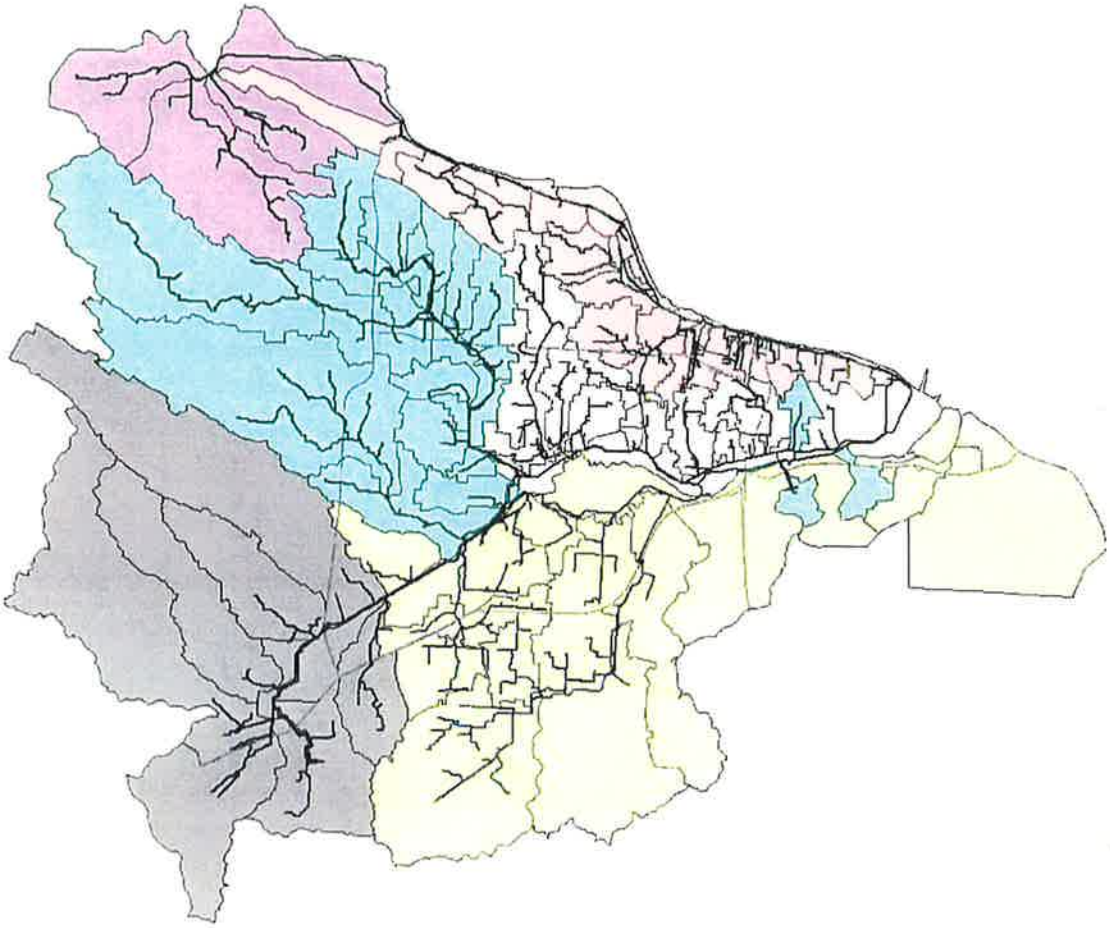
SECAP



SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

MWH
MONTGOMERY WATSON HARZA

Little Rock
Wastewater Utility

FINAL DRAFT REPORT
MARCH 2002

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This report presents the results and recommendations of the System Evaluation and Capacity Assurance Plan (SECAP), for Little Rock's wastewater collection system. The report prepared by MWH under an agreement with the Little Rock Sewer Committee dated June 28, 2000.

BACKGROUND AND SECAP OBJECTIVES

This report incorporates information from previous engineering studies for the Adams Field and Fourche Creek Wastewater Treatment Plants (WWTP), analysis for Little Maumelle Sewer Basin, and provides a comprehensive evaluation of the current and future needs of the entire Little Rock Wastewater Utility (LRWU) collection system. The overall objectives of the SECAP study are as follows:

- Develop a hydraulic model of the trunk sewer system.
- Use the model to identify existing capacity deficiencies and confirm capacity related sanitary sewer overflow locations
- Use the model to determine the capacity improvements required to eliminate capacity related sanitary sewer overflows for a selected design storm
- Develop a phased projects improvement plan and budgetary estimates for implementing the required capacity improvements to the wastewater collection system.
- Provide recommendations for potential infiltration/inflow reduction measures
- Outline a sewer system renewal and replacement plan

LWRU SERVICE AREA AND WASTEWATER COLLECTION SYSTEM

The LRWU wastewater service area, corresponding to the SECAP study area, is composed of six basins: Little Maumelle, Fourche, North and South 60, District 142 and Riverfront. The Utility provides service to over 60,000 customers and maintains over 1,100 miles of collection system lines ranging in size from 6 to 60-inches in diameter for the greater Little Rock area. This report addresses both the capacity-related system deficiencies found in the larger diameter lines and their supporting conveyance and treatment facilities. Specific facilities that are impacted by the results of this report are the Adams Field and Fourche Creek WWTPs, and the Cantrell, Little Maumelle and Arch Street Pump Stations (**Figure 1**).

DESIGN FLOWS / DESIGN STORM

A temporary flow-monitoring program was conducted to evaluate the dry weather and wet weather flows for the six (6) basins. The program lasted from March 15 to April 28, 2000. The following equipment was installed throughout the system for monitoring purposes:

- 63 gravity flow meters
- 4 force main flow meters
- 8 groundwater gauges
- 8 rain gauges

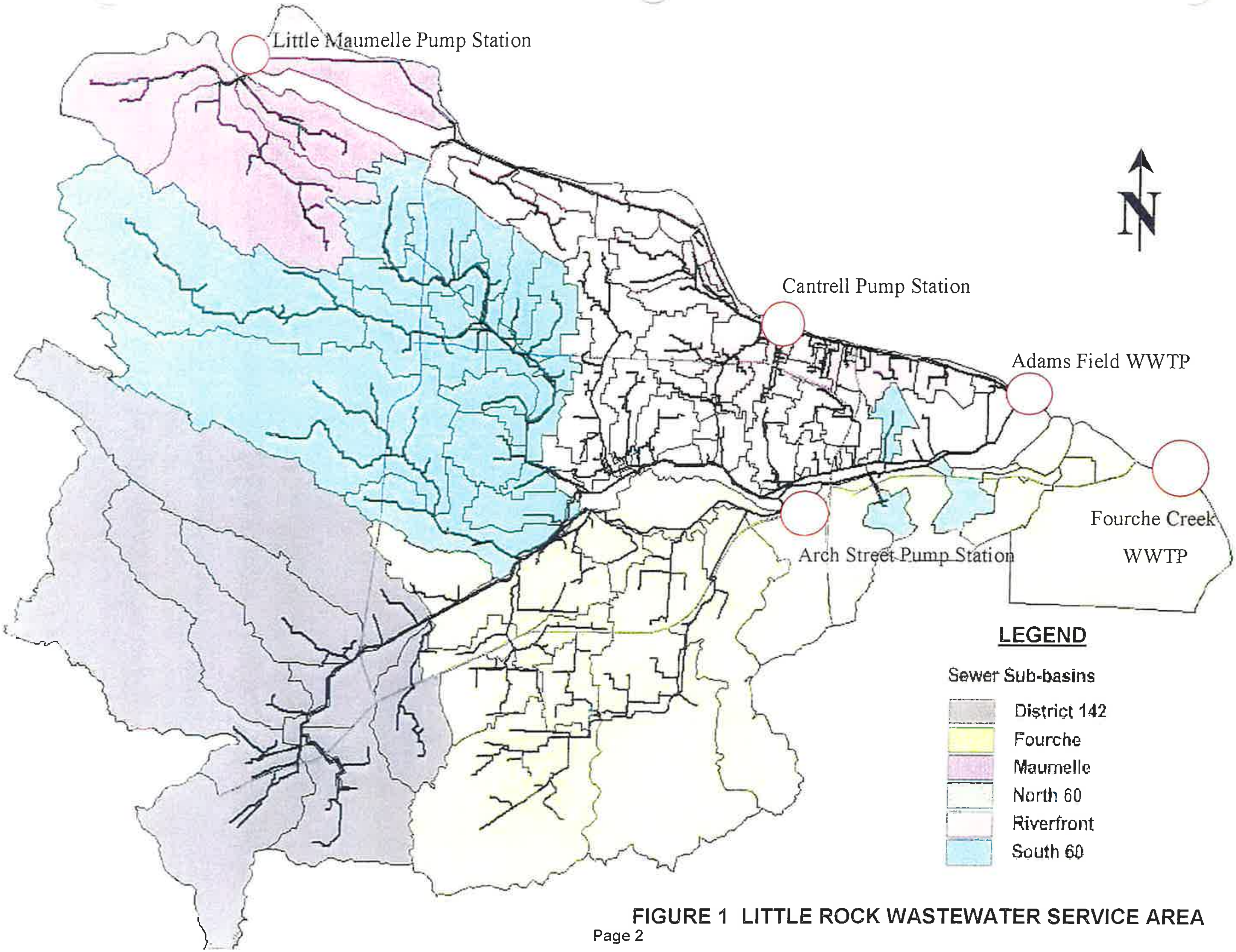


FIGURE 1 LITTLE ROCK WASTEWATER SERVICE AREA

Existing Flows. The hydraulic sewer model requires a determination of dry weather and wet-weather flows to assess the hydraulic impact on the existing sewer system.

Flows

Flows in the sewer system are comprised of wastewater from residential, commercial and industrial discharges, ground water infiltration and rainfall-related inflow/infiltration. The population based wastewater flows were derived from the building and land-use data provided by LRWU with the ground water and rainfall flows derived from the flow meter data.

Groundwater Infiltration

Groundwater infiltration (GWI) enters the sewer system via pipe joints, manholes, and pipe cracks, and are typically observed as a constant inflow, the GWI flow varies seasonally. The flow will fluctuate according to local rainfall patterns, soil, ground conditions, and increases after prolonged rainfall periods. The flow monitoring data collected for this study shows significant GWI throughout the sewer network and the basin.

Wet Weather Infiltration / Inflow

According to the flow meter data collected during the monitoring period, the Little Rock sewer basin exhibits a significant wet-weather flow response. Based on the flow meter data, the wet weather flow response in the Little Rock collection system appears to be due primarily to rapid infiltration into sewer defects rather than inflow from direct drainage connections like roof leaders or area drains. The meter data also indicated significant variation in wet weather flow response between different areas of the system.

Future Flows. The hydraulic sewer model requires forecasted dry weather and wet-weather inflows to assess the hydraulic impact on the future sewer system. The future dry weather flows represent increased flows caused by population growth, while future wet weather flows are based on a *design rainfall event.* The design rainfall event is generated to create a "worst-case" design scenario for predicting future problems and providing flow criteria for developing hydraulic improvements.

Model Assumptions

The model of future flows were based on the following assumptions:

- No net population growth in the six sewer basins
- No net reduction in I/I associated with the proposed sewer rehabilitation program or increase in I/I due to future sewer deterioration in unrehabilitated areas.

Design Rainfall Event

During November 2000, LRWU experienced a significant rainfall event following a prolonged month of antecedent rainfall producing high groundwater conditions. The rainfall duration exceeded 48 hours and generated over 5 inches of total rainfall. For this study, the November 2000 observed rainfall event was used as the "design event" to identify and develop solutions for the master plan.

The observed rainfall event was quantified in terms of *return period* by comparing the recorded depth and duration with historical rainfall intensity-duration-frequency (IDF) relationships for the Little Rock area. The November 2000 rainfall event equates to a storm event with a return period between 2 and 5 years and was selected as the design storm event because the storm:

- Exceeded LRWU design criteria, which is a 2-year event
- Provided a realistic spatial distribution of rainfall throughout the service area
- Coincided with reported hydraulic spills / flooding
- Provided model calibration confirmation since permanent meter data was available for this event
- Combined with an unusually long period of antecedent rainfall, provided "worst case" design condition

HYDRAULIC MODELING AND CAPACITY ANALYSIS

A fully dynamic hydraulic model was built to simulate operation of the LRWU wastewater collection system. The model was calibrated to both dry and wet weather flow conditions and was used to identify hydraulic capacity deficiencies in the system during the design wet weather event.

Hydraulic Model Description. The computerized hydraulic model includes pump stations, the force main system and gravity lines 10 inches in diameter and larger. Links and nodes represent pipes, manholes, controls and pump station wet-wells. Delineated sewer sub-basins represent flow in unmodeled pipes draining to specific modeled nodes. Population and land-use data determine the amount of flow entering the modeled system from these areas. Groundwater infiltration and I/I due to wet-weather runoff provide additional model inflows.

Little Maumelle, Cantrell, and Jamison Pump Stations were fully modeled, real time control was used to accurately model pump sequencing at Little Maumelle and Jamison Pump Stations; the Interstate Park Gate was also modeled using real time control. Adams WWTP and Arch Street Pump Station were represented in the model as limited discharge orifices, meaning that the influent flow to these facilities was limited based on their current maximum capacities.

Model Calibration. The model was calibrated for both dry and wet weather flow conditions based on data from 63 temporary flow meters. During the calibration process, model results were compared to meter data, and model parameters such as per capita flows, diurnal patterns, groundwater infiltration, runoff routing, and pump curves were adjusted to provide more accurate model and meter data fits.

Initial model results for the design storm indicated that hydrologic conditions were different during the design storm compared to the wet weather calibration event, using data from five permanent flow meters, model runoff parameters were slightly modified to more accurately model conditions during the design event. This calibration was verified by comparing reported historical overflows to model predicted overflows for this event.

Hydraulic Analysis. The calibrated model was used to evaluate the hydraulic performance of the trunk system during the design storm event. Areas with hydraulic problems such as overflows or surcharging were identified, and, where possible, the cause of the problem was determined. Causes of surcharging and overflows included localized limited capacity and backwater due to downstream capacity restrictions.

ALTERNATIVES ANALYSIS

The objective of the hydraulic model was to predict flow conditions during the design storm event and provide a tool to identify capacity improvements that would eliminate system deficiencies. From the modeled output data, potential alternatives were developed to address identified capacity problems. Alternatives included paralleling existing deficient sewers, replacement of undersized sewers with larger diameter pipes, upgrading capacity for existing pumping and treatment facilities, and providing additional system capacity by storing wet weather related flows. After capacity-related alternatives were developed, each alternative was evaluated against a set of criteria that included project feasibility, construction methods, community issues, long term flexibility, and cost.

Identification of Wastewater System Alternatives. Five alternative scenarios correcting system deficiencies were identified for comprehensive evaluation. Each alternative represented an overall view of Little Rock's wastewater system and to varying degrees incorporated wastewater technology for increased conveyance capacity, storm water storage capabilities, and additional treatment capacity through new or expanded facilities.

Alternatives Evaluation. A Citizens Advisory Group (CAG) was formed to obtain input on the various system alternatives. The CAG identified evaluation criteria from a citizen or community perspective. The criteria included:

- Environmental concerns
- Citizen awareness – social impacts and aesthetics
- Rate and property value impacts
- Technical and ongoing operation and maintenance concerns
- Regulatory concerns
- Construction issues

The five alternatives were also reviewed by representatives from the Little Rock Wastewater Utility (LRWU). When conducting their evaluation, the Utility considered additional issues related to schedule, budget, and implementation of construction projects.

Selected Alternative. Input from both the CAG and Utility was used to select the preferred alternative for the overall capacity assurance program. In general increased system capacity was preferred over construction of new wet weather storage facilities, which were considered less desirable due to permitting issues, site esthetics, environmental and odor concerns.

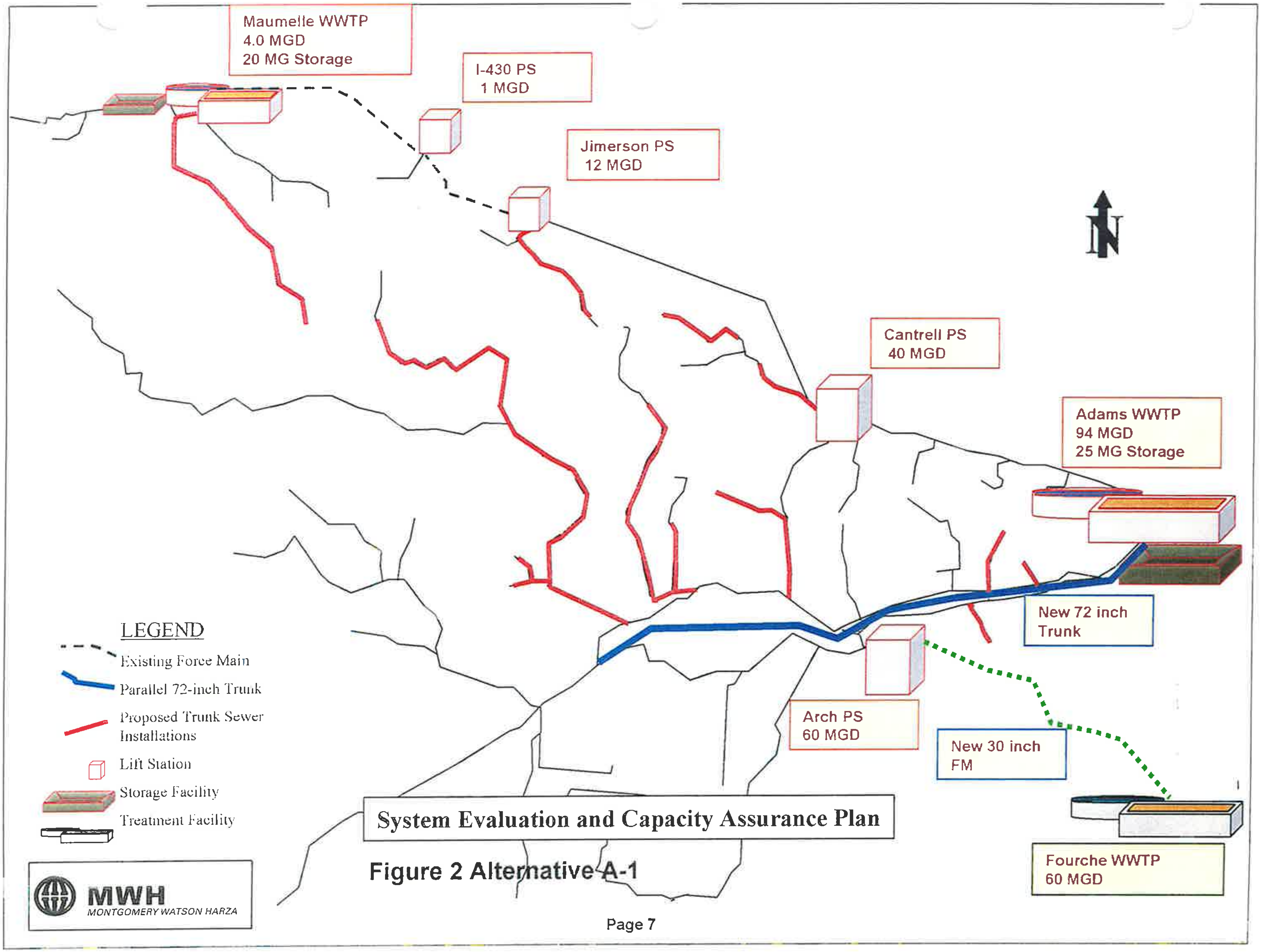
Permitting, environmental and community concerns were identified with respect to the construction of a new wastewater treatment plant in the Maumelle basin; however, limitations on the ability to expand the existing Adams Field WWTP capabilities in order to accept increased flows outweighed these concerns. Hence, Alternative A1 (**Figure 2**) was selected as the preferred alternative for meeting system capacity deficiencies. Alternative A1 consists of the following improvements:

- A new treatment plant in the Little Maumelle Basin, including 20 million gallons of equalization basins.
- Increased capacity at the Adams Field WWTP (72 to 94 MGD), including 25 million gallons of equalization basins.
- Increased capacity in the Fourche Creek WWTP (38 to 60 MGD).
- Increased capacity at the Arch Street Pump Station (38 to 60 MGD), including 41,500 LF of new 30-inch parallel force main.
- Increased capacity in the Cantrell Pump Station (25 to 40 MGD).
- New Jimerson Creek Pump Station (12 MGD).
- New I-430 Booster Pump Station (1 MGD),
- 72-inch parallel trunk line, from Adams Field WWTP to the west-end of the Twin 60s interceptors.
- Various trunk sewer improvements needed for additional capacity throughout the system.
- Implementation of a sewer rehabilitation and replacement program to reduce system I/I.

Costs. Estimated costs were developed for comparison purposes and do not include land right-of-way acquisition, construction management, legal work and financing fees, and operation and maintenance costs. Capital costs include an additional 25% mark up for contingencies and engineering. No inflation factors were used in the calculations. **Table 1** shows capital costs for all of Alternative A1 improvements.

Table 1
Estimated Capital Costs for Alternative A1

Type of Project	Description	Cost ($ million)
Trunk Sewer Improvements	Trunk Improvements Throughout the 6 Basins 72-Inch Parallel Line (45,800 linear feet)	$53.1 $30.4
Pump Station Improvements	Cantrell (40 MGD) Arch (60 MGD), w/41,500 LF of 30-inch FM Jimerson (12MGD) I-430 Booster (1 MGD)	$4.6 $12.6 $2.5 $0.4
Treatment Plant Improvements	Maumelle (4 MGD), w/20 MG Basins Adams Field (94 MGD), w/25 MG Basins Fourche Creek (60 MGD)	$19.9 $24.0 $23.4
	Total	**$171.0**



System Evaluation and Capacity Assurance Plan

Figure 2 Alternative A-1

IMPLEMENTATION RECOMMENDATIONS

The implementation schedule was developed to accommodate immediate improvement needs at existing facilities while constructing the new Little Maumelle WWTP. Trunk sewer improvements have been scheduled starting with upstream sewer line rehabilitation then moving down stream and concluding with construction of the major 72-inch parallel trunk line. An aggressive I/I abatement program is targeted for areas that would have a direct impact on proposed line work. Projects that increase line capacity were staged to allow for potential credit for any flow reductions resulting from the I/I abatement program. Construction of the major trunk sewers and expansion of the Fourche WWTP would follow completion of the upstream work. This staged implementation approach resulted in a recommended 15 year schedule for installation of recommended capacity improvements. Projects were prioritized based on response to critical conditions existing in the collection system, program flexibility, and coordination with development of the Utility's Wastewater Capital Improvements Plan (CIP). Beyond the costs for the SECAP improvements, the Utility's CIP includes continuing sewer rehabilitation work, facility operation and maintenance improvements, and miscellaneous improvements to wastewater facilities. Capacity improvements outlined in this report were not intended to serve as a substitute for the Utility's comprehensive CIP. The estimated capital costs and schedule for implementation for the SECAP improvements are shown in **Figure 3** and **Figure 4**.

Recommendations. The Utility should begin implementation of the capacity improvement program recommended by the System Evaluation and Capacity Assurance Plan Report. Proposed alignments and sizes of all recommended projects should be verified with detailed pre-design analyses, including topographic surveys, geotechnical investigations, utility research, and constructability reviews. The decision to parallel or replace existing sewers should consider the physical condition and remaining useful life of the existing pipelines; the availability of pipeline corridors for new sewer construction; and operation and maintenance concerns. After completion of sewer rehabilitation, flows should be re-monitored to verify that reductions in I/I have been achieved for local systems. The hydraulic model should be updated accordingly upon completion of that work and credit for downsizing or elimination of additional capacity related improvements should be documented.

INFILTRATION/INFLOW ABATEMENT

The Utility should focus on making the I/I abatement plan an integrated approach that addresses I/I problems with an ongoing sewer replacement and repair effort. The plan should link ongoing emergency repair and sewer renewal programs with a focused effort on removing extraneous I/I from the system. Plan provisions should be consistent with the emerging Environmental Protection Agency's (EPA) Sanitary Sewer Overflow (SSO) policy including capacity, management, operations and maintenance (cMOM) requirements. The targeted I/I reduction program should prioritize sewer rehabilitation and replacement based on the areas with the highest I/I contributions and the ability to impact the capacity improvement plan by reducing or eliminating trunk sewer improvements. The program should also address the complex issue of I/I abatement for private sewer laterals and service

Figure 3
Annual Expenditures for Capacity Assurance Plan Improvements

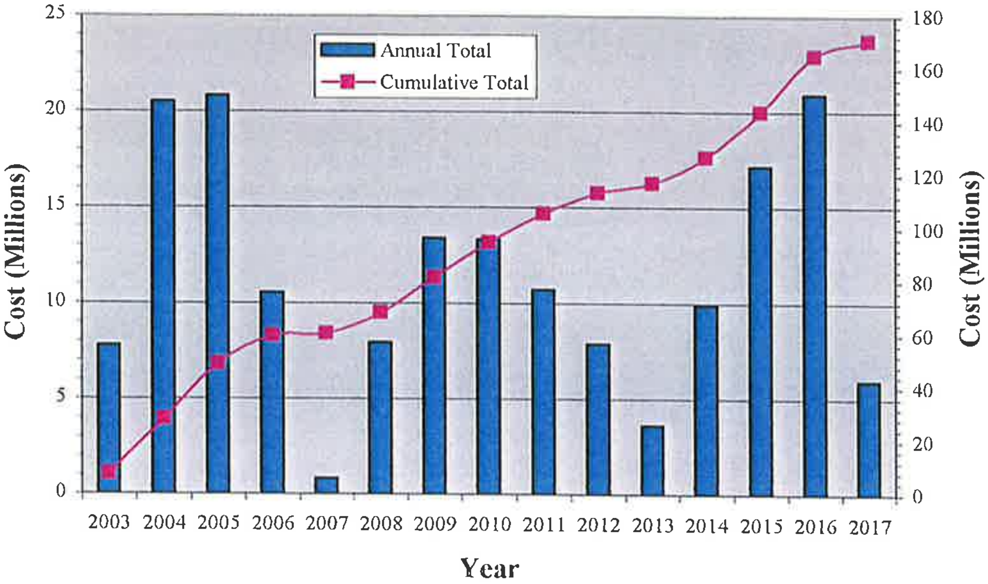
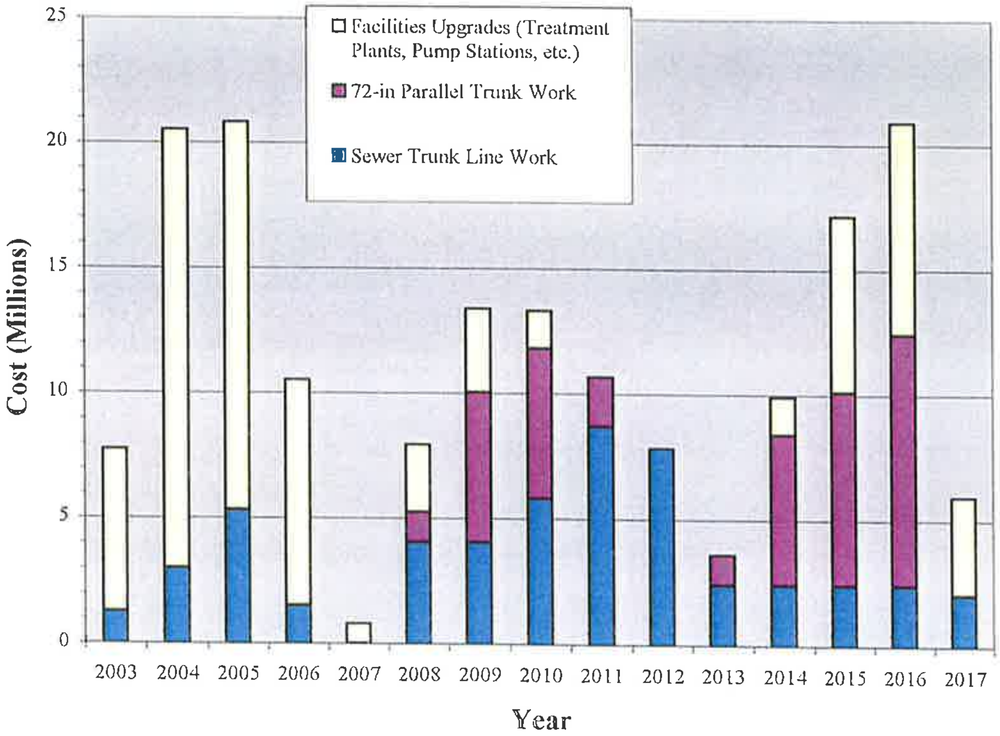


Figure 4
Annual Expenditures by Type of Construction



connections. The infiltration/inflow reduction plan should consist of the following components:

- Flow targeted I/I reduction
- Emergency, corrective and preventative maintenance
- Inspection and condition assessment prioritization
- I/I source identification and abatement
- Private property I/I correction programs

The integrated I/I abatement program should be implemented as part of the overall sewer system improvement program, ongoing maintenance, and capital rehabilitation and replacement efforts. The I/I program should directs its initial focus on known problem areas like Upper Hinson in the Maumelle Basin and developed areas located in the South 60 Basin along the upper reaches of the Rock Creek trunk line.

CITIZEN PARTICIPATION

Members of a Citizens Advisory Group were selected from a cross section of the Little Rock Community representing municipal, regulatory agencies, commercial, industrial, as well as private citizens groups. The Group was organized to exchange information and discuss options for correcting Little Rock's wastewater system capacity deficiencies and to ensure that community values were reflected in the decisions and recommendations of the System Evaluation and Capacity Assurance Plan for Little Rock.

Review of Alternatives. The CAG evaluated options for addressing system capacity deficiencies that included wet weather storage, conveyance and treatment improvements. The CAG developed criteria and an evaluation matrix for ranking capacity improvements and selecting their preferred options. The results of their selections and recommendations became an integral part of the Utility's SECAP evaluation.

Recommendations. The matrix evaluation indicated options involving storage facilities were not preferred. However, opinions regarding construction of a new Maumelle WWTP was less definitive for the Group. While the conveyance option was slightly favored the Group did express concerns regarding higher costs and adverse impacts to the community during construction. The CAG favored implementing a comprehensive rehabilitation program before committing to an extensive program to add capacity by installing larger interceptors or relief sewers. The Group also recommended addressing I/I contributed by private lines and service connections and that the City consider initiating smart growth initiatives to control new development in logical manner.

OTHER RECOMMENDATIONS

Two additional options were identified during the evaluation process. While technically feasible, further evaluation of both of these options would require a collaborative effort with outside parties that extends beyond the scope of this contract and were, therefore, not included in evaluation for the SECAP. However both of these options appear to merit further consideration due to their cost effectiveness and community minded approach.

North Little Rock WWTP Option. Wastewater from the Maumelle Basin is currently conveyed through the Riverfront Basin to the Adams Field WWTP. The White Oak Bayou WWTP, owned and operated by the North Little Rock Wastewater Utility (NLRWU), may be capable of accepting and treating wastewater from the Maumelle Basin and North Riverfront service area. This option includes installation of a new pump station for the Maumelle Basin and possibly new pump stations for the Jimerson Creek and I-430 areas. Wastewater would be conveyed across Murray Lock and Dam and to the existing White Oak Bayou Treatment Plant. At a minimum, the plant would need additional capacity improvements as well as a revision to permit conditions for plant discharge. This option would reduce the amount of flow to the Adams WWTP and eliminate the need for a new treatment plant in the Maumelle Basin.

