided with upgraded enclosures and scrubber systems. In addition, the feasibility of enclosures and scrubbers for ammonia at both plants should be assessed. The previously provided ozone study should be expanded to assess the total costs of ozonation systems at both plants and compare these potential costs to alternative technologies such as membranes and ultraviolet disinfection. Additional ozone pilot testing should be provided as necessary. The costs and schedule for this study are provided in **Table 9-1** and **Figure 9-1**, respectively.

F. Algiers Disinfection Improvements
Static mixers should be installed downstream of the new filters and the cold weather ammonia injection point. This will assure proper mixing and chloramine formation prior to the high service pumps at the new pump station. This should improve operational conditions to delay the need for a chlorine contact channel to a long term disinfection solution to pending regulations is established. Budgetary costs and schedule for implementing these improvements are provided in **Table 9-1** and **Figure 9-1**, respectively.

G. Zebra Mussel Inspection Program – Both Plants
An inspection program for zebra mussels should be continued at both the Algiers and Carrollton WTPs as discussed within this document. The costs of continuing this program are provided in **Table 9-1**.

H. Chemical Feed and Instrumentation Improvements – Short Term
For planning purposes an budgetary allocation for improvements recommended by the Chemical Feed and Instrumentation study has been provided within **Table 9-1** and **Figure 9-1**.

I. Algiers Filter Backwash Discharge Modifications
Improvements proposed would include piping and pump modifications to discharge filter backwash to the Mississippi River. The need to discharge to the river may not be required by the Filter Recycle Rule. However, discharge to the river may further assure protection of the water supply at this plant. The need to provide this improvement requires further discussion with the S&WB staff. The costs and schedule to implement these improvements is provided in **Table 9-1** and **Figure 9-1**, respectively.

Phase I Immediate Improvements – Discretionary

These are improvements that may be instituted within the short term, but only at the discretion of the S&WB. Further discussion may be required prior to their implementation.

A. Carrollton Filter Backwash Discharge Piping

Improvements proposed would include piping and pump modifications to discharge filter backwash to the Mississippi River. The need to discharge to the river may not be required by the Filter Recycle Rule. However, discharge to the river may further assure protection of the water supply at this plant. The need to provide this improvement requires further discussion with the S&WB staff. The costs and schedule to implement this improvement is provided in **Table 9-1** and **Figure 9-1**, respectively.

B. Algiers Chemical Feed Improvements
Movement of the ferric feed point for the Algiers WTP has been recommended to improve the effectiveness of the PAC feed facility at this WTP. This improvement is still recommended, however, due to current funding concerns, the urgency of providing this project in the near term needs to be further discussed with S&WB staff. The costs and schedule for this improvement is provided in **Table 9-1** and **Figure 9-1**, respectively.

C. Emergency Scrubber/Sodium Hypochlorite Systems
Dependent on the outcome of the ozone/disinfection study either conversion to a sodium hypochlorite disinfection system or provision of enclosures and emergency scrubbers for the existing systems will be recommended. These items are not required, but most likely will be strongly recommended to minimize the S&WB's potential liabilities associated with operating a gaseous chlorine disinfection system. The budgetary costs and schedule to implement these improvements are provided in **Table 9-1** and **Figure 9-1**, respectively.

Phase II Long Term Improvements

A. Carrollton Polymer Feed Facilities
The need to move the polymer feed point at the intake pumping stations for the Carrollton WTP was previously provided based upon the need to control Zebra Mussels. This improvement should be instituted based upon need demonstrated through the Zebra Mussel monitoring program. The costs and schedule for this improvement is provided in **Table 9-1** and **Figure 9-1**, respectively.

B. Carrollton PAC Feed Facilities
The approval to proceed with these facilities was postponed until 2001 based up correspondence received from the S&WB (Appendix D). The schedule and need for these improvements have been adjusted accordingly. The cost and schedule for this project are provided in **Table 9-1** and **Figure 9-1**, respectively.

C. Ozonation Facilities – Both Plants
The costs and estimated implementation schedules for both plants were provided in the Water Quality Master Plan Update and Water Quality Master Plan Update Summary. Review of the ozonation pilot study indicated the need to further evaluate the feasibility of ozone with other technology alternatives. Until this completed previous cost estimated and schedules for ozone facilities are included for planning purposes. These are provided in **Table 9-1** and **Figure 9-1**.

D. Chemical Feed and Instrumentation Improvements – Long Term
Based upon the outcome of the Chemical Feed and Instrumentation Study, long term improvements may be provided based upon their long term cost effectiveness.

E. Carrollton WTP Finished Water Storage Piping Changes
As a long term improvement the need to provide piping improvements to allow better utilization of finished water storage is recommended but should be provided when funds are available.

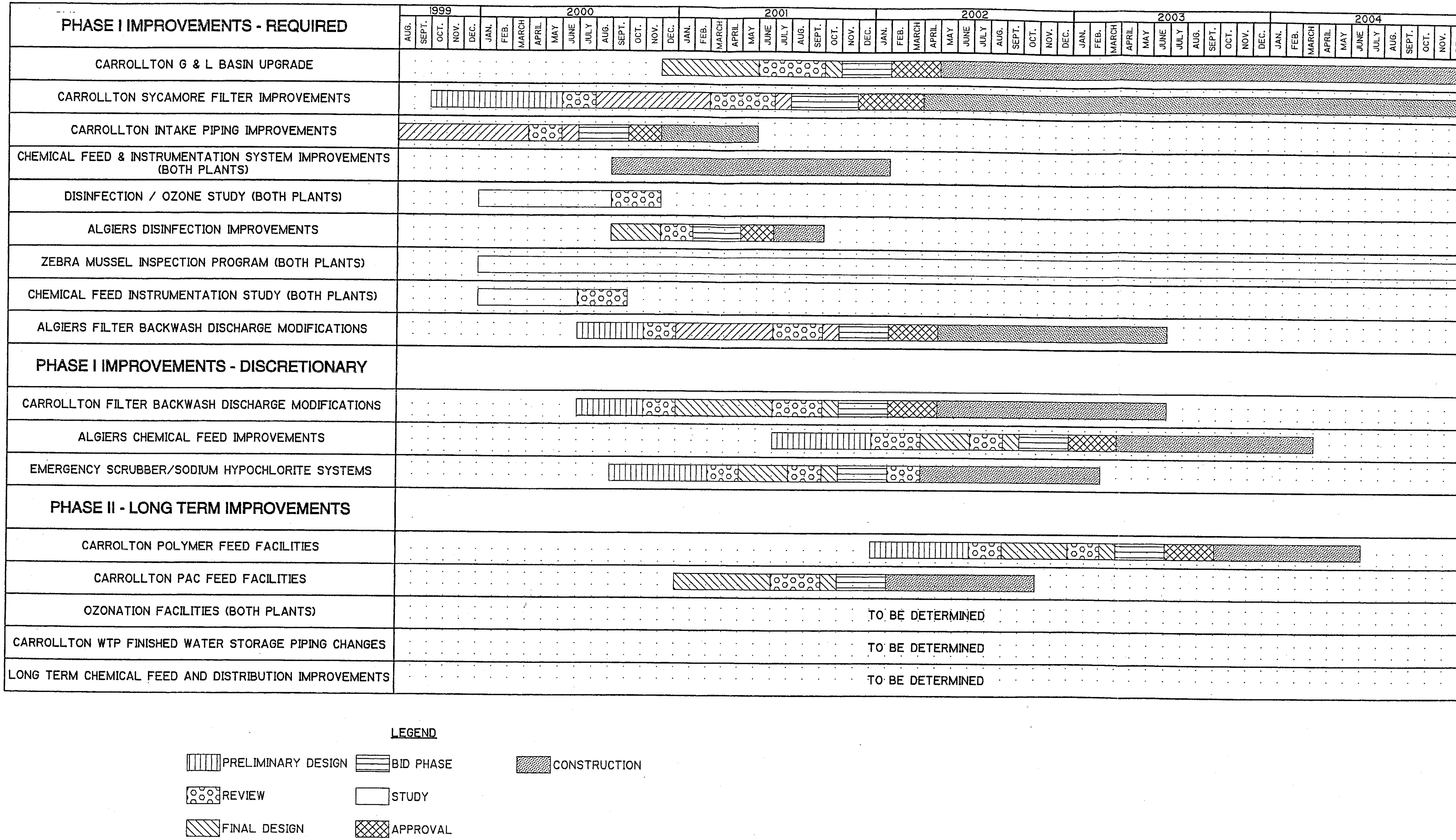


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Figure No. 9.1
SCHEDULE FOR IMPROVEMENTS TO ALGIERS & CARROLLTON WTP

Table 9-1: Capital Improvements Implementation Plan
Cost and Schedule

		Anticipated Expenditures					
Phase I Improvements - Required	Cost	2000	2001	2002	2003	2004	2005
Carrollton WTP							
G&L Basin Improvements	$12,000,000	$500,000	$2,500.000	$4,500,000	$4,500,000	$0	$0
Sycamore Filter Improvements	$11,500,000	$500,000	$200,000	$3,600,000	$3,600,000	$3,600,000	$0
Intake Piping Improvements	$1,300,000	$400,000	$900,000	$0	$0	$0	$0
Chemical Feed/Instru. Improvements (Study Only)	$180,000	$180,000	$0	$0	$0	$0	$0
Ozone/Disinfection (Study Only)	$200,000	$200,000	$0	$0	$0	$0	$0
Chemical Feed/Instrumentation - Short term*	$600,000	$100,000	$400,000	$100,000	$0	$0	$0
Algiers WTP							
Filter Backwash Discharge Modifications	$1,140,000	$50,000	$150,000	$800,000	$125,000		
Chemical Feed/Instru. Improvements (Study Only)	$180,000	$180,000	$0	$0	$0	$0	$0
Disinfection Improvements	$200,000	$200,000	$0	$0	$0	$0	$0
Ozone/Disinfection (Study Only)	$200,000	$200,000	$0	$0	$0	$0	$0
Chemical Feed/Instrumentation - Short term*	$600,000	$100,000	$400,000	$100,000	$0	$0	$0
Subtotal	$28,100,000	$2,610,000	$4,550,000	$9,100,000	$8,225,000	$3,600,000	$0
Contingency (10%)	$2,810,000	$261,000	$455,000	$910,000	$822,500	$360,000	$0
TOTAL	**$30,910,000**	**$2,871,000**	**5,005,000**	**$10,010,000**	**$9,047,500**	**$3,960,000**	**$0**

* Budgetary Allocation Only

Table 9-1 (cont.)
Capital Improvements Implementation Plan
Cost and Schedule

		Anticipated Expenditures					
Phase I Improvements - Discretionary	Cost	2000	2001	2002	2003	2004	2005
Carrollton Filter Backwash Discharge Modifications	$1,825,000	$60,000	$190,000	$1,300,000	$275,000	$0	$0
Algiers Chemical Feed Improvements	$1,180,000	$0	$90,000	$90,000	$1,000,000	$0	$0
Emergency Scrubber/Hypochlorite Systems*	$1,000,000	$50,000	$50,000	$900,000	$0	$0	$0
SUBTOTAL	$4,005,000	$110,000	$330,000	$2,290,000	$1,275,000	$0	$0
Contigency (10%)	$400,500	$11,000	$33,000	$229,000	$127,500	$0	$0
TOTAL	$4,405,500	$121,000	$363,000	$2,519,000	$1,402,500	$0	$0

* Budgetary Allocation Only

Table 9-1: (Cont.)
Capital Improvements Implementation Plan
Cost and Schedule

Phase II Improvements	Cost	2000	2001	2002	2003	2004	2005
				Anticipated Expenditures			
Carrollton Polymer Feed Facilities	$1,200,000	$0	$0	$120,000	$380,000	$700,000	$0
Carrollton PAC Feed Facilities	$1,460,000		$60,000	$1,400,000	$0	$0	$0
Carrollton Ozone Facilities	$28,000,000	$0	$0	$0	$700,000	$1,400,000	$13,000,000
Algiers Ozone Facilities	$9,900,000	$0	$0	$0	$200,000	$600,000	$4,500,000
Long term Chemical Feed and Instrumentation Improvements*	$6,000,000	$0	$500,000	$2,750,000	$2,750,000	$0	$0
Carrollton WTP Finished Water Storage Piping	$2,000,000	$0	$0	$1,000,000	$1,000,000	$0	$0
Subtotal	$48,560,000	$0	$560,000	$5,270,000	$5,030,000	$2,700,000	$17,500,000
Contingency (10%)	$4,856,000	$0	$56,000	$527,000	$503,000	$270,000	$1,750,000
TOTAL	**$53,416,000**	**$0**	**$616,000**	**$5,797,000**	**$5,533,000**	**$2,970,000**	**$19,250,000**

*Budgetary Allocation Only

Table 9-1 (Cont.)
Capital Improvement's Implementation Plan

SUMMARY OF CAPITAL IMPROVEMENTS IMPLEMENTATION PLAN

Project Description	Cost	Anticipated Expenditures 2000	2001	2002	2003	2004	2005
Phase I Improvements - Required	$30,910,000	$2,817,000	$5,005,000	$10,010,000	$9,047,500	$3,960,000	$0
Phase I Improvements-Discretionary	$4,405,500	$121,000	$363,000	$2,519,000	$1,402,500	$0	$0
Phase II - Long Term Improvements	$53,416,000	$0	$616,000	$5,797,00	$5,533,000	$2,970,000	$19,250,000
TOTAL	**$88,731,500**	**$2,992,000**	**$5,984,000**	**$18,326,000**	**$15,983,000**	**$6,930,000**	**$19,250,000**

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APPENDIX A

DETAILED SCOPE OF SERVICES

APPENDIX A

DETAILED SCOPE OF SERVICES

PHASE A - EVALUATION/STUDY

Task A1 - Plant Evaluations

Task Objectives: To develop an Implementation Plan for improvements and modifications at both the Algiers WTP and Carrollton WTP that will result in providing the desired performance to meet water quality goals and regulatory requirements; maintaining future capacity requirements; and improving the ease of facility operations and plant process control.