Wet Weather Storage Facility Option. Though the Utility and CAG preferred not to incorporate new storage facilities in the selected alternative, site evaluations for the SECAP revealed the existence of a landfill facility located in the same general vicinity where proposed storage facilities might have been installed. Using existing borrow pits to construct wet weather storage facilities at the landfill site could at the least partially alleviate many of the community and environmental concerns. Furthermore, constructing the least cost alternative with wet weather storage would provide $24.1 million savings over Alternative A1. With a significant amount of the excavation needed for storage facilities already completed in the borrow area, additional savings would be realized by using the landfill site for storage.

Section 1
Introduction

This report presents the results and recommendations of the System Evaluation and Capacity Assurance Plan (SECAP) for Little Rock's wastewater collection system. The report was prepared by MWH under an agreement with the Little Rock Sewer Committee dated June 28, 2000.

1.1 BACKGROUND AND MASTER PLAN OBJECTIVES

The Little Rock Wastewater Utility (LRWU) completed the first phase of collection system study and small line improvements in year 2000. Part of this ongoing work involved initial engineering studies completed for Adams Field WWTP in 1998 and Fourche WWTP in 1999; an evaluation of options to handle wastewater for the Little Maumelle Basin was also completed in 2001. This report incorporates information from these planning documents and provides a comprehensive evaluation of the current and future needs of the entire LRWU collection system.

The overall objectives of the SECAP study are as follows:

- Develop a hydraulic model of the trunk sewer system.
- Use the model to identify existing capacity deficiencies and capacity requirements
- Develop phased improvement projects plan and budget estimates for implementing the required capacity improvements to the wastewater collection system.
- Provide recommendations for potential infiltration/inflow reduction measures
- Outline a sewer system renewal and replacement plan

1.2 LWRU SERVICE AREA

The LWRU system provides wastewater collection and treatment services for the City of Little Rock, Arkansas. The Utility's wastewater service area includes six basins: Little Maumelle, Fourche, North and South 60, District 142 and Riverfront. The Utility's wastewater service area boundary, which defines the study area for the SECAP, is shown in **Figure 1.1**.

1.3 LWRU WASTEWATER COLLECTION SYSTEM

The Little Rock Wastewater Utility provides service to over 60,000 customers within the city of Little Rock and maintains over 1,100 miles of collection system lines ranging in size from 6 to 60-inches in diameter. This report addresses capacity-related deficiency found in the larger diameter line and conveyance facilities. LRWU owns and operates two wastewater treatment plants: the Adams Field and Fourche Creek Wastewater Treatment Plants (WWTPs). The Adams Field WWTP has a design flow of 36 million gallons per day (MGD) with a maximum capacity of 72 MGD; the Fourche Creek WWTP has a design flow of 16 MGD with a maximum of 38 MGD. Major conveyance facilities that impact the larger trunk collection and conveyance system include the Cantrell, Little Maumelle and Arch Street

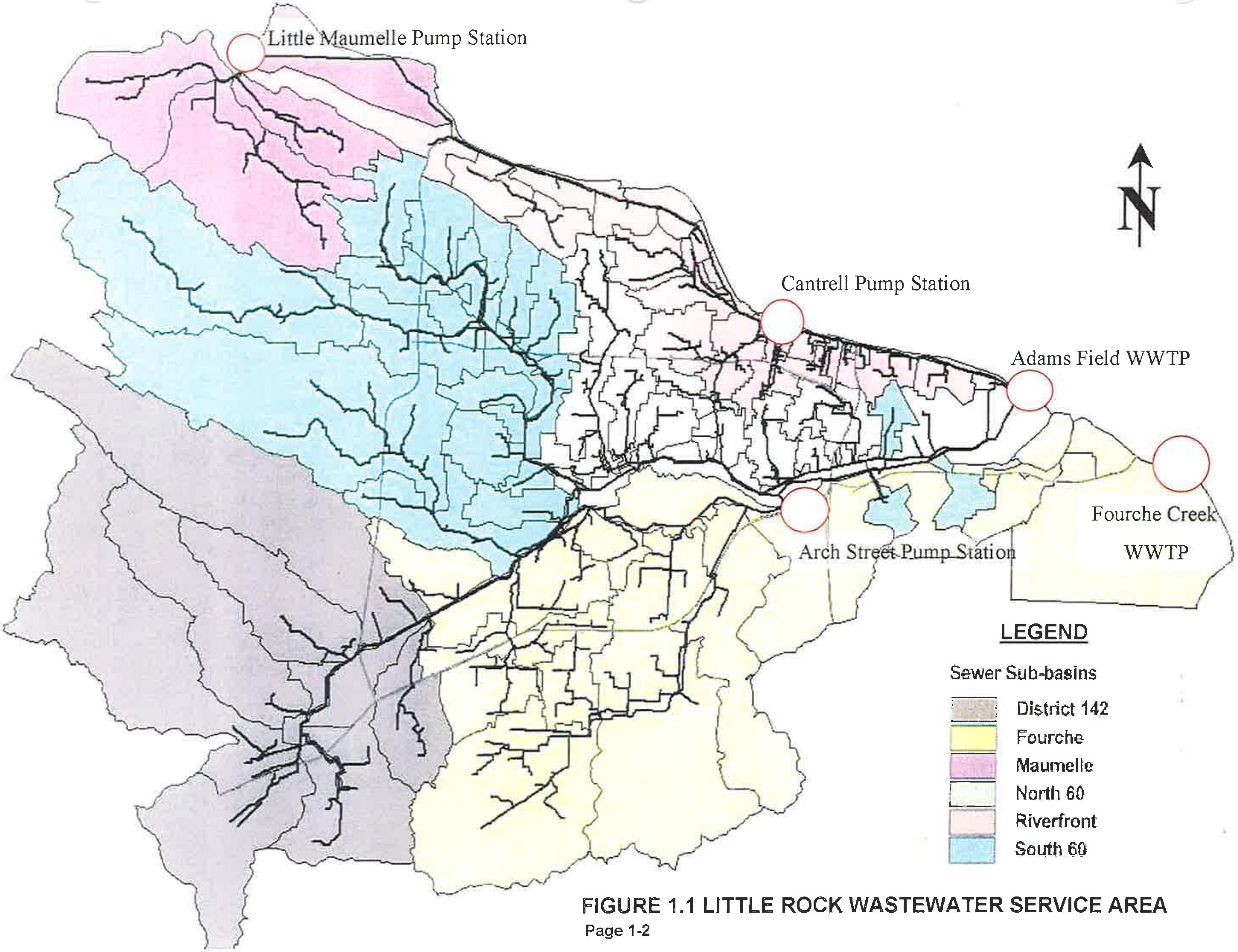


FIGURE 1.1 LITTLE ROCK WASTEWATER SERVICE AREA

Pump Stations. The Arch Street Station has a capacity of 38 MGD, Little Maumelle 5.6 MGD and Cantrell 25 MGD.

1.4 SCOPE OF MASTER PLAN UPDATE

MWH was authorized by LWRU to provide engineering consulting services for the System Evaluation and Capacity Assurance Plan under an agreement dated June 28, 2000.

The scope of the project, as well as a brief discussion of work conducted under each task, is described below.

Task 1 – Project Management. The purpose of this task was to provide project management, identify key members of the project team, mobilize team personnel, conduct meetings with LRWU staff, and provide general project administration throughout duration of the project. MWH coordinated with LRWU to establish agendas for meetings that included:

- Communication issues
- Project Scope
- Project Schedule
- Meeting formats
- Deliverables
- Data sources
- Data Structures for deliverables
- Data Retrieval Coordination
- Large Diameter Pipe Investigation
- Flow Monitoring Status
- Technical Memorandum Standards
- Initial Report Format

Task 2 – Data Collection. The object of this task was to the collect existing data, maps and flow information for review and to determine impact on evaluation procedures and inclusion in the project report. The collected data included existing electronic and hardcopy data, data collected under separate contract with LRWU and Pitometer, Byrd / Forbes, and field data collected within the scope of this contract. Data were used to better understand the existing collection system and to develop recommendations for capacity upgrade alternatives. Technical Memoranda (TM) were provided for model standards, large diameter line investigation and pump station evaluations.

Task 3 – Evaluation Criteria. This task involved three phases: establishment of standard evaluation criteria to be used in the hydraulic model, alternatives analysis, and project development based on the data collected and discussions with LRWU personnel. Criteria were developed for interpreting flow data, determining dry and wet weather benchmarks, and estimating dry and wet weather base and peak flows. Standards were developed for determining collection system physical characteristics, I/I rates for the study areas, and data formats compatible with LRWU datasets and systems. A TM was provided to the Utility for evaluation criteria.

Task 4 – Model Development. This task involved the development and calibration of the LRWU Hydroworks sewer model. In coordination with LRWU, line segment and manhole data necessary for a complete model network were input, into the model. In conjunction with LRWU staff, field verification of this data were supplied and sewershed areas were developed using the evaluation criteria. The model was initially calibrated for dry weather flows and infiltration rates, before the simulation of actual recorded wet weather events for three storms. Upon completion of this task, hard and electronic copies of a technical memorandum of the sewershed data set were provided to LRWU for review and approval.

Task 5 – Development Improvement Projects. This task included developing specific capital improvement projects required to address modeled system deficiencies and future capacity requirements. A proposed phasing plan for projects was developed based upon capacity needs and the City's ability to fund new projects while sustaining existing levels of system operation and maintenance. Recommended alignments were identified and cost estimates were prepared, this task also included the involvement of a Citizens Advisory Group to gather input and obtain acceptance from the public, utility and city officials

Task 6 – Recommendation and Final Report. This task included the creation of draft and final engineering reports summarizing the results of all previous tasks. The report describes:

- Work performed during the various tasks
- Procedures and methodologies used
- Alternatives evaluated in developing the recommended plan
- Detailed plan with cost estimates

The draft report was developed to meet Arkansas Department of Environmental Quality (ADEQ) Revolving Loan Fund requirements. The final report was presented to the Little Rock Sewer Committee, technical memoranda, intermediate reports and previous studies are attached to the report under separate appendicies.

1.5 REPORT ORGANIZATION

The System Evaluation and Capacity Assurance Plan Report includes eight sections, which are described below.

- **Section 1, Introduction,** presents the background, objectives, and scope of the Capacity Plan study.

- **Section 2, Existing and Future Flows,** discusses the planning area land use projections, the basis for developing estimates for each component of wastewater flows, and the flow projections for the service areas.

- **Section 3, Modeling and Capacity Analysis,** describes the modeled sewer system, model scenarios, model analysis criteria, and capacity analysis results.
- **Section 4, Alternative Improvement Projects,** explains the process for developing capacity improvement projects and presents the recommended projects.
- **Section 5, Recommendation for Improvement Plan,** presents the recommended improvement projects including project prioritization, budgets, cost allocations, and implementation recommendations.
- **Section 6, Infiltration / Inflow Abatement,** summarizes recommendations and alternatives for I/I reduction plan.
- **Section 7, Citizen Participation,** describes participation of the Citizens Advisory Group, and their concerns and recommendations regarding system capacity deficiencies.
- **Section 8, Other Options,** summarizes additional options for improvements that are not included as a part of the scope for this contract. Identified options indicate sufficient initial feasibility to merit further consideration for possible implementation.

The Appendices to this report include documentation for the recommended improvement plan including flow calculations, model output, and cost estimates. The Technical Memoranda (TMs) completed during the study are included in a separately bound volume.

Section 2
Existing and Future Flows

This section of the report presents the basis of the existing model inflows used to calibrate the model, and the future model inflows used for evaluating hydraulic capacity issues and developing solutions. The section provides a summary of the flow monitoring data collected for calibration and infiltration/inflow (I/I) analysis, development of dry and wet weather flows, and the design rainfall event used to assess capacities and plan solutions.

2.1 FLOW MONITORING SUMMARY

2.1.1 Flow Monitoring Data

The flow meter data was obtained from a temporary flow monitoring contract conducted by Pitometer, Byrd / Forbes (PBF). The goals of the contract were to provide LRWU with dry and wet weather sewer flows for model calibration, measure I/I quantities upstream of each flow meter site, measure pump output of four LRWU pump stations, and monitor groundwater levels at eight locations in the collection system.

PBF installed 63 gravity flow meters, 4 force main flow meters, 8 groundwater gauges, 5 sewer gas meters and 8 rain gauges throughout the study area. The flow monitoring period extended from March 15th 2000 to April 28th 2000 and captured 5 rain events ranging from 0.50 to 3.09 inches per event. Typical dry weather periods or "events" were also identified for purposes of dry weather model calibration. **Table 2.1** lists the dry and wet weather events.

Table 2.1
Dry and Wet Weather Event Summary

TITLE	REF	DURATION (hrs)	START DATE	START DAY	END DATE	END DAY
DWF Event X (Weekday)	X	48	04/26/2000	Wednesday	04/28/2000	Friday
DWF Event Y (Weekday)	Y	48	04/19/2000	Wednesday	04/21/2000	Friday
DWF Event Z (Weekend)	Z	48	04/29/2000	Saturday	05/01/2000	Monday
WWF Event A	A	192	03/15/2000	Wednesday	03/23/2000	Thursday
WWF Event B	B	383	03/23/2000	Thursday	04/08/2000	Saturday
WWF Event C	C	240	04/09/2000	Sunday	04/19/2000	Wednesday
Flow Survey Period	T	1055	03/15/2000	Wednesday	04/28/2000	Friday

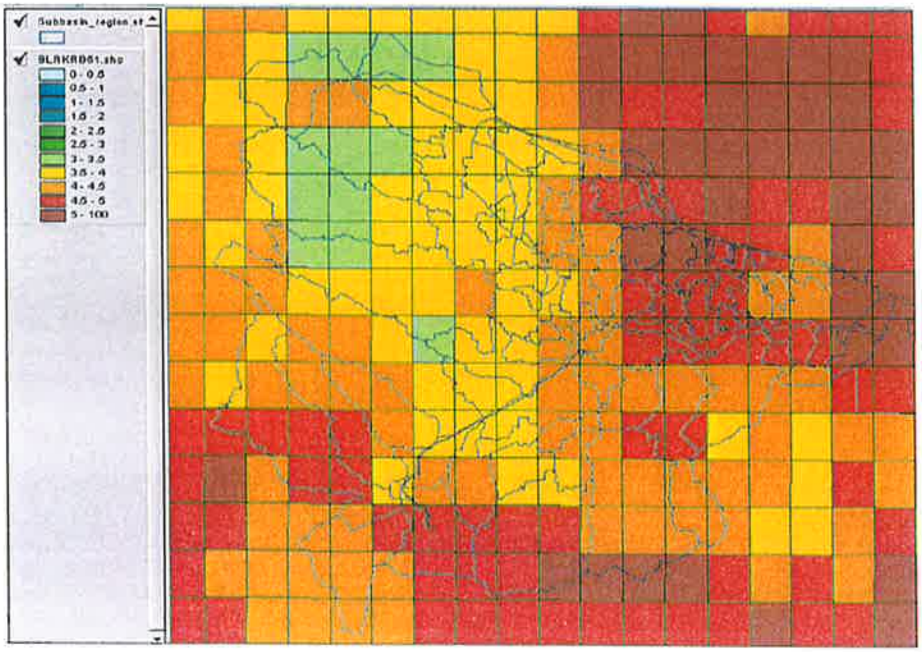
For more information about the flow meters including meter locations, model references, and location descriptions, refer to the Flow Monitoring Technical Memorandum (TM) included as **Appendix I**.

2.1.2 Observed Rainfall Data

The rainfall data used for the project is gauge-adjusted radar-rainfall data provided by NEXRAIN Corporation. Radar rainfall data provides an accurate estimation of the spatial distribution of rainfall which is critical to model calibration. In the past, hydraulic models have been calibrated using rainfall data collected from rain gauge networks providing accurate rain measurements at discrete points, but with poor estimates falling between gauges. Conversely, radar is able to see between the gauges but lacks the consistency in estimating rainfall at a specific point.

The radar data was converted into ArcADE rain data DBF files, and a graphic theme of the grid cells. The data is used to develop HydroWorks rain data (RED) files for selected wet-weather events, and evaluate the spatial variation over the Little Rock study area. **Figure 2.1** shows the spatial variation of total rainfall during the flow monitoring period.

Figure 2.1
Total Rain Depths (in) from 03/15/2000 to 04/28/2000



2.2 EXISTING MODEL INFLOWS

The hydraulic sewer model requires dry weather and wet-weather inflows to assess the hydraulic impact of the existing sewer system. Sewer flows are generated from residential populations, commercial and industrial flows, ground water infiltration and rainfall related infiltration. The population based flows were derived from the building and land-use data provided by LRWU with the ground water and rainfall flows derived from the flow meter data.

2.2.1 Residential and Employment Wastewater Flows

The population data is used to estimate the dry weather flows generated from residential and employment-based populations (i.e.: commercial and industrial). The population estimates were derived from an ArcView GIS building theme which provided a spatial distribution of all residential, commercial and industrial buildings. The populations were expressed as equivalent residential units (ERU) per building. For example, a typical single family home was equal to 1 ERU; where as commercial buildings were assigned multiple ERU values.

The ArcView building theme (buildings2.shp) contained a field defining the building code ("Structure") which allowed the consultant to identify the building type and estimate the ERU based on the building area. However, approximately 60% of the buildings had missing building codes, hence an alternative method of identifying the building type was implemented. The approach compared the building area (ie; 'footprint') with average building footprints for single family, multiple family, and commercial and industrial buildings. Building footprints less than 500 ft^2 were eliminated from the process to avoid including garages, storage sheds etc. The average building footprints were derived from buildings with known types. **Table 2.2** below lists the building types with average building footprint areas.

Table 2.2
Average Building Footprint Areas

Description	Structure Code	Minimum Area (sq. ft.)	Maximum Area (sq. ft.)
Mobile Homes	410	500	1000
Single Family	411	1000	3000
Multi Family	414	3000	12,000
Commercial	580	12,000	50,000
Industrial	650	50,000	No limit

Population data was used to calculate dry weather flows for residential and employment areas. The dry weather flow was calculated in the model by multiplying the population by a per capita flow rate (eg; 75 gallons/day/capita for residential and 25 gallons/day/capita for employment). The HydroWorks model only accepts one population per sewer basin, therefore it was necessary to derive 'equivalent' residential and employment populations. The following formula was used to calculate the equivalent population:

Population (equiv) = *Res Pop + [Emp Pop x (Emp PCF / Res PCF)]*

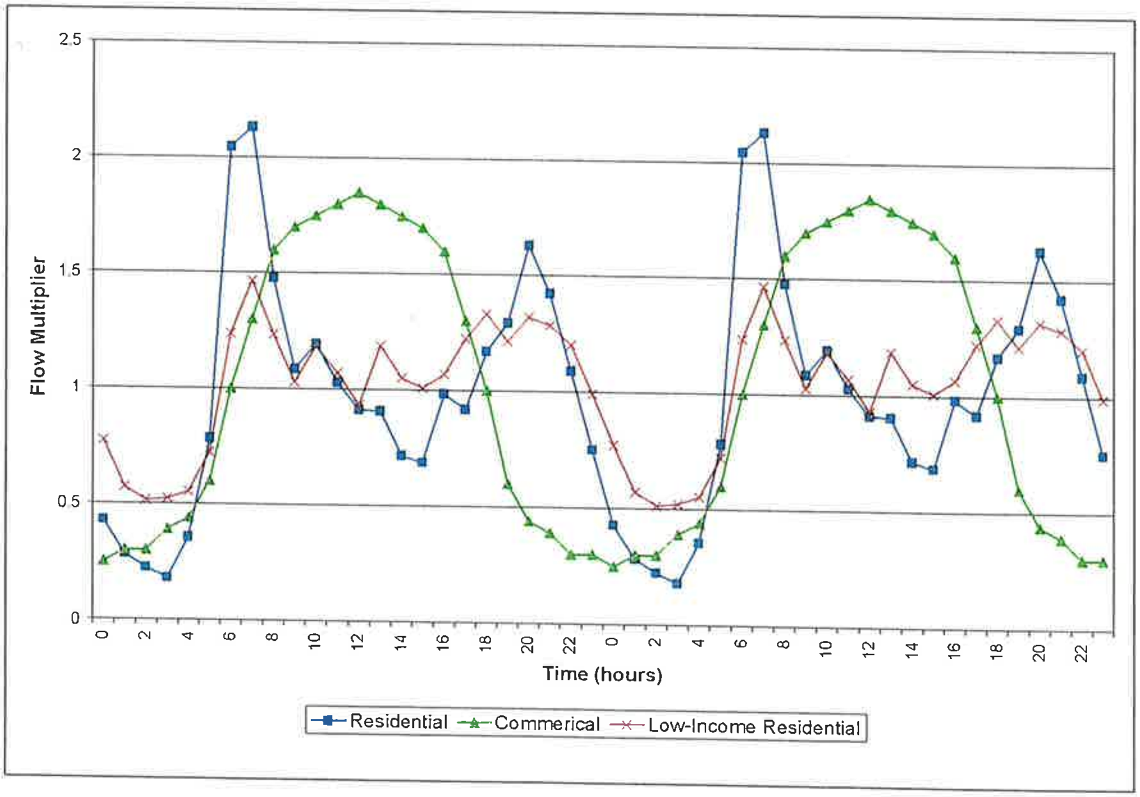
where; *Res Pop* = Residential Population
Emp Pop = Employment Population
Res PCF = Residential Per Capita Flow (eg; 75 g/day/head)
Emp PCF = Employment Per Capita Flow (eg; 25 g/day/head)

The Sewer Basin Manager tool, within the ArcADE suite, was used to allocate the populations to each sewer basin. This was achieved by overlaying the population theme (converted from the building theme) on top of the sewer basin polygons and spatially distributing the population data.

2.2.2 Wastewater Diurnal Profiles

Diurnal profiles for residential and employment wastewater flows are used to model the daily dry weather flow variation. The profiles were generated from observed flow meter data to create a true representation of time-varying dry weather flows in the Little Rock service area. Flow meters located in the upstream portions of the network were selected to provide a typical residential profile, and a low-income residential profile. The flow data was averaged and normalized to create flow multipliers for 24 hour weekday and weekend periods. The employment diurnal profile was created from a standard commercial diurnal curve. This standard curve was adjusted during initial calibration based on model results to make it specific to the LRWU system. **Figure 2.2** displays the diurnal curves used for this project.

Figure 2.2
Wastewater Diurnal Profiles



2.2.3 Groundwater Infiltration

Groundwater infiltration (GWI) enters the sewer system via pipe joints, manholes, and pipe cracks, and is typically observed as a constant inflow. The GWI flow varies seasonally and will fluctuate according to local rainfall patterns and soil and ground conditions. The flow monitoring data collected for this study shows significant GWI throughout the sewer network.

The GWI flows were derived from the flow monitoring data by extracting the calculated population-based dry weather flow (base DWF) from the observed minimum dry weather flows. Minimum flows typically occur during the nighttime or early morning hours when base wastewater flows are low. Subtracting an estimate of minimum base DWF from the minimum measured flow yields the estimated GWI for each monitored area. The minimum base DWF is typically about 15 to 20 percent of average base DWF. The resulting GWI is expressed on a unit basis (gallons/day/acre) by dividing by the sewered acreage of the monitored area.

The GWI flows were distributed throughout the model network using ArcADE by allocating observed GWI rates to the sewer basins. Comparing the dry weather flows with the flow monitoring data validated the model and ensured the application of the correct GWI distribution.

2.2.4 Wet Weather Infiltration / Inflow

According to the flow meter data collected during the monitoring period, the Little Rock sewer basin exhibits a significant wet-weather flow response. The data were reviewed to interpret the flow response to rainfall and to develop the wet-weather modeling approach. The flow meter data revealed the following conditions:

- Increased infiltration during rainfall event
- Decreasing infiltration after rainfall event
- Rapid flow response following the initial rainfall
- Increased groundwater infiltration (GWI) during a succession of rainfall events
- Low rapid response flows indicating few direct connections
- Large wet-weather flow variation between flow meters

Following the identification and evaluation of the hydrological processes, the consultant developed an approach for modeling the rainfall, runoff and routing processes. In this context, rainfall is defined as the intensity and duration of rain falling onto the sewer basin during and preceding the event period. The spatial variation of rainfall is significant when relating the rainfall to the wet-weather inflow. After rainfall commences, the runoff process converts the rainfall depth to an inflow volume; this process uses an "effective area" to represent the flow mechanisms such as groundwater seepage, storm water connections, and flow through laterals. Finally, flow routing describes the translation and attenuation of inflow caused by overland routing, seepage through ground, and slows leakage via cracks.

Rainfall data is needed to compute wet weather flows for model events. For any storm event, rainfall may vary throughout the basin. Therefore, specific rainfall amounts must be assigned to each sewer basin in the model. A graphical representation of this model was created using the radar cells to allocate individual rainfall hyetographs to each sewer basin. ArcADE includes a process for graphically assigning a specified "rainfall index" to each sewer basin using the rainfall basin (radar cell) theme. The rainfall index defines the rainfall to be used for that sewer basin in the model. The actual rainfall data used for model runs are stored in HydroWorks rainfall event data (RED) files. The RED file contains the rainfall data by time step (a 15-minute rainfall time step has been used for the LRWU model) for each rainfall index.

For more information about the wet weather flow modeling and the development of the model files, refer to the Data Management, Model Building, and Model Inflows Technical Memorandums (TMs) included in the **Appendices H, J, & K** respectively.

2.3 DESIGN FLOWS

Forecasted dry weather and wet weather inflows are necessary to assess future sewer system hydraulics and to plan system improvements over the next ten to fifteen years. Future dry weather flows generally represent increased flows caused by population growth, while future wet weather flows are based on a *design rainfall event*. The design rainfall event is generated to create a "worst-case" scenario for predicting future problems and providing flow criteria for developing hydraulic improvements.

2.3.1 Residential / Employment Flow Projections

The following assumptions where made during the assessment of future residential and employment based dry weather flows.

- No population growth for the current sewer basin
- Future development west of Little Maumelle, which *may* drain into the proposed new wastewater treatment plant. Inflow from this development was not included in the model as it is expected to drain directly to the proposed plant without any impact on the existing system.

The hydraulic analysis of the future sewer system used the existing residential and employment dry weather flows. As described previously, these flows were generated from the building data supplied by LRWU.

2.3.2 Groundwater Infiltration Projections

Groundwater infiltration varies seasonally depending on annual rainfall conditions. The variation and magnitude of GWI was examined by reviewing the daily average dry weather flows at the Adams Field WWTP. Based on this review, the following observations were made:

- GWI is predominantly related to rainfall depth and duration
- High GWI occurs during March / April, following the winter rainfall
- Low GWI occurs during the summer months
- GWI is present throughout the year due to winter and summer rainfall

The study assumed the GWI rate remained constant during the existing and future flow projections. This assumption was based on a trade-off in which system degradation and future rehabilitation would exactly offset one another. The GWI was present in all flow meter data indicating that GWI was distributed throughout the system so that it would be difficult to isolate and eliminate. Therefore, the design flows used for developing hydraulic schemes include both groundwater infiltration and the rainfall dependent inflow and infiltration (RDI/I) flow components.

The GWI flow projections were based on existing GWI obtained from the March / April period. This period represented the worst-case scenario of high seasonal groundwater infiltration. The GWI rates from this seasonally high period were extracted from the flow data and used for both model calibration and infiltration projections.

2.3.3 Design Flow Condition

Wastewater collection systems are typically sized for a specific "design" condition, which defines a designated system performance criterion during a wet weather event.

Generally, the performance criterion is defined by the maximum allowable water level in the system, which may be at the ground surface (i.e., "no overflows"), a specified distance below the ground (say, 3 to 5 feet below the manhole rims), or more conservatively, by a maximum allowable flow depth to pipe diameter (d/D) ratio. The "design event" establishes the maximum recurrence frequency under which the design performance criterion can be exceeded. Thus, if the performance criterion is "no overflows" and the recurrence frequency is 10 years, then the system must be designed such that overflows would occur no more frequently than once every 10 years.

In practice, the design event is often equated to a specified recurrence frequency *rainfall* event. Thus, the "design flow" is equated to the flow that would occur for a x-year frequency rainfall event, and the system is sized such that the design performance criterion is not exceeded for the x-year rainfall event flows. Since the magnitude of rain dependent inflow and infiltration flows are not governed solely by the intensity and duration of the rainfall, this system design technique does not necessarily ensure that the flows in the system will violate the performance criterion only once in every x years. However, using rainfall recurrence frequency as a design *flow* criterion is generally considered to be a reasonable approach for establishing collection system design flows.

2.3.4 Design Rainfall Event

Design storms are based on long-term historical rainfall data. During November 2000, LRWU experienced a significant rainfall event following a prolonged month of antecedent rainfall producing high groundwater conditions. The rainfall duration exceeded 48 hours and generated over 5 inches of total rainfall. For this study, the November 2000 observed rainfall event was used as the "design event" to identify and develop solutions for the master plan.

The observed rainfall event was quantified in terms of *return period* by comparing the recorded depth and duration with rainfall intensity-duration-frequency (IDF) relationships. The November 2000 rainfall event equates to a design event with a return period between 2 and 5 years. In addition to meeting LRWU design storm criteria, the November 2000 event was selected as the design event because this rainfall event:

- Exceeds LRWU design criteria
- Provides a realistic spatial distribution of rainfall
- Coincides with reported hydraulic spills / flooding
- Was used for confirming model calibration with permanent flow meters
- Occurred after an unusually long period of rainfall, giving rise to high groundwater infiltration and therefore creating a *worst-case* scenario.
- Had available rainfall radar data providing an accurate spatial representation of rainfall depths.

Table 2.3 summarizes the design rainfall event details, and **Figure 2.3** shows a sample rainfall hyetograph with a total depth of 4.8 inches. **Figure 2.4** shows the spatial variation of total rainfall depth over the entire sewer basin.