Subtask A1.1 - Review of Existing Studies and Reports. The CDM team will review all available documents, including the existing plans and specifications, and such reports as the "Water Master Plan Update", and the pilot scale ozonation study to familiarize itself with the existing WTP facilities and recent plans for improvements.

Duration:	*4 weeks*
Deliverables:	*Briefing Paper discussing the documents reviewed, with comments and potential concerns to be addressed.*

Subtask A1.2 - Review of Preliminary Designs. The CDM team will provide a detailed review of the preliminary design plans and specifications for two projects, the Carrollton WTP Intake Piping Modifications and the Carrollton WTP G&L Bain Modifications. This will allow CDM to accept responsibility for the final design to be provided for both projects. Recommendations changes will be provided upon complete of the review.

Duration:	*10 weeks*
Deliverables:	*A detailed summary of recommended changes to be provided within the final design for both projects.*

Subtask A1.3 - Perform Process & Hydraulic Evaluations. The CDM team will conduct an audit of the Algiers WTP and the Carrollton WTP to evaluate the process and hydraulic systems to ascertain current capabilities and vulnerabilities in light of current and proposed regulations; desired capacities; reliability and redundancy concerns; safety; and operational and maintenance ease and flexibility. The audit will address the following:

1. Raw water supply and chemical feed
2. Coagulation and sedimentation systems, including sludge collection
3. Filtration systems, including backwash

4. Disinfection systems,
5. Clearwell storage and pumping
6. Waste backwash water disposal
7. Sludge handling and disposal
8. Chemical storage, handling and application systems
9. Electrical distribution and control systems
10. Instrumentation monitoring and control systems
11. In-plant hydraulic conveyance systems
12. Ancillary support systems, including plant drainage, plumbing, and HVAC

Audit determinations will be based on physical inspections; plan and specification review conducted in Subtask A1.1; engineering calculation; field measurements (flows, pressures, levels, etc.) operations and maintenance staff interviews; engineering report review conducted in Subtask A1.1; and raw, process unit, and finished water quality report reviews. Hydraulic determinations will be calibrated through actual liquid level to known elevation measurements (referenced to plant evaluation datum) at a minimum of two steady state flow conditions.

The CDM team will prepare a status paper that documents the results of the process and hydraulic audit and will describe the condition and capabilities of each of the WTP's systems and delineate system vulnerabilities with respect to capacity, regulatory compliance, reliability and redundancy, safety, operational flexibility, and maintenance ease. All identified vulnerabilities will be substantiated with appropriate rationale. The status paper will also include the established hydraulic profiles; process and instrumentation diagrams; and supporting graphics as necessary to establish the status of the existing WTPs.

This draft status paper will be distributed to the Sewerage & Water Board of New Orleans staff for review and comment and a workshop will be scheduled and convened to discuss and finalize the paper.

Duration: *8 weeks*
Deliverables: *Status Paper documenting the plant audit*

Subtask A1.4 - Regulatory Update

The purpose of this subtask is to review the both WTPs' capabilities of meeting the current and proposed federal regulatory requirements, while maintaining desired water quality goals. The proposed Disinfectants/Disinfection Byproducts Rule (D/DBPR) and Enhanced Surface Water Treatment Rule (ESWTR), to be finalized in November 1998, have been revised since completion of the "Water Quality Master Plan Update". These changes may impact previously anticipated disinfection and/or filtration requirements. For example, the implementation of ozonation may not be required for the plants to meet the Stage 1 requirements of the D/DBPR while complying with the ESWTR.

Limited bench scale testing will be conducted to evaluate the current process in terms of total organic carbon (TOC) removal and disinfection byproduct (DBP) formation.

A status paper will be prepared discussing the capabilities of each of the plants in meeting the requirements of these rules; the process changes and facility modifications or additions required; impacts of modifications on other facilities; operational and cost impacts. This status paper will present schematic diagrams and facility layouts for proposed modifications. It will also recommend the need for future studies, i.e. **Task 3 - Ozonation Study**, should such facilities be required.

Duration:	*4 - 6 weeks*
Deliverables:	*Status Paper presenting an update of regulations and outlining the impact on the WTPs and their current and future operation.*

Subtask A1.5 - Develop Implementation Plan for Improvements. The results of subtasks A1.1, A1.2, and A1.3 will be used to develop an Implementation Plan for recommended improvements to both the Algiers WTP and Carrollton WTP. This implementation plan will present phased improvements required for each plant. The scheduling of the these improvements will be based upon current condition of facilities, regulatory compliance requirements, operational cost implications, and other factors. The implementation plan will present estimated construction costs associated with each of the improvements.

The implementation plan will also include potential long-term improvements that may be required in the future depending upon such things as potential water quality changes or longer term regulatory requirements.

Duration:	*6 weeks*
Deliverables:	*Implementation Plan for Improvements - a bound document including descriptions of the phased improvement items, plant site layouts showing the phased improvements, implementation schedule, and construction costs.*

APPENDIX B

REVIEW COMMENTS FOR CARROLLTON INTAKE PIPING PROJECT

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

3445 North Causeway Boulevard, Suite 600
Metairie, Louisiana 70002
Tel: 504 832-7272 Fax: 504 832-7282

February 19, 1999

Mr. G. Joseph Sullivan
General Superintendent
Sewerage & Water Board of New Orleans
625 St. Joseph Street
New Orleans, LA 70165

Subject: Notice to Proceed with Final Design
Carrollton Water Treatment Plant
Low Lift River Pumping Station Intake Piping Modifications
CDM PN: 8013-22543

Dear Mr. Sullivan:

Camp Dresser & McKee, Inc. (CDM) has completed our review of the Preliminary Engineering Report for the subject project. Our questions/comments generated from this review are enclosed. Based upon this review, CDM requests a Notice to Proceed with the final design for this project to include replacement of the existing lines under the New Orleans Public Belt Road (NOBPR). Resolution of the enclosed questions/comments can occur during the preparation of final plans and specifications.

On March 25, 1998, the Sewerage & Water Board (S&WB) issued a notice to proceed to Malcolm Pirnie, Inc. for the development of final plans and specifications for this project (see enclosure). In addition, the February 2, 1999 Inter-Office Memorandum from your office indicated the urgency to address the replacement of the intake lines under the (NOPBR).

The fee for the final design should be based upon the attached construction cost estimate of $1,340,000 or a total fee of $102,840 based upon CDM's contract with the S&WB. 40% of this fee would be paid for final design services or Articles 1.30 through 1.38 of CDM's contract.

CDM does not intend to bill the S&WB for preliminary design services for this project as allowed within our contract. However, due to services rendered by our subconsultants for the project design, CDM may request an adjustment for preliminary design services completed to date corresponding to changes in the construction cost estimate.

If you wish CDM to proceed with the final design for this project at the total fee estimate of $102,840.00, please indicate your approval below and return one copy of this letter to our office.

Sincerely,

CAMP DRESSER & McKEE, INC.

Adam Faschan, Ph.D., P.E.

AF/gln

Approval:______________________ Date:_____________
G. Joseph Sullivan
General Superintendent

cc: R. St. Germain
J. Hercamp
D. Gerrity
D. Shannon

CDM Camp Dresser & McKee Inc.

QUESTIONS/COMMENTS

CARROLLTON WTP - LOW LIFT RIVER PUMPING STATION INTAKE PIPING MODIFICATIONS

1. Consider bidding project suction piping of steel and ductile iron piping (Class 53) with 40 mil inside coating of ceramic epoxu and 16 mil coal tar epoxy coating on exterior (contractors/manufacturers option).

2. Fill abandon suction pipes at embankments with 2500 psi concrete, not sand.

3. Types of piles to be used--concrete, wood or a combination of both and differential settlement for new pipe installation should be determined upon receipt of soils report.

4. Are all vacuum pump motors to operate on 25 hertz, 480 volts in lieu of 60 hertz?

5. Are cathodic projection systems required on all steel materials or just on major transmission mains?

6. Acceptable S&WB preference of vacuum pump manufacturers.

7. The preliminary intake piping modifications should be submitted/reviewed with C.O.E. and appropriate permits obtained.

8. What are conditions of the existing Oak Street Pump Station valves when a vacuum is placed on these old valves? Have they been tested?

9. Sequence of operation of the vacuum pumps with raw water pump motors. How does the system presently operate?

10. What is the City's new schedule to have these projects completed or ready for advertisement?

11. Interoffice memorandum from City, dated March 20, 1998, referred to an intake pipe leak under the railroad tracks. It is assumed these lines will be added into the contract for repair.

12. What is the City's minimum criteria concerning wall thickness for steel pipe, minimum 3/8", desirable ½"? Include cathodic protection.

13. Does the City want to increase the 4" waterline to be relocated to 8" size water main?

CDM Camp Dresser & McKee Inc.

OPINION OF ESTIMATED COST

DESCRIPTION

A. Site Improvements
1. Sewer Line and Manhole
2. New Fire Hydrant
3. Water Main
4. Seeding and Fertilizer

Quantity	Unit	Unit Cost	Cost
1	LS	-	$10,000
1	EA	$2,000	$2,000
750	LF	$80	$60,000
530	LB	$9	$4,770
		Subtotal:	$76,770

B. Material and Equipment
1. 48" Diameter Raw Water
2. Concrete
3. Piles
4. Vacuum Pumps
5. River Sand Fill
6. Jack and Bore (2 - 48" Pipe)

Quantity	Unit	Unit Cost	Cost
1600	LF	$350	$560,000
250	SY	$300	$75,000
1500	LF	$10	$15,000
1	LS	-	$30,000
6200	CY	$10	$62,000
360	LF	$500	$180,000
		Subtotal:	$922,000

C. Electrical
1. Electrical & Instrumentation

Quantity	Unit	Unit Cost	Cost
1	LS	-	60000
		Subtotal:	$60,000

SUBTOTAL INSTALLED COST:	$1,058,770
CONTRACTOR'S OH&P 15%	$158,816
SUBTOTAL:	$1,217,586
CONTINGENCY 10%	$121,759
OPINION OF TOTAL COST:	$1,339,345

(Revised: Feb. 1999)

RECEIVED

40-1105

MAR 30 REC'D

MALCOLM PIRNIE, INC.
NEW ORLEANS, LA

Sewerage & Water Board OF NEW ORLEANS

625 ST. JOSEPH STREET
NEW ORLEANS, LA., 70165 . 585-2365

G. JOSEPH SULLIVAN
General Superintendent

March 25, 1998

RECEIVED
APR 2 1998
C & S CONSULTANTS INC.

Malcolm Pirnie, Inc.
Two United Plaza
8550 United Plaza Boulevard-Suite 307
Baton Rouge, Louisiana 70809-2256

Attn: Mr. Ray F. Rials, P.E., Senior Project Engineer

RE: Carrollton Water Treatment Plant - Preliminary Engineering Report - Low Lift River Pumping Station Intake Piping Modifications - January 1998

Gentlemen:

Attached are the Engineering Department's comments on subject report. Please incorporate these comments into the plans and specifications for this job.

It should be noted that the repair of the existing 48" water intake lines should be added to this contract.

Also, please proceed with the development of final plans and specifications so that this project can be bid in early 1999.

Very truly yours,

G. Joseph Sullivan

G. Joseph Sullivan
General Superintendent

GJS/RSTG/aan

Attachments - 5

cc: H. J. Gorman
w/o Attachments.

R. St. Germain P. Barcelona
J. Huerkamp G. Preau
L. Langley G. Sarrat
M. Arnold

w/Relevant Attachments.

APPENDIX C

MAY 21, 1999 MEMORANDUM

LEAK AT OAK STREET AND PUBLIC BELT RAILROAD TRACK

CDM Camp Dresser & McKee Inc.

Memorandum

To: Attendees
Mr. Sullivan
Mr. Gorman
Mr. Marinello - NOPBRR

From: Adam Faschan *a.f.*

Date: May 21, 1999

Subject: Leak at Oak Street and Public Belt Railroad Track
CDM PN: 8013-24510-RT.MGT

A meeting was held on May 14, 1999, to discuss the need and methods to proceed with replacement of the existing 2-48 inch water lines under the New Orleans Public Belt Railroad on an emergency basis.

In Attendance Were:		
	Rudolph St. Germain	Sewerage & Water Board of New Orleans (S&WB)
	Gerald Preau	S&WB
	Larry Federico	S&WB
	Adam Faschan	Camp Dresser & McKee, Inc. (CDM)
	Jens Neilson	C&S Consultants, Inc. (C&S)
	Ricardo Contreras	C&S

Items discussed were as follows:

- It was agreed the replacement of the two (2) 48 inch diameter lines beneath the New Orleans Public Belt Railroad (NOPBR) would be replaced on an emergency basis.
- It was confirmed that engineering documents required for the emergency bid process would consist primarily of a plan and profile with notes on materials required provided on the drawings.
- The engineering documents provided would be utilized to obtain three (3) letter bids from contractors.
- A general discussion occurred on the extent of line to installed under an emergency basis. Two options were presented, replacement of the line from beneath NOPBR to the Oak Street pump station and replacement of the line from beneath NOPBR to the northern edge of Oak Street.
- Concerns were raised about the replacement of the line to the Oak Street pump station, since this would require closing Oak Street. Mr. St. Germain indicated he would confirm the extent of line to be installed by Monday, May 17, 1999.

- To proceed with the design and installation, CDM and C&S were requested to confirm the elevations of existing pipes prior to finalizing plans for the installation.

- It was suggested that Wave Tech be connected to locate the depths of existing lines.

- A general discussion of design requirements occurred which resulted in the following design criteria:

  1. Utilization of Class 54, ductile iron pipe.
  2. The replaced lines should be filled with grout.
  3. Tie-ins to the existing lines should be performed one at a time with each tie-in to take less than 24 hours.

- It was indicated that the design should be completed with two to three weeks from May 14, 1999.

- It was recommended that pipe suppliers be contacted to confirm the delivery time necessary for the required pipe and the methods required to tie into the existing pipe.

APPENDIX D

REVIEW COMMENTS FOR PAC FEED FACILITIES – CARROLLTON WTP

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

3445 North Causeway Boulevard, Suite 600
Metairie, Louisiana 70002
Tel: 504 832-7272 Fax: 504 832-7282

March 4, 1999

Mr. G. Joseph Sullivan
General Superintendent
Sewerage & Water Board of New Orleans
625 St. Joseph Street
New Orleans, LA 70165

Subject: Algiers and Carrollton WTP Improvements
Carrollton Powdered Activated Carbon Feed Facility
CDM PNS: 8013-24510

Dear Mr. Sullivan:

Camp Dresser & McKee, Inc. (CDM) has reviewed the preliminary design submittal for the subject project and enclosed our comments and questions. As indicated in the enclosed comments, CDM has concerns about the structural integrity of the platform utilized to support the proposed storage tanks. This is particularly true if a third tank is required due to height restrictions. Prior to the project proceeding as designed, CDM recommends a structural analysis be completed.

Based upon CDM's review, we support the installation of these facilities and can provide the design services for them under Task C4 - Carrollton WTP Intake Chemical Feed Facility Improvements of our contract. The preliminary design report and plans for this project have been submitted to your office for review. CDM requests your office complete your review, so we can arrange a meeting to discuss the completion of this project.

If you have any comment or questions concerning this matter, please contact me at this office.

Sincerely,

CAMP DRESSER & McKEE, INC.

Adam Faschan, Ph.D., P.E.

AF/js

cc: R. St. Germain
J. Hercamp
L. Langley
V. Fouchi
L. Fitzpatrick
C. Tobelman
D. Gerrity
D. Shannon

M145.012

COMMENTS/QUESTIONS

CARROLLTON WTP - POWDERED ACTIVATED CARBON FEED FACILITY

1. Due to the height of the proposed two (2) storage hoppers of 85' height, consideration needs to be given to the addition of a third storage hopper.

2. CDM structural engineers need to check the load bearing capacity of the PAC structure platform for the addition of another chemical storage tank(s). It is questionable as to whether existing platform has sufficient load bearing capacity.

3. Verify if existing 1 ½" Potassium Permanganate line to the Oak Street Pump Station warrants to remain in surface for PAC service due to age. Consider replacement regardless of condition.

4. Does the City prefer pneumatic or electrically controlled slurry discharge valves?

5. Does the City prefer volumetric feeders for PAC controlled dosages?

6. Verify in probable cost estimate if costs for scheduling and maintenance of flow is included in the 10% contingencies, an increase to 15-20% would be a more appropriate budgetary contingency figure at this time.

7. **Several S & WB staff have indicated the design of the PAC system should be similar to the system utilized at the Algiers WTP. This issue needs to be discussed further, since it would require significant design changes.**

MARC H. MORIAL, President
HENRY A. DILLON, JR., President Pro-Tem

REC'D MAR 19 1999

Sewerage & Water Board OF NEW ORLEANS

G. JOSEPH SULLIVAN
General Superintendent

625 ST. JOSEPH STREET
NEW ORLEANS, LA., 70165 • 585-2365

March 15, 1999

Camp, Dresser & McKee, Inc.
3445 N. Causeway Blvd.-Suite 600
Metairie, Louisiana 70002

Attn: Mr. Adam Faschan, Ph.D., P.E.

RE: Carrollton Powdered Activated Carbon Feed Facility

Gentlemen:

In response to your letter of March 4, 1999, we offer the following comments, in addition to the attached responses by our Operations Department and Electrical and Civil Engineering:

1. Since we have experience with both dry PAC and slurry PAC storage facilities, we will not accept a dry PAC storage and/or feed facility.

2. In light of the above response, it is imperative that the structural integrity of the platform be analyzed.

3. The storage facility must be two tanks minimum with at least five (5) days' storage in each tank at a feed rate of ten (10) ppm for a flow of 120 MGD.

4. It is suggested that the existing 1½" Potassium Permanganate line not be used, it is old and probably clogged.

5. The S&WB prefers using electrically controlled valves, especially since valves must be remotely controlled from the Chemical Building.

6. Metering of slurry should be through peristaltic pumps. Feeds should be introduced into common manifolded lines at the station, not at each pump suction/discharge. Use existing chemical feed locations.

7. Use bubbler system to indicate tank liquid levels such as presently used at sewer stations. Designs can be furnished.

Since this project is presently budgeted in 2001, it is premature to issue a notice to proceed with design at this time. We will reevaluate this project as funds become available.

Very truly yours,

G. Joseph Sullivan
General Superintendent

GJS/RSTG/aan

Attachments

cc: R. St. Germain
J. Huerkamp
M. Russell
V. Fouchi
M. Arnold
P. Barcelona
G. Sarrat

w/Relevant Documents.

SEWERAGE AND WATER BOARD OF NEW ORLEANS

INTER-OFFICE MEMORANDUM

DATE: October 20, 1998

FROM: Vincent P. Fouchi, Jr., Water Purification Superintendent Assistant

TO: Louis Langley, Water Purification Superintendent

RE: Comments on PAC Preliminary Design

The preliminary design drawings for the PAC facility for the Carrollton Water Plant have been reviewed and the following comments are offered.

1. Why have our consultant engineers decided on dry storage and feed of PAC? We have a fairly successful design in Algiers using slurry storage and feed. The proposed dry storage and feed system is complicated and appears that it will be a maintenance nightmare. No description of the operation of the system was offered. I think we should start over and work on designing a simple, effective, PAC slurry storage and feed system expanding off the operating (not designed) system in Algiers.

2. I believe that the slurry transfer system needs to be investigated further. The long distance between the Oak Street Station and the Industrial Avenue Station may be a problem. Also the transfer water supply should be drawn directly from the river so that the carbon system can operate when the Industrial Avenue Station is out of service.

Vincent P. Fouchi, Jr.

Vincent P. Fouchi, Jr.

SEWERAGE AND WATER BOARD OF NEW ORLEANS

INTER-OFFICE MEMORANDUM

DATE: October 14, 1998

FROM: Electrical Engineering

TO: Mr. Rudolph St. Germain, *Chief of Engineering*

RE: **Preliminary Plan - P.A.C. Facility, East Bank Plants**

We have reviewed subject preliminary plan and have little commentary to offer as there was very little presented for review.

We do offer the following:

1. We have a P.A.C. facility in Algiers. Project Title should reference Carrollton Waterworks for future clarity.

2. Rework Vicinity Map on Title Sheet, Lighten River, show all plants.

3. Sheet 1 - Proofread.

4. Sheet 2 - Two sets of LP&L Transformers? Delete nonexistent bank near station. Trestle fence gate is in the wrong place.

   There are quite a bit of existing utilities on the North edge of the storage platform, numerous relocations will be required. The existing platform was designed to support three liquid filled tanks on the North end. More than enough space would be available with Permanganate removed. Recheck for adequacy.

   Will P.A.C. Feed Equipment, Flows, Rates, etc. be monitored at the Chemical House Chemical Control System? Everything installed at Industrial Ave. River Station was monitored.

New slab area conflicts with 24KV Entergy Underground Feeder.

G. P. Sarrat

GPS/so

cc: M. Arnold
P. Barcelona
V. Fouchi

SEWERAGE AND WATER BOARD OF NEW ORLEANS

Interoffice Memorandum

DATE: October 12, 1998

FROM: Civil Engineering

TO: Rudy St. Germain, Chief of Engineering

RE: **Carrollton PAC Facility**
Preliminary Plans and Specs

We have reviewed the preliminary documents for the referenced project and respond as follows:

Drawings

Sheet 2

Sheet 2 indicates 3 - 2" PAC Feeder Lines while Sheet 1 calls for 2 - 2" PAC Feeder Lines. Which is correct?

Sheet 7

Make sure that new battered piles do not conflict with existing battered piles.

Paul W. Barcelona

PWB/pm

cc: P. Barcelona, M. Arnold, G. Sarrat

APPENDIX E

JUNE 17, 1999 - CARROLLTON G & L BASINS

PRELIMINARY DESIGN REVIEW

Memorandum

To: G. Joseph Sullivan
R. St. Germain
J. Hercamp
C. Tobelman
L. Fitzpatrick

From: Danny Shannon
Adam Faschan

Date: June 17, 1999

Subject: Sewerage and Water Board of New Orleans
Carrollton Water Treatment Plant - G and L Basins
Preliminary Design Review
CDM PN: 8013-24510-RT.MGT

Camp Dresser & McKee Inc. (CDM) has completed review of the following documents related to proposed improvements and modifications to the Carrollton Water Treatment Plant (WTP) G and L Basins prepared by Malcolm Pirnie, in association with Burk-Kleinpeter, Inc. and C&S Consultants, Inc.:

- "G and L Basins Upgrade Plan" dated February 1997.
- "Preliminary Plan Development Summary for the G and L Basin Upgrade" dated April 1998.
- Preliminary construction plans for the Modifications to the G and L Basins dated May 1998.