Table 2.3
Design Rainfall Event Details

TITLE	REF	DURATION (hrs)	TOTAL DEPTH (in)	START DATE	END DATE
Design Rainfall Event	E	50	4.5	11/22/2000	11/25/2000

Figure 2.3
Rainfall Hyetograph for Design Rainfall Event (Event E)

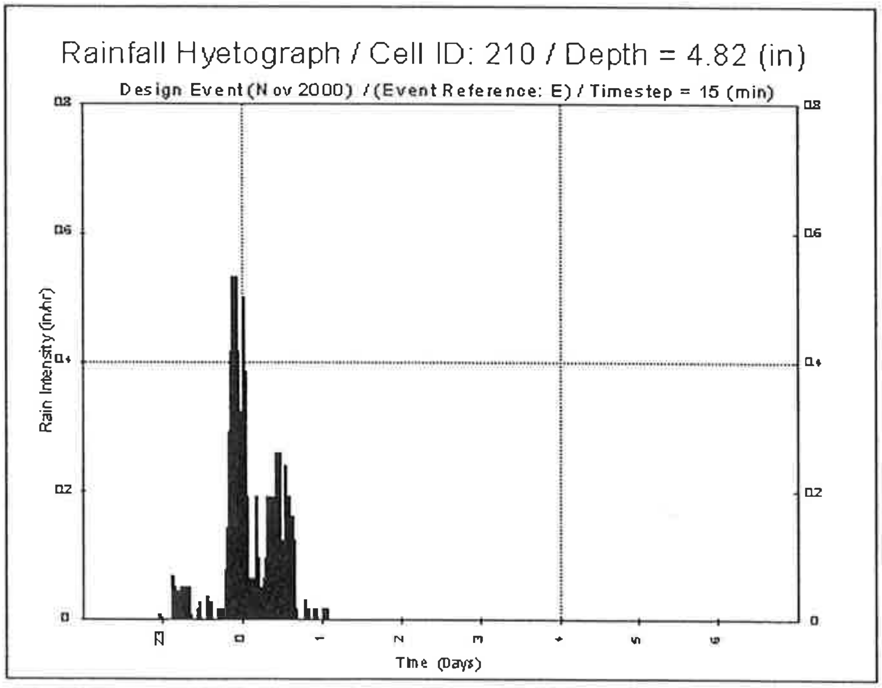
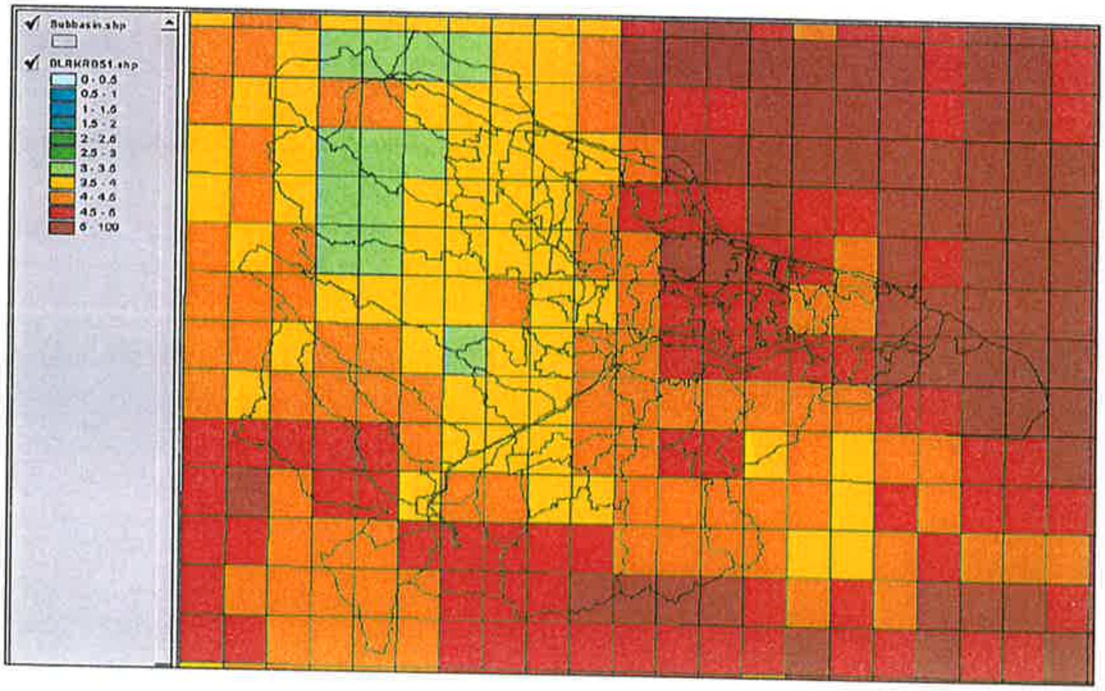


Figure 2.4
Total Rain Depths (in) for Design Rainfall Event (Event E)



2.3.5 Design Wet Weather I/I

The rain dependent inflow and infiltration (RDI/I) was generated from the design rainfall event and revised model runoff parameters calibrated using flow data obtained from four permanent flow monitors. In addition to this flow data, the model spill predictions were verified against reported spills occurring during the storm.

The revised calibration process identified a change in hydraulic conditions that proportionally reduced the wet weather I/I entering the system. This I/I reduction occurs when the system exhibits significant surcharging that prevents additional flow entering the system. As a result, the ratio of I/I to rainfall decreases as the system becomes overloaded. Model calibration parameters were modified to account for this effect. Further calibration details are described in Section 3 and the Model Calibration Technical Memorandum in **Appendix L**.

As previously stated, the study assumed the wet-weather I/I rates remained constant during the existing and future flow projections. This assumption was based on a trade-off between system degradation and future rehabilitation. The wet-weather I/I was present in all flow meter data indicating that I/I is distributed throughout the system making it difficult to isolate and eliminate. Therefore, the design flows used for developing hydraulic schemes includes both the groundwater infiltration and the RDI/I flow components.

Section 3
Modeling and Capacity Analysis

This section describes the hydraulic model used to identify and analyze capacity deficiencies in the LRWU collection system. Model components such as; the modeled network, model areas, pumps, and controls are described and model calibration is discussed. Capacity deficiencies were identified based on model-predicted overflows and surcharging, these deficiencies are divided by service area and presented in this section. The problem areas described in this section correspond to the recommended upgrades for increased conveyance capacity presented in **Section 4**.

3.1 HYDRAULIC MODEL DESCRIPTION

The LRWU collection system was modeled using HydroWorks™, a fully dynamic hydraulic model developed by Wallingford Software in the U.K. HydroWorks was selected based on a previous model evaluation conducted by LRWU.

The HydroWorks model was used in conjunction with an ArcView GIS interface. The interface, called ArcADE, is an ArcView extension developed by MWH specifically for use with HydroWorks and other hydraulic modeling programs. ArcADE facilitates the management and validation of sewer modeling data, the creation of model-input files, and the review of model results. The ArcADE extension has been provided to LRWU as part of this project.

The modeled system consists of links and nodes, which represent pipes, manholes, controls (e.g., pumps, weirs, gates, etc.), and pump station wet-wells. Delineated sewer sub-basins represent flow in unmodeled pipes draining to a modeled node. Population, land use, and groundwater infiltration data determine the amount of dry weather flow entering the modeled system from these areas. In addition to the sewer network and sub-basin areas, rainfall data and runoff information were built into the model to simulate wet-weather conditions. The model uses real time control to simulate operation of pump stations and controls. Detailed information about the model and model files is contained in the Data Management, Model Building, and Model Inflows Technical Memorandums (TMs) located in **Appendices H, J & K**, respectively.

3.1.1 Sewer Network

The LRWU modeled system contains pipes ten inches and greater in diameter, six and eight inch diameter pipes located downstream of larger pipes were also included in the model. Some pipes 10 inches or larger were not included in the modeled system because data for these pipes was not readily available.

The complete modeled network contains 4,814 nodes and 4,847 links. The nodes and links represent actual manholes, pipes, pump station wet-wells and control links (e.g., pumps). The control links included the Little Maumelle, Cantrell, and Jamison Pump Stations and the Interstate Park Gate. The Adams WWTP and Arch Street Pump Station were both represented as 'limited discharge orifices' meaning that the influent flow to these facilities was limited, based on existing and future flow conditions. **Figure 3.1** shows the entire LRWU collection system with the modeled pipes shown in blue.

All network and pump station information was obtained from LRWU. The data input into the model was validated for common errors, including but not limited to connectivity problems, duplicated or missing data, negative pipe slopes, and pipe crown elevations higher than ground level. In addition to the validation routine, profiles of modeled lines were used to visually identify errors. All discrepancies were corrected with the use of as-built or survey information. These data validation procedures are detailed in the Data Validation TM located in **Appendix H**.

3.1.2 Collection System Areas

i) Service Areas

The LRWU wastewater collection system has six basins, also known as services areas: Little Maumelle, Riverfront, North 60, South 60, Fourche, and District 142 as defined by LRWU. The model system was divided into these service areas for data validation and initial model building and calibration. The system was recombined into a single model during final calibration. The complete model was used to identify areas with capacity deficiencies and to develop solutions to address these deficiencies. The six collection system service areas are shown in **Figure 3.2**.

ii) Sewer Sub-basins

Sewer sub-basins define the areas used to allocate populations and associated flow data to the model network. The sewer sub-basins for this study were created by sub-dividing the service areas defined by LRWU. Sewer sub-basins were delineated to include all unmodeled pipes flowing to a particular node in the modeled system. The average size of a sewer sub-basin is approximately 60 acres. **Figure 3.2** shows the sewer sub-basins within each service area. Population and land use information was obtained for each sewer sub-basin.

iii) Flow Meter Basins

Flow meter basins define the area draining to a downstream flow meter. These basins, consisting of the sewer sub-basins draining between upstream and downstream flow meters, were used for allocating groundwater and rainfall dependent infiltration and inflow. For this study, 60 flow meter basins were defined based on 63 temporary flow meter sites. Three flow meters were on pipe interconnections and, therefore, do not have associated basins.

3.1.3 Pump Stations

As previously stated, the Little Maumelle, Cantrell and Jamison Pump Stations were fully modeled. Although the operation of Arch Street Pump Station was not modeled, the pump station was represented in the model as a limited discharge orifice. No other pumping facilities in the LRWU system were included in the model.

All pumps at Little Maumelle, Cantrell, and Jamison Pump Stations were modeled as rotodynamic pumps, i.e., curves describing the head-discharge relationship for each pump

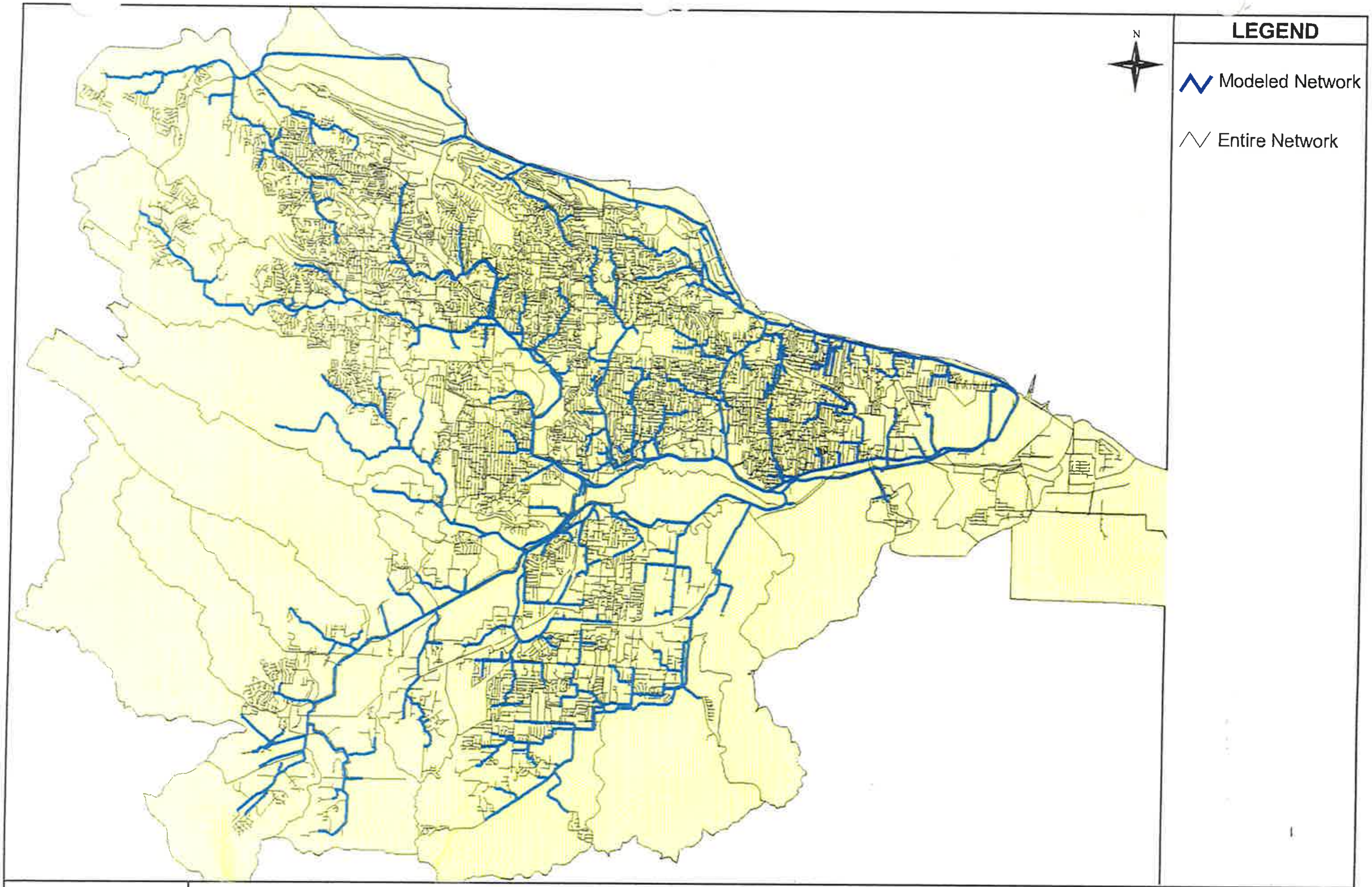


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FIGURE 3.1 MODELED NETWORK

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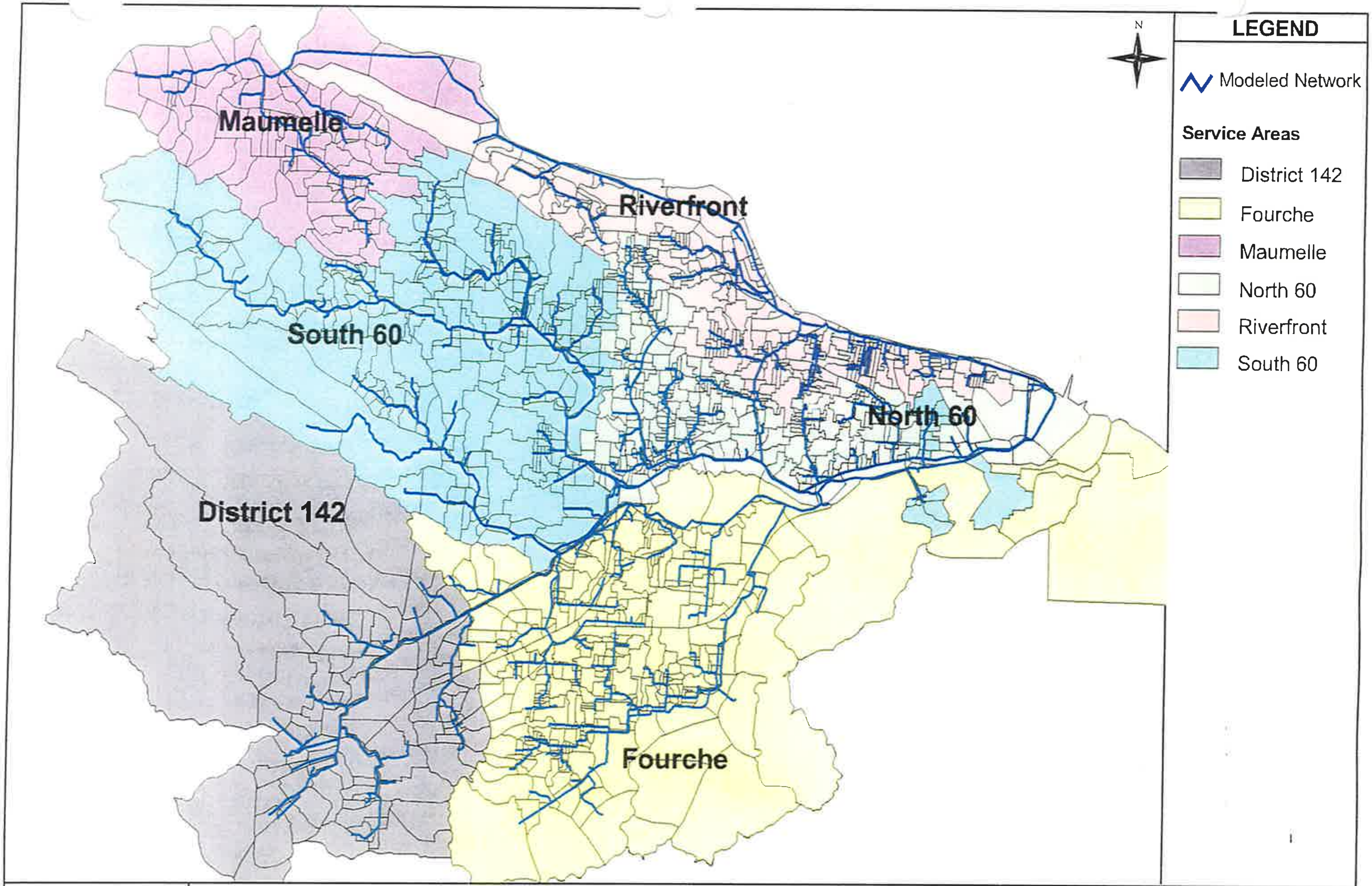

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FIGURE 3.2 SERVICE AREAS AND SUB-BASINS

SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

governed pump operation in the model. These pump curves were entered into the model and calibrated based on observed pumping capacities. Wet-well levels at which pumps turn on and off were defined to model pump sequencing. In addition, the real time control features of HydroWorks were used to model operating rules such as the shut-down of a small pump in response to the start-up of a large pump. Tertiary mode status, when pumping at Little Maumelle is reduced based on the wet-well level at Cantrell, was also modeled using real time control.

3.1.4 Wastewater Treatment Plants

Neither the Adams Field nor the Fourche WWTPs was fully modeled. Adams Field WWTP was represented as a limited discharge orifice in the model; the flow discharge from the collection system was limited to 72 MGD to simulate maximum plant capacity and any backwater in the collection system that may result. Although the Fourche WWTP, was not included in the model, this omission does not affect the accuracy of the model since the capacity of the Arch Street Pump Station, also modeled as a limited discharge orifice, was the limiting factor for this portion of the system. The Arch Street Pump Station was the farthest downstream point in the Fourche system included in the model.

3.1.5 Interstate Gate Park Control Facility

The Interstate Park Gate is operated based on the flow at Adams WWTP; when the flow reaches approximately 42 MGD, this gate is fully opened to divert more flow through the Arch Street Pump Station to the Fourche treatment plant. After the flow at Adams WWTP subsides, the gate is lowered to its standard opening of approximately 15 percent.

This gate was modeled using real time control. Based on historical operating conditions, the gate was modeled to open fully when the flow reaching Adams WWTP increased to 45 MGD. The modeled gate closes to a 15% opening after flow at the treatment plant decreases to 30 MGD. The difference in flow required to open and close the gate prevents the gate from opening and closing too rapidly.

3.2 MODEL CALIBRATION

Model calibration is the process of comparing predicted model flows and depths with observed flow data, identifying anomalies with the model data, and correcting and verifying model changes. The process provides a calibrated hydraulic model that can be used to assess existing and future flow conditions, and enable the user to develop and plan capacity upgrade solutions.

3.2.1 Model Calibration Process

The hydraulic model was calibrated against observed dry weather and wet weather flow events recorded during the flow survey period (**Table 2.1**). The dry weather event, Event X, and the wet weather event, Event A, were selected from the flow survey period between March and May 2000. The survey collected flow and depth data from 63 temporary flow meters strategically located throughout the collection system to capture flow data from the major trunks and interceptor systems. **Table 3.1** summarizes the calibration event data used for this study.

Table 3.1
Event Information

Event Name	Event Type	Event Dates	Rainfall (inches)
Event X	DWF Calibration	April 26 – April 27, 2000	0.0
Event A	WWF Calibration	March 15 – March 22, 2000	2.4
Event E	Design	November 22 – November 30, 2000	4.1

Model calibration is an iterative process involving many model runs and sequential model modifications until satisfactory model fits are obtained. Model fits (i.e., comparison between predicted and observed hydrographs) were assessed for peak flows, total volume, base flows, timing of peaks, and overall hydrograph shape. Overall, the allowable error between peak flows and volumes is 20 percent for critical locations within the network.

Model parameters such as per capita flows, residential and employment diurnal patterns, and groundwater infiltration were refined during dry weather flow calibration. Runoff routing parameters and the effective areas from which runoff into the collection system occurs were determined during wet weather flow calibration. Pump curves were calibrated based on reported observed pumping capacities, reported pump on/off durations, and downstream flow meters, if available.

3.2.2 Design Storm Calibration

Since the "design storm" described in **Section 2** of this report is an observed rainfall event, this design event data allowed the model predictions to be verified against observed flow data obtained from LRWU's permanent flow meters. Initial findings revealed differences between the model and the design storm occurring due to changes in hydrological and hydraulic conditions. The overall effect was proportionally lower inflows for large rainfall events, due to surcharging and back ups in the sewer system that prevented rainfall inflow from entering the system.

Based on the design storm calibration results, the model runoff parameters were modified to accommodate the change in hydraulic conditions observed during the design event. The calibration was verified by comparing reported historical overflows to model predicted overflows for this event. **Figure 3.3** and **Figure 3.4** show the historical overflows and the model predicted overflows, respectively. The model predicts more overflows than historically recorded. This difference may be because some actual overflows that occurred in secluded areas were not witnessed and reported. In addition, leakage from pipes, which could be significant in some areas, is contained within the modeled system, thus resulting in additional manhole overflows.

A detailed account of the model calibration procedures are included in the Model Calibration TM located in **Appendix L**.

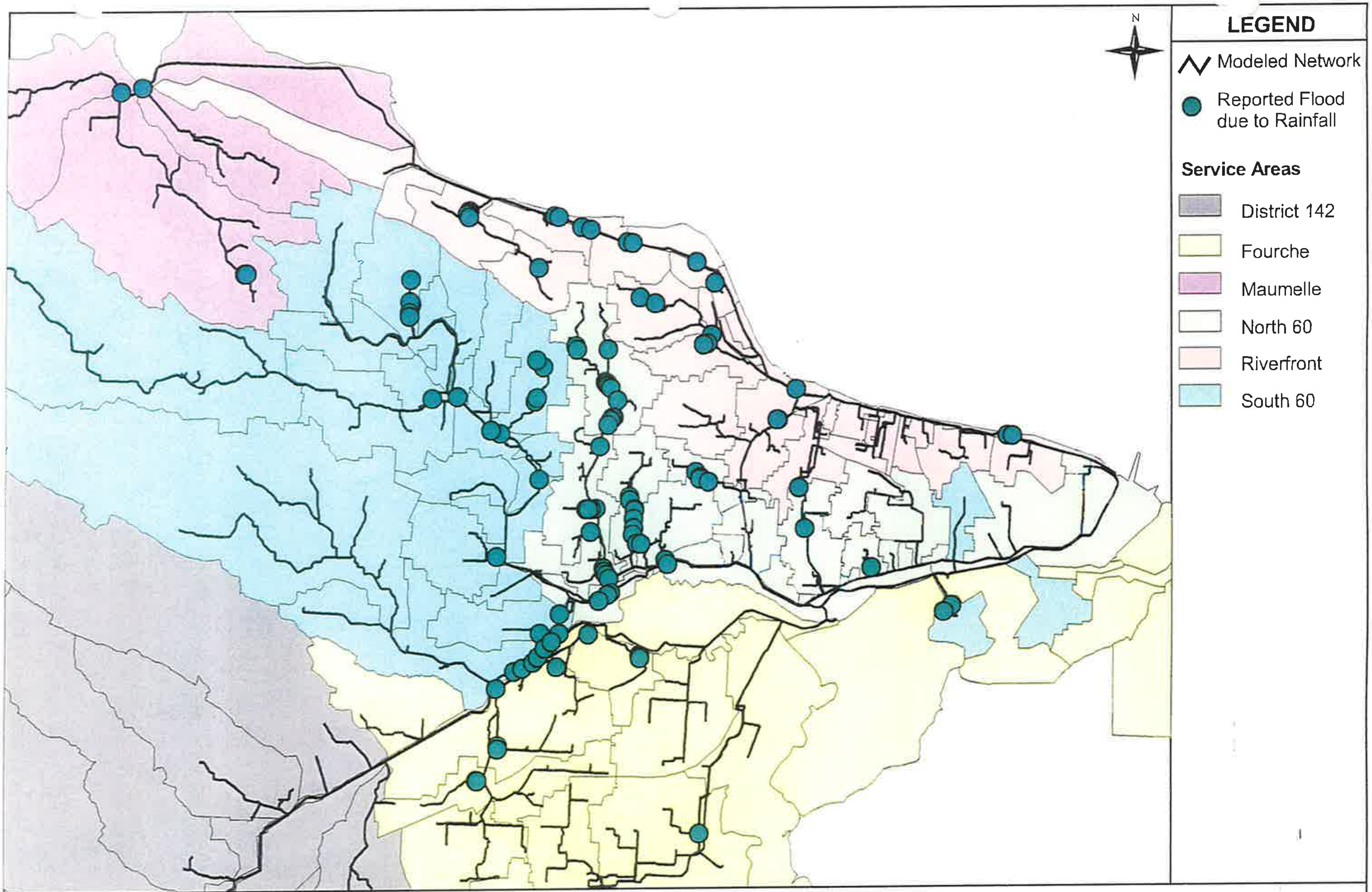

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FIGURE 3.3 HISTORICAL FLOODING DUE TO RAINFALL

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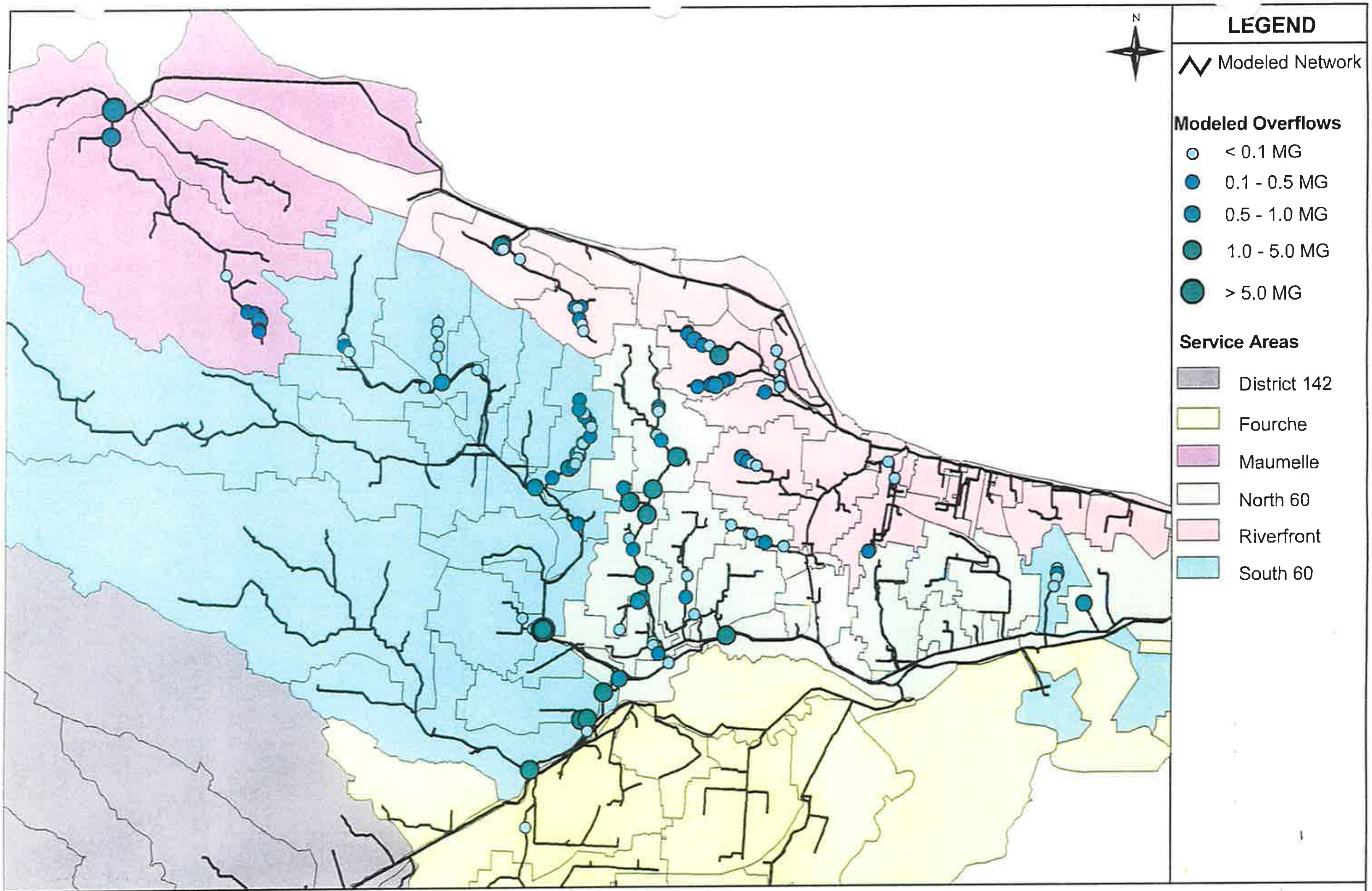

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FIGURE 3.4 MODELED OVERFLOWS, DESIGN EVENT

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3.3 HYDRAULIC ANALYSIS

The calibrated model was used to evaluate the hydraulic performance of the trunk system for existing and future flow conditions. This hydraulic analysis was used to identify problems such as spills and capacity constraints and to determine the cause of the hydraulic problems through the use of the hydraulic model.

3.3.1 Hydraulic Model Assumptions

During modeling, hydraulic analysis of sewer networks is typically conducted for existing and future flow conditions. However, since LRWU forecasts a negligible change in population in the service area of the existing WWTPs, the study assumed existing inflows remained the same for the duration of the planning horizon. The following assumptions were applied when developing the model inflows:

- System fully built-out (excluding Little Maumelle)
- No major changes in land use.
- Floodwater assumed not to drain back into the system.
- No net I/I reduction, based on assumed trade-off between sewer system rehabilitation and further deterioration of the pipe network.

3.3.2 Model Inflows

The hydraulic analysis was conducted for dry weather and wet weather flow events. The calibration dry weather flow event (Event X) was considered appropriate for evaluating the worst-case DWF condition as the event included a seasonally high groundwater component. Since the model was calibrated for this event, the model included the groundwater infiltration (GWI).

The “design rainfall event” as described in **Section 2** provided the wet weather event for evaluating the hydraulic performance of the system. The design rainfall event is an observed rainfall event with the data captured in a radar data format. The radar data allowed the consultant to model accurately the spatial distribution of rain over the sewer basin. The rainfall distribution showed a 'non-localized' spatial variation of rainfall depth with minimal variation between high and low elevations. The distribution was discussed with LRWU and concluded to be a typical winter event suitable for using as a 'worst-case' design event.

The design rainfall event (Event E) was used in conjunction with calibration DWF event (Event X). This combined the seasonal high GWI with a major (2-year to 5-year) rainfall event represented the final the wet weather design event.

3.3.3 Hydraulic Model Results

Model runs were conducted for dry weather and wet weather flow conditions, using DWF Event X and WWF Events E, as described above.