This memorandum presents comments on these documents and recommendations for proceeding with design completion and construction of modifications. Comments from the Sewerage and Water Board on this memorandum will be discussed in our meeting planned for Wednesday, June 30, 1999.

General Comments

The purpose of the proposed modifications to the G and L basins is to improve the rapid mix, flocculation, and sedimentation processes at the Carrollton WTP and provide improved water quality, reduce equipment maintenance requirements, and increase reliable plant capacity. The

1992 Water Quality Master Plan established a peak hourly flow rate of 240 mgd and assumed flow rates of 40 mgd through each of the L Basins and 80 mgd through each of the G Basins. Typically flocculation and sedimentation basins should be designed based upon maximum day flow. Review of maximum daily production rates as provided in the 1997 Water Quality Master Plan Update indicated a maximum daily flow of 240 mgd was only reached in one year from 1985 to 1995. It should be noted that the plant normally operates with only one L Basin and one G Basin, with the second L and G basins being down for maintenance, including manual sludge removal.

To maximize treatment capacity and maintain maximum operational flexibility the following items must be addressed:

- *Improvements to mechanical equipment to provide for minimum downtime for maintenance and repairs.*
- *Process modifications to minimize precipitation of calcium carbonate onto process equipment and structures.*
- *Improvements to sludge removal facilities to minimize manual sludge removal requirements. Provisions for simpler cleaning of sludge from process basins.*

To improve the overall treatment process the following items must be addressed:

- *Improve rapid mixing to ensure proper dispersion of chemicals.*
- *Provide capability of varying flocculation energy (G value) through the basins to improve floc formation.*
- *Improve inlet and outlet conditions at the sedimentation basins to improve settling performance.*
- *Provide variable chemical application points to allow field optimization of process.*

Rapid Mixing

1. The preliminary design includes new vertical turbine type rapid mixers for the G Basins. The plans show two new mixers for each of the two rapid mix basins. **CDM agrees with this recommendation.** Proper rapid mixing is critical for providing optimal coagulation. The mixers should be designed to provide a G value of about 300 to 500 sec^{-1}. Although the recommendation for lime addition is not at the rapid mix basin, the mixers should be specified with shafts suitable for lime addition in case lime is added at this location in the future.

2. The preliminary design includes static mixers for the L Basins. This type of mixer should provide sufficient mixing for chemical coagulant. However, it is strongly recommended that lime not be added upstream of the mixers due to the potential of calcium carbonate precipitation and resultant maintenance concerns. The design should provide proper sizing of the unit over a range of flow rates to ensure proper mixing under all operating conditions.

Chemical Addition

1. Ferric sulfate coagulant should be added as close to the point of mixing as possible to maximize chemical dispersion and minimize chemical usage requirements. **CDM agrees with the recommendation to dilute the ferric sulfate prior to injection.** This will improve dispersion.

2. Feeding lime at the rapid mix basin will inhibit ferric sulfate coagulation due to the operating pH range. **CDM agrees with the recommendation to add lime toward the last flocculation basin for raising pH to about pH 9.0.** More than one application point should be provided for operational flexibility.

3. Consider adding a parallel lime feed line to the distribution points to allow for cleaning. If chlorine solution could be added to one of the lines while the other was in service, the lime lines should remain clean.

CDM utilized the services of Susan Kane Booth, Consulting Engineer to conduct water quality modeling using the "Rothberg, Tamburini & Winsor Model for Corrosion Control and Process Chemistry" (RTW Model). The purpose of this model was to determine the potential for precipitation of calcium carbonate under various raw and settled water conditions that occur at the Carrollton WTP. A copy of the model results with a summary letter is attached. The results indicate under all conditions when a settled water pH of about 9 is achieved by lime addition, a relatively high calcium carbonate precipitation potential (CCPP) exists. Therefore, such precipitation will occur within the process basins. Ideally, adjusting pH with lime prior to the filters would prevent such precipitation within the G and L Basins or the C Basins, improve coagulation and result in better disinfection through the C Basins. However, problems associated with precipitation onto the filter media and underdrains, as well as the feasibility of adding lime at the end of the C Basins makes this option less desirable.

Flocculators

1. Variable speed drives should be maintained with the flocculators to provide for tapered flocculation. **CDM agrees with the recommendation for modifying the existing flocculator lubrication system on the G Basin units.**

Sedimentation Basins

1. **CDM agrees with the recommendation for providing a ported inlet baffle wall for the G Basins.** CDM recommends constructing the wall with reinforced concrete in lieu of fiberglass due to structural integrity. CDM further recommends that the wall ports be increased in size from 6 inches to 8 to 9 inches for two reasons: 1) the potential for calcium carbonate precipitation may result in deposits within the openings decreasing their actual size and 2) the holes should be sized to minimize the G value through the openings, so as not to shear the formed floc prior to settling. The number of openings should be determined based upon a minimum 10 to 1 ratio of velocity through the openings and velocity through the channel. This velocity difference will ensure proper flow distribution.

2. CDM recommends the inlet configuration to the L Basins be modified to reduce the energy dissipated at the inlet. The current inlet configuration results in maintenance problems due to a large deposition of solids.

   Fillets and over and under baffling should be considered at this location to assure sufficient velocity to keep solids in suspension.

3. CDM has significant concerns about using tube settlers in this application due to the potential for calcium carbonate precipitation. We feel this may present significant maintenance concerns with the tubes. CDM agrees with the preliminary design assertions that tube settlers will significantly increase the capacity of the settling basins. However, it is our recommendation to eliminate the addition of tube settlers as part of the initial design contract and to improve the sedimentation basin inlet and outlet conditions to provide optimal settling conditions. At a relatively conservative surface overflow rate of 1000 gpd/sf, the total capacity of all basins would be about 167 mgd. We feel that the basins should be able to produce low turbidity settled water at surface overflow rates up to 1.0 gpm/sf (1,440 gpd/sf). This would equate to a capacity of 240 mgd with all basins in operation.

   CDM understands that all four basins are not operated at the same time due to maintenance requirements. Improvements to the mechanical equipment and process should help to reduce the amount of downtime for these basins, such that the basins could be operated during high flow conditions.

4. CDM recommends removing the existing outlet launders and installing ported outlet walls similar to the inlet walls to be installed. This will lengthen the effective area of settling within each basin, increasing basin capacity.

5. Should tube settlers be added to the basins at some future time, the following comments will apply:

CDM agrees with the recommendation to incorporate chain and flight sludge collectors in lieu of the vacuum type sludge removal mechanisms.

The basin floors should be leveled to ensure that settled sludge does not accumulate on the bottom of the basin.

The plans show an area near the common wall to the two G basins that sludge collection is not provided. This will cause a maintenance and operation problem. This area should be filleted or provided with some means for sludge collection.

The chain and flight sludge collectors will require a polyethylene wear strip to be installed on the bottom of the existing basin to minimize wear on the flights and wear shoes.

6. Sludge collection and removal is operations and maintenance intensive process. CDM recommends the following be incorporated into the design:

Provide sufficient means for cleanout of the sludge lines, particularly those that are to be installed below the basins.

Provide properly sized pumps and consider adding VFDs to regulate/control sludge flows.

Consider larger hoppers for sludge collection within the basins. The flat slopes on the hopper bottoms may not allow for sludge to flow toward the outlet pipes. **The proposed sludge intake piping configuration for the G basins should be redesigned.** It is questionable whether even sludge removal will be obtained from the sludge hopper with the currently proposed piping. Larger hoppers with a single drawoff point should be considered. If a larger hopper is not possible, a screw conveyor to a central drawoff point can be considered.

If the tube settlers are not installed, the chain and flight mechanisms are not required, since the traveling bridge collector will be able to continue to travel the entire basin length.

SUSAN KANE BOOTH, P.E.
CONSULTING ENGINEER

2405 Greenlee Drive Austin, Texas 78703 512/499-0616 FAX: 512/499-8815

April 9, 1999

Mr. Danny Shannon, P.E.
Camp Dresser & McKee Inc.
801 Cherry Street, Suite 1440
Fort Worth, Texas 76102

Project: Carrollton Water Treatment Plant

Re: Model Results

Dear Mr. Shannon:

Enclosed are the modeling results using the data you faxed for selected dates. As expected, the actual laboratory data report the pH in Basin L for the split-treatment scenario between 10.9 and 11.5 (higher than 10.6, the 1998 reported average pH) which is consistent with the magnesium removal achieved. The two models used were "The Rothberg, Tamburini & Winsor Model for Corrosion Control and Process Chemistry" and the "RTW Blending Application Package".

The data used for each run are reported on the model sheets. Three sets of data were used in this latest effort. Data from 1/23/96 were selected since they represent the actual plant results when lime was added to both basins G and L. For comparison, data from 1/27/98 were used as the example of cold water data from the plant with lime addition to basin L only. The model was also run using the data set from 9/22/98 to represent warm water conditions.

Note that the raw data faxed to me show iron coagulant dosages reported at a mg/L level consistent with an "as iron" dosage. Plant information that I have indicates that the plant uses a 60% solution of ferric sulfate. This is consistent with FerriClear or equal as supplied by Eaglebrook. FerriClear has an iron concentration of 12% so a 3.5 mg/L dosage of iron would be equivalent to approximately 29 mg/L of liquid coagulant – also consistent with reported plant usage. The dosages provided were converted to an ennea hydrate dosage to enter into the model for ferric sulfate with 9 waters as a calculation based on the molecular weight of iron and ferric sulfate.

Run 1 shows the modeled finished water results using the raw water data from January 1996 with iron and lime added. The model predicts a Langelier Index (LI)of approximately 1.35 with a pH of the blend of 9.2 immediately following blending. The calcium carbonate precipiation potential (CCPP) is 16.75 mg/L. Run 2 shows the results of the blending of the water with reported effluent data from G and L. Note that the tap pH is lower than the pH in either of the basin effluents. This is consistent with the water being supersaturated with calcium and immediately beginning to deposit some of the calcium and the pH dropping with to achieve stability. For this run the LI was 1.42 and the CCPP 19.09 mg/L.

Run No. 3 uses the data from the basins with a blend selected (22% basin L) to result in an immediate blend pH of 9.2 to correspond to the tap data provided. The model reports the expected alkalinity of 76 with the data showing an actual alkalinity of 75. The LI for this run is 1.27 with a CCPP of 11.93. Run No. 4 uses the raw data from 1/27/98, which is very similar to the raw data from 1/23/96, and adds the lime and ferric dosages from 1996. The pH is 9.29 for this run. The LI is 1.39 and the CCPP is 16.87 mg/L. Similar to the results reported for 1/23/96. Note that the theoretical final pH for all 4 runs is the same, approximately 8.0.

Run Nos. 5, 6, and 7 are warm water runs. Data from 9/22/99 were used in all of these runs. Run No. 5 uses actual effluent data from the basins and sets the blend to achieve a pH of 9.2. The blend ratio is 23% Basin L. The LI is 1.69 for this run and the CCPP is high at 29 mg/L. The theoretical final pH is 7.8. Run No. 6 is the same raw data using the iron and ferric numbers from January 1996. This results in an LI of 1.59 and a CCPP of 30.90 mg/L. Since the water is warmer the chemical needs would be expected to be lower than in January. Using the actual iron values from this date for Basin G the model would predict that a lime dosage of approximately 10 parts would be required to result a blended water pH of 9, LI of 1.62, and a CCPP of 31 mg/L.

Please call me if you have any questions or comments or need additional information.

Sincerely,

Susan Kane Booth

Susan Kane Booth, P.E.

The RTW Model   Ver. 3.0

Carrollton Water Treatment Plant, New Orleans
Data from 1/23/95, Raw water with lime and ferric

Run 1

Enter initial raw water characteristics

Measured TDS	265	mg/L
Measured temperature	6.7	deg C
Measured pH	8.09	
Measured alk, as CaCO3	101	mg/L
Measured Ca, as CaCO3	100	mg/L
Measured Cl	NA	mg/L
Measured SO4	NA	mg/L

Amount of each chemical
to be added (expressed as 100% chemical).

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	22	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	14.7	mg/L
Soda ash	0	mg/L
Sodium bicarbonate	0	mg/L

Theoretical interim water characteristics			Desired
Interim alkalinity	109	mg/L	> 40 mg/L
Interim Ca, as CaCO3	120	mg/L	> 40 mg/L
Alk/(Cl+SO4)	N/A		> 5.0

Theoretical interim water characteristics			Desired
Interim pH	9.24		6.8-9.3
Precipitation potential	16.75	mg/L	4-10 mg/L
Langelier index	1.35		>0

Calculated initial water characteristics

Initial acidity	105	mg/L
Initial Ca sat, as CaCO3	83	mg/L
Initial DIC, as CaCO3	206	mg/L

Theoretical interim water characteristics

Interim acidity	97	mg/L
Interim Ca sat, as CaCO3	5	mg/L
Ryznar index	6.55	
Interim DIC, as CaCO3	206	mg/L
Aggressiveness Index	13.36	

Theoretical final water characteristics
after CaCO3 precipitation

Final alkalinity	92	mg/L
Final Ca	103	mg/L
Final acidity	97	mg/L
Final pH	8.03	
Final DIC, as CaCO3	189	mg/L

The RTW Model Ver. 3.0

Blending Application Package

Carrollton Water Treatment Plant, New Orleans

Data from 1/23/96

Blend based on 40% Basin L

Run 2

Characteristics for waters to be blended,

Basin L

TDS	265	mg/L
Temperature	12.5	deg C
pH	9.33	
Alkalinity, as CaCO3	117	mg/L
Ca, as CaCO3	118	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Basin G

TDS	265	mg/L
Temperature	12.5	deg C
pH	9.1	
Alkalinity, as CaCO3	113	mg/L
Ca, as CaCO3	114	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Portion of blend that is Basin L:

% Basin L in blend	40	%

Blended water characteristics immediately following blending and before chemical addition shown on right:

TDS	265	mg/L
Temperature	12.5	deg C
pH	9.21	
Alkalinity, as CaCO3	114.6	mg/L
Ca, as CaCO3	115.6	mg/L
Cl	0	mg/L
SO4	0	mg/L
Acidity	100	mg/L
Ca sat, as CaCO3	5	mg/L
DIC, as CaCO3	215	mg/L

Shown below is the amount of each chemical to be added to blended water (expressed as 100% chemical):

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	0	mg/L
Ferrous sulfate *7H2O	0	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	0	mg/L
Soda ash	0	mg/L

Calculation of indices for blended water after chemical addition indicated above:

Theoretical interim characteristics

			Desired
Interim alkalinity	115	mg/L	> 40 mg/L
Interim Ca, as CaCO3	116	mg/L	> 40 mg/L
Alk/(Cl+SO4)	N/A		> 5.0

Theoretical interim characteristics

			Desired
Interim pH	9.21		6.8-9.3
Precipitation potential	19.09	mg/L	4-10 mg/L
Langelier index	1.42		>0

Note: Interim charateristics calculated by the model assume that no calcium carbonate precipitation has occurred. This is an approximation of the actual characteristics of the blended water immediately following blending and any chemical addition.

Additional results:

Theoretical interim blended water characteristics

Interim acidity	100	mg/L
Interim Ca sat, as CaCO3	5	mg/L
Ryznar index	6.38	
Interim DIC, as CaCO3	215	mg/L
Aggressiveness Index	13.33	

Theoretical final blended water characteristics after CaCO3 precipitation:

Final alkalinity	96	mg/L
Final Ca	97	mg/L
Final acidity	100	mg/L
Final pH	7.96	
Final DIC, as CaCO3	196	mg/L

The RTW Model Ver. 3.0

Blending Application Package

Carrollton Water Treatment Plant, New Orleans

Data from 1/27/98

Split set to achieve tap pH

Run No. 3

Characteristics for waters to be blended,

Basin L

TDS	182	mg/L
Temperature	12.5	deg C
pH	10.97	
Alkalinity, as CaCO3	68	mg/L
Ca, as CaCO3	106	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Basin G

TDS	182	mg/L
Temperature	12.5	deg C
pH	7.6	
Alkalinity, as CaCO3	79	mg/L
Ca, as CaCO3	112	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Portion of blend that is Basin L:

% Basin L in blend	22	%

Blended water characteristics immediately following blending and before chemical addition shown on right:

TDS	182	mg/L
Temperature	12.5	deg C
pH	9.23	
Alkalinity, as CaCO3	76.58	mg/L
Ca, as CaCO3	110.68	mg/L
Cl	0	mg/L
SO4	0	mg/L
Acidity	67	mg/L
Ca sat, as CaCO3	7	mg/L
DIC, as CaCO3	143	mg/L

Shown below is the amount of each chemical to be added to blended water (expressed as 100% chemical):

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	0	mg/L
Ferrous sulfate *7H2O	0	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	0	mg/L
Soda ash	0	mg/L

Calculation of indices for blended water after chemical addition indicated above:

Theoretical interim characteristics			Desired	Theoretical interim characteristics			Desired
Interim alkalinity	77	mg/L	> 40 mg/L	Interim pH	9.23		6.8-9.3
Interim Ca, as CaCO3	111	mg/L	> 40 mg/L	Precipitation potential	11.93	mg/L	4-10 mg/L
Alk/(Cl+SO4)	N/A		> 5.0	Langelier Index	1.27		>0

Note: Interim charateristics calculated by the model assume that no calcium carbonate precipitation has occurred.
This is an approximation of the actual characteristics of the blended water immediately following blending and any chemical addition.

Additional results:

Theoretical interim blended water characteristics

Interim acidity	67	mg/L
Interim Ca sat, as CaCO3	7	mg/L
Ryznar Index	6.69	
Interim DIC, as CaCO3	143	mg/L
Aggressiveness Index	13.16	

Theoretical final blended water characteristics after CaCO3 precipitation:

Final alkalinity	65	mg/L
Final Ca	99	mg/L
Final acidity	67	mg/L
Final pH	8.09	
Final DIC, as CaCO3	131	mg/L

The RTW Model Ver. 3.0

Carrollton Water Treatment Plant, New Orleans
Data from 1/27/98, Raw water with lime and ferric

Run No. 4

Enter initial raw water characteristics

Measured TDS	182	mg/L
Measured temperature	9.4	deg C
Measured pH	8.13	
Measured alk, as CaCO3	93	mg/L
Measured Ca, as CaCO3	88	mg/L
Measured Cl	NA	mg/L
Measured SO4	NA	mg/L

Amount of each chemical
to be added (expressed as 100% chemical).

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	22	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	14.7	mg/L
Soda ash	0	mg/L
Sodium bicarbonate	0	mg/L

Theoretical interim water characteristics

			Desired
Interim alkalinity	101	mg/L	> 40 mg/L
Interim Ca, as CaCO3	108	mg/L	> 40 mg/L
Alk/(Cl+SO4)	N/A		> 5.0

Theoretical interim water characteristics

			Desired
Interim pH	9.29		6.8-9.3
Precipitation potential	16.87	mg/L	4-10 mg/L
Langelier index	1.39		>0

Calculated initial water characteristics

Initial acidity	96	mg/L
Initial Ca sat. as CaCO3	70	mg/L
Initial DIC, as CaCO3	189	mg/L

Theoretical interim water characteristics

Interim acidity	88	mg/L
Interim Ca sat, as CaCO3	5	mg/L
Ryznar index	6.51	
Interim DIC, as CaCO3	189	mg/L
Aggressiveness Index	13.33	

Theoretical final water characteristics
after CaCO3 precipitation

Final alkalinity	84	mg/L
Final Ca	91	mg/L
Final acidity	88	mg/L
Final pH	8.06	
Final DIC, as CaCO3	172	mg/L

The RTW Model Ver. 3.0

Blending Application Package

Carrollton Water Treatment Plant, New Orleans
Data from 9/22/98
Blended pH of 9.2

Run No. 5

Characteristics for waters to be blended.

Basin L

TDS	200	mg/L
Temperature	28	deg C
pH	10.92	
Alkalinity, as CaCO3	62	mg/L
Ca, as CaCO3	86	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Basin G

TDS	200	mg/L
Temperature	28	deg C
pH	7.93	
Alkalinity, as CaCO3	149	mg/L
Ca, as CaCO3	116	mg/L
Cl	NA	mg/L
SO4	NA	mg/L

Portion of blend that is Basin L:

% Basin L in blend	23	%

Blended water characteristics immediately following blending and before chemical addition shown on right:

TDS	200	mg/L
Temperature	28	deg C
pH	9.21	
Alkalinity, as CaCO3	128.99	mg/L
Ca, as CaCO3	109.1	mg/L
Cl	0	mg/L
SO4	0	mg/L
Acidity	106	mg/L
Ca sat, as CaCO3	3	mg/L
DIC, as CaCO3	235	mg/L

Shown below is the amount of each chemical to be added to blended water (expressed as 100% chemical):

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	0	mg/L
Ferrous sulfate *7H2O	0	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	0	mg/L
Soda ash	0	mg/L

Calculation of indices for blended water after chemical addition indicated above:

Theoretical interim characteristics			Desired	Theoretical interim characteristics			Desired
Interim alkalinity	129	mg/L	> 40 mg/L	Interim pH	9.21		6.8-8.3
Interim Ca, as CaCO3	109	mg/L	> 40 mg/L	Precipitation potential	29.00	mg/L	4-10 mg/L
Alk/(Cl+SO4)	N/A		> 5.0	Langelier Index	1.69		>0

Note: Interim charateristics calculated by the model assume that no calcium carbonate precipitation has occurred.
This is an approximation of the actual characteristics of the blended water immediately following blending and any chemical addition.

Additional results:
Theoretical interim blended water characteristics

Interim acidity	106	mg/L
Interim Ca sat, as CaCO3	3	mg/L
Ryznar Index	5.83	
Interim DIC, as CaCO3	235	mg/L
Aggressiveness Index	13.36	

Theoretical final blended water characteristics after CaCO3 precipitation:

Final alkalinity	100	mg/L
Final Ca	80	mg/L
Final acidity	106	mg/L
Final pH	7.77	
Final DIC, as CaCO3	206	mg/L

Run No. 6

The RTW Model   Ver. 3.0

Carrollton Water Treatment Plant, New Orleans
Data from 9/22/98, Raw water with lime and ferric

Enter initial raw water characteristics

Measured TDS	210	mg/L
Measured temperature	27	deg C
Measured pH	8.16	
Measured alk, as CaCO3	156	mg/L
Measured Ca, as CaCO3	123	mg/L
Measured Cl	NA	mg/L
Measured SO4	NA	mg/L

Amount of each chemical
to be added (expressed as 100% chemical).

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	22	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	14.7	mg/L
Soda ash	0	mg/L
Sodium bicarbonate	0	mg/L

Value from 1/23/96
4.4 mg/L iron or
22 as
Ferric w/
$9H_2O$

Theoretical interim water characteristics

			Desired
Interim alkalinity	164	mg/L	> 40 mg/L
Interim Ca, as CaCO3	143	mg/L	> 40 mg/L
Alk/(Cl+SO4)	N/A		> 5.0

Theoretical interim water characteristics

			Desired
Interim pH	8.91		6.8-9.3
Precipitation potential	30.90	mg/L	4-10 mg/L
Langelier index	1.59		>0

Calculated initial water characteristics

Initial acidity	157	mg/L
Initial Ca sat, as CaCO3	22	mg/L
Initial DIC, as CaCO3	313	mg/L

Theoretical interim water characteristics

Interim acidity	149	mg/L
Interim Ca sat, as CaCO3	4	mg/L
Ryznar index	5.72	
Interim DIC, as CaCO3	313	mg/L
Aggressiveness Index	13.28	

Theoretical final water characteristics
after CaCO3 precipitation

Final alkalinity	133	mg/L
Final Ca	112	mg/L
Final acidity	149	mg/L
Final pH	7.51	
Final DIC, as CaCO3	283	mg/L

The RTW Model — Ver. 3.0

Carrollton Water Treatment Plant, New Orleans
Data from 9/22/98, Raw water with lime and ferric

Run No. 7

Enter initial raw water characteristics

Measured TDS	210	mg/L
Measured temperature	27	deg C
Measured pH	8.16	
Measured alk, as CaCO3	158	mg/L
Measured Ca, as CaCO3	123	mg/L
Measured Cl	NA	mg/L
Measured SO4	NA	mg/L

Amount of each chemical
to be added (expressed as 100% chemical).