The hydraulic model calculated peak flows and flow depths for each modeled pipe segment. The flow depths were expressed as a ratio of pipe diameter (i.e., d/D) and used to evaluate the level of surcharging for the DWF and WWF events. **Figure 3.5** and **Figure 3.6** show d/D ratios for DWF Event X and Design Event E, respectively, as well as model predicted wet weather overflows. Surcharged pipes are identified by d/D values greater than 1.0 (d/D > 1.0). The d/D ratios of surcharged pipes are computed based on the height of the hydraulic grade line above the pipe invert.

The model distinguishes between pipes surcharged due to capacity limitations (throttle pipes) and pipes surcharged due to backwater. The initial model results identified pipes with limited capacities causing a 'throttling' effect resulting in backwater upstream of the restriction. These pipes referred as throttle pipes possess a hydraulic gradient steeper than the pipe slope.

Pipes surcharged with backwater can mask potential throttle pipes when the downstream restrictions are removed, i.e., pipes upsized. Therefore, the initial model results do not reveal the entire extent of hydraulic problems. These additional problems are exposed and solved during the solution development phase (see **Section 4**).

3.3.4 Hydraulic Analysis – Description of Problems

Capacity problems described in this section are grouped by LRWU service basins and are listed based on improvement schemes recommended in **Section 4**. For the LRWU collection system, eliminating overflows was the priority when identifying capacity upgrade solutions. Not all surcharged pipes were recommended for capacity upgrades, particularly where surcharging was relatively minor. For a thorough evaluation of deficient areas, system problem areas were determined from a combination of model results and historical reported overflows due to rainfall. The following capacity problems are described for Design Event E.

Overview
Most of the major capacity-related problems in the LRWU collection system occur in the North 60 service area, Riverfront, older sections of South 60, and selected areas in Little Maumelle. District 142 appears to have no capacity deficiencies in the modeled pipes, while capacity deficiencies in Fourche are relatively minor. A more detailed description of each service area, the twin 60 interceptors, and Adams Field WWTP is presented below.

Little Maumelle
Truss Pipe Region – Significant surcharging and overflows occurred in the truss pipe region of Little Maumelle. This area approximately encompasses the area upstream of manhole –5C116. Maximum d/D ratios in this region ranged from 0.2 to 10, with most values over 2.5. Approximately 6,500 feet of pipe were surcharged. The model predicted overflows at manhole –5C092 and at several manholes surrounding –5D014. The maximum spill volume in this area was predicted to be 0.6 million gallons (MG) from manhole –5D015, with a total spill volume in the region of approximately 1.5 MG.

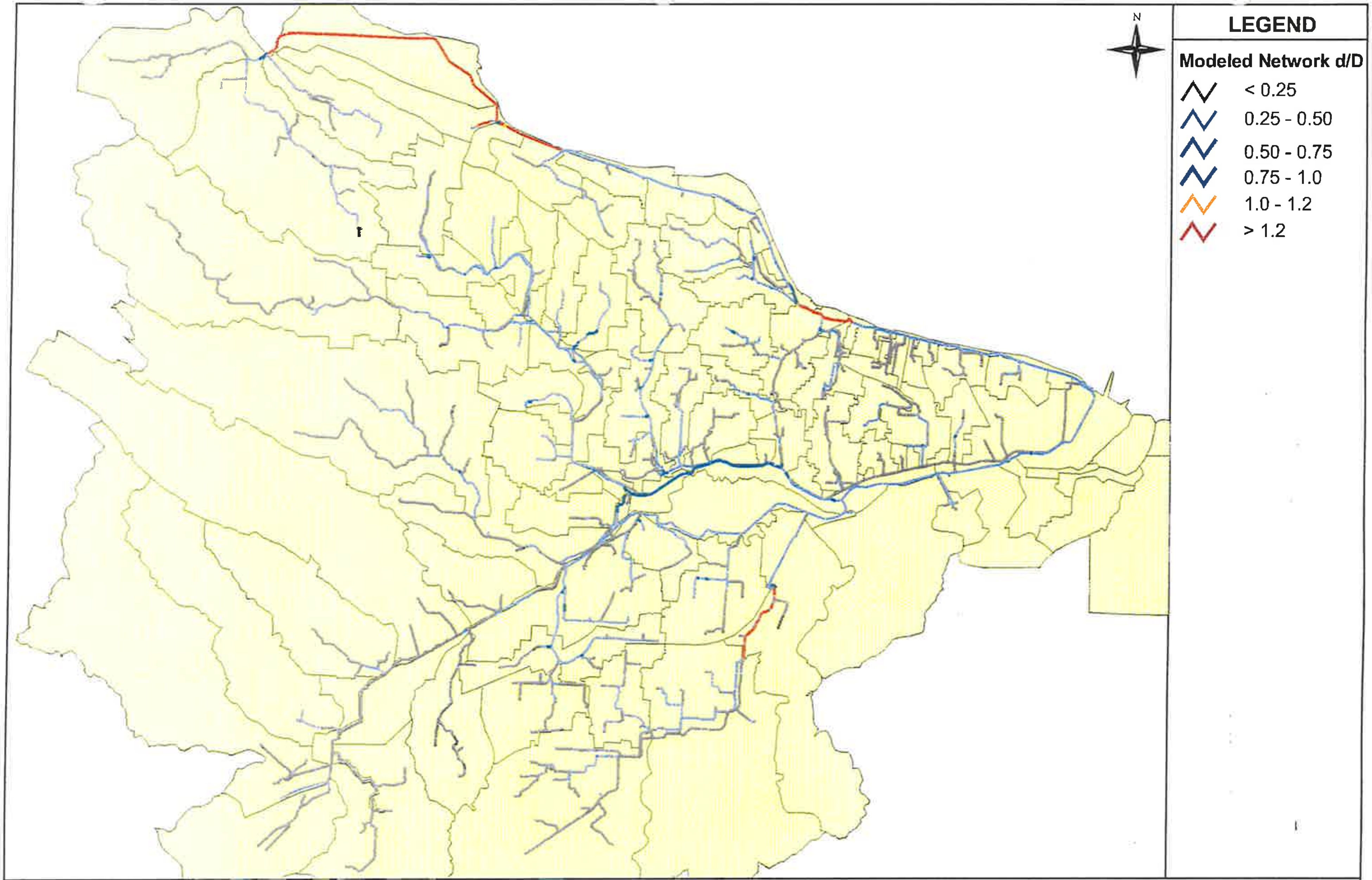

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FIGURE 3.5 DEPTH TO DIAMETER RATIOS, DWF EVENT X

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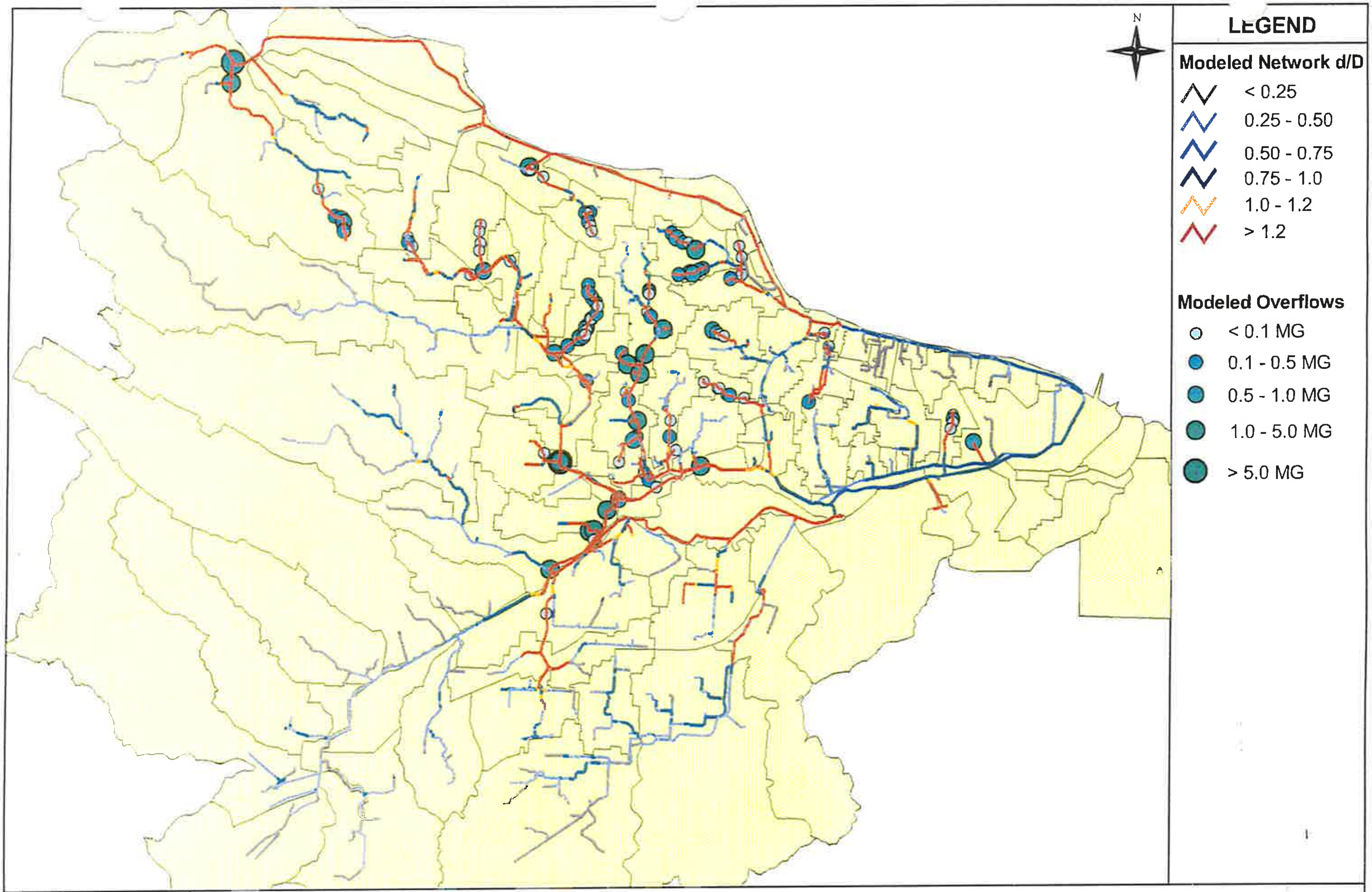

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FIGURE 3.6 DEPTH TO DIAMETER RATIOS, DESIGN EVENT

SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

Pump Station Region – Surcharging due to backwater from the Little Maumelle Pump Station occurred along all major lines upstream of the pump station. Along each of these three lines, surcharging extended to manholes –10-B013, -7B043 and –6-A018, with a total surcharged length of approximately 21,700 feet. Maximum d/D in the surcharged area ranged from 1 to 12.6. Selected pipes along the middle line showed throttle conditions, indicating that isolated capacity issues may exist along this line in addition to backwater from the pump station. Overflows were predicted at manholes -8-B002, -8-A006, and -8-A012, with a total spill volume of approximately 7.2 MG.

Riverfront

Jimerson Creek

A combination of limited capacity in the Jimerson Creek region and backwater from the surcharged Rebsamen truck sewer contributed to surcharging and overflows in the Jimerson Creek area.

Upstream Region – The upstream region of this area, above manhole 3C139, showed isolated capacity limitations. The longest section of surcharged pipe in this area extended from 3D110 to 3D161, although other, shorter sections of pipe in this area were also surcharged. The total length of surcharged pipe in this region was approximately 3,900 feet. Maximum d/D in the surcharged areas ranged from 1 to 8. Overflows were predicted at several manholes around 3D109, with a total overflow volume of approximately 0.7 MG.

Downstream Region – The downstream region of the Jimerson Creek area, above manhole 2B003 on the Rebsamen trunk sewer, showed significant surcharging due to capacity limitations. This surcharging, however, is likely exacerbated by backwater from the Rebsamen trunk sewer. The total length of surcharged pipe in this region was approximately 6,200 feet, with maximum d/D ranging from 1.3 to 7.4. Overflows were predicted at manholes 1B015, 1B017, 1B018, and 2C005, with a total spill volume of approximately 2.4 MG.

Allsop

Overflows occurred in this area due to capacity limitations and high rates of infiltration. Although overflows in this region were possibly exacerbated by downstream restrictions, this area does have isolated capacity limitations. Surcharging in this region extended from 7E061 to 6D031, a total length of approximately 4,100 feet. Maximum d/D in the surcharged areas ranged from 1.4 to 12. Overflows were predicted at several manholes fairly even intervals between 6D026 and 7E055, with a total spill volume of approximately 2.5 MG.

Country Club

Surcharging and overflows occurred in this area due to a combination of significant backwater from Cantrell PS and isolated capacity restrictions. Surcharging in this region extended from 9F033 to upstream pipes 8D054, 8E051, and 7F109. Overflows occurred at 8E088, 8E046, 8E063, 8E049 and 8F003, with a total spill volume of approximately 0.4 MG.

The upstream area of the Country Club region, between manholes 7E042 and 6E172, also showed some surcharging and overflows. Although the model suggested that this area may have isolated capacity limitations, further investigation indicated that overflows in this area were caused by backwater from downstream capacity limitations.

Cantrell PS

Cantrell Pump Station was shown to have insufficient capacity during significant wet weather events. During Event E, surcharging due to backwater from the pump station extended along the entire Rebsamen trunk sewer. During DWF Event X, surcharging extended up to 9F022 because the first pump activation level is set higher than the invert of the inflow pipe in order to utilize in-line storage. The current pumping capacity of Cantrell PS is less than the capacity of the downstream pipe.

Other

Rebsamen Trunk – Backwater from Cantrell Pump Station combined with flows from the Maumelle service area caused significant surcharging along this line. Surcharging extended the entire length of this trunk sewer from the Maumelle force main discharge location to Cantrell PS. Additional flow will enter this trunk sewer after upstream overflows in Jimerson Creek and Maumelle are relieved. However, as discussed in **Section 4**, this trunk sewer was not recommended for upgrade, as Cantrell Pump Station upgrades and alternative conveyance options for the flow from Maumelle were determined to be more cost-effective solutions.

Rose Creek – Surcharging and overflows were predicted in the model in certain sections of the Rose Creek area. However, since this area was modeled in a recent study and upgrade schemes were recommended, no further review was performed at this time.

South 60

Rock Creek/Grassy Flats

Backwater from the South 60 interceptor and isolated capacity limitations cause surcharging and overflows from the Rock Creek area to the Grassy Flats area along the parallel lines in the South 60 service area. The total spill volume along the entire length of this line, between manholes 4L012 and –2C002, was predicted to be approximately 10 MG. Additional overflows would likely occur after upstream areas with overflows are upgraded.

Barrow Addition

This region of the South 60 service area shows isolated capacity limitations. Overflows were predicted at manholes 2K077 and 2K143, with a total modeled spill volume of 0.13 MG. Maximum d/D ratios ranged from 1.5 to 10. All but two modeled pipes in this area were surcharged.

Other

Hall High – The model predicted significant overflows and surcharging in the Hall High area. However, the pipes in this region were upgraded after the model was built.

Echo Valley – The model predicted significant overflows and surcharging in the Echo Canyon area. However, the pipes in this region were upgraded after the model was built.

Brodie Creek – The model predicted significant overflows in the Brodie Creek area at manholes 4L015, 4M014, 4N016, 3N055, and 2O025, with a total spill volume of 8.3 MG. The model also predicted reverse flow from pipe 4L013 to 2O024 at certain times during the model simulation. These problems do not indicate isolated capacity deficiencies in this area, but rather are caused by backwater from the South 60 interceptor.

North 60

Coleman Creek

Surcharging in the Coleman Creek area effectively extends from the intersection of the Coleman Creek trunk sewer with the North 60 interceptor up to 5F164.1. Overflows were predicted at several manholes spread throughout this area, with a total spill volume of approximately 9 MG. This flooding and surcharging results from several isolated capacity deficiencies in the Coleman Creek area; these problems are not caused by backwater from the North 60 interceptor.

District 119

Surcharging in District 119 extends from the intersection of the District 119 trunk sewer with the North 60 interceptor up to 6J004.1. Overflows were predicted at manholes 6K060, 6J079, and 6J031, with a total spill volume of 0.15 MG. This flooding and surcharging results from a combination of backwater from the North 60 interceptor and isolated capacity deficiencies in the District 119 area.

Barton

Surcharging predicted at the downstream end of the Barton area is caused by backwater from the North 60 interceptor. In the upstream area of Barton, overflows and surcharging are caused by capacity deficiencies. Surcharging in the upstream region extends from 9J069 to 7I007, the farthest upstream modeled pipe. Overflows were predicted at manholes 7I009, 7I048, 7I050, 8I066, 8I062, and 8I145. The total predicted spill volume was approximately 0.27 MG.

Sub-Basin 30100

For this report, Sub-Basin 30100 was assumed to include the line from 15K013 to 15I018, which drains into the South 60 interceptor, and the line from 16K012 to 15J045 draining into the North 60 interceptor. The model predicted surcharging and overflows on both of these lines due to isolated capacity deficiencies. The total spill volume was approximately 0.69 MG.

Granite Mountain

The model predicted surcharging, but no overflows, in the Granite Mountain area. The maximum d/D ranged from approximately 1.1 to 5.6. This surcharging was caused by capacity limitations, not by backwater from the South 60 interceptor. Overflows due to capacity deficiencies has been reported in this area by LRWU staff.

Fourche

Arch Street PS

Although the Arch Street Pump Station was not modeled, this pump station was represented in the model by a limited discharge orifice. Flow through this orifice was restricted to 35 MGD. Limiting the flow in this area to 35 MGD caused surcharging due to backwater along the Fourche interceptor from the pump station to District 142. The maximum d/D ranged from 1 to 5.

Other

The model predicted surcharging in two other areas in the Fourche region. The area surrounding 7O012 had maximum d/D ratios between 1 and 3.8 with no overflows. Maximum d/D in the area around 2Q016 ranged from 1 to 5.4. The model predicted one relatively small overflow at manhole 2P013, with a spill volume of approximately 3,500 gallons. Although there may be limited capacity in both of these areas, backwater from the Fourche interceptor contributes significantly to the surcharging. If Arch Street PS were upgraded to prevent surcharging in the Fourche interceptor, maximum d/D ratios in these two areas would be reduced to near 1, and no overflows would occur.

District 142

No capacity limitations were identified in District 142.

Twin 60 Interceptors

The model of the original system shows significant surcharging and some flooding in the upper reaches of the North and South 60 interceptors. The maximum d/D ratios reached 4.6 on North 60 and 3.2 on South 60 with a maximum spill volume of 4.6 MG. Spill volumes and surcharge levels would be considerably higher after upstream capacity deficiencies are corrected. Restricted flow through these sections, particularly on North 60, also cause significant backwater in several pipes draining into these Interceptors. As discussed in the sub-section on the South 60 service area, backwater from South 60 causes reverse flow and overflows in the Brodie Creek area.

Although the model of the existing system shows unrestricted flow through the lower reaches of North and South 60, these reaches would be under capacity if upstream overflows and restrictions were relieved, allowing more flow to be conveyed downstream.

Adams Field WWTP

Although the Adams Field WWTP was not modeled, the WWTP was represented as a limited discharge orifice. Flow through this orifice was limited to 72 MGD to simulate maximum plant capacity. In the model of the existing system, this capacity was sufficient to treat incoming flow. However, because the model lost overflow volume due to upstream restrictions, the peak flow at Adams WWTP would be expected to be significantly higher after upstream capacity limitations are corrected.

Section 4
Alternative Improvement Projects

This section summarizes alternative projects that address the capacity issues identified during computer modeling for the LRWU wastewater collection system. The objective of the hydraulic model were to predict flow conditions within Little Rock's trunk sewer system during the design storm event and identify capacity improvements that would eliminate overflows, as described in **Section 3**. The model, which included each of Little Rock's six sewer basins, identified capacity problems in the collection system. From this model output data, potential alternatives were developed to address the capacity problems. These alternatives included paralleling existing deficient sewers, replacement of undersized sewers with larger diameter pipes, upgrading capacity for existing pumping and treatment facilities and providing additional collection system capacity by conveying wet weather related flows to storage facilities. After the capacity upgrade alternatives were developed, each alternative was evaluated against a set of criteria including project feasibility, construction methods, community issues, long term flexibility, and cost.

4.1 BACKGROUND

The Little Rock wastewater collection system consists of six sewer basins: Fourche, North and South 60, Maumelle, District 142 and Riverfront. The wastewater flows from these basins are treated by two existing plants, the Adams Field Wastewater Treatment Plant (WWTP) and the Fourche Creek Wastewater Treatment Plant. The Adams Field WWTP is located east of the Little Rock Airport and treats flows from the Maumelle and Riverfront basins and a portion of the flows from the North 60 and South 60 basins. The Adams Field WWTP has a design flow of 36 MGD with a maximum capacity of 72 MGD. The Fourche Creek WWTP is located farther to the south and at the east-end of Frazier Park Road and treats flows from the District 142 basin and a portion of flow from the North 60 and South 60 basins. The Fourche WWTP has a design flow of 16 MGD with a maximum capacity of 38 MGD. Both plants have permits to discharge into the Arkansas River regulated by the Arkansas Department of Environmental Quality (ADEQ). Studies have been completed that identify proposed capacity upgrades for both WWTPs. Identified improvements include a capacity increase to 94 MGD with equalization basins having a total volume of 25 MG for the Adams Field WWTP, and a capacity increase to 60 MGD for the Fourche Creek WWTP. These proposed capacity upgrades to the existing Adams Field and Fourche Creek WWTPs are detailed in **Appendix E** and **Appendix F**, respectively.

As part the data collection process for capacity system evaluation three existing pump stations were studied: the Cantrell Pump Station located in the Riverfront Basin having a current maximum pumping capacity of 25 MGD; Little Maumelle Pump Station located in the Maumelle Basin with a capacity of 5.6 MGD and; Arch Street Pump Station located in the Fourche Basin with a current capacity of 38 MGD.

At present, all wastewater from the Maumelle Basin is pumped by the Little Maumelle Pump Station into the Adams Field WWTP collection system. The pump station discharges via a 24-inch force main into trunk lines servicing the Riverfront Basin at the upstream connection located north of the Jimerson Creek Area. This flow travels through the Riverfront gravity trunk lines to the Cantrell Pump Station, located south of the Country Club Area. The Cantrell Pump Station then pumps its flow through a 30-inch force main which discharges into trunk lines that eventually enter Adams Field WWTP. The Maumelle and Riverfront Basins comprise the total flow Adams WWTP receives from the northern part of Little Rock. Wastewater from the southern part of Little Rock enters Adams WWTP via Twin 60-inch Interceptors that run downstream from west to east along the borders for Fourche, North 60 and South 60 Basins. The majority of the flow impacting the Fourche Creek WWTP is diverted to the plant by a gate structure, known as the Interstate Gate Park Control Facility, installed in the Twin 60-inch Interceptors located upstream of the Arch Street Pump Station. The amount of flow diverted by the gate is regulated by operational limits in the Adams Field WWTP. As the flow reaches capacity limits, as explained in **Section 3.1.5**, the gate automatically adjusts to divert a greater amount of flow to the Fourche WWTP via the Arch Street Pump Station and its 42-inch force main. The Fourche WWTP also receives minor flows from tributary areas located upstream of College Pump Station, which discharges into the 42-inch Arch Street force main.

4.2 IDENTIFICATION OF WASTEWATER SYSTEM ALTERNATIVES

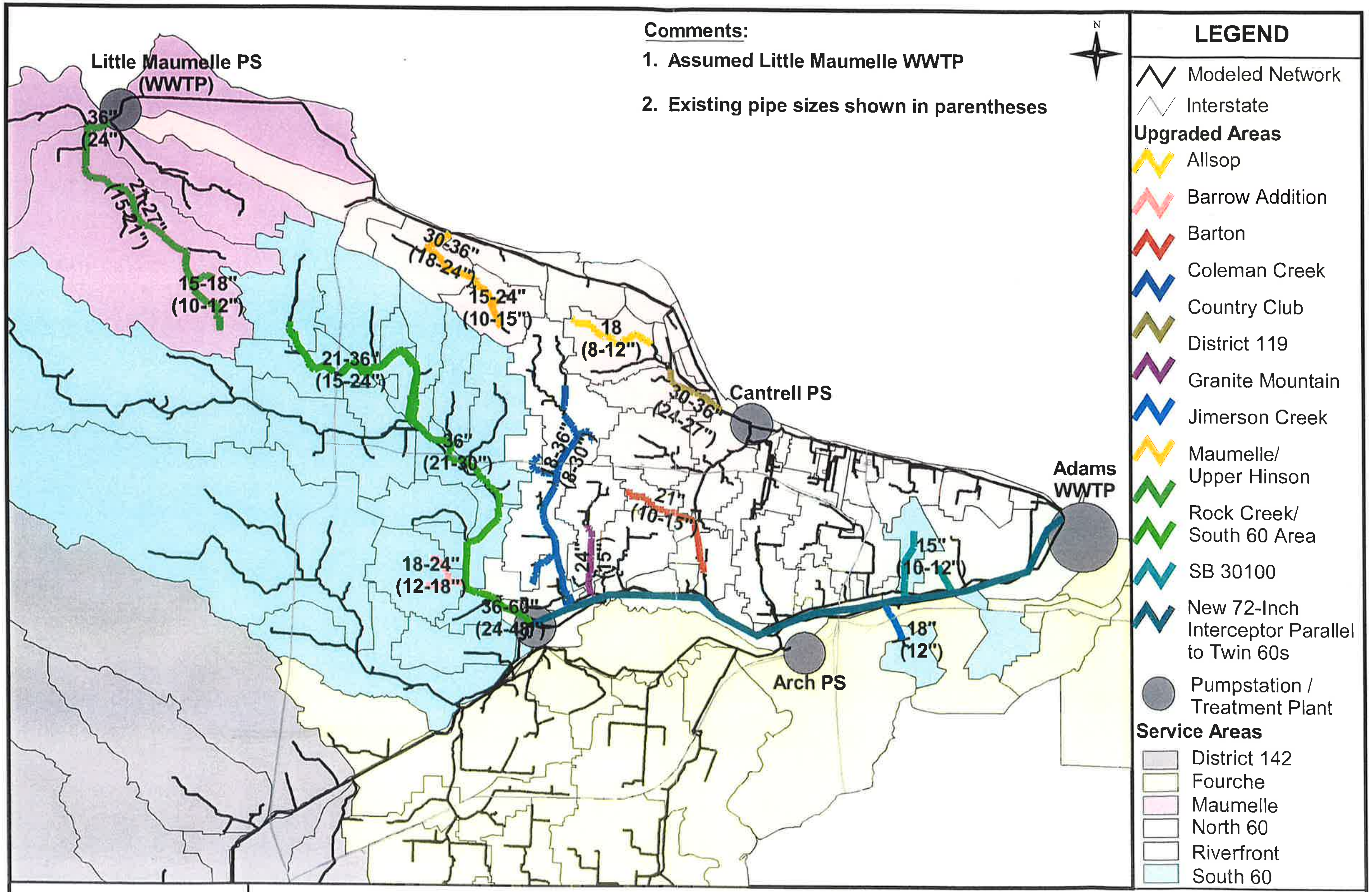
Five alternatives to correct Little Rock wastewater system deficiencies were identified for further review and evaluation. Each alternative represents an overall view of Little Rock's wastewater system and to varying degrees incorporates the following three capacity upgrades:

- increased wastewater conveyance capacity
- wet weather water storage capabilities, and
- additional treatment facilities.

Each of these capacity upgrades is discussed below.

4.2.1 Increased Conveyance Capacity

Alternatives for increased conveyance capacity were modeled into the system by substituting existing lines determined to be undersized with new larger diameter pipes. Additional capacity upgrades were also included for the Cantrell and Arch Street pump stations to accommodate the modeled flows. In sizing new pipes, no reduction in flow was assumed from comprehensive line rehabilitation for I/I abatement (**Section 6** provides a discussion of I/I abatement). Eleven improvement projects to provide additional hydraulic capacity were identified with the hydraulic model described in **Section 3**. **Table 4.1** lists a summary of the trunk system improvement projects with approximate lengths, pipe size and capital costs for each. The sizes, capacities, and costs listed in the table and discussed in the following text were estimated assuming the existing pipe would be replaced with new pipe segments. **Figure 4.1** shows the general location for each of the proposed line replacements. It should be noted that modeled results indicate that these eleven sewer trunk improvements are required in order to eliminate overall system deficiencies. Hence these projects have been identified as common improvements requiring integration into the five overall system alternatives that were evaluated and discussed later in this section.



LITTLE ROCK WASTEWATER UTILITY

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FIGURE 4.1 PROPOSED SYSTEM UPGRADES

SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

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Table 4.1
Proposed Trunk Upgrades

Project Name	Location	Description of Upgrades	Estimated Capital Cost
Allsop	Hawthorne Rd, Van Buren St, Country Club Blvd, Spruce St	7,800 linear feet 18-inch pipe	$ 1,550,000
Barrow Addition	W 35th St, W 36th St, Potter St, Walker St, Gilman St	5,600 linear feet 18 to 24-inch pipe	$ 1,220,000
Barton	W 17th St, W 15th St, W 14th St, Maple St	10,600 feet 15 to 21-inch pipe	$ 2,290,000
Coleman Creek	Coleman Creek, Polk St, W 10th St, W 28th St, Asher Ave	26,200 feet 18 to 36-inch pipe	$ 8,020,000
Country Club	Cantrell Road, Rebsamen Park Rd	7,500 linear feet 30 to 54-inch pipe	$ 3,210,000
District 119	W 34th St, Mary St, Boulevard Ave, W 22nd St	5,500 linear feet 24-inch pipe	$ 1,570,000
Granite Mountain	Springer Blvd	2,900 linear feet 18-inch pipe	$ 570,000
Jimerson Creek	Near Foxcroft Rd, Tallyho Ln, Youngblood Rd, Pine Valley Rd	11,500 linear feet 15 to 36-inch pipe	$ 3,060,000
Maumelle (a)	Near Hinson Rd, Jennifer Dr	24,500 linear feet 15 to 36-inch pipe	$ 6,540,000
Rock Creek/ Grassy Flats (b)	Rooney Parham Rd, Cunningham Lake Rd, Barrow Rd, Serenity Dr, Grassy Flat Creek	57,800 linear feet 21 to 60-inch pipe	$ 23,650,000
Sub-Basin 301000 Area	Near Security Ave, Bolton St	7,500 linear feet 15 inch pipe	$ 1,420,000
		Total:	$ 53,100,000

72-inch Parallel Trunk Line			
72-inch Line	From University to Adams Field WWTP	45,800 linear feet 72-inch Trunk	$ 30,360,000

(a) An alternative for Maumelle would be to achieve significant inflow and infiltration reduction in the Upper Hinson area.

(b) An alternative for the Rock Creek/Grassy Flats area would be to replace parallel pipes with a single, larger pipe and reduce inflow and infiltration upstream of the Grassy Flat Creek area.

Each of these trunk system improvements is briefly described below, by service area. The proposed trunk upgrades address the capacity deficiencies described in **Section 3**. Detail lists of the specific pipes recommend for upgrade are included in **Appendix C**. The lists include the pipe reference, length, suggested replacement size, and estimated replacement cost for each pipe segment recommended for upgrade.