Alum 50% solution	0	mg/L
Carbon dioxide	0	mg/L
Caustic soda	0	mg/L
Chlorine gas	0	mg/L
Ferric sulfate *9H2O	8.8	mg/L
Hydrochloric acid	0	mg/L
Hydrofluosilicic acid	0	mg/L
Lime (slaked)	10	mg/L
Soda ash	0	mg/L
Sodium bicarbonate	0	mg/L

Ferric - Baum G
1.74 iron
8.8 mg/L w/ 9 H2

Theoretical interim water characteristics			Desired
Interim alkalinity	165	mg/L	> 40 mg/L
Interim Ca, as CaCO3	137	mg/L	> 40 mg/L
Alk/(Cl+SO4)	N/A		> 5.0

Theoretical interim water characteristics			Desired
Interim pH	8.95		6.8-9.3
Precipitation potential	31.25	mg/L	4-10 mg/L
Langelier index	1.62		>0

Calculated initial water characteristics

Initial acidity	157	mg/L
Initial Ca sat, as CaCO3	22	mg/L
Initial DIC, as CaCO3	313	mg/L

Theoretical interim water characteristics

Interim acidity	149	mg/L
Interim Ca sat, as CaCO3	4	mg/L
Ryznar index	5.72	
Interim DIC, as CaCO3	313	mg/L
Aggressiveness Index	13.30	

Theoretical final water characteristics
after CaCO3 precipitation

Final alkalinity	134	mg/L
Final Ca	105	mg/L
Final acidity	149	mg/L
Final pH	7.54	
Final DIC, as CaCO3	282	mg/L

DATA => NEW ORLEANS Notes FYI

1/27/98	river	G	L	Tap
temp	49	12.5°C	12.5°C	60
alk	93	79	68	75
hard	121	137	129	128
ca hard	88	112	106	98
mg hard	33	25	23	30
pH	8.13	7.6	10.97	9.2
tds	182			182
lime		0	104 31.77	
iron		11.84 2.34	6.28	

2/3/98	river	G	L	Tap
temp	47			59
alk	91	85	66	75
hard	138	138	131	123
ca hard	85	95	113	97
mg hard	53	43	18	26
pH	7.76	7.6	11.08	8.92
tds	188			188
lime		0	98.37	
~~iron~~		2.32	6.12	

9/22/98	river	G	L	Tap
temp	81	20 c	20c	84
alk	156	149	62	114
hard	185	183	101	155
ca hard	123	116	88	106
mg hard	62	67		49
pH	8.16	7.93	10.92	8.83
tds	210	200	200	184
lime		0	126	
iron		1.74	3.63	

12/15/98	river	G	L	Tap
temp	58			65
alk	152	136	64	106
hard	191	184	117	159
ca hard	132	120	91	113
mg hard	59	64	26	46
pH	8.31	7.76	10.9	8.67
tds	266			188
lime		0	145	
iron		2.91	3.8	

12/15/98	river	G	L	Tap
temp	58			65
alk	152	136	64	106
hard	191	184	117	159
ca hard	132	120	91	113
mg hard	59	64	26	46
pH	8.31	7.76	10.9	8.67
tds	266			188
lime		0	145	
iron		2.91	3.8	

1/7/97	river	G	L	Tap

MW of Ferric Sulfate = 400

$Fe_2(SO_4)_3$ Fe_2 = 112

w/ 9 H_2O = 562

$\frac{\text{mg/L iron}}{112} \times 562$ = enna hydrate in mg/L for model

ex: 3.5 mg/L iron
17.6 mg/L for model.

Ferriclear is 60% solution of ferric sulfate.

Ferriclear is 12% iron

$\frac{3.5 \text{ mg/L}}{.12}$ = 29 mg/L Dose of ferriclear => consistent w/ plant reports.

$\frac{561}{112}$ = 5.02 × iron = mg/L for model.

temp	49			64	
alk	93	63	116	78	
hard	135	142	156	139	
ca hard	91	95	148	112	
mg hard	44	47		27	
pH	7.92	7.47	11.47	9.03	
tds	197			205	
lime		0	127		
iron					
5/7/97	river	G	L	Tap	
temp	59			72	
alk	106	105	62	88	Alk readings very different
hard	143	140	144	135	for different sample times.
ca hard	93	96	141	97	
mg hard	50	44	3	38	
pH	7.97	7.85	11.14	9.27	
tds	283			220	
lime		0	171		
~~iron~~		3.69	3.56		
1/23/96	river 6.7	G	L	Tap	
~~temp~~	44	pay 12.2?	12.5?	say 60?	
alk	101	113	117	114	
hard	143	157	165	164	
ca hard	100	114	118	118	
mg hard	43	43	47	46	
pH	8.09	9.1	9.33	8.92	
tds	265			258	
lime		14.68	14.67		
iron	4.4	14.7		4.53	
	22 mg/L				

APPENDIX F

APRIL 15, 1999
TECHNICAL MEMORANDUM

CARROLLTON WTP

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

3445 North Causeway Boulevard, Suite 600
Metairie, Louisiana 70002
Tel: 504 832-7272 Fax: 504 832-7282

April 15, 1999

Mr. G. Joseph Sullivan
General Superintendent
Sewerage & Water Board of New Orleans
625 St. Joseph Street
New Orleans, Louisiana 70165

SUBJECT: Technical Memorandum
Review of the Carrollton Water Treatment Plant
Filter Improvements Implementation Plan
CDM PNS: 8013-24510-RT

Dear Mr. Sullivan:

Camp Dresser & McKee, Inc. (CDM) has reviewed the Carrollton Water Treatment Plant Filter Improvements Implementation Plan (FIIP) as prepared by Malcom-Pirnie, 1998 and provided our recommendations in the enclosed Technical Memorandum. As indicated in the enclosed Technical Memorandum, CDM agrees with the majority of the FIIP's recommendations and recommends preliminary design be initiated for this project. Upon initiation of preliminary design services, CDM will arrange a meeting kickoff meeting with your staff to discuss the enclosed memorandum and time schedule for this project.

The design fee currently included in our contract with the Board was based upon an estimated construction cost of $8,350,000 as provided in the Water Quality Master Plan of April, 1997. The FIIP revised these costs to reflect an estimated construction cost of $10,831,000. CDM believes these cost are accurate and request our fee be adjusted accordingly based upon the provisions of our contract to a total design fee of $888,576.

If you wish CDM to proceed with the preliminary design for this project based upon the fee indicated above, please indicate your approval below and return one copy of this letter to our office.

Sincerely,

CAMP DRESSER & McKEE, INC.

Adam Faschan, Ph.D., P.E.

AF/kh

Approval:____________________ Date:____________
G. Joseph Sullivan
General Superintendent

cc: R. St. Germain
J. Hercamp
D. Gerrity
D. Shannon

M145.022

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

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Adam Faschan, Ph.D., P.E.

AF/kh

Approval:______________________ Date:______________
G. Joseph Sullivan
General Superintendent

cc: R. St. Germain
J. Hercamp
D. Gerrity
D. Shannon

M145.022

Technical Memorandum

To: *Sewerage & Water Board of New Orleans*
Mr. G. Joseph Sullivan

From: *Adam Faschan*

Date: *April 15, 1999*

Subject: *Review of the Carrollton Water Treatment Plant Filter Improvements Implementation Plan*

1.0 Introduction

1.1 Background

Two galleries of high-rate, dual-media filters, the Claiborne and Sycamore filters, comprise the Carrollton Water Treatment Plant filtration facilities. The Claiborne filter bank, built in 1950, is a dual-cell, constant rate design composed of eight filters or 16 cells. The filters are divided by a center gullet. The gullet distributes settled water to the filters and during cleaning removes backwash water. Each filter cell is 24' 3" wide by 108' long. These dimensions yield a surface area of 5,240 square feet per filter or 41,920 square feet combined.

The Sycamore filter gallery includes 28 dual-media, constant rate filters. As with the Claiborne gallery, a center gullet divides each filter into two equally sized cells. The center gullet provides for distribution of settled water and removal of backwash water. Filters 1-10 were installed in 1906. This was followed by the addition of filters 11-28 in 1932. Each filter cell is 13' 6" wide by 53' in length. This equates to a filtration area of 1,432 square feet per filter, or combined, 40,096 square feet.

The filters in each gallery are operated at loading rates up to 2.2 gpm/sf. Plant operators manually set the Sycamore effluent filter rate by adjusting the effluent control valve. The differential measured across this valve is used to monitor flow rate. The filtration rate of the Claiborne filters, as compared to the Sycamore Filters, is controlled by the wet-well water level. This rate fluctuates throughout the operational day.

It was previously determined by plant staff that the loading rates for the filters in both galleries are approximately equal. However, due to hydraulic limitations, Sycamore filters 1-10 operate at lower loading rates.

1.2 Project Scope

This Technical Memorandum presents a review of recommendations and associated commentary regarding the Carrollton Water Treatment Plant Filter Improvements Implementation Plan (FIIP) (Malcolm-Pirnie, 1998).

2.0 Summary of Problems & Recommendations

The previous evaluation, FIIP, identified operational problems and suggested methods to rehabilitate the Claiborne and Sycamore filter galleries. The individual operating subsystems of each filter gallery were addressed. These subsystems included: piping and valves; media and underdrains; backwash facilities; filter-to-waste piping; and instrumentation and controls. The following sections, with regard to each filter gallery and the respective subsystems, summarize the previous findings and recommendations.

2.1 Claiborne Filters

The Claiborne filters, as in place, were determined to meet turbidity removal requirements. Also, these filters were predicted to be able to effectively achieve present and future regulatory requirements over the next 15 to 20 years. This prediction was made dependent on routine maintenance and periodic, as-needed upgrades. The following sections summarize the previous findings and recommendations as stated in the FIIP.

2.1.1 Piping and Valves

The Claiborne filter structures were determined to be in good condition. Filter valves operated easily and properly, and were readily accessible. All visible piping appeared in good condition.

It was recommended that the existing valve operators be replaced with electric actuators on an as-needed basis.

Camp Dresser & McKee Inc. (CDM) agrees with this recommendation. No modifications will be included in the filter improvements design contract.

2.1.2 Media and Underdrains

The filter beds are dual-media designs that consist of 6.5 inches of anthracite over 23 inches of sand supported by a 16-inch gravel layer. Filter media specifications obtained from the plant staff indicated that the anthracite and sand media have effective sizes of 0.8 to 1.2 mm and 0.40 ± 0.05 mm, respectively. Each layer has a uniformity coefficient less than 1.5. The filter media was considered in good condition due to an ongoing filter media replacement program. The filter underdrains are a nozzled, plenum style with a 6-inch depth. The washwater troughs are 26 inches deep. A 25-inch clearance exists between the filter media and the base of the washwater troughs. During filter backwash cycles, this distance allows for an 85% expansion of the filter media; therefore, loss of filter media is not a concern. The filter operating water depth is approximately nine feet and air binding problems have not been experienced.

The recommendation was made that the media be switched to 12 inches of sand and 18 inches of anthracite, with effective sizes of 0.45 to 0.55 mm and 0.9 to 1.0 mm, respectively. Uniformity coefficients of 1.4 were suggested for both media. These modifications were stated to conform with the requirements of the Louisiana Department of Health and Hospitals.

CDM recommends that the existing media remain in place, being replaced with the recommended media on an as-needed basis. No modifications will be included in the filter improvements design project.

2.1.3 Backwash Facilities

The Claiborne filters are equipped with hydraulic backwash equipment. No mechanisms or provisions for auxiliary scouring exist. As stated in the FIIP, the filters are normally backwashed following a run time of 100 hours or when the head loss approaches three feet. Backwashing is controlled manually using valve controls on a control panel in the filter building. Filter cells are washed individually. The plant staff estimated a backwash rate of 23.8 gpm/sf. This rate equated to a total wash volume of 650,000 to 800,000 gallons per filter cell. A ground-level, finished-water, storage tank gravity feeds backwash water. A dedicated device for backwash rate control does not exist. The operators use a flow meter and a totalizer located on the control panel to monitor volume of backwash water. Provisions do not exist for diversion of filtered water to waste lines (filter-to-waste) following backwash cycles.

No improvements were recommended for the filter backwash system.