Little Maumelle

The recommended capacity improvements in the Little Maumelle service area consist of approximately 4.5 miles of 15 to 36-inch replacement pipe. The existing pipe sizes in this line range from 10 to 24-inches. As seen on **Figure 4.1**, this improvement scheme stretches from the Upper Hinson area to the Little Maumelle Pump Station. Although two separate problem areas, Upper Hinson and the Maumelle Pump Station region, were identified in **Section 3**, overflow relief due to proposed capacity improvements in the Upper Hinson area would result in additional downstream capacity limitations. Therefore, capacity upgrades were necessary along the entire length of this trunk sewer. As indicated in **Table 4.1**, significantly reducting I/I in the Upper Hinson area could reduce the pipe length requiring capacity upgrades.

Flooding and surcharging associated with backwater from the existing Little Maumelle Pump Station along the other trunk sewers was relieved by assuming sufficient future storage and treatment capacity would be provided by the new Maumelle WWTP.

Riverfront

Jimerson Creek

Approximately 2 miles of pipe from 3D066 to 2B002 are recommended for capacity upgrades in this area. The existing 10 to 24-inch pipes are suggested for upgrade to 15 to 36-inch to provide sufficient capacity for peak wet weather flows.

Allsop

This scheme refers to pipes from 7E001.1 to 5D096.1. Approximately 1.5 miles of 8 to 12-inch diameter pipe are recommended for upgrade to 18-inch diameter pipe to relieve capacity-related overflows.

Country Club

This scheme refers to pipes from 10G069.1 to 8E049.1, from Allsop to the Cantrell pump station. Replacement size of 30 to 54 inch diameter is recommended for approximately 1.5 miles of existing 24 to 42-inch diameter pipe. These upgrades provide sufficient capacity for additional flow resulting from upstream capacity upgrades as well as previously identified localized capacity limitations.

South 60

Rock Creek/Grassy Flats

This scheme refers to the parallel trunk sewer stretching from the discharge into the South 60 Interceptor (4L012.1) to the truss pipe region in the northwest area of the South 60 service area. Recommended upgrades provide sufficient capacity for several existing isolated capacity problems and for additional flow resulting from upgrades of the Echo Valley and Hall High areas. For modeling purposes, both parallel pipes were upgraded from 15 to 48-inch diameter pipes to 21 to 60-inch diameter pipes, a total length of approximately 11 miles. Estimated costs listed in **Table 4.1** and in the **Appendix B** are based on replacement of both parallel pipes. However, a single replacement pipe providing equivalent additional capacity would be an alternate, less expensive solution.

Barrow Addition
Overflows resulting from isolated capacity restrictions in this region were relieved in the model with the replacement of existing 12 to 18-inch pipes with new 18 to 24-inch pipes. A total length of approximately 1-mile of pipe is recommended for upgrade.

North 60

Coleman Creek
Outside of Twin 60 interceptor system, Coleman Creek requires the most extensive upgrades in the North 60 service area. Approximately 5 miles of pipe are recommended for upgrade from the existing 8 to 30-inch diameter to 18 to 36-inch diameter pipes.

District 119
Approximately 1 mile of pipe is recommended for upgrade in District 119, stretching from the North 60 interceptor to 6J005.1. Upgrade from the existing 15-inch diameter pipes to 24-inch diameter pipes provides sufficient capacity for peak wet weather flows.

Barton
Approximately 2 miles of pipe in the Barton area require upgrade from 10 to 15-inch diameter pipe to 21-inch diameter. These recommended upgrades stretch from 9K034.1 to 7I007.1.

Sub-Basin 30100
For this report, the Sub-Basin 30100 area was assumed to include the line from 15K013.1 to 15I018.1 draining to the South 60 interceptor and the line from 16K012.1 to 15J045.1 draining to the North 60 interceptor. A total length of approximately 1.5 miles of pipe is recommended for upgrade to 15-inch diameter pipe to relieve modeled overflows.

Granite Mountain
Approximately 0.5 mile of pipe is recommended for upgrade in the Granite Mountain area. A new 18-inch diameter pipe is recommend for replacement of the existing 12-inch pipe. The hydraulic model predicted surcharging but no flooding in this area. However, these pipes are recommended for upgrade because of reported capacity-related overflows.

Twin 60 Interceptors

The existing Twin 60-inch Interceptors that convey the wastewater from the southern part of Little Rock experience line surcharging that contributes to upstream system overflows during severe storm events. To achieve the additional conveyance capacity needed to alleviate these surcharge conditions, a new 72-inch trunk line that parallels the Twin 60s could be installed. Since the remaining four capacity upgrade alternatives require varying volumes of temporary wastewater storage (storm water I/I detention) to control surcharging in the Twin 60s, the required length of proposed 72-inch trunk line would be reduced for two of the evaluated alternatives and completely eliminated for the remaining two.

4.2.2 Wet Weather Storage Capabilities

Several alternatives evaluated included off-line wet weather storage as an option to reduce downstream conveyance capacity requirements that occurs during wet weather events. This technology would utilize partially buried lagoons to store estimated volumes of wet weather flow calculated by the hydraulic model for the design storm event. Wastewater surcharging in the Twin 60s during a storm event would be taken out of the interceptor(s) by means of an in-line overflow weir structure(s). The diverted surcharging flow would then be conveyed through a gravity line(s) to the storage site and pumped into a series of tandemly filled lagoons. Once the wet weather surge occurring in the main trunk system had passed, stored wastewater in the lagoons would be returned to the main system by gravity or pumping (as needed), and the lagoons would be cleaned.

4.2.3 Additional Treatment Plant

Currently, Maumelle Basin wastewater flows to the existing Little Maumelle Pump Station that pumps to the Cantrell Pump Station which pumps its flow into the gravity sewer system that feeds the Adams Field WWTP. Each alternative discussed in this section of the report propose the elimination of the Little Maumelle Pump Station and construction of a new treatment plant in the Maumelle Basin. The engineering and cost report for this new treatment plant is detailed in the "Little Maumelle River Subbasin Sewerage Study" developed by Tanner Engineering Consultants, in affiliation with Carter Burgess. This report, contained in **Appendix G**, describes the recommended process facilities and equalization basins needed for the treatment plant and estimated capital cost for construction.

4.3 ALTERNATIVE IMPROVEMENT PROJECTS

4.3.1 Costs

Estimated costs were developed for each alternative based on conceptual designs for facility improvements. These costs were developed for comparison purposes and are not intended to be detailed design cost estimates. Where possible, standard materials and equipment were assumed for costing purposes. Material and construction costs were based on local prices derived from similar types of construction projects completed in the Little Rock Area; other costs were estimated by using the Engineering News Record (ENR) Construction Cost Index adjusted for year 2001. These costs do not include land right-of-way acquisition, construction management and inspection, legal work and financing fees, and operation and maintenance costs. Capital costs do include 25% for contingencies and engineering. No inflation factors were used in the calculations.

4.3.2 Alternatives

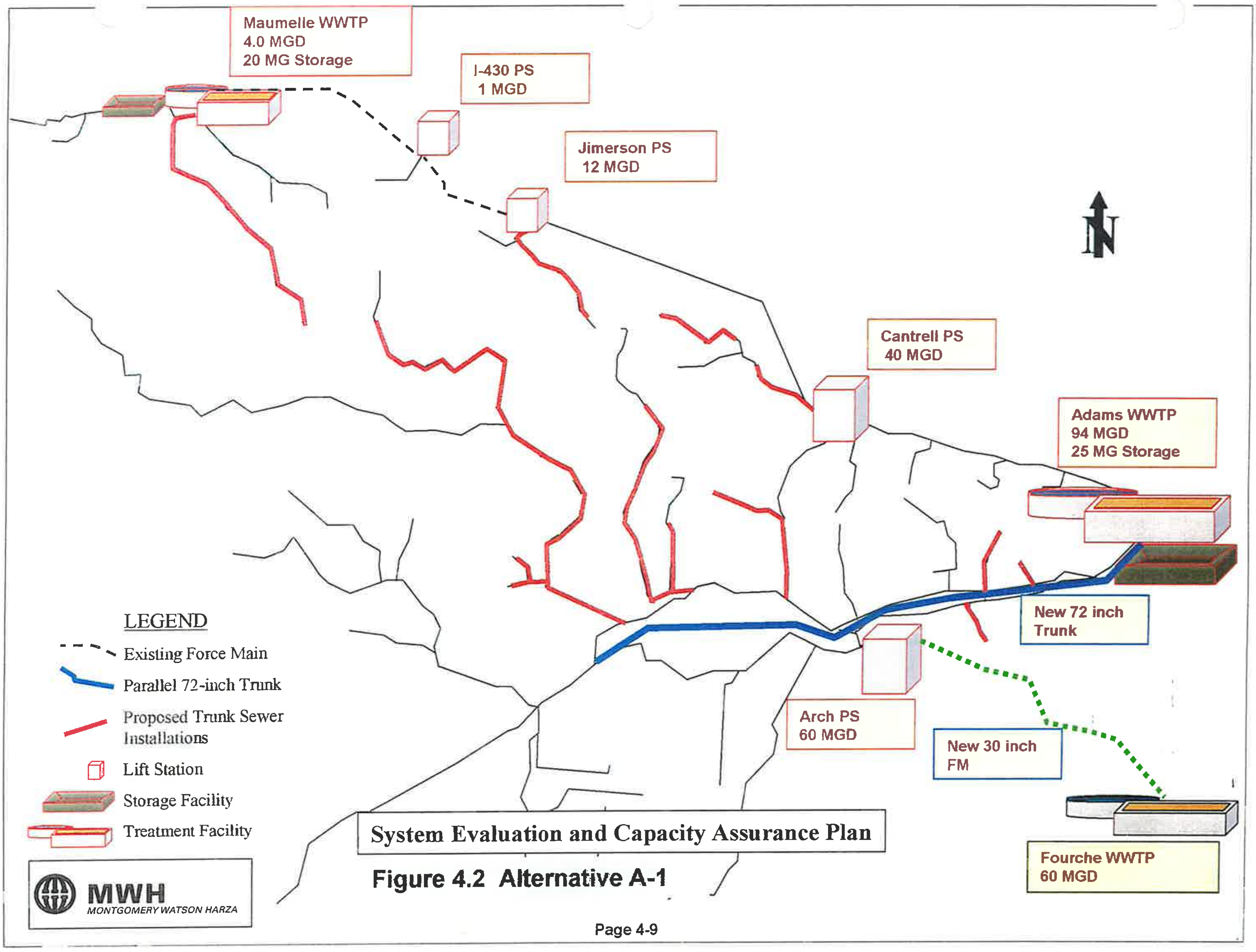
Through a series of workshops with Wastewater Utility staff and a Little Rock Citizen's Group, five alternatives (A1, B1, B2, C1 and C2) to resolve capacity deficiencies for the entire Little Rock wastewater system were developed. Alternative A1 proposes capacity upgrades to convey the entire collection system flows to the Adams Field, Fourche Creek and the proposed Maumelle WWTPs. Alternatives B1 and B2 employ large storage facilities located at the upper end of the Twin 60-inch Interceptors in lieu of the proposed parallel 72-inch line. Alternatives C1 and C2 propose a combination of partial storage and partial conveyance through the proposed 72-inch parallel line to eliminate system deficiencies. This section discusses the significant improvement projects associated with each of these alternatives.

Alternative A1: Conveyance and Treatment. This alternative incorporates a philosophy of conveyance of all flows to the wastewater treatment plants. This alternative consists of the following capacity upgrades:

- construct a new treatment plant in the Little Maumelle Basin,
- increase the treatment capacity of the Adams Field WWTP from 72 MGD to 94 MGD,
- increase the treatment capacity of the Fourche Creek WWTP from 38 MGD to 60 MGD,
- increase the pumping capacity of the Arch Street Pump Station from 38 MGD to 60 MGD,
- increase the pumping capacity of the Cantrell Pump Station from 25 MGD to 40 MGD,
- construct a new 12 MGD Jimerson Creek Pump Station,
- construct a new 1.0 MGD I-430 booster pump station, and
- install eleven trunk lines listed in **Table 4.1**.

Under Alternative A1 (**Figure 4.2**), the Maumelle Basin wastewater flows would be treated and discharged by a new plant located within the Maumelle Basin along the Little Maumelle River. This new plant would alleviate the surcharging problems in the existing trunk system along the Riverfront Basin from Maumelle to the Adams WWTP and reduce the capacity problems at the Cantrell Pump Station. Despite the flow reduction provided by the new plant, the model revealed that the existing Riverfront system would continue to surcharge during the design storm event. In response to this model identified deficiency, this alternative included installation of an additional pump station located at the east-end of the Jimerson Creek Area and a booster pump station located near the I-430 connection along the river. The proposed Jimerson Pump Station (12 MGD) would divert wet weather flow from the Jimerson Creek Area from the Riverfront system by conveying its effluent to the new Maumelle WWTP. This proposed station would be configured so that it would connect to the existing 24-inch force main, presently being used by the Maumelle Pump Station, in order to return Jimerson Creek flow to the Maumelle Basin. During dry weather conditions, the wastewater from the Jimerson Pump Station service area would flow through the Riverfront system to the Adams WWTP. Tributary flow into the new I-430 Pump Station (1 MGD) could either be boosted into the existing 24-inch force main or returned to the new Jimerson Pump Station for conveyance based on the conditions described above.

For the southern part of Little Rock, a proposed 72-inch trunk line would parallel the entire length of the existing Twin 60-inch Interceptors providing additional conveyance capacity. Although the proposed Maumelle WWTP would reduce the amount of flow to the Adams Field WWTP, modeled results indicate that the following additional capacity upgrades are required to address the collection system deficiencies:



System Evaluation and Capacity Assurance Plan

Figure 4.2 Alternative A-1

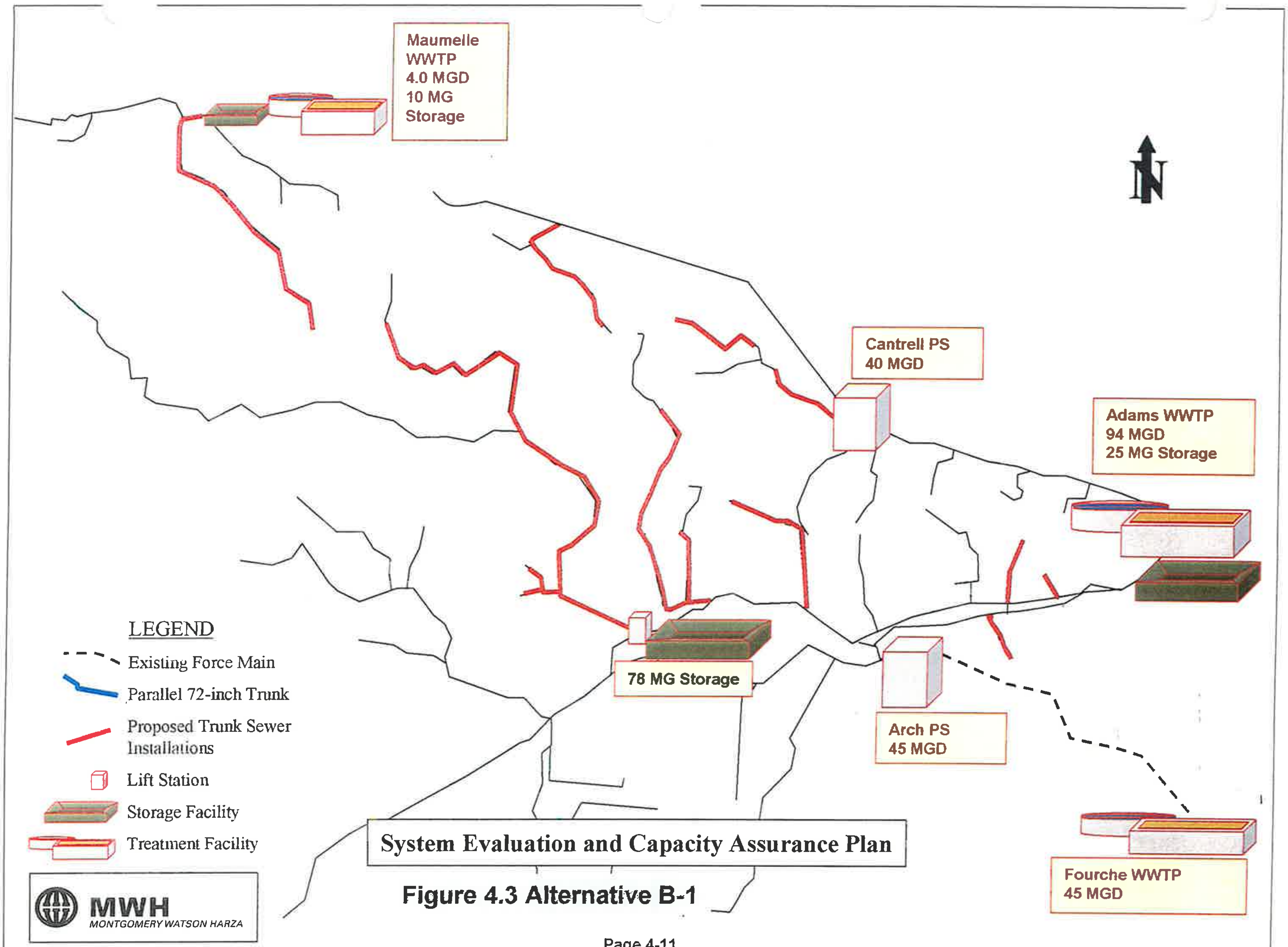
- increase the Adams Field WWTP capacity to 94 MGD with 25 million gallon equalization basin volume(**Appendix** E),
- upgrade the Arch Pump Station to 60 MGD, including 41,500 LF of new 30-inch parallel force main,
- upgrade Fourche Creek WWTP to treat 60 MGD (**Appendix F**)
- install the 72-inch parallel trunk from Adams to the west-end of the Twin 60s, and
- install eleven trunk lines listed in **Table 4.1**.

Estimated capital costs for each of the project improvements in Alternative A1 are listed in **Table 4.2**.

Table 4.2
Estimated Capital Costs for Alternative A1

Type of Project	Description	Costs ($ million)
Trunk Sewer Upgrades	Trunk Line Improvements (**Table 4.1**) 72-Inch Parallel Line (45,772 feet)	$53.1 $30.4
Pump Station Improvements	Cantrell (40 MGD) Arch (60 MGD), w/41,500 LF of 30-inch FM Jimerson (12MGD) I-430 (1 MGD)	$4.6 $12.6 $2.5 $0.4
Treatment Plant Improvements	Maumelle (4 MGD), w/20 MG Basins Adams Field (94 MGD), w/25 MG Basins Fourche Creek (60 MGD)	$19.9 $24.0 $23.4
	Total	**$171.0**

Alternative B1: Large Volume Storage with Arch Street Pump Station and Fourche WWTP Improvements. Alternatives B1 and B2 apply a different strategy for resolving modeled system deficiencies for the southern part of Little Rock. These alternatives would utilize large volume storage facilities, described in **Section 4.2.2**, to divert excess storm water from the Twin 60-inch Interceptors rather than increasing conveyance capacity by installing a parallel 72-inch line. Alternative B1 (**Figure 4.3**) proposes the construction of a 78 MG storage facility located at the upper end of the Twin 60s, immediately downstream of the District 119 Area. This scenario provides sufficient flow reduction to the Adams WWTP to eliminate the need for a 72-inch parallel line and for the Jimerson Creek and I-430 Pump Stations. However, additional improvements increasing capacities at the Arch Street Pump Station from 38 to 45 MGD, Cantrell Pump Station from 25 to 40 MGD and Fourche Creek WWTP from 38 to 45 MGD would be required. Additionally, the installation of the eleven trunk lines noted in **Table 4.1** would be required. Estimated capital costs are shown below in **Table 4.3**.



System Evaluation and Capacity Assurance Plan

Figure 4.3 Alternative B-1

Table 4.3
Estimated Capital Costs for Alternative B1

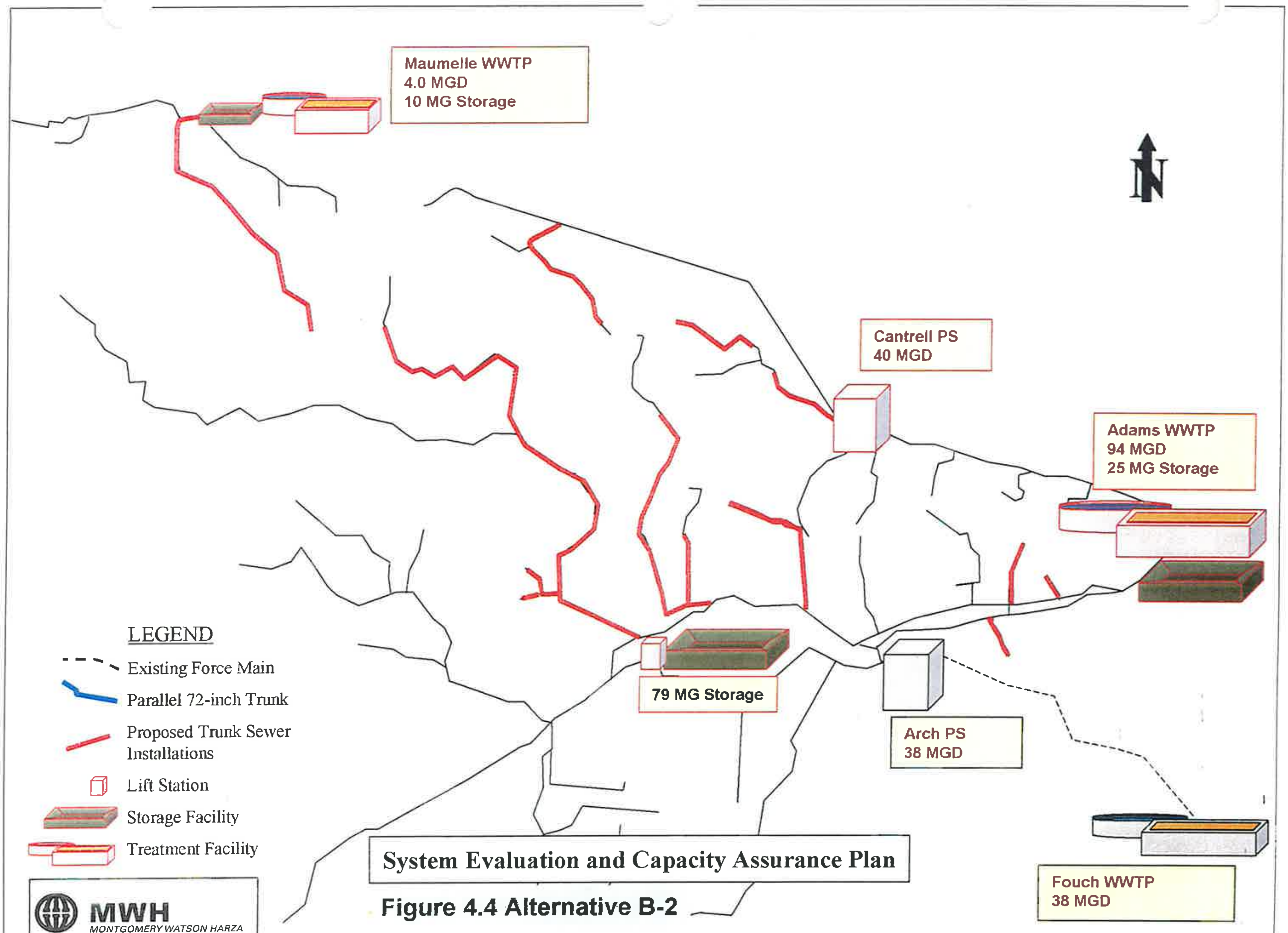
Type of Project	Description	Costs ($ million)
Trunk Sewer Upgrades	Trunk Line Improvements (**Table 4.1**)	$53.1
Pump Station Improvements	Cantrell (40 MGD) Arch (45 MGD)	$4.6 $1.8
Treatment Plant Improvements	Maumelle (4 MGD), w/10 MG Basins Adams Field (94 MGD), w/25 MG Basins Fourche Creek (45 MGD)	$18.9 $24.0 $12.0
Storage Facilities	78 MG	$50.6
	Total	**$164.8**

Alternative B2: Large Storage. Alternative B2 (**Figure 4.4**) also utilizes a large volume storage facility at the west-end of the Twin 60s to relieve system deficiencies for the south Little Rock collection system. Modeled results indicated that a 79 MG storage facility would eliminate the need for increased pumping capacity in the Arch Street Station and increased treatment capacity for Fourche WWTP. With exception of the increased storage volume proposed in this Alternative and elimination of the need for capacity improvements to the Arch Street Station and Fourche WWTP, all other improvements noted for Alternative B1 would be required to resolve system deficiencies. Estimated capital costs are listed below in **Table 4.4**.

Table 4.4
Estimated Capital Costs for Alternative B2

Type of Project	Description	Costs ($ million)
Trunk Sewer Upgrades	Trunk Line Improvements (**Table 4.1**)	$53.1
Pump Station Improvements	Cantrell (40 MGD)	$4.6
Treatment Plant Improvements	Maumelle (4 MGD), w/10 MG Basins Adams Field (94 MGD), w/25 MG Basins	$18.9 $24.0
Storage Facilities	79 MG	$50.6
	Total	**$151.3**

Alternative C1: Reduced Storage with Conveyance and Improvements to Arch Street Pump Station and Fourche WWTP. The last two Alternatives, C1 and C2, combine storage and conveyance improvements to relieve surcharge conditions for the southern part of the Little Rock collection system. Both Alternatives require construction of the new Maumelle WWTP, increased treatment capacity for the Adams Field WWTP to 94 MGD, increased



System Evaluation and Capacity Assurance Plan

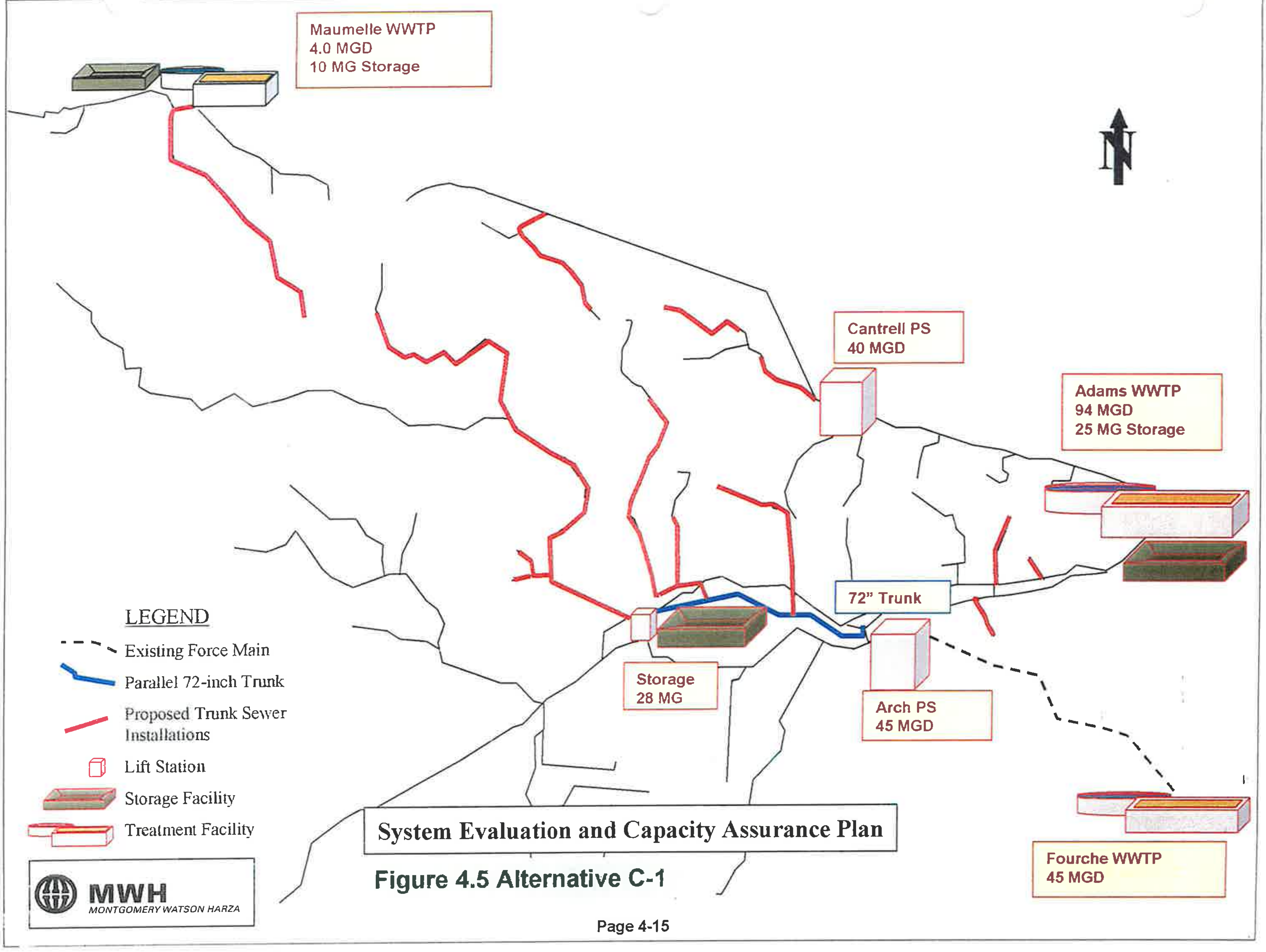
Figure 4.4 Alternative B-2

capacity for the Cantrell Pump Station to 40 MGD, and installation of the eleven area trunk lines noted in **Table 4.1**. The significant differences between alternatives for the B and C scenarios are the amount of storage volume diverted from the Twin 60-inch Interceptor system and partial use of the proposed parallel 72-inch trunk line. While Alternatives B1 and B2 utilize large storage volumes to eliminate the need for the 72-inch parallel line, Alternatives C1 and C2 utilize a combination of reduced storage volume and improvements for additional conveyance capacity. Alternative C1 (**Figure 4.5**) proposes installation of a 28 MG storage facility located in the same area as proposed for similar facilities noted in Alternatives B1 and B2. The model shows that with the reduced level of storage, the 72-inch parallel line must be installed from the Arch Street Pump Station upstream to the Rock Creek Trunk line, for added conveyance capacity and surcharge relief. This Alternative also requires increasing Arch Street Station capacity from 38 to 45 MGD and the Fourche WWTP capacity from 38 to 45 MGD. Capital costs for Alternative C1 are listed in **Table 4.5**.

Table 4.5
Estimated Capital Costs for Alternative C1

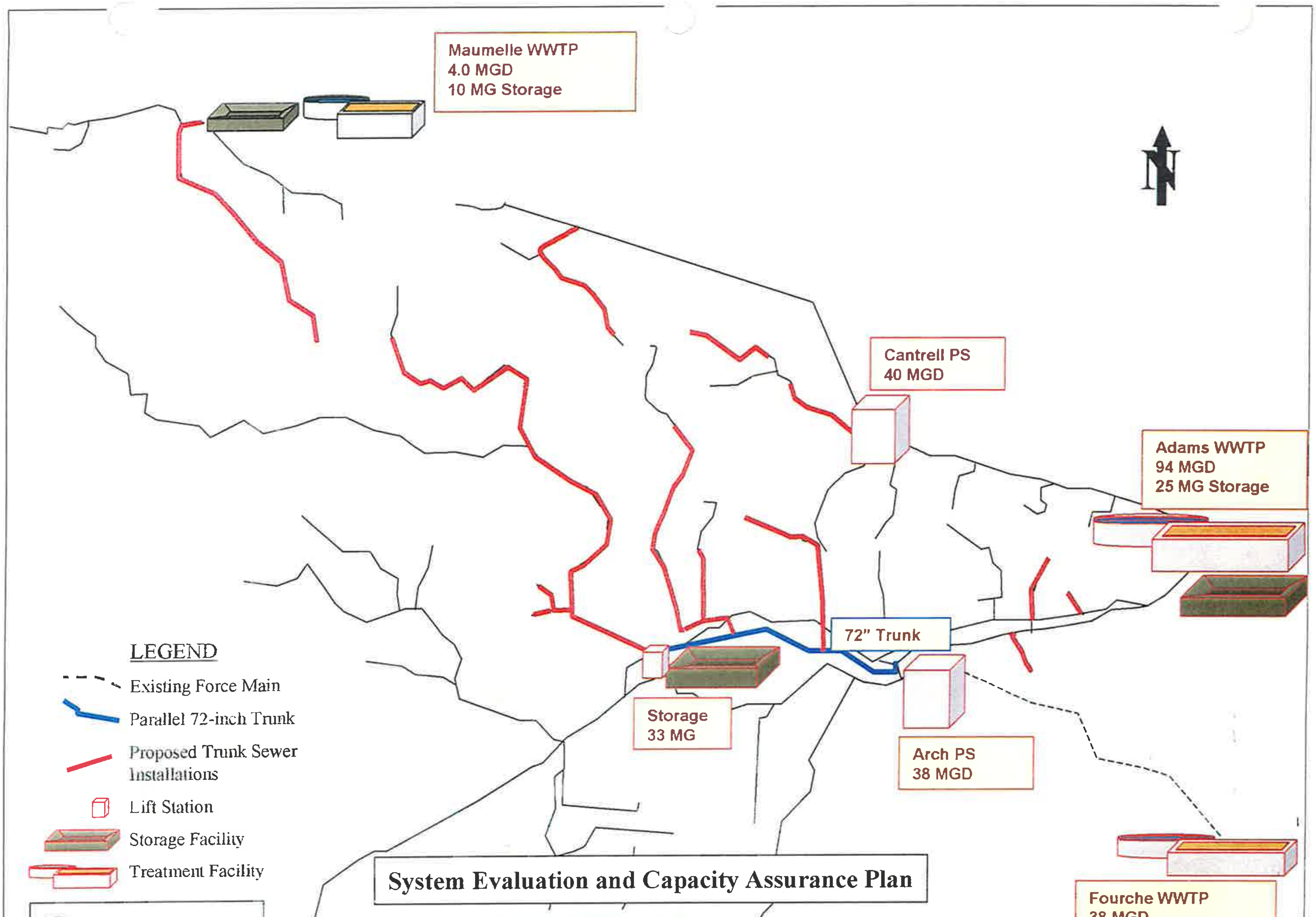
Type of Project	Description	Costs ($ million)
Trunk Sewer Upgrades	Trunk Line Improvements (**Table 4.1**) 72-Inch Parallel Line (22,900 feet)	$53.1 $15.2
Pump Station Improvements	Cantrell (40 MGD) Arch (45 MGD)	$4.6 $1.8
Treatment Plant Improvements	Maumelle (4 MGD), w / 10 MG Basins Adams Field (94 MGD), w / 25 MG Basins Fourche (45 MGD)	$18.9 $24.0 $12.0
Storage Facilities	28 MG	$27.0
	Total	**$156.6**

Alternative C2: Reduced Storage with Conveyance. Alternative C2 (**Figure 4.6**) proposes an increase in storage volume to 33 MG. Model results indicated that increasing storage still requires the added conveyance capacity provided by the 72-inch parallel, from Arch Street Station upstream to the Rock Creek trunk, in order to relieve surcharge conditions in the Twin 60s. However, the increase in storage volume eliminated the need to increase capacities for the Arch Street Station and Fourche WWTP. All other capacity improvements noted in Alternative C1 are required for this Alternative. Capital costs for Alternative C2 are listed in **Table 4.6**.



System Evaluation and Capacity Assurance Plan

Figure 4.5 Alternative C-1



System Evaluation and Capacity Assurance Plan

Figure 4.6 Alternative C-2

Table 4.6
Capital Costs for Alternative C2

Type of Project	Description	Cost ($ million)
Trunk Sewer Upgrades	Trunk Line Improvements (**Table 4.1**) 72-Inch Parallel Line (22,900 feet)	$53.1 $15.2
Pump Station Improvements	Cantrell (40 MGD)	$4.6
Treatment Plant Improvements	Maumelle (4 MGD), w / 10 MG Basins Adams Field (94 MGD), w / 25 MG Basins	$18.9 $24.0
Storage Facilities	33 MG	$28.9
	Total	**$146.9**

4.3.3 City and Public Participation

Alternatives for capacity assurance projects were reviewed by representatives from the Wastewater Utility and a Little Rock Citizens Advisory Group (see **Section 7**). The Utility and Citizens Advisory Group (CAG) met in separate groups to review proposed improvements, provide technical input, identify city interests, and incorporate community values. The information provided to the Utility and CAG to evaluate each alternative included the model results, proposed improvement projects, and cost figures developed by MWH and Crist Engineering. This information included the following components:

- descriptions of the wastewater model developed for the study and model results,
- construction technology available for installation and repair of systems,
- permitting and technical requirements for each alternative,
- and preliminary costs.

Evaluation Matrix
The CAG developed an Evaluation Matrix containing the following eight categories for evaluation and consideration of the five alternative scenarios:

1. Environmental Concerns
2. Citizen Awareness - Social Impact Esthetic
3. Financial
4. Technical Concerns
5. Regulatory Concerns
6. Construction Issues
7. Growth Planning
8. Property Value

Each evaluation category was assigned a weight from 0 to 3 to indicate a level of importance the CAG placed on the item as it might impact the community. A maximum weight of 3 indicated that major consideration should be given to the item, while a weight of 1 indicated minimum consideration. Any category given a weight of 0 indicated a consensus that the category should not be given consideration in the alternative evaluation. For each of the eight categories listed above, additional criteria described in descending levels of feasibility of each improvement's implementation were assigned. As shown in **Table 4.7**, a selected weight of 3 would indicate that an alternative was deemed to have the greatest level of feasibility for installation with the least impact on the community, while a weight of 1 would indicate the lowest level of feasibility with increased adverse affects to the community. Again, a weight of 0 would preclude the assigned criteria from further consideration during the ranking process. Total ranking is based on the selected level of importance for each category multiplied by the criteria ranking for each alternative improvement. Scores ranking each alternative were totaled for all eight categories with the highest total indicating the most preferred alternative by the CAG.

To compare the improvements proposed in the five alternatives and to simplify the ranking process, Little Rock's wastewater system was separated into a north and a south collection system. The north area included improvements for the Little Maumelle and Riverfront Basins. The south area consisted of improvements located in the North and South 60, Fourche, and District 142 Basins. Additionally, the matrix was subdivided by critical elements for alternative improvements related to total storage, partial storage and conveyance, and total conveyance scenarios for the south area, and conveyance versus constructing the new Maumelle WWTP in the north. The summary of the Citizens Advisory Group ranking is shown in **Table 4.8**.

It should be noted that although the Citizens Advisory Group developed the Evaluation Matrix the Utility concurred with the general approach and the content for each item discussed. While conducting their evaluation, the Utility incorporated additional considerations such as scheduling, budgeting for construction, and implementation of the selected improvements.

4.3.4 Selected Alternative

Based on the selection criteria and evaluation methodology presented above, the preferred capacity upgrade alternative for south Little Rock was to utilize total conveyance, i.e, installation of the 72-inch gravity trunk line, pump station and WWTP capacity upgrades rather than wet weather storage. Matrix categories related to permitting issues, site aesthetics, environmental and odor concerns were the major factors that depressed the rankings for the storage alternatives.

The Citizens Advisory Group also expressed its concerns over the construction of a new Maumelle WWTP in north Little Rock. Environmental and community concerns were identified as the pertinent issues. Despite the CAG's slightly higher ranking (24 versus 23) favoring an option to convey all flow from the Maumelle and Riverfront Basins to the Adams WWTP, the Utility chose an alternative that included construction of the new treatment plant. The compelling factor was the cost differential of $33.2 million between the two alternatives, required to convey wastewater from Maumelle through the Riverfront Basin and onto the Adams WWTP. Another disadvantage of the CAG conveyance option was that no additional space is available to expand facilities to increase treatment capacities at the Adams Field

Table 4.7
Evaluation Criteria

	Category	3	2	1	0
1	Environmental Concerns	No sight or odor problems. Maintains water quality	Potential sight or odor problems during extreme rain events. Maintains water quality.	Potential sight or odor problems during seasonal rains. Maintains water quality.	Year round sight and odor problems, potential for water quality problems.
2	Citizen Awareness – Social Impact Aesthetic	Operations do not effect neighborhoods or quality of life	Minimal disruptions due to operations during extreme rain events.	Moderate disruptions seasonally.	Moderate year round disruptions.
3	Financial	Lowest effect on rates	Moderate impact on rates	Major impact on rates	Extreme impact on rates
4	Technical / Ongoing Concerns	Compatible with existing system, capable of being expanded cost effectively, and timely. Meets long-term need. Minimal maintenance and operational costs, only functions during periods of high flow.	Minimal system disruption, moderate system changes with medium costs, longer period construction, multiple phasing. Moderate operational costs and minimal maintenance.	Moderate system changes. High initial costs, multiple phases for long term needs. High operation and maintenance costs. Repairs difficult. Operations continual for low and high flow conditions.	Technically difficult to implement, major changes to existing system. High initial costs, extremely long lead times for equipment. Highest operation maintenance costs. Outside contractors needed for routine maintenance.
5	Regulatory Concerns	Meets regulatory agency requirements with no unusual features.	Meets regulatory agency requirements. Permits required.	Regulatory education required, Clean Water Act amendments necessary. Meets intent of CWA.	Agency approvals will be extremely difficult to obtain
6	Construction Issues	Construction does not disrupt neighborhoods.	Minimal disruption due to construction.	Major disruptions due to construction.	Major long term construction disruptions.
7	Growth Planning	Anticipates municipal growth and addresses those issues	Considers municipal growth with minimal impact.	Only slightly realizes municipal growth and its impact.	Does not consider municipal growth
8	Property Value	No effect on property values	Minimal effect on property values	Moderate effect on property values	Major effect on property values.

Table 4.8
Evaluation Matrix

Evaluation Category	Wt	Options for South Little Rock (North 60, South 60, District 142, & Fourche)			Options for North Little Rock (Maumelle and Riverfront)	
		Full Storage Option #1	Partial Storage Option #2	72" Line Conveyance Option #3	New WWTP Option #4	Conveyance Option #5
Environmental Concerns	3[1]	1[2] / 3[3]	1/3	3/9	1/3	3/9
Social Impact Aesthetic	3	2/6	2/6	3/9	0/0	2/6
Financial	3	3/9	2/6	1/3	3/9	0/0
Technical /Ongoing Concerns	2	1/2	1/2	3/6	1/2	3/6
Regulatory Concerns	1	1/1	2/2	2/2	2/2	2/1
Construction Issues	1	2/2	2/2	0/0	1/1	0/0
Growth Planning	2	0/0	0/0	1/2	3/6	1/2
Property Value	0	0/0	0	0	0	0
Total Points		23[4]	21	31	23	24
Ranking		2	3	1	Preference Unknown	

Note:

1. Represents the level of importance CAG gave to each category.
2. Represents weigth for criteria (0-3) for each category in Table 4.7, as assigned by the CAG when evaluating collection system options.
3. Ranking score for each category calculated by multiplying weight given for importance by the assigned criteria weight.
4. Total calculated ranking for each option.

WWTP. The facility is land locked and improvements identified by the previous study completed for the plant (**Appendix E**), increasing its capacity to 94 MGD, would essentially take up all remaining space for the site. Hence, delivering wastewater from Maumelle to Adams WWTP as part of a total conveyance option would exceed the limits of 94 MGD treatment and 25 MG of equalization/storage capacity. Based on the criteria described above, Alternative A1 was selected as the preferred alternative for meeting Little Rock's overall wastewater system capacity needs.

Section 5
Recommended Improvement Plan

This section presents the implementation schedule for the recommended improvements and additional recommendations for capacity assurance for the LRWU wastewater system. The improvement plan includes estimated capital costs for a 15-year implementation schedule.

5.1 PROJECT COSTS

Among the LRWU wastewater collection system capacity improvement alternatives presented in **Section 4**, Alternative A1 was selected for implementation. Preliminary construction cost estimates were prepared for each capacity improvement project described under Alternative A1. Pipeline project costs based on conceptual designs were developed from construction projects for similar installations recently completed in the Little Rock Area. Costs for pump station upgrades and/or replacement were obtained from the Engineering News Record (ENR) "Construction Cost Index" for 1994 Los Angeles, California, for similar projects. Applying a conversion factor of 0.98 the costs, pump station estimates were adjusted to comply with a national average based on October 2001 dollars. After determining the base construction cost for each project, an allowance of 25% for contingencies and engineering was added to develop the capital cost estimates. The estimated capital costs for treatment plant improvements were derived from studies completed for the proposed Maumelle WWTP (**Appendix G**), the Adams Field WWTP (**Appendix E**), and the Fourche WWTP (**Appendix F**). All costs should be considered budgetary planning level estimates with an estimated accuracy of –30 to +50 percent. The estimated costs do not account for inflation between the time of estimate development and the anticipated construction. The pipeline installation estimates do not include costs for land right-of-way acquisition, construction management, inspection, legal work, financing fees, operation and maintenance costs. These costs should be reviewed and revised based on the detailed information developed during design.

5.2 PROJECT PRIORITIZATION AND SCHEDULE

The proposed schedule for construction of the recommended capacity improvement projects is based on a 15-year implementation plan. The capacity upgrade projects were prioritized and scheduled based on the severity of existing capacity deficiencies, the extent of potential surcharge during the design storm condition, planning flexibility, and funding constraints.

Projects proposed to address existing trunk line capacity deficiencies include the eleven trunk sewer line replacements (the Alsop, Barrow Addition, Barton, Coleman Creek, Country Club, District 119, Granite Mountain, Sub-Basin 30100, Jimerson Creek, Maumelle and Rock Creek trunk lines), and the installation of the parallel 72-inch trunk line extending from Adams WWTP upstream to the west end of the existing Twin 60s. The pump station capacity improvement projects include upgrades for the Cantrell Pump Station and Arch Street Pump Station with its new parallel force main, and new pump stations for the Jimerson Creek and I-430 areas. Treatment capacity upgrades include construction of the new Maumelle WWTP, and expansions of the Adams Field and the Fourche Creek WWTPs.

Trunk Line Improvements. With exception of the new trunk lines required for the Jimerson Creek, Rock Creek and Coleman Creek Areas, new trunk line installations listed in **Table 4.1** are scheduled to occur between years 2008 and 2012. Reoccurring historical overflows verified by the hydraulic model results indicate a significant need to provide additional sewer capacity for these areas. Jimerson Creek and Coleman Creek trunks are scheduled to occur between 2003 and 2006. Rock Creek improvements are scheduled to occur between years 2008 and 2017 with the 72-inch parallel trunk scheduled between 2008 and 2016. This sequencing prioritizes the most critical trunk replacement projects. It also provides the Utility the option to perform trunk rehabilitation and system monitoring in order to minimize the level of needed future trunk replacement. **Table 5.1** indicates the schedule for installation of all gravity trunk sewer improvements.

Table 5.1
Schedule for Trunk Line Improvements

Project Name	Begin Planning/Design	Complete Construction
Alsop	2011	2012
Barrow Addition	2011	2012
Barton	2010	2012
Coleman Creek	2003	2006
Country Club	2010	2012
District 119	2011	2012
Granite Mountain	2012	2012
Sub-Basin 30100	2011	2012
Jimerson Creek	2003	2005
Maumelle	2008	2011
Rock Creek	2008	2017
Upper 72-inch Parallel Line **(a)**	2008	2011
Lower 72-inch Parallel Line **(b)**	2013	2016

(a) Upper reach for the 72-inch line runs from Arch Street PS upstream to the west-end of the existing Twin 60-inch Interceptors.

(b) Lower reach for the 72-inch line runs from the Adams WWTP upstream to Arch Street Pump Station.

Pump Station Improvements. With exception of the Arch Street facility, improvements for upgrading and installing new pump stations are scheduled to occur between years 2008 and 2015. The capacity upgrades to the Arch Street Pump Station have been prioritized since the facility represents the major conveyance component for the Fourche Creek WWTP system. The station currently experiences operational problems limiting the capacity of Fourche's collection system. Although the facility's existing 42-inch force main was recently repaired to correct problems related to entrapped air in the line, the station itself is in need of additional internal mechanical upgrades. These upgrades are scheduled to occur during years 2005 to 2007. Although the Cantrell Pump Station experiences operational problems, needed improvements for this facility received a lower priority and were scheduled for installation from years 2008 to 2010. Also, improvements to the Arch Street and Cantrell Pump Stations were not scheduled concurrently because of financial constraints. The construction of the Jimerson and I-430 facilities was also scheduled from 2008 to 2010. **Table 5.2** summarizes scheduled improvements for all pump stations and their associated force mains. It should be noted that the 30-inch parallel force main intended to support capacity improvements for Arch Street has been scheduled for installation much later than the station improvements, from years 2015 to 2016. Although the new parallel force main is required for the ultimate conveyance capacity, the existing 42-inch force main can support a maximum flow of approximately 45 MGD. Since the planned Arch Street Pump Station improvements add 7 MGD of additional conveyance capacity prior to the force main installation, it was believe that scheduling the new force main installation could be delayed.

Table 5.2
Schedule for Pump Station Improvements

Project Name	Begin Planning/Design	Complete Construction
Arch Street PS (60 MGD)	2005	2007
30-inch Force Main (for Arch)	2015	2016
Cantrell PS (40 MGD)	2008	2010
Jimerson Creek PS (12 MGD)	2008	2009
24-inch Force Main (for Jimerson)	2008	2009
I-430 PS (1 MGD)	2008	2009

Treatment Plant Improvements. Prior to the development of the hydraulic model, engineering studies were completed that identify proposed capacity upgrades for both the Adams Field and the Fourche Creek WWTPs. These capacity upgrades include a capacity increase from 72 MGD to 94 MGD for the Adams Field WWTP and a capacity increase from 38 MGD to 60 MGD for the Fourche WWTP. The Adams study also includes equalization basins having a total volume of 25 MG. The proposed capacity upgrades are provided in greater detailed in **Appendix E** and **Appendix F**.

At present, during storm events, the Adams Field WWTP becomes overloaded due to high flow conditions. Since the automatic gate upstream of the Arch Pump Station is regulated by the amount of flow occurring at Adams Field WWTP, the line surcharge conditions in the Twin 60s and upstream tributary areas are a function of the capacity limitations experienced by the Adams Field Plant. Due to permitting issues and the need for immediate response to system overflows, scheduling for the existing plant improvements was slated to start in 2003 with completion in 2005. Small upgrades to the Fourche Creek WWTP are scheduled to occur 2004 with the bulk of the capacity improvements scheduled between 2014 and 2017. In order to relieve line surcharges along the Riverfront Basin and to help further relieve capacity constraints at the Adams WWTP, the Maumelle WWTP is schedule to start the engineering and permitting process for the new facilities in 2003 with installation completed by 2006. **Table 5.3** presents the anticipated schedule for implementation of the treatment facilities.

Table 5.3
Schedule for Treatment Plant Improvements

Project Name	Begin Planning/Design	Complete Construction
Fourche WWTP (60 MGD)	2004 / 2014	2005 / 2017
Adams Field WWTP (94 MGD) **(a)**	2003	2005
Maumelle WWTP **(b)**	2003	2006

(a) Adams WWTP improvements include installation of 25 MG of equalization basins.
(b) Maumelle WWTP improvements include installation of 30 MG of equalization basins.

The implementation schedule for capacity related improvements was developed during a series of program workshops with LRWU staff. Projects were prioritized based on response to critical conditions existing in the collection system, program flexibility, and coordination with development of the Utility's Wastewater Capital Improvements Plan (CIP). The CIP also includes continuing line rehabilitation work, facility operation and maintenance costs, and miscellaneous wastewater installations. Capacity improvements outlined in the SECAP Report are not intended to serve as a substitute for the Utility's comprehensive CIP. The complete schedule for capacity improvements for this SECAP are shown in **Table 5.4**. Note that the schedule has been divided into three 5-year phases. This phasing was done to provide greater flexibility for assigning costs to interim milestone projects, assessment of schedule progress, and ongoing evaluation for planned improvements. **Figure 5.1** provides a graphical representation of cash flow for improvements and **Figure 5.2** shows the annual expenditures by type of construction.

5.3 IMPLEMENTATION RECOMMENDATIONS

The Utility should begin implementation of the capacity improvement program recommended in this System Evaluation and Capacity Assurance Plan, in accordance with the schedule shown above. The following items should be considered during project scheduling and design, and in future updates of the capacity plan.

- The alignments and sizes of all recommended projects should be verified with detailed predesign analyses, including topographic surveys, geotechnical investigations, utility research, and constructability reviews.
- Evaluation for paralleling or replacing existing sewers should consider the physical condition and remaining useful life of the existing pipelines; the availability of pipeline corridors for new sewer construction; and operation and maintenance concerns.

Table 5.4
System Evaluation and Capacity Assurance Plan
15-Year Implementation Schedule and Costs

Estimated Capital Costs ($ Millions)

				1st 5-years					2nd 5-years					3rd 5-years		
Project	**Total Project Cost (Million)**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Allsop	1.55			REHAB						0.77	0.78					
Barrow Add.	1.22			REHAB						0.61	0.61					
Barton	2.29			REHAB					0.76	0.76	0.77					
Coleman Creek	8.01	0.75	1.50	4.26	1.50											
Country Club	3.21			REHAB					1.00	1.00	1.21					
District 119	1.57			REHAB						0.78	0.79					
Granite Mt	0.57										0.57					
SB 30100	1.42			REHAB						0.71	0.71					
Jimerson Creek	3.06	0.50	1.50	1.06												
Maumelle	6.54			REHAB			1.63	1.63	1.64	1.64						
Rock Creek	23.64			REHAB			2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.04
Subtotals:	**53.08**	**1.25**	**3.00**	**5.32**	**1.50**	**0.00**	**4.03**	**4.03**	**5.80**	**8.67**	**7.84**	**2.40**	**2.40**	**2.40**	**2.40**	**2.04**
									Upper					**Lower**		
72" Trunk	30.40						1.20	6.00	6.00	2.00		1.20	6.00	6.00	2.00	
30-inch Parallel Force Main for Arch Street PS	9.72													1.72	8.00	
Subtotals:	**40.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.20**	**6.00**	**6.00**	**2.00**	**0.00**	**1.20**	**6.00**	**7.72**	**10.00**	**0.00**
Adam Field WWTP (94 MGD + 25 MG Storage)	24.00	6.00	12.00	6.00												
Maumelle WWTP (w/ 20 MG Storage)	19.90	0.50	3.00	9.00	7.40											
Fourche WWTP (60 MGD)	23.42		2.50										1.50	7.02	8.50	3.90
40 MGD Cantrell L.S.	4.60						1.50	1.60	1.50							
60 MGD Arch L.S.	2.92			0.50	1.62	0.80										
12 MGD Jimerson L.S.	2.54						1.00	1.54								
1 MGD I-430 L.S.	0.40						0.20	0.20								
Subtotals:	**77.78**	**6.50**	**17.50**	**15.50**	**9.02**	**0.80**	**2.70**	**3.34**	**1.50**	**0.00**	**0.00**	**0.00**	**1.50**	**7.02**	**8.50**	**3.90**
Yearly Total (Millions)		**7.75**	**20.50**	**20.82**	**10.52**	**0.80**	**7.93**	**13.37**	**13.30**	**10.67**	**7.84**	**3.60**	**9.90**	**17.14**	**20.90**	**5.94**
Total:	**170.98**	**Million**														

Figure 5.1
Annual Expenditures for Capacity Assurance Plan Improvements

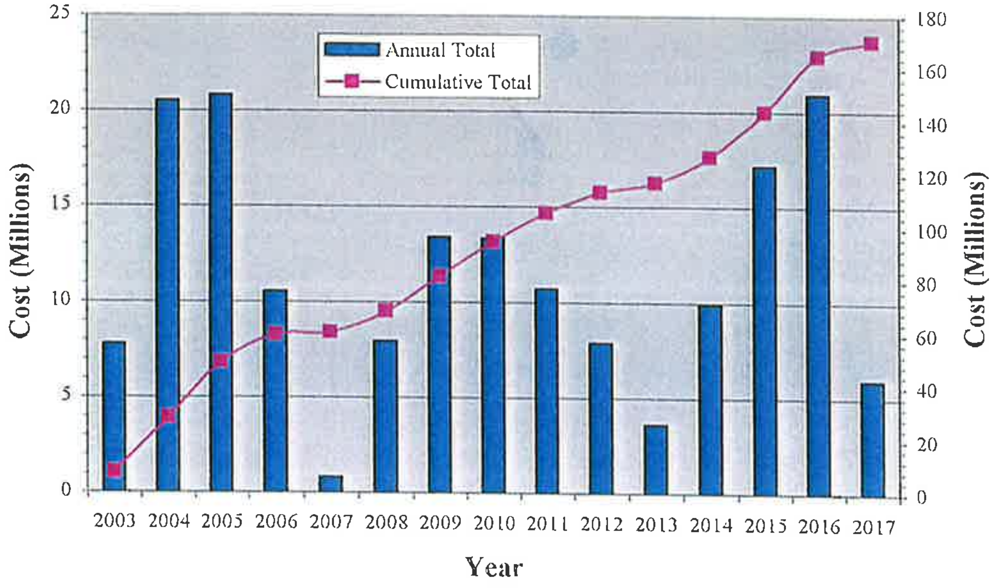
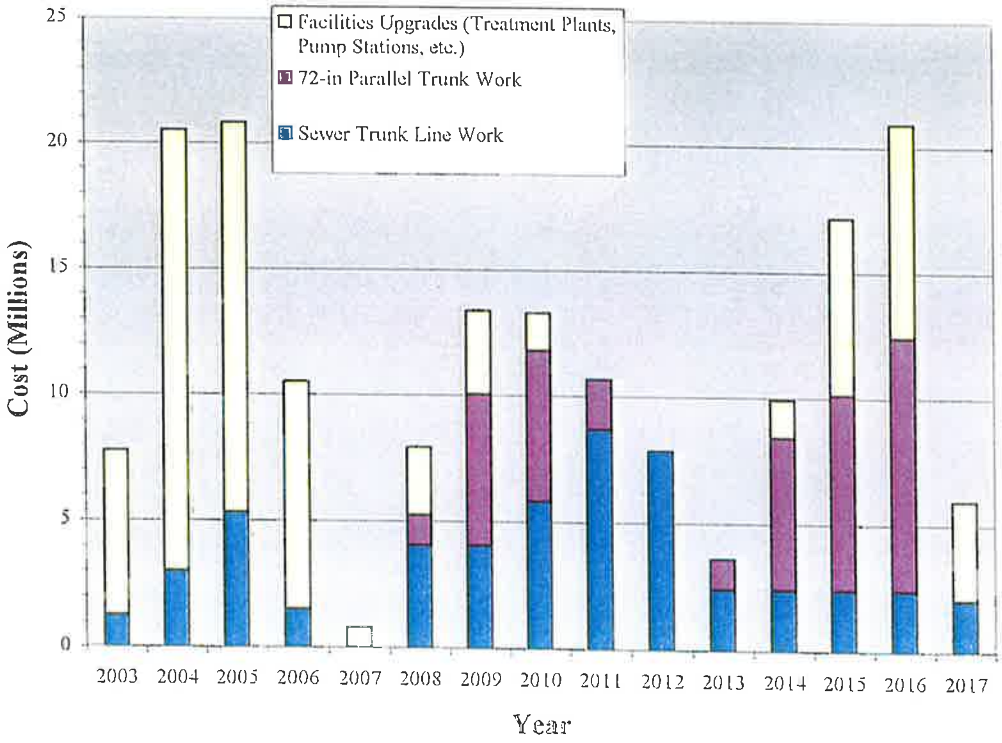


Figure 5.2
Annual Expenditures by Type of Construction



- The hydraulic model has been developed to assist the Utility in performing capacity analyses and updating their assurance plan in the future. The model should be kept up-to-date with any changes to existing sewer connections, sewer system facilities, or other collection system improvements.
- The Utility should continue to monitor flow at key locations in the sewer system, particularly in areas were comprehensive line rehabilitation is scheduled to occur. Flow levels during large storm events should be compared to the peak flows simulated by the hydraulic model to verify the modeling predictions for the design storm.
- After completion of line rehabilitation, flows should be re-monitored to verify that reductions in I/I have been achieved for local systems. The hydraulic model should be updated accordingly upon completion of that work and credit for downsizing or elimination of additional capacity related improvements should be documented.

This System Evaluation and Capacity Assurance Plan report is intended to be a working document to be refined and updated as additional data and new planning information becomes available. The Capacity Plan should be updated whenever changes are made to the sewer collection and treatment system.

Section 6
Infiltration / Inflow Abatement

This section provides discussion and recommendations for implementing a correction and maintenance program to address problems related to system infiltration and inflow (I/I). The discussion provided in this section is intended to assist the Utility with identifying sub-basin areas that contribute excessive I/I into the sewer system and provide recommendations for implementing a comprehensive plan that employs appropriate repair technologies, continued system flow monitoring, and modeling updates.

6.1 INFILTRATION/INFLOW REDUCTION PLAN

This section summarizes recommendations to The Utility with respect to infiltration/inflow (I/I) reduction and an ongoing sewer system renewal and replacement effort. The I/I abatement plan is an integrated approach that addresses I/I problems with an ongoing sewer replacement and repair effort. The plan links ongoing emergency repair and sewer renewal programs with a focused effort on removing extraneous I/I from the system. The plan includes provisions that are consistent with the emerging EPA SSO policy, including capacity, management, operations and maintenance (cMOM) requirements.

I/I reduction is system specific and rehabilitation is far less effective in removing I/I than most, including regulators expect. Factors such as pipe and manhole materials, system age, number of pipe joints, etc. impact the ability to remove I/I. The approach to emergency, preventive, and corrective maintenance also impact the level of I/I reduction. Peak flows depend on a number of variables that interact in a complex way. In addition, the accuracy of monitoring peak flows is limited, which impacts our ability to effectively quantify I/I flows and reductions from rehabilitation.

The previous section (**Section 5**) of this report presents the recommended system capacity improvement plan for the LRWU wastewater collection system, based on the hydraulic capacity required to handle a design wet weather event. In identifying wastewater system alternatives, no credit was given for potential I/I reduction obtained through the proposed I/I abatement program outlined in this section. However, I/I abatement is recommended as a cornerstone of every sewer system improvement program. The CAG recommended that the Utility address I/I reduction as part of the overall system improvement program.