Based on the information supplied in the FIIP, CDM recommends the installation of a new rate-of-flow controller for the backwash pump to provide for a controlled backwashing rate.

2.1.4 Instrumentation and Controls

The instrumentation and controls for the Claiborne filters are located on a control panel in the filter building. This panel includes the following controls and indicators:

- Loss of head gauge for each filter cell (16)
- Filtered water flow totalizer for each filter cell (16)
- Filtered water flow rate set switch for each filter cell (16)
- Instrument air auto/manual switch for each filter cell (16)
- Open/close switch for each washwater valve (16)

- Open/closed indicator lights for each washwater valve (16)
- Open/close switch for each drain valve (8)
- Open/closed indicator lights for each drain valve (8)
- Instrument air pressure gauges (one for Filters 1-4, one for Filters 5-8)
- Filter auto/manual switch (one for Filters 1-4, one for Filters 5-8)

In addition, strip-chart recorders and totalizers for total flow measurements from Filters 1-4 and 5-8 are located on the control panel. However, these units are not in service. New turbidity meters and loggers were to be installed for further monitoring of the filter system.

No recommendations were suggested for the instrumentation and controls system.

Provided the proposed turbidimeters and data loggers have been installed and the strip-chart recorders and totalizers are functional, CDM, at this time, does not recommend further improvements.

2.2 Sycamore Filters

The Sycamore filters were determined to possess several deficiencies. As stated previously, the Sycamore filter gallery was constructed in two phases. Filters 1-10 and 11-28, respectively, were constructed in 1906 and 1932. It was determined that, short of a complete overhaul and replacement of all components, design deficiencies of Filters 1-10 could not be corrected. Therefore, it was recommended that these filters be removed from service but retained for emergency backup. Periodic maintenance and operation of Filters 1-10 was suggested. Consequently, the FIIP focused on Filters 11-28. The following sections summarize the previous findings and recommendations as stated in the FIIP.

CDM agrees with the recommendation for removing Filters 1-10 from service. However, the periodic maintenance and operation of Filters 1-10, to keep them for emergency backup, may not be practical. Therefore, a determination should be made as to whether these filters can be permanently removed from service.

2.2.1 Piping and Valves

Various pipe and valve configurations exist within the filter galleries due to different periods of construction and periodic upgrades. In general, the condition and sizing of the filter, header piping is adequate; however, several of the appurtenant joints and fittings leak. The current isolation valves for settled inlet water, backwash water, and drain lines are hand-controlled, hydraulic gate valves. These units do not open and close properly due to insufficient hydraulic pressure. The controllers for the filter outlet valve are in poor condition and require frequent maintenance. On a trial basis as a replacement, plant staff installed a globe-type, flow-control valve in conjunction with a venturi flow meter. According to plant staff, this flow-control valve has functioned well.

Recommendations were made regarding piping and valve replacement. It was proposed that all filter piping be replaced by either ductile iron or steel pipe. This is intended to correct the leakage problems and eliminate the existing multiple pipe spools. The replacement of the settled water inlet, the backwash water, and the drain valves with electric, motor-operated AWWA butterfly valves was suggested. These valves would be operated by open/close signals from a programmable logic controller (PLC). In addition, it was suggested that the flow-control valve be replaced by a modulating valve linked to a new flow meter.

CDM agrees with the proposed recommendations. However, environmental conditions should be considered during design to determine the potential effect on electrical equipment and subsequent solutions. Pneumatic operators would be an alternative to installing motor-operated butterfly valves.

2.2.2 Media and Underdrains

The Sycamore filters (11-28) include several filter bed designs due to various renovation projects since original construction. Filters 11-20 and 24-28 incorporate Delery tube underdrains; whereas, Filters 21-23 employ dual-lateral, underdrain systems. All underdrain systems include a gravel cap for media support. The filter media depth fluctuates between each filter. However, the clearance between the washwater troughs and the filter media is limited in all filters. In some cases, the media surface is equivalent to the base of the washwater troughs. This results in media loss during backwash cycles.

Replacement of all underdrain systems with new, low-profile underdrains and an integrated media cap was proposed. Also, replacement of the existing media with a uniform, dual-media profile consisting of 12 inches of sand topped by 18 inches of anthracite was recommended. Uniformity coefficients of 1.4 and effective sizes of 0.45 to 0.55 mm and 0.9 to 1.0 mm were suggested for the sand and anthracite, respectively. The combination of the low-profile underdrains, integrated media cap, and reduced filter media was predicted to allow for proper expansion of the filter media during backwash cycles. These modifications were estimated to yield an additional 10 inches of clearance between the top of the media and bottom of the washwater troughs.

CDM agrees with the proposed recommendations.

2.2.3 Backwash Facilities

The Sycamore filters, as with the Claiborne filters, are equipped with hydraulic backwash equipment. No mechanisms or provisions for auxiliary scouring exist. As stated in the FIIP, the filters are normally backwashed following a run time of 100 hours or when the head loss approaches three feet. Backwashing is controlled manually using valve controls located on individual filter consoles. Backwash water is gravity fed from a ground-level, finished-water, storage tank. The plant staff installed a booster pump due to insufficient head supplied by the storage tank. This pump allows for a maximum wash rate of 17.1 gpm/sf. However, as previously mentioned, insufficient clearance exists between the filter media and the washwater trough. Therefore, adequate media expansion is not possible without media loss to the washwater troughs. Mudballs are a common operational problem following backwash. Plant staff is required to wash the media using a high-pressure, water hose following initial backwash, and then incorporate another brief backwash cycle.

Recommendations to improve the backwash system were proposed. The primary limitations of the backwash system were stated to be the current backwash pump and the inability to monitor and control the backwash flow. Therefore, it was recommended that the existing backwash pump be replaced by two new vertical turbine pumps (one operating, one stand-by). These pumps were sized for a maximum backwash rate of 18 gpm/sf at 45 total dynamic head (approximately 350 to 400 hp). The incorporation of soft start and stop to limit current inrush and provide surge control was suggested. Also, the improvements were to include installation of a new flow meter in conjunction with a new, motor-operated butterfly valve. These were intended to maintain backwash flow at designated levels. An air scour system, in conjunction with the new underdrain system mentioned previously, was recommended to aid filter backwashing. The air scour system would include two air blowers (one operating, one standby), a new support building, and all ancillary equipment. As stated in the FIIP, the air blowers were sized to provide 5,730 scfm (4 scfm/sf) at 8 to 10 psi.

The proposed backwashing and air scouring sequence was as follows:

Step 1: Air scour at 4 scfm per square foot (5730 scfm total)
Step 2: Air scour at 4 scfm per square foot (5730 scfm total) plus backwash water of 5 gpm per square foot (7160 gpm total)
Step 3: Backwash water at a maximum of 18 gpm per square foot (25,800 gpm total)

The backwash water rate was stated to vary depending on the water temperature. The 18 gpm per square foot was a maximum value.

CDM agrees with the proposed recommendations. However, the exact backwash sequence may require revision to allow for greater operational flexibility.

2.2.4 Filter-to-Waste

The Sycamore filter gallery does not currently include a filter-to-waste system (FTW). A FTW allows for an initial cycle following backwash wherein the filtered water may directly flow to the drain line. This system may reduce or eliminate turbidity spikes typically observed following backwash cycles.

As recommended, the FTW would drain filtered water to an air gap. This air gap would be connected to the drain line by a ten-inch tie-in to the filtered water line, a ten-inch motor operated valve, and a 12-inch connection line. The exact sizes of valves and piping were to be determined following a hydraulic analysis.

CDM agrees with the proposed recommendations.

2.2.5 Instrumentation and Controls

The Sycamore filters are individually connected to control panels. Each panel contains an indicator for filtered water flow, a flow set switch for the filtered water effluent valve, a flow totalizer for filtered water flow, a head loss gauge, and an auto/manual switch for instrument air.

Filter turbidity readings are recorded manually every four hours. These readings are based on measurements taken by newly installed on-line turbidimeters. In addition, grab samples of the settled water feed, of the combined filtered water from each set (11-20 and 21-28), and of the total combined filtered water are taken every hour and analyzed.

The following instruments and controls were recommended for each of the Sycamore filters:

- Programmable logic controller (PLC) to automatically control filter operation and backwash cycles, as determined by the operator.
- Turbidity meters, elapsed time meters, and head loss indicators to permit staff monitoring of filter operating parameters.
- Manual/automatic switches and individual valve open/close pushbuttons to allow for manual operator control of filters and backwash cycles.
- Local/remote and open/close valve pushbuttons to enable testing and operation from either the main panel or valve location.

The PLC would automatically control the backwash cycles and filter-to-waste operations. However, an attached keypad would allow the operator to override the programmed instructions.

CDM agrees with the proposed recommendations.

APPENDIX G

CARROLLTON WTP
RECYCLE BACKWASH
PUMP SYSTEM CURVES

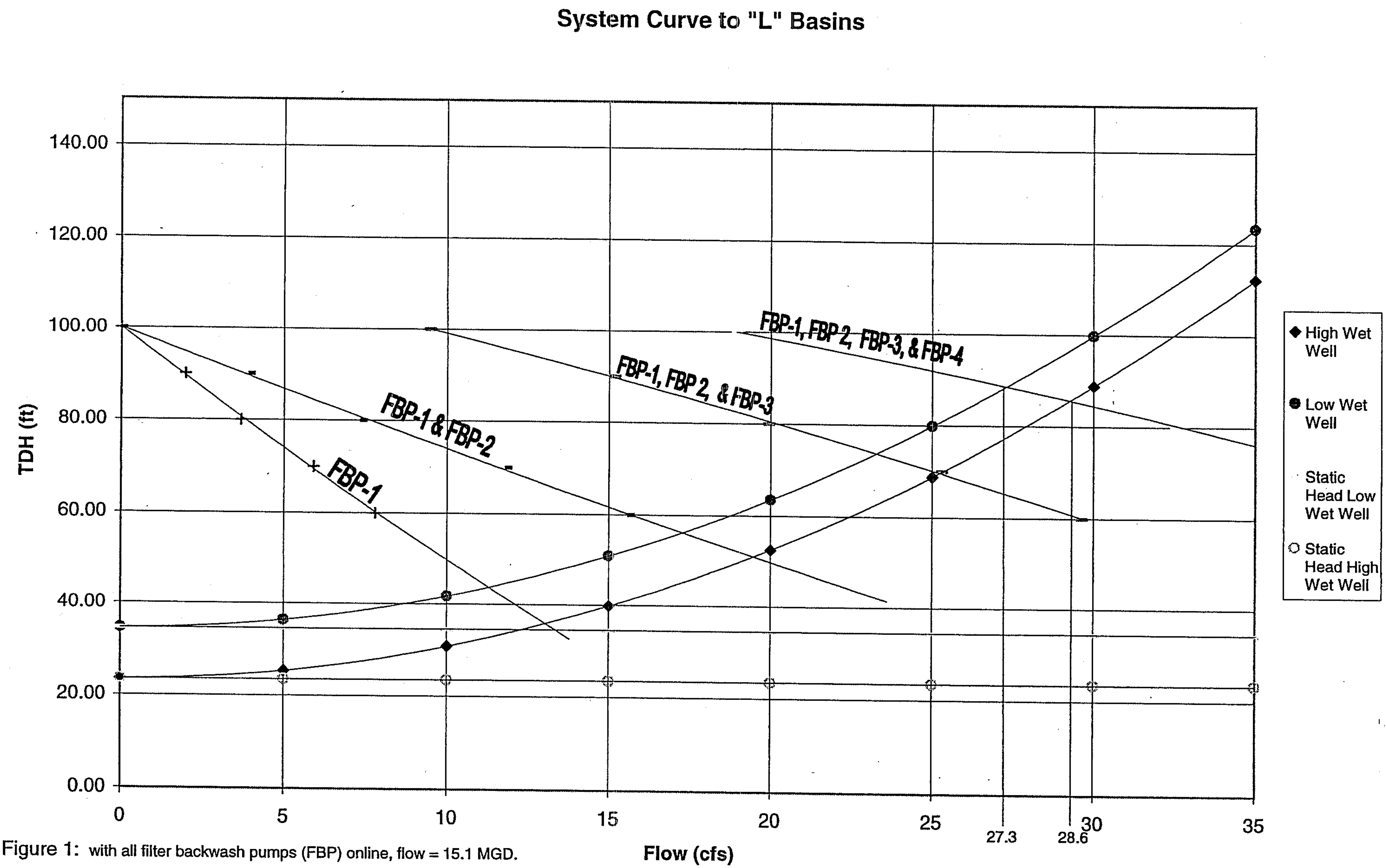

Figure 1: with all filter backwash pumps (FBP) online, flow = 15.1 MGD.

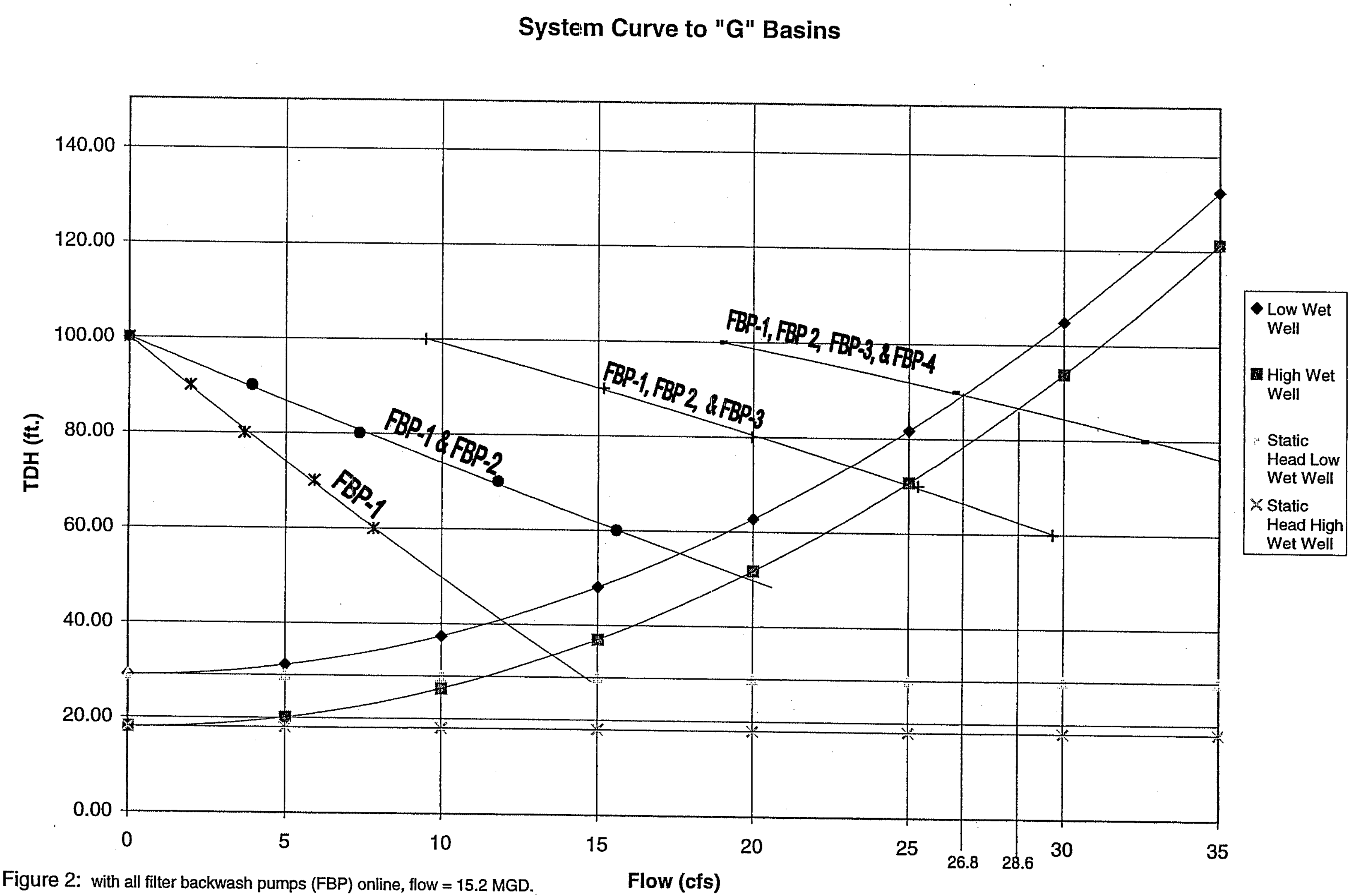

Figure 2: with all filter backwash pumps (FBP) online, flow = 15.2 MGD.

Existing System Curve to the River (20")

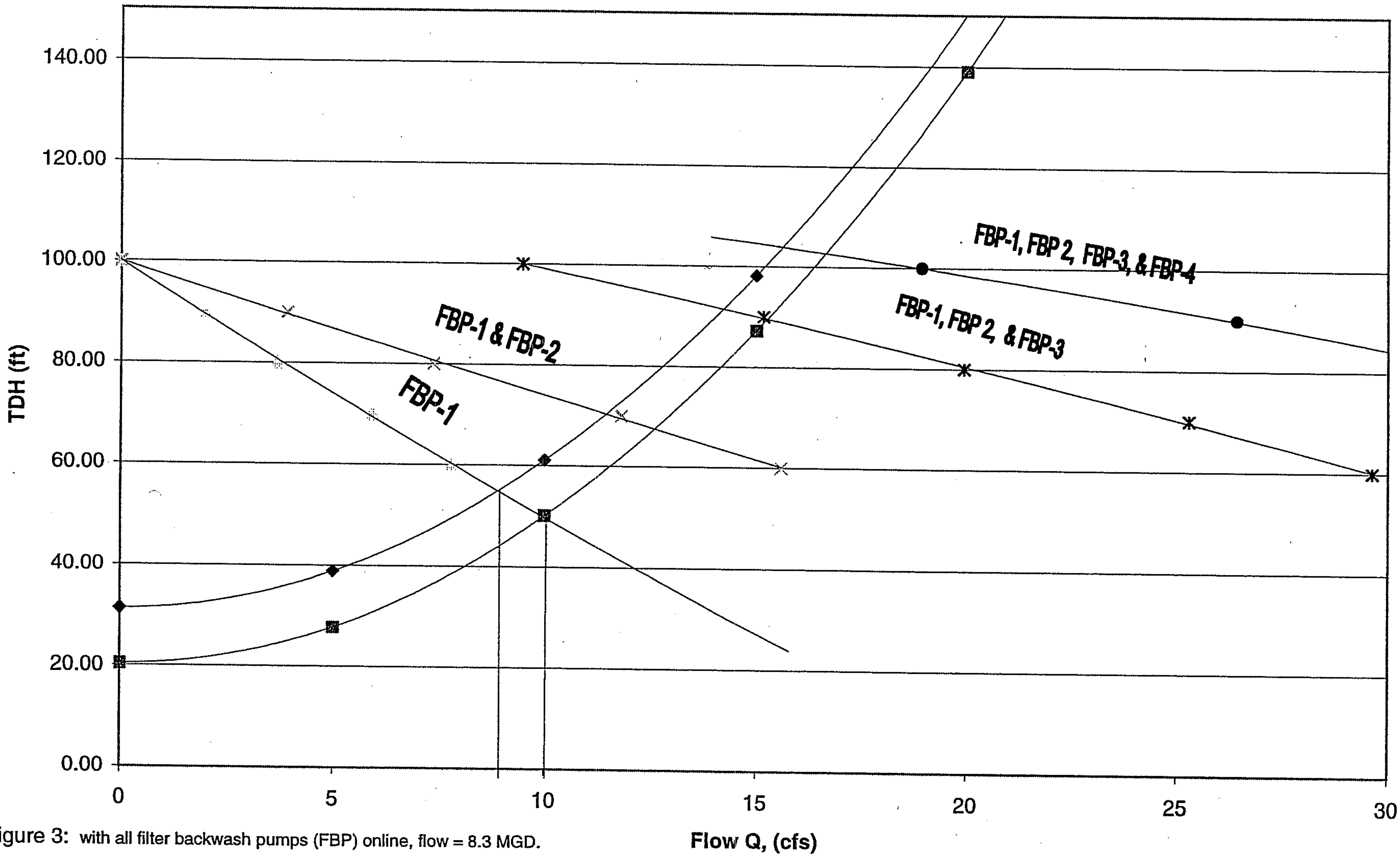

Figure 3: with all filter backwash pumps (FBP) online, flow = 8.3 MGD.

System Curve for Proposed FB Discharge Line to River (36")

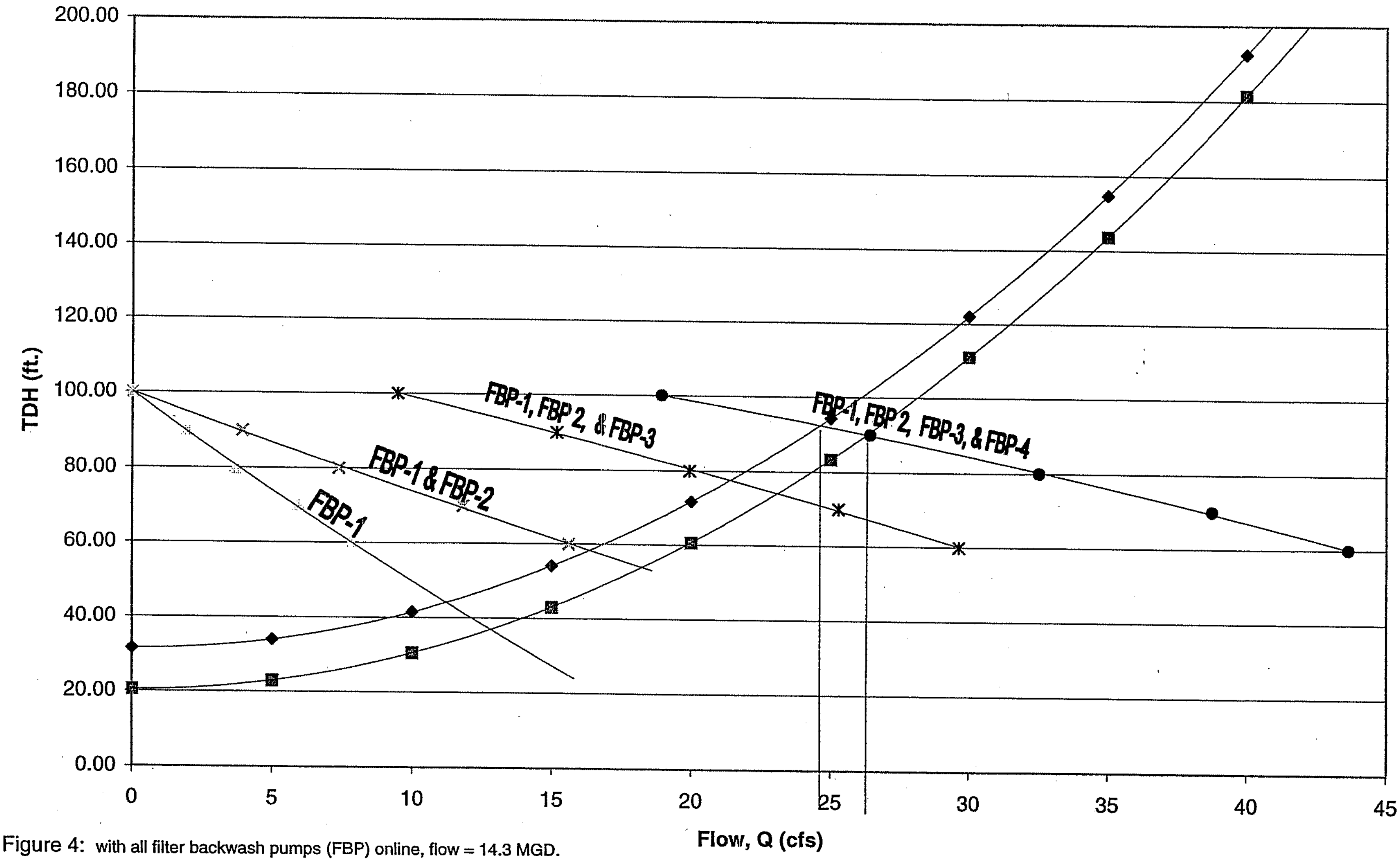

Figure 4: with all filter backwash pumps (FBP) online, flow = 14.3 MGD.

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