The flow targeted I/I reduction program would prioritize sewer rehabilitation and replacement based on the areas with the highest I/I contributions and the ability to impact the capacity improvement plan by reducing or proposed trunk sewer replacements. Targeted areas would be scheduled for comprehensive closed-circuit television (CCTV) inspection as warranted by the results of the hydraulic model and field observations. The program should also begin to address the complex issue of I/I abatement on sewer laterals located on private property. The proposed targeted I/I reduction and sewer rehabilitation/replacement plan should reduce I/I and peak wet weather flows (WWF) in the collection system. However, final credit for I/I reductions would not be taken until post rehabilitation flow monitoring confirms the volume reduction.

6.2 SOURCES OF INFILTRATION AND INFLOW

The flow monitoring and hydraulic analyses conducted for this SECAP Report indicated that the collection system experiences inflow and infiltration (I/I) of extraneous groundwater and storm water, into the sewer system. Inflow results in a rapid increased flow response to rainfall and includes storm water that enters the sanitary sewer system from:

- roof leaders,
- cellar drains,
- yard drains,
- area drains,
- drains from springs and swampy areas,
- manhole covers,
- cross connections between storm sewers and sanitary sewers.

Infiltration, on the other hand, is reflected by a slower, sustained response to rainfall and high groundwater conditions. Infiltration generally enters the sewer system through the ground via such means as defective pipes, pipe joints, connections, or manholes. The magnitude of I/I flows varies with the age, location and pipe material across the entire City. Some areas of the Little Rock system do have significant I/I as indicated by the flow monitoring data. The flow monitoring analysis produced the following system I/I characteristics:

- Delayed infiltration
- Increased infiltration during rainfall event
- Decreasing infiltration after rainfall event
- Rapid flow response is delayed following the initial rainfall
- Groundwater infiltration (GWI) increases during a succession of rainfall events
- Low rapid response flows indicating few direct connections
- Large wet-weather flow variation between flow meters

The above characteristics suggest that the I/I in the Little Rock system is predominantly steady, rainfall-induced infiltration as opposed to a rapid inflow response associated with direct connection to the City's storm water conveyance system

The Utility's ongoing sewer inspection program, which includes closed-circuit television (CCTV) has shown typical sewer defects such as offset joints, minor cracks, extensive corrosion, major structural failures, sags, etc. One specific area of concern is the extensive use of ABS truss pipe in the upper Rock Creek and Maumelle areas. There are numerous structural failures associated with the truss pipe in these areas resulting in high I/I potential.

6.3 CHALLENGE OF EFFECTIVE I/I ABATEMENT

Large expenditures for the correction of I/I sometimes produce only a small reduction in infiltration. The EPA recognized that the correction of excessive infiltration is likely to be unsuccessful in many circumstances.

While the technology and procedures associated with measuring and removing I/I continue to improve, the success of specific I/I removal projects depends on an extremely complex set of variables. This indicates that I/I removal is only one component of a collection system management program and that such a program needs to accommodate the variability in the success of I/I removal. Experience with I/I work has highlighted the need to address the following concerns during I/I removal efforts:

- The success of I/I removal efforts can be significantly limited if these efforts do not address private laterals. Many municipalities have hesitated to address private laterals due to legal, institutional, and technical problems.
- Peak flows must be correctly characterized. Infiltration may be incorrectly identified as inflow when RDI/I (Rainfall Derived Infiltration and Inflow) enters the sewer system through defects and produces a peak flow response similar to that of inflow from direct inflow connections.
- A correlation between measured rainfall and RDI/I entering a particular system is very difficult to determine reliable quantities without many years of historical data.
- Groundwater migration affects the effectiveness of I/I removal. Correction of a specific infiltration source may not result in corresponding reduction in the infiltration rate where groundwater migration occurs. Traditional approaches to identifying the cost effectiveness of sewer system rehabilitation that evaluate each inflow source or sewer defect on an individual basis may overestimate the amount of flow reduction by failing to account for the migration of water into pipe defects that remain unrepaired. Hence, groundwater that was precluded from entering main pipes prior to I/I removal efforts can enter the system after major sources of I/I have been repaired.
- The relationship between monitored flows and I/I from source defects may overestimate I/I removal. Metering programs may not have accounted for peak flows that bypass the treatment facility or that overflow from the system itself.
- Capital relief and replacement projects will lower surcharged conditions in numerous pipeline segments. Meeting this sewer system program objective may allow for additional I/I to enter the system. Accurately projecting and modeling this effect is difficult

The above challenges do not preclude the need to take pro-active steps to reduce excessive I/I and prevent I/I levels from increasing due to further deterioration of the collection system. However, they do offer a realistic assessment of the difficulties in dealing with a complex sewer system. They also support the approach that limits credit for I/I reduction in the planning process until actual I/I volume and peak flow reductions can be confirmed by actual observed decreases in peak wet weather flows.

6.4 FLOW TARGETED I/I REDUCTION

Sustained reduction in infiltration and inflow is a difficult challenge in any wastewater collection system. This is especially true in older systems or in systems where the material used and installation procedures resulted in multiple failure points throughout the area. As part of the integrated I/I reduction and sewer rehabilitation program, a flow targeted effort will:

- Identify parts of the system with high I/I volumes,
- Prioritize areas that will have a tangible impact on the size and location of capital infrastructure improvements,
- Employ comprehensive CCTV inspection and rehabilitation to effectively reduce I/I volumes,
- Confirm reductions in I/I by observed consistent decreases in wet weather flows.

An initial analysis of peak wet weather flow (PWWF) versus dry weather flow (DWF) for modeled line segments in the Little Rock system is shown in **Figure 6.1**.

Figure 6.1
PWWF to DWF Analysis

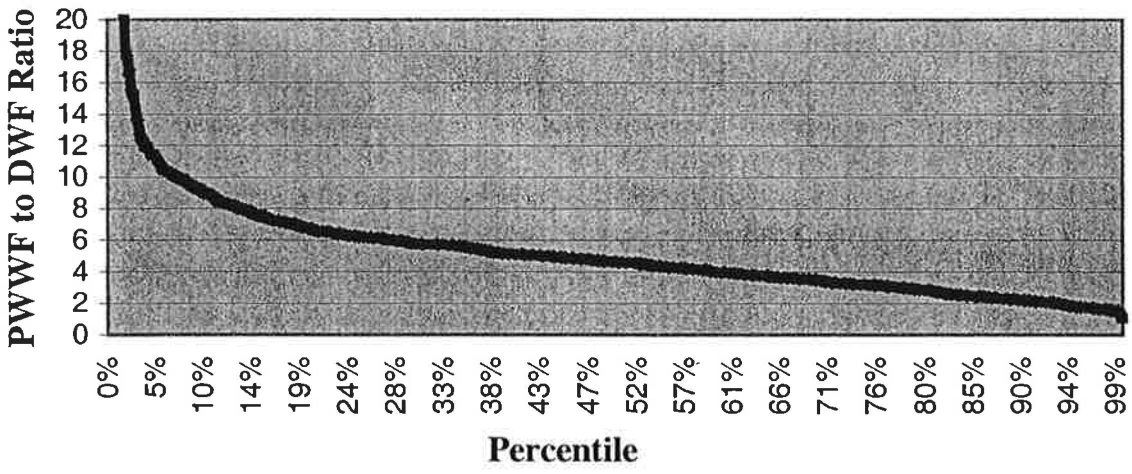


Figure 6.1 plots the PWWF to DWF ratio for the percentile of modeled lines segments. This "knee-of-the-curve" type analysis indicates that less than 12% of the modeled lines had a PWWF to DWF ratio above 8. Therefore, as an initial target, the rehabilitation program would focus I/I reduction on trunk segments and areas with PWWF to DWF ratios in excess of 8.

Infiltration and inflow reduction would be an ongoing effort for LRWU. The near term, 5-year I/I reduction plan would target those prioritized trunk segments or areas that would have a tangible impact, on the planned capital pipeline relief and replacement program. **Figure 6.2** illustrates the areas in the collection system, which show the highest PWWF to average DWF. In general, those areas with high PWWF to average DWF that are upstream of those pipelines scheduled for replacement or relief over the next 15 years will be targeted. **Figure 6.3** shows the relation between the Peak / Dry ratio and the proposed system trunk line upgrades. As part of the I/I abatement initiative, a more detailed analysis of trunk lines in the initial 5-year construction schedule would target those areas for comprehensive CCTV inspection and rehabilitation.

Flow targeted areas for I/I abatement must be checked against maintenance and repair histories and other factors to maximize the impact, of sewer rehabilitation on actual peak flow reduction. Targeted areas would require additional flow monitoring to isolate areas for inspection and rehabilitation. Pre-rehabilitation flow monitoring may also be helpful in establishing a baseline to gauge actual PWWF reduction.

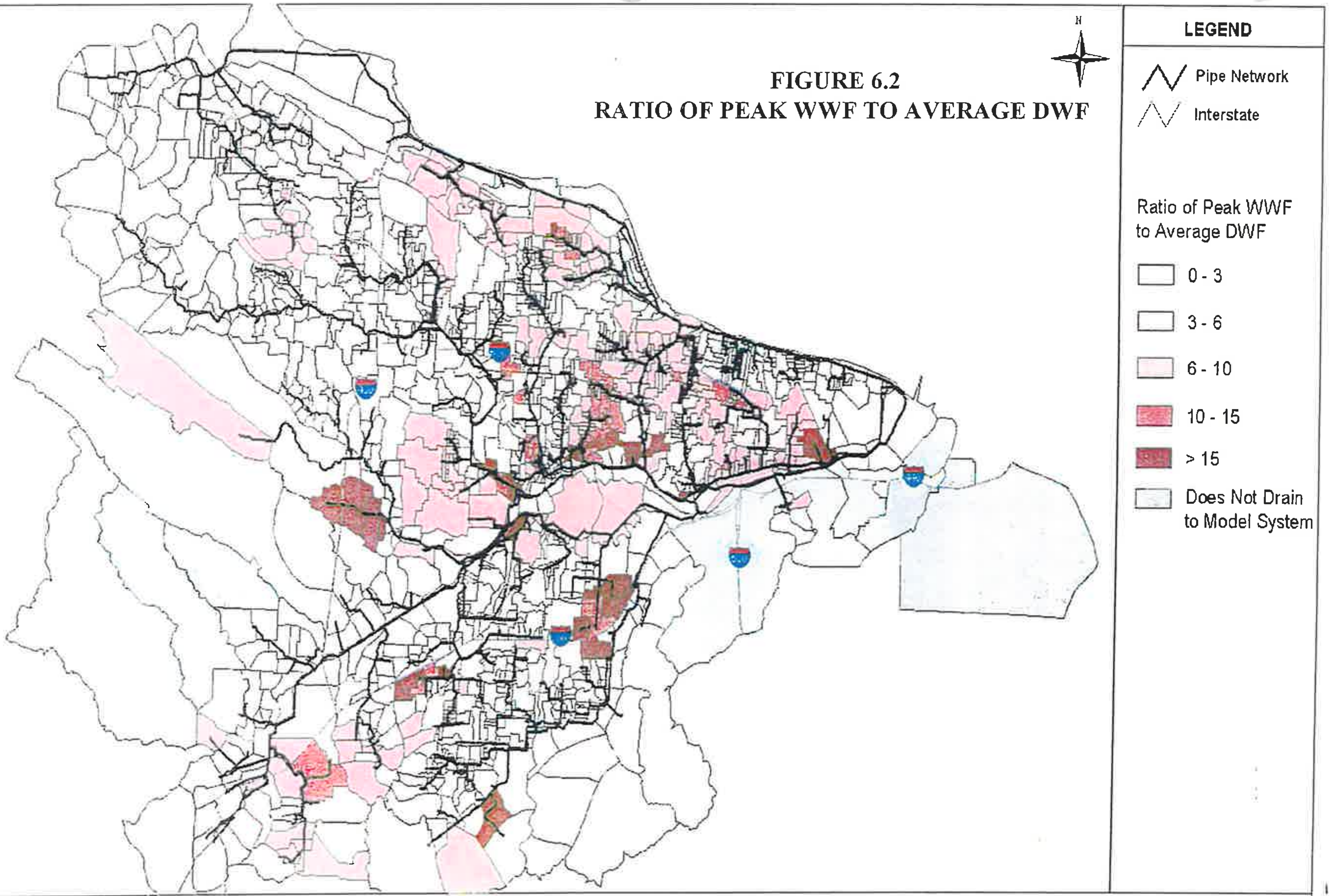
Comprehensive cleaning and physical inspection using CCTV and other leak detection methods should be performed in the targeted areas. Comprehensive sewer replacement or rehabilitation should follow the results of he inspection efforts. Consideration should be given to the utilization of available unit-priced construction contracts and work order systems to perform most of the routine replacement and rehabilitation construction. This approach provides a direct link between inspection and repair in a “find and fix” mode, which provides rapid, cost effective rehabilitation, and may be helpful in monitoring the actual effects on I/I reduction. Larger mainline repairs and replacement in busy streets or those requiring more analysis and design can be accomplished in a more traditional capital sewer rehabilitation program.

Post-construction flow monitoring is essential to verify the actual reduction in I/I volume and the corresponding reduction in peak WWF. The results of post rehab flow monitoring coupled with re-modeling results can then be used to reevaluate the proposed pipeline replacement program. The proposed pipeline replacement program should be scheduled to accommodate the results of the I/I abatement effort and avoid replacing sewers that may be impacted by the I/I abatement effort.

6.5 EMERGENCY, CORRECTIVE, AND PREVENTIVE MAINTENANCE

Emergency and routine repairs and replacement of sewers can impact the success of the overall I/I abatement effort. Customer complaints, back-ups and overflows are indicators of sewer system maintenance, structural and capacity problems. The primary objectives of these ongoing maintenance programs are customer service and overall asset management. However, work order, customer complaint and overflow history can provide critical data in assessing I/I sources. The Utility field workers have the best hands-on knowledge of system condition and potential I/I sources. Coordination of emergency and corrective maintenance with I/I abatement can expand the mission of these ongoing maintenance programs to include I/I reduction.

FIGURE 6.2
RATIO OF PEAK WWF TO AVERAGE DWF



MWH
MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

RATIO OF PEAK WWF TO AVERAGE DWF

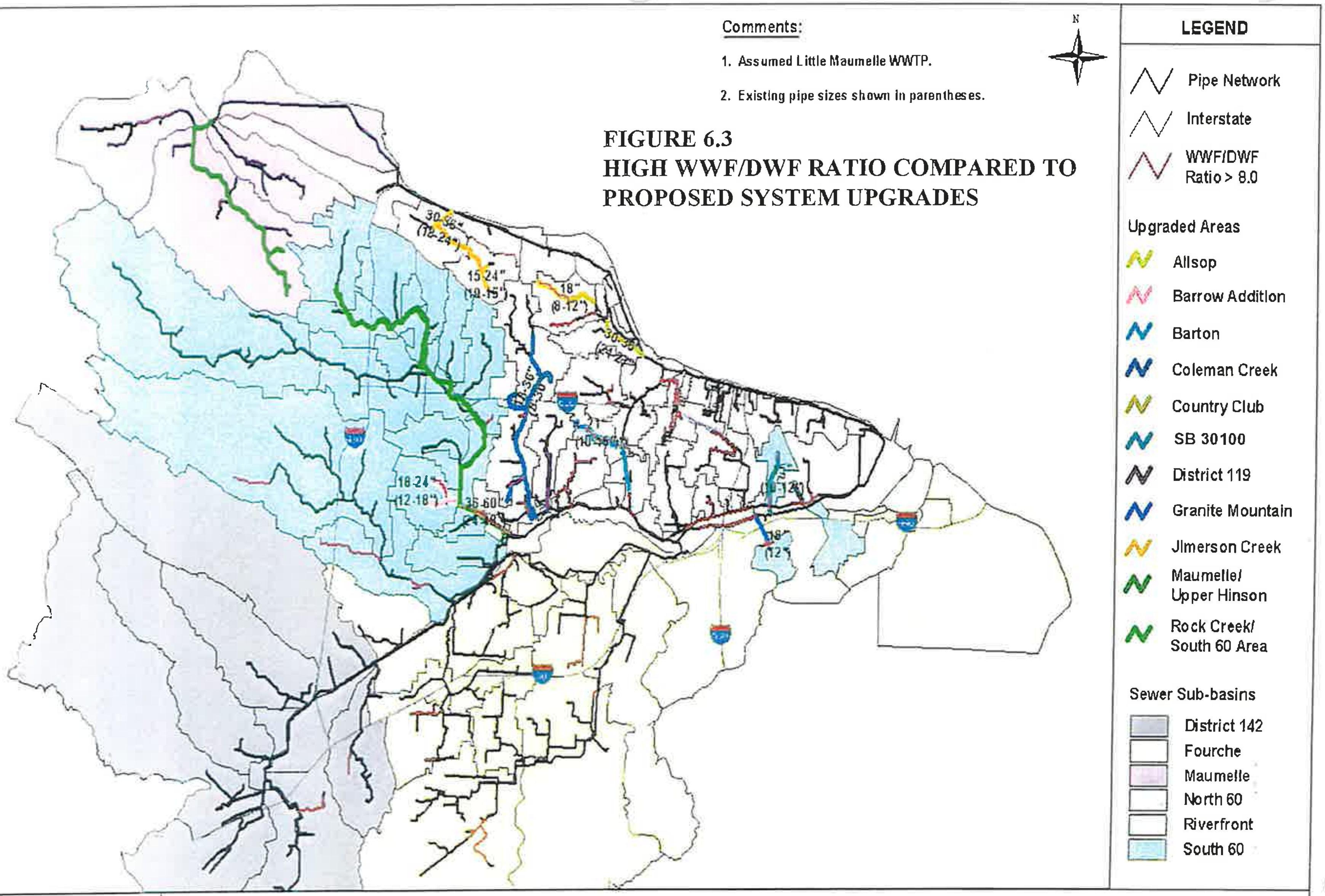
STORM EVENT A: MARCH 15, 2000 - MARCH 23, 2000

D:/Projects/LRWU/apr/littlerock.apr

Comments:

1. Assumed Little Maumelle WWTP.
2. Existing pipe sizes shown in parentheses.

FIGURE 6.3
HIGH WWF/DWF RATIO COMPARED TO PROPOSED SYSTEM UPGRADES



MWH
MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

HIGH WWF/DWF RATIO COMPARED TO PROPOSED SYSTEM UPGRADES

The I/I abatement program would serve as a catalyst for information sharing, program assessment, and work order coordination to maximize the impact of ongoing repairs on I/I reduction.

Emergency Maintenance. Emergency maintenance is typically made in response to a customer complaint or critical system problem. Typically, emergency maintenance crews deal with blockages and structural failures. Deposition and blockages may occur from introducing improper materials into sewers, and from introduction of grease, grit, roots, or other debris. The potential for blockages can increase in sewers having flat slopes that reduce flow velocities or other structural defects.

A wide range of structural defects occurs in sanitary sewer collection systems. Examples include cracks or holes in pipes caused by corrosion or external forces and separated joints. A continuous maintenance effort, including an inspection program, should reduce the occurrence of overflows due to structural failures.

Corrective and Preventive Maintenance. The same approach holds true for ongoing corrective and preventative maintenance programs. A good preventive and corrective maintenance program is one of the best ways to keep a system in good repair, prevent service interruptions, avoid system failures, and reduce I/I. In addition to preventing overflows, backups, service interruptions, and system failures, a preventive and corrective maintenance program can protect the capital investment in the collection system. Preventive maintenance typically bases system management on historical information and how the system ages. Predictive management is an important feature of preventive maintenance and can be used for both long-range replacement and repairs and for establishing routine maintenance work orders for areas with known histories. Good record keeping and information management is the key for an effective predictive management program.

Components of a good preventive and corrective maintenance program would typically include:

- Routine inspection of the collection system, including pump stations
- Correction of faulty conditions that produce historical complaints
- Adequate workforce and appropriate equipment
- Maintain a schedule of planned activities
- Planned, systematic, and scheduled cleaning and repairs
- Proper sealing and/or maintenance of manholes
- Regular repair of deteriorating sewer lines
- Remediation of poor construction
- Regular inspection and maintenance of pump stations and other appurtenances

The inventory identified various types of sewer type materials in the LRWU collection system, as listed in **Table 6.1**. The table also indicates the projected service life of each material based on generally accepted values derived from manufacturers' estimates and experience in other communities. For the purpose of this study, service life is considered to be the age at which the deterioration and defect accumulation may begin to affect the structural integrity of a pipe, or allow excessive infiltration to occur. The service life is useful for anticipating future renewal or replacement requirements.

Table 6.1
Estimated Sewer Pipe Service Life

Pipe Material	Lower Service Life (years)	Upper Service Life (years)	Comments/Potential Problems
Reinforced Concrete Pipe (RCP) **(a)**	25	50	Hydrogen sulfide corrosion
Unreinforced Concrete (CON)	25	50	Hydrogen sulfide corrosion
Asbestos Cement (ACP)	25	50	Hydrogen sulfide corrosion
Vitrified Clay with Gasket Joints (VCP)	75	100	Joint flexibility, bell and spigot cracking. Material brittleness-cracking and breakage
Vitrified Clay with Cement or Bituminous Joints (VCP)	50	75	Inflexible joint, bell and spigot cracking and breakage. Material brittleness-cracking and breakage
Polyvinyl Chloride (PVC)	50	75	Lacks long term life data
Acrylonitrile Butadiene Styrene (ABS)	50	75	Lacks long term life data
Polyethylene (PEP)	50	75	Lacks long term life data
ABS Truss Pipe	10	50	Material failures
Ductile Iron (DIP) and Steel (STL)	75	100	Corrosion

(a) Expected service life of PVC-lined RCP (T-lock) would be longer (50 to 100 years).

Inspection and Condition Assessment Prioritization. Specific needs for sewer renewal and replacement can be identified by CCTV inspection of the pipes and performing a condition assessment based on the CCTV data. Condition "ratings" based on CCTV data can be developed and used to prioritize renewal and replacement efforts. A key component of developing a renewal/replacement plan is a systematic program for cyclic CCTV inspection of the sewers. Performing CCTV inspection on a regular cycle is important for tracking changes in condition over time

One method of grouping or prioritizing sewers for CCTV inspection is by age and relative risk of failure. While age is a good guideline for prioritizing inspection other considerations, such as potential susceptibility to corrosion or location in a critical area (e.g., crossing a creek or highway), may dictate higher priority for certain segments. A plan should be proposed that utilizes a schedule for inspection and condition assessment based on two factors: corrosion resistance of the pipe material and age. The I/I abatement program should utilize comprehensive CCTV inspection to identify rehabilitation needs in the targeted flow reduction areas.

6.6 PRIVATE PROPERTY PROGRAMS

Private sewer connections represent 50% or more total sewer length of the collection system. Many storm water cross connection like foundation drains, area drains, downspouts are associated with these private sewers including connections that are intentionally made to provide site drainage. A number of studies have shown that the overall effectiveness of I/I removal efforts will be limited in many municipal collection systems if private sources of I/I are not addressed. Typically the I/I contribution from private sewers can range form 40% to 60% of the total I/I problem.

There are numerous legal, institutional, social, financial, and political issues associated with the inspection, rehabilitation and repair of private sewer laterals. The political will to force utility customers and citizens to spend large amounts of money in repair of their sewer, which seems to work perfectly fine, is typically lacking. Investment of public funds on private property presents another funding challenge. Equity and social impacts that result from the high replacement costs in the older and impoverished parts of the City also present a challenge.

There are successful private property programs around the country. Some of ideas from these programs should be adapted to Little Rock and tested in a private sewer prototype program. The results of these prototype efforts should be monitored and modeled to evaluate the true effectiveness with regards to I/I reduction.

6.7 POTENTIAL I/I REDUCTION METHODS

Potential methods to reduce I/I are based on the types of sources found in the system. Methods for addressing direct inflow sources, infiltration sources in sewer mains and manholes, and sources on private property are summarized below. The I/I abatement program will employ a comprehensive approach to system rehabilitation and replacement.

Direct Inflow Sources. Direct inflow sources such as roof and area drains and storm drain connections are a possibility throughout the system, and will be indicated by the high peak flow rate during rainfall events. Elimination of direct inflow connections requires disconnection of the source and re-direction of the drainage to an appropriate location. Manholes subject to ponding or located in drainage courses are also considered to be sources of direct inflow. Physical inspection of manholes can identify such conditions and correction is straightforward (replace cover, realign frame, raise manhole to grade, remove or relocate manhole in watercourse, etc.).

Infiltration Sources in Sewer Mains and Manholes. Infiltration sources are primarily defects in sewer pipes or manholes caused by defective materials or construction, general deterioration, or damage caused by physical conditions. Visual inspection (for manholes) and CCTV inspection (for sewers) can detect infiltration sources. Infiltration correction methods generally involve lining or replacement of entire pipe segments, manholes or spot repair of localized defects. The cost per unit amount of I/I removed is relatively high, since the defects individually contribute relatively small amounts of flow. Rehabilitation is cost effective only if a significant volume of infiltration can be isolated to a small area. Isolation of areas of infiltration can be done by flow monitoring or other flow measurement techniques, which are most effective, where very localized problems are suspected.

I/I Sources on Private Property. These I/I sources are mainly defective laterals, but may also include broken cleanouts or cleanout caps, or directly connected roof and area drains. Smoke testing is the primary method of detection. Correction of private property defects can be expensive due to the necessity of manual excavation of trenches and measures to protect and/or restore improvements such as driveways and fences. One method that has been implemented by sewerage agencies is an ordinance requiring testing or inspection of the sewer lateral at the sale of the property. If the lateral fails the inspection, appropriate repairs must be made before the sale closes. Therefore, the repair cost can be added to the sale price or closing costs.

6.8 RECOMMENDATIONS

- An integrated I/I abatement program should be implemented as part of the overall sewer system improvement program. This program should link a flow targeted I/I reduction effort with ongoing maintenance and capital rehabilitation and replacement efforts.

- The flow targeted I/I reduction program should prioritize areas for comprehensive inspection and rehabilitation. Post rehabilitation flow monitoring and modeling should be used to verify I/I volume and peak-flow reductions.

- The I/I abatement program should initially focus on known problem areas such as the Upper Hinson area in the Rock Trunk system and Maumelle Basin in order to maximize the I/I reduction impact of this ongoing program.

- Capital pipeline repair and replacement projects should be adjusted during the preliminary design stage to accommodate the verified results of the I/I abatement effort.

- The overall I/I abatement program should address the requirements of emerging EPA SSO policies including the cMOM initiative.

Section 7
Citizen Participation

This section presents recommendations developed by the Little Rock Citizens Advisory Group. Members of the Group were selected from a cross section of the Little Rock Community representing municipal and regulatory agencies, commercial and industry, and private citizens groups. The Group was organized to exchange information and discuss options for correcting Little Rock's wastewater system capacity deficiencies.

7.1 CITIZENS ADVISORY GROUP OVERVIEW

The Citizens Advisory Group (CAG) was formed to ensure that community values were reflected in the decisions and recommendations of the System Evaluation and Capacity Assurance Plan for Little Rock. The roles and objectives for the Group were to:

- Serve as a communication link between the community and the Little Rock Wastewater Utility
- Assist in educating the public about the issues, proposed solutions, and the decision making process
- Define and prioritize community-related issues regarding wastewater
- Articulate community values and opinions
- Review studies' results and help evaluate alternatives using previously agreed upon criteria
- Issue recommendations to the Wastewater Utility
- Become familiar with the issues and take identified issues back to their constituents
- Provide input on the cost-effectiveness of the program
- Identify potential public concerns regarding wastewater-related issues and solutions facing the City of Little Rock and the Utility
- Identify potential community impacts of the alternative improvement projects including noise, access limitations, and traffic disruption
- Assist the City by making specific recommendations for the prioritization of the System Evaluation and Capacity Assurance Plan (SECAP)

Members of the CAG were selected from the community to represent neighborhood groups, municipal and public works agencies, business and industry, environmental groups, and the Little Rock Sewer Committee. The Group met independently of the LRWU so that conventional engineering and administrative contributions by the LRWU would not bias the opinions of the CAG. The Group developed their own set of criteria and selection matrix to assist them with identifying important issues and resolutions to Little Rock's sewer system capacity problems. A notebook was developed for the CAG members to track progress for the Group's four meetings; a copy of this notebook is provided in **Appendix D**.

7.2 REVIEW OF ALTERNATIVES

Four options for addressing system capacity deficiencies were evaluated and ranked by the Group. Each of the four options utilized varying capacity upgrade techniques including peak wet weather storage, conveyance and treatment improvements. To effectively rank and ultimately select a capacity upgrade option, the CAG developed an evaluation matrix and criteria for defining each option's feasibility and impact to community. **Section 4.3.3**, Evaluation Matrix, discusses the criteria (**Table 4.3**) and evaluation matrix (**Table 4.4**) for ranking wastewater construction technologies. The four options evaluated included:

Option 1. This option includes the same project components for Alternative A1 as noted in **Section 4.3**, Alternative Improvement Projects. These components include the construction of the new Maumelle WWTP and the 72-inch parallel trunk line from Adams Field WWTP upstream to the west-end of the existing Twin 60s.

Option 2. This option eliminates the need for the proposed Maumelle WWTP by installing additional line and facility improvements through the Riverfront Basin with sufficient conveyance capacity to deliver all Maumelle Basin flow to the Adams Field WWTP.

Option 3. This option provides the same improvement components as Alternative B2. This option uses a large storage facility to collect wastewater surcharge from the system during a storm event. The large storage volume eliminates the need to install the 72-inch parallel trunk line and capacity improvements to the Arch Street Pump Station and the Adams Field WWTP. This option includes the construction of the proposed Maumelle WWTP.

Option 4. This option is similar to Alternative C2. It provides reduced storage and partial installation of the 72-inch parallel trunk line from Arch Pump Station upstream to the west-end of the Twin 60s.

7.2 RECOMMENDATIONS

Estimated capital costs for each option along with the CAG ranking are shown in **Table 7.1**. The options presented to the CAG were conceptual in nature and used only to convey a general understanding of the basic components, available technologies, and overall strategy for solving capacity deficiencies. Similarly, capital improvement costs estimated for options presented at the CAG workshops were developed only for discussion purposes. These estimates were not intended to reflect the same budget definition required for the Utility's Capital Improvement Plan. Also, further alternative analysis and refinement of the hydraulic model continued beyond the scheduled CAG workshops. As additional capacity improvement projects were identified, the costs were better defined and revisions were made to each alternative appropriately. Because of this progressive refinement of alternatives, **Table 4.1** and **Table 7.1** may show similar project components with different overall costs. However, a cost-based review of the alternative analysis rankings compared to the CAG selected options, showed no change in ranking position.

The results of the CAG matrix evaluation clearly indicated that options involving storage facilities were not preferred. Instead of storage, the CAG favored options involving installing the 72-inch parallel trunk line and increasing capacities for the Arch Street and Fourche facilities to eliminate system deficiencies in south Little Rock.

Table 7.1
Summary of Options Presented to the Citizens Advisory Group

Option	Type of Work	Description	Component Cost (Millions)	Cost Ranking	Matrix Ranking
1	Line Work	Utility Trunk Sewer Upgrades	$53.1	3	2
		72" Parallel to Twin 60" Trunks (45,772 L.F.)	$30.4		
		36" Force Main from Arch L.S. to Fourche WWTP (42,000 L.F.)	$7.5		
		42" Force Main from Cantrell L.S. to Gravity Line	$0.6		
	Pump Stations	Cantrell - 25MGD to 40 MGD	$5.7		
		Arch - 35 MGD to 60 MGD (FM - 30" @ 41,500 L.F.)	$7.5		
	Treatment	Little Maumelle 4 MGD WWTP (w/ 30 MG Storage)	$18.9		
		Adam WWTP Upgrades (94 MGD w/ 25 MG Storage)	$24.0		
		Fourche WWTP Upgrade (from 38 MGD to 60 MGD)	$29.3		
		Total	$177.0		
2	Line Work	Utility Trunk Sewer Upgrades	$53.1	4	1
		72" Parallel to Twin 60" Trunks (45,772 L.F.)	$30.4		
		30" Force Main form Little Maumelle L.S. to Gravity Line	$13.3		
		60" Gravity Line for Little Maumelle FM to Cantrell L.S.	$18.6		
		Twin 36" Force Main from Cantrell L.S. to Gravity Line	$1.1		
		72" Gravity Line from Cantrell FM to Adams WWTP	$17.5		
		36" Force Main from Arch L.S. to Fourche WWTP (42,000 L.F.)	$7.5		
	Pump Stations	Cantrell - 25MGD to 70 MGD (New Station)	$8.3		
		Arch - 35 MGD to 60 MGD (New Station)	$7.5		
		Little Maumelle to 16 MGD (New Station)	$3.1		
	Treatment	Adam WWTP Upgrades (94 MGD w/ 25 MG Storage)	$24.0		
		Fourche WWTP Upgrade (from 38 MGD to 45 MGD)	$29.3		
		Total	$213.7		

Table 7.1
Summary of Options Presented to the Citizens Advisory Group

(continued)

Option	Type of Work	Description	Component Cost (Millions)	Cost Ranking	Matrix Ranking
3	Line Work	Utility Trunk Sewer Upgrades	$53.1	1	3
		42" Force Main from Cantrell L.S. to Grav Line	$0.6		
	Pump Stations	Cantrell - 25MGD to 40 MGD	$5.7		
	Treatment	Little Maumelle 4 MGD WWTP (w/ 10 MG Storage)	$18.9		
	Storage Facility	65 MGD Storage Facility (w/ 65 MGD Pump Station, Yard piping, Chlorination/Dechlorination facilites, influent / return piping & property)	$43.6		
		Total	$121.9		
4	Line Work	Utility Trunk Sewer Upgrades	$53.1	2	3
		60" Parallel to Twin 60" Trunks	$13.1		
	Pump Stations	Cantrell - 25MGD to 40 MGD	$5.7		
		Arch - 35 MGD to 45 MGD (FM - 30" @ 41,500 L.F.)	$2.2		
	Treatment	Little Maumelle 4 MGD WWTP (w/ 10 MG Storage)	$18.9		
		Adam WWTP Upgrades (94 MGD w/ 25 MG Storage)	$24.0		
		Fourche WWTP Upgrade (from 38 MGD to 50 MGD)	$12.0		
	Storage Facility	35 MGD Storage Facility (w/ 35 MGD Pump Station, Yard piping, Chlorination/Dechlorination facilites, influent / return piping & property)	$30.6		
		Total	$159.6		

The Group's evaluation of options related to system deficiencies in north Little Rock yielded a less definitive group opinion. Although the matrix slightly favored system improvements, to convey all wastewater from the Maumelle Basin to the Adams WWTP over the construction of the new Maumelle WWTP, the Group did express significant concerns regarding the additional costs and potential community impact that would be caused by construction of the associated conveyance capacity projects.

The CAG also applied the matrix evaluation to an option that compared immediate construction of trunk sewer improvements before performing a comprehensive program of line rehabilitation. The results showed that the Group favored prioritizing the comprehensive rehabilitation program. The Group made the following additional recommendations:

- The Utility should address the issue of correcting I/I contributed by private lines and service connections located on private property. A pilot program to study I/I reduction realized by repairing service connections was suggested.
- For basins and sewer sub-basins where extensive I/I have been monitored, the Utility should conduct a comprehensive line/manhole rehabilitation program rather than performing immediate trunk line replacement. This program would consist of ongoing rehabilitation and flow monitoring to identify I/I reductions that might otherwise minimize the number of required new trunk lines, or possibly decrease the diameter size of new trunk lines needing to be replaced.
- The Utility should continue to install new facilities to incorporate areas that are not presently served by the Little Rock Wastewater Utility.
- The City of Little Rock should consider smart growth initiatives to control new development in logical manner. The intent is to provide an opportunity for Public Utilities to keep pace with service needs for both existing and new development without creating a major impact to the City's ability to finance continuing improvements.
- The City should adopt a schedule for implementing the recommended capacity system improvements that would minimize impact on future user rate increases.
- The Citizens Advisory Group should continue to work with the Little Rock Sewer Committee, Wastewater Utility and City Council toward the final development and adoption of the Capacity Assurance and System Evaluation Plan and the implementation schedule for Little Rock's Wastewater Capital Improvement Plan.

This section discusses two additional options for increasing capacity in the overall Little Rock Wastewater System. The discussion below shows that each option is worthy of further consideration as a cost effective and community minded approach to solving system capacity deficiencies. To ensure that these options are viable, a collaborative effort between the Utility, Sewer Committee and City, Browning-Ferris, Inc. (BFI), and North Little Rock Wastewater Utility will be required. The full development of these alternatives extends beyond the parameters of this report. Therefore, additional studies will be required to determine the feasibility for each option, identify facility improvements, define capital costs, and schedule implementation. This section provides conceptual parameters for each option and discusses some of the potential benefits.

8.1 ADDITIONAL OPTIONS

8.1.1 Background for North Little Rock WWTP Option

The Maumelle Basin is projected to experience more population growth over the next 25 years than any other basin in Little Rock. To better understand the impact that population growth would have on the wastewater system; the LRWU commissioned an engineering study. The "Little Maumelle Sub-basin Sewerage Study" (**Appendix G**) predicted that the average daily flow (ADF) of the basin would increase by 45% in 10 years and would more than double in 25 years.

The Maumelle Basin is located in the northwest part of the city. Wastewater from the basin currently flows to the existing Maumelle Pump Station before being pumped to gravity lines running along the Riverfront Basin to the Cantrell Pump Station. The flow at the Cantrell Station is then pumped to gravity trunk lines that flow to the Adams WWTP. This conveyance system experiences surcharging at the Cantrell Station and in the gravity lines along the Riverfront Basin during storm events. Since this system configuration already surcharges, these current conditions would be further stressed by the anticipated population growth in the Maumelle Basin. Hence, Maumelle's impending growth necessitates some form of collection system capacity upgrade or a new treatment plant for the area. The following paragraphs discuss one option for the conveyance and treatment for wastewater flow from the Maumelle Basin.

8.1.2 Description of North Little Rock WWTP Option

This option differs from previous alternatives discussed in the report by eliminating the need for a new treatment plant in the Maumelle Basin and improvements for total conveyance of flow to the Adams WWTP. This option includes the installation of a new pump station having an ultimate build-out capacity of 16 MGD, replacing the existing Maumelle Pump Station. The replacement station would also require the installation of an additional parallel force main to meet ultimate capacity requirements. Under this option wastewater from Maumelle would be pumped through the existing station's 24-inch force main, and the new parallel line, to Murray Lock and Dam. Crossing the Arkansas River, attached to a proposed pedestrian/bikeway bridge located just downstream of the dam, the force mains would combine into a single larger diameter force main and continue onto the White Oak Bayou WWTP for treatment.

8.1.3 White Oak Bayou WWTP

The White Oak Bayou WWTP is owned and operated by the North Little Rock Wastewater Utility (NLRWU). The plant is a partial mix aerated facultative lagoon facility with a design capacity of 4.25 MGD and an average daily flow ranging from 2.25 to 2.5 MGD. At a minimum, in order to accommodate the Maumelle flows, the facility would need to expand its lagoon system and install additional aeration equipment. The chlorine contact chamber will require expansion as well. Since NLRWU does not own adjacent property where these potential capacity improvements would be constructed, additional land will have to be purchased. This expansion also requires increasing the NPDES permitting limits for additional discharge of treated effluent created by Maumelle. Should this option be selected for implementation by LWRU, its anticipated that the NLRWU will continue to operate and maintain the facility after improvements are made. Since additional study outside the scope of this report is required to identify and quantify needed capacity improvements to the WWTP construction costs estimates were not completed for this option. **Figure 8.1** shows the general location for the facilities.

8.1.4 Additional Option Improvements

Jimerson Creek and I-430 Pump Stations. Maumelle's wastewater would be conveyed across the Arkansas River through a single force main passing directly adjacent to the Jimerson Creek and I-430 Areas. Should the replacement pump station for Maumelle be feasible, and if capacity is available in the new larger force main crossing the Arkansas River, it may be practical to include flows from the new pump stations for Jimerson Creek (12 MGD) and I-430 (1 MGD), by connecting one or both discharges directly to the proposed force main crossing the Arkansas River.

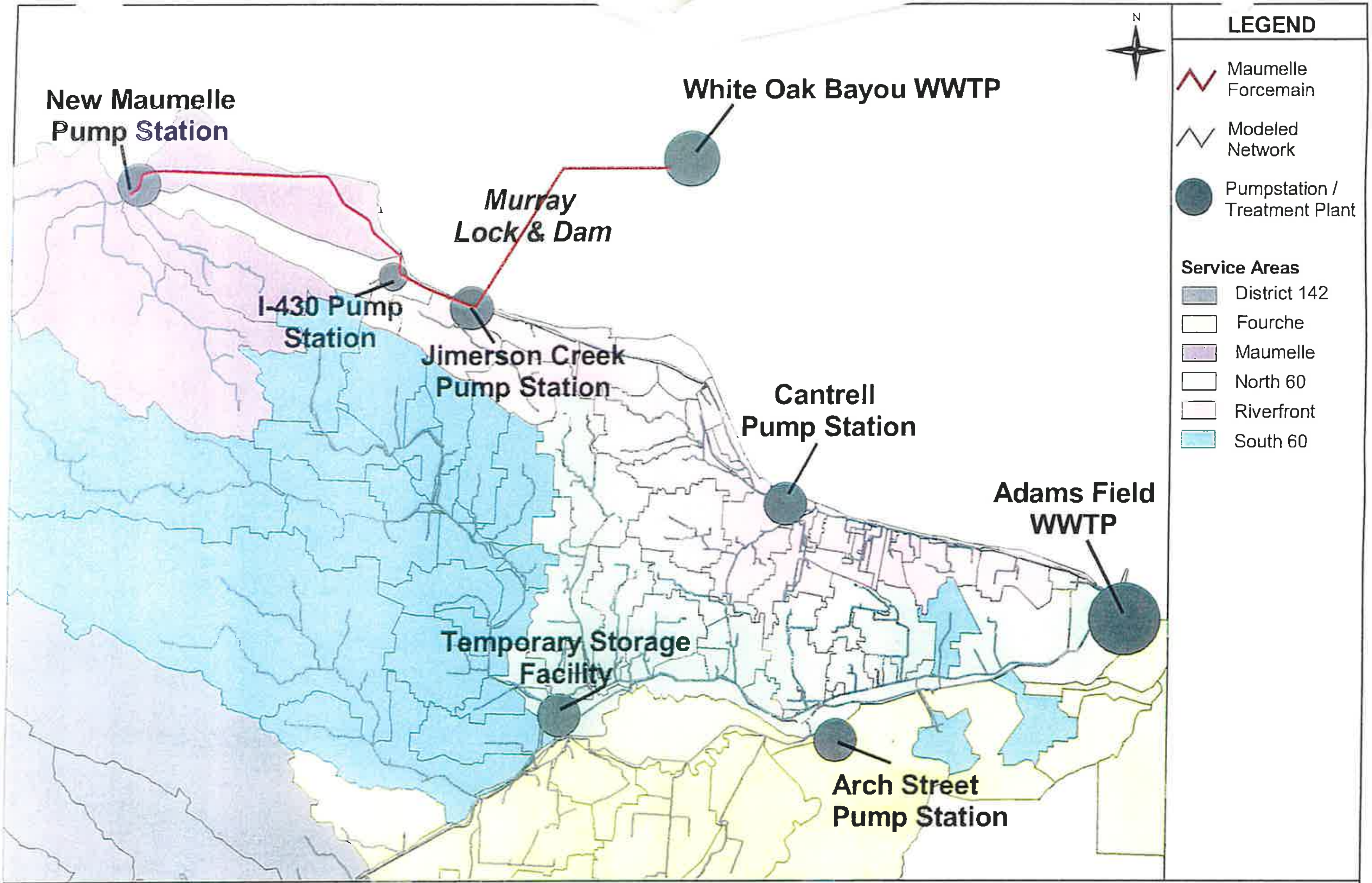
8.1.5 Benefits of North Little Rock Option

The reduction of flow provided by diverting wastewater from Jimerson Creek, Maumelle and the I-430 areas would alleviate surcharge conditions along the Riverfront Basin and at the Cantrell Pump Station. Additionally, this option would provide the added treatment capacity to allow the Adams Field WWTP to handle flow from south Little Rock more effectively. In addition to solving many of the system's deficiencies and operational problems, this option would avoid installation of a new treatment plant in the Maumelle Basin. This option would thereby eliminate the community concerns about the proposed Maumelle WWTP expressed by the Citizens Advisory Group, as well as associated environmental issues.

8.2 STORAGE DETENTION FACILITY

8.2.1 Landfill Site Storage Option

The Utility and Citizens Advisory Group selected alternatives that incorporated storage facilities as the least desirable options. However, as site investigations were conducted for



LITTLE ROCK WASTEWATER UTILITY

MWH MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

FIGURE 8.1 OTHER OPTION

SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

the original storage alternatives it was discovered that existing landfill facilities are located in the same general vicinity where proposed lagoons might have been installed. The landfill site includes a large excavated borrow area with adequate volume to achieve the 79 MG of storage requirements outlined in Alternative B2. Additional property surrounding the borrow area is also available for purchase in order to install needed ancillary facilities such as an over-flow discharge structure and a return pump station. Due to the strategic location of the existing landfill facilities, near the west-end of the Twin 60s, and the fact that the borrow area has already been excavated, this option showed additional merit for continued evaluation. It should be noted that although the borrow area has already been excavated, the installation of containment berms to enclose the storage basin and basin lining will be required.

8.2.2 Storage Facility Operation

The storage site is located between the north and south Twin 60 interceptors, near Geyer Springs. As described in Alternative B2, a weir structure(s) would be installed over the Twin 60-inch Interceptor(s) to divert surcharging wastewater from the system. Collected flows would then be conveyed to the storage facility through a series of gravity lines and pumped into the storage area. Collected wastewater would remain in storage until the wet weather surge pasted through Little Rock's collection system. Wastewater would then be returned to the main system either by gravity lines or pumping, as needed. **Figure 8.1** shows the general location of the facilities.

8.2.3 Benefits of Landfill Storage Option

This option represents considerable capital cost savings to the Utility's capacity plan. Most of the excavation required for installing storage facilities at the landfill site has already been completed. Less excavation translates into further reduction of the $50.6 million in capital costs estimated for installation of the 79 MG storage facilities identified for Alternative B2. Implementation of Alternative B2 would also provide an additional $19.7 million savings over Alternative A1. Furthermore, since proposed storage facilities would be located at an existing landfill site community and environmental concerns (location and aesthetics) may at least be partially alleviated.

8.2 RECOMMENDATIONS FOR OPTIONS

In order to determine the feasibility for the White Oak Bayou WWTP and storage options, the Utility would need to conduct additional studies that should involve citizen group participation. For the White Oak Bayou WWTP Option, the recommended studies include:

- Detailed flow analysis for existing, interim and ultimate build-out flow conditions for the Jimerson Creek, I-430 and Maumelle areas.
- Detailed analysis for proposed treatment facility improvements required for projected w conditions. This analysis should include an investigation of available land for hase to expand plant capacity and an evaluation for revising the NPDES discharge t.

- Detailed capital cost estimates for all improvements at the plant, as well as the new Maumelle Pump Station, parallel force main and larger diameter force main to the plant.
- Study to confirm that flows from the proposed Jimerson Creek and I-430 Pump Stations can be included with this option. This should include detailed capital costs of associated improvements.

For the Storage Option, the additional studies should include:

- Soil investigations including permeability evaluations for the storage area and an environmental assessment of the site in general.
- Alignment studies for the delivery line(s) conveying flow from the Twin 60 Interceptors into the storage facility.
- Evaluation of potential and existing permitting issues that, at a minimum, should include an investigation of requirements from the Arkansas Department of Environmental Quality, US Army Corp of Engineers, and the landfill operator.

ESTIMATED PIPELINE CONSTRUCTION COST -- ALLSOP

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:...	Allsop
LOCATION:..	Hawthorne Rd, Van Buren St, Country Club Blvd, Spruce S
BRIEF PROJECT DESCRIPTION:.......................	7800 ft, 18 inch pipe
ESTIMATED COST:...	$ 1,551,600
ASSUMPTIONS:...	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:..	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5D096.1	10	18	28	9.16	9.06	9	$ 200.00	$ 5,600
5D095.1	10	18	158	9.06	14.92	12	$ 200.00	$ 31,600
5D094.1	10	18	264	14.92	12.97	14	$ 200.00	$ 52,800
5D093.1	10	18	358	12.97	7.79	10	$ 200.00	$ 71,600
5D092.1	10	18	346	7.79	4.23	6	$ 200.00	$ 69,200
6D031.1	8	18	292	4.23	2.4	3	$ 200.00	$ 58,400
6D028.1	8	18	138	2.48	3.27	3	$ 200.00	$ 27,600
6D026.1	8	18	175	3.3	4.08	4	$ 200.00	$ 35,000
6D032.1	8	18	174	4.08	9.08	7	$ 200.00	$ 34,800
6D035.1	8	18	189	9.05	4.58	7	$ 200.00	$ 37,800
6D036.1	8	18	235	4.62	5.48	5	$ 200.00	$ 47,000
6D040.1	8	18	197	5.55	6.54	6	$ 200.00	$ 39,400
6D048.1	8	18	25	7.04	6.25	7	$ 200.00	$ 5,000
6D050.1	8	18	273	6.41	9.27	8	$ 200.00	$ 54,600
6D064.1	8	18	355	9.35	2.81	6	$ 200.00	$ 71,000
6D065.1	8	18	84	3.04	6.5	5	$ 200.00	$ 16,800
6D094.1	8	18	81	6.85	4.09	5	$ 200.00	$ 16,200
6D095.1	8	18	153	4.33	7.01	6	$ 200.00	$ 30,600
6D073.1	8	18	134	7.01	2.94	5	$ 200.00	$ 26,800
6D092.1	8	18	105	2.94	3.41	3	$ 200.00	$ 21,000
6D074.1	8	18	211	3.41	4.85	4	$ 200.00	$ 42,200
6E156.1	12	18	97	4.85	4.11	4	$ 200.00	$ 19,400
6E155.1	12	18	55	4.11	3.98	4	$ 200.00	$ 11,000
6E144.1	12	18	193	4.09	4.27	4	$ 200.00	$ 38,600
6E143.1	10	18	344	4.27	4.13	4	$ 200.00	$ 68,800
7E055.1	8	18	62	4.13	5.97	5	$ 200.00	$ 12,400
7E121.1	8	18	45	5.97	3.12	5	$ 200.00	$ 9,000
7E057.1	8	18	195	3.34	4.14	4	$ 200.00	$ 39,000
7E058.1	8	18	179	4.32	3.25	4	$ 200.00	$ 35,800
7E059.1	8	18	73	3.28	6.99	5	$ 200.00	$ 14,600
7E120.1	8	18	30	6.99	2.9	5	$ 200.00	$ 6,000
7E060.1	8	18	142	3.04	4.67	4	$ 200.00	$ 28,400
7E061.1	8	18	237	4.91	7.31	6	$ 200.00	$ 47,400
7E062.1	8	18	119	7.35	3.7	6	$ 200.00	$ 23,800
7E063.1	9	18	64	3.7	5.972	5	$ 200.00	$ 12,800
7D030.1	9	18	106	5.972	5.03	6	$ 200.00	$ 21,200
7D023.1	12	18	97	5.03	7.4	6	$ 200.00	$ 19,400
7D028.1	12	18	133	7.44	6.38	7	$ 200.00	$ 26,600
7D026.1	10	18	152	6.5	5.03	6	$ 200.00	$ 30,400
7D022.1	10	18	154	5.12	4.98	5	$ 200.00	$ 30,800
7D021.1	10	18	330	5.23	3.58	4	$ 200.00	$ 66,000
7D020.1	10	18	339	3.65	3.89	4	$ 200.00	$ 67,800
7D019.1	12	18	168	3.89	6.017	5	$ 200.00	$ 33,600
7D029.1	12	18	282	6.017	3.58	5	$ 200.00	$ 56,400
7E001.1	12	18	187	3.58	4.29	4	$ 200.00	$ 37,400

Total: $ 1,551,600

ESTIMATED PIPELINE CONSTRUCTION COST -- BARROW ADDITION

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:... Barrow Addition
LOCATION:... W 35th St, W 36th St, Potter St, Walker St, Gilman St
BRIEF PROJECT DESCRIPTION:...................... 5600 feet, 18-24 inch pipe
ESTIMATED COST:...................................... $ 1,223,420
ASSUMPTIONS:.. (i) New diameter based on pipe replacement
(ii) Pipeline costs based on gravity construction in congested urban installations
(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation
(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
1K120.1	12	18	327	10.85	5.79	8	$ 200.00	$ 65,400
2K006.1	12	18	331	10.52	8.96	10	$ 200.00	$ 66,200
2K007.1	12	18	320	12.03	5.55	9	$ 200.00	$ 64,000
2K042.1	12	18	333	9.28	7.29	8	$ 200.00	$ 66,600
1K138.1	12	18	337	8.8	8.66	9	$ 200.00	$ 67,400
2K021.1	12	18	313	8.66	7.37	8	$ 200.00	$ 62,600
2K028.1	12	18	180	7.37	8.35	8	$ 200.00	$ 36,000
2K029.1	12	18	130	8.35	17.55	13	$ 200.00	$ 26,000
2K030.1	12	18	334	17.55	7.21	12	$ 200.00	$ 66,800
2K057.1	12	18	327	8.48	10.79	10	$ 200.00	$ 65,400
2K058.1	12	18	177	10.79	8.85	10	$ 200.00	$ 35,400
2K080.1	12	18	329	8.85	8.27	9	$ 200.00	$ 65,800
2K078.1	12	18	156	8.27	4.51	6	$ 200.00	$ 31,200
2K077.1	12	18	335	4.51	15.72	10	$ 200.00	$ 67,000
2K076.1	12	18	292	15.72	10.63	13	$ 200.00	$ 58,400
2K075.1	18	24	156	10.63	8.08	9	$ 283.00	$ 44,148
2K145.1	18	24	220	8.08	6.08	7	$ 283.00	$ 62,260
2K144.1	18	24	346	6.08	4.03	5	$ 283.00	$ 97,918
2K143.1	18	24	387	4.03	5.3	5	$ 283.00	$ 109,521
2K142.1	18	24	231	5.3	4.86	5	$ 283.00	$ 65,373

Total: $ 1,223,420

ESTIMATED PIPELINE CONSTRUCTION COST -- BARTON

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:..	Barton
LOCATION:..	W 17th St, W 15th St, W 14th St, Maple St
BRIEF PROJECT DESCRIPTION:.........................	10,600 feet, 15-21 inch pipe
ESTIMATED COST:...	$ 2,289,448
ASSUMPTIONS:...	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:...	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
7I007.1	10	15	320	11	4	8	$ 188.00	$ 60,160
7I008.1	10	15	29	4	4	4	$ 188.00	$ 5,452
7I009.1	10	15	149	4	10	7	$ 188.00	$ 28,012
7I039.1	12	18	3	10	10	10	$ 200.00	$ 600
7I035.1	12	18	342	10	11	11	$ 200.00	$ 68,400
7I156.1	12	18	174	12	15	13	$ 200.00	$ 34,800
7I041.1	12	18	315	15	10	12	$ 200.00	$ 63,000
7I044.1	12	18	173	10	11	10	$ 200.00	$ 34,600
7I045.1	12	18	160	11	9	10	$ 200.00	$ 32,000
7I046.1	12	18	150	9	4	7	$ 200.00	$ 30,000
7I047.1	12	21	176	4	6	5	$ 221.00	$ 38,896
7I048.1	10	21	159	6	6	6	$ 221.00	$ 35,139
7I050.1	10	21	323	6	7	6	$ 221.00	$ 71,383
8I006.1	10	21	303	7	7	7	$ 221.00	$ 66,963
8I170.1	10	21	263	7	4	5	$ 221.00	$ 58,123
8I069.1	10	21	145	5	4	5	$ 221.00	$ 32,045
8I066.1	10	21	256	5	5	5	$ 221.00	$ 56,576
8I176.1	10	21	33	5	5	5	$ 221.00	$ 7,293
8I062.1	10	21	360	5	5	5	$ 221.00	$ 79,560
8I060.1	12	21	155	5	6	5	$ 221.00	$ 34,255
8I059.1	12	21	154	6	5	5	$ 221.00	$ 34,034
8I053.1	10	21	152	5	5	5	$ 221.00	$ 33,592
8I080.1	12	21	13	5	4	4	$ 221.00	$ 2,873
8I051.1	10	21	133	4	4	4	$ 221.00	$ 29,393
8I050.1	10	21	13	5	6	6	$ 221.00	$ 2,873
8I049.1	12	21	182	6	7	7	$ 221.00	$ 40,222
8I048.1	12	21	196	7	7	7	$ 221.00	$ 43,316
8I145.1	12	21	154	7	6	6	$ 221.00	$ 34,034
8I047.1	12	21	104	6	7	7	$ 221.00	$ 22,984
8I046.1	12	21	298	7	7	7	$ 221.00	$ 65,858
8I045.1	12	21	32	7	7	7	$ 221.00	$ 7,072
8I044.1	12	21	280	7	7	7	$ 221.00	$ 61,880
8I043.1	12	21	386	7	9	8	$ 221.00	$ 85,306
9I072.1	12	21	271	9	7	8	$ 221.00	$ 59,891
9I071.1	12	21	277	7	9	8	$ 221.00	$ 61,217
9I070.1	15	21	130	9	9	9	$ 221.00	$ 28,730
9I065.1	15	21	92	9	8	8	$ 221.00	$ 20,332
9I064.1	15	21	237	8	12	10	$ 221.00	$ 52,377
9J070.1	15	21	289	12	13	12	$ 221.00	$ 63,869
9J069.1	15	21	113	13	16	15	$ 221.00	$ 24,973
9J068.1	15	21	235	16	16	16	$ 221.00	$ 51,935
9J067.1	15	21	426	16	8	12	$ 221.00	$ 94,146
9J066.1	15	21	362	8	15	12	$ 221.00	$ 80,002
9J065.1	15	21	404	15	17	16	$ 221.00	$ 89,284
9J064.1	15	21	432	17	9	13	$ 221.00	$ 95,472
9J058.1	15	21	297	9	18	13	$ 221.00	$ 65,637
9J057.1	15	21	126	23	7	15	$ 221.00	$ 27,846
9J026.1	15	21	187	7	8	7	$ 221.00	$ 41,327

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
9K036.1	15	21	297	8	6	7	$ 221.00	$ 65,637
9K035.1	18	21	129	6	9	8	$ 221.00	$ 28,509
9K034.1	18	21	170	9	9	9	$ 221.00	$ 37,570
							Total:	**$ 2,289,448**

ESTIMATED PIPELINE CONSTRUCTION COST -- COLEMAN CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Coleman Creek
LOCATION:.. Coleman Creek, Polk St, W 10th St, W 28th St, Asher Ave
BRIEF PROJECT DESCRIPTION:......................... 26,200 feet, 18-36 inch pipe
ESTIMATED COST:... $ 8,014,600
ASSUMPTIONS:.. (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5F159.1	12	18	301	9.4	7.32	8	$ 200.00	$ 60,200
5F158.1	12	18	155	7.41	7.37	7	$ 200.00	$ 31,000
5F162.1	12	18	33	7.43	7.45	7	$ 200.00	$ 6,600
5F116.1	10	18	132	7.56	6.71	7	$ 200.00	$ 26,400
5F115.1	10	18	195	7.05	6.92	7	$ 200.00	$ 39,000
5F114.1	10	18	175	7.23	13.44	10	$ 200.00	$ 35,000
5F113.1	16	21	174	13.44	5.1	9	$ 221.00	$ 38,454
5F145.1	16	21	166	5.1	6.61	6	$ 221.00	$ 36,686
5F112.1	16	21	168	7.01	5.87	6	$ 221.00	$ 37,128
5F111.1	16	21	186	5.97	5.39	6	$ 221.00	$ 41,106
5F110.1	16	21	111	5.39	7.22	6	$ 221.00	$ 24,531
5F152.1	16	21	39	8.6	9.98	9	$ 221.00	$ 8,619
6G088.1	10	15	74	5.18	5.92	6	$ 188.00	$ 13,912
6G124.1	10	15	175	6.38	6.84	7	$ 188.00	$ 32,900
6G123.1	10	15	183	6.9	9	8	$ 188.00	$ 34,404
6G122.1	10	15	199	9.08	6.19	8	$ 188.00	$ 37,412
6G121.1	10	15	178	6.33	5.84	6	$ 188.00	$ 33,464
6G120.1	8	15	129	6.2	4.57	5	$ 188.00	$ 24,252
6G073.1	8	15	131	7.55	5.24	6	$ 188.00	$ 24,628
6G072.1	8	15	331	5.23	3.8	5	$ 188.00	$ 62,228
6G011.1	8	15	197	3.8	3.39	4	$ 188.00	$ 37,036
4H047.1	10	15	91	8.95	11.04	10	$ 188.00	$ 17,108
4H041.1	10	15	10	11.04	10.39	11	$ 188.00	$ 1,880
4H040.1	12	18	224	10.39	15.45	13	$ 200.00	$ 44,800
4H039.1	12	18	291	15.45	10.3	13	$ 200.00	$ 58,200
4H038.1	10	18	129	10.4	13.28	12	$ 200.00	$ 25,800
4H037.1	16	18	299	13.28	19.6	16	$ 200.00	$ 59,800
4H062.1	12	18	22	19.6	19.716	20	$ 200.00	$ 4,400
4H061.1	12	18	84	19.716	18.16	19	$ 200.00	$ 16,800
4H060.1	12	18	144	18.26	13.58	16	$ 200.00	$ 28,800
4H059.1	12	18	94	13.68	7.398	11	$ 200.00	$ 18,800
4H149.1	12	18	14	7.398	5.93	7	$ 200.00	$ 2,800
4H058.1	12	18	136	6	16.75	11	$ 200.00	$ 27,200
4H057.1	12	18	58	17.1	13.6	15	$ 200.00	$ 11,600
4H056.1	16	18	210	14.05	7.7	11	$ 200.00	$ 42,000
4H055.1	16	18	56	7.85	10.3	9	$ 200.00	$ 11,200
4H054.1	12	18	84	10.4	9.78	10	$ 200.00	$ 16,800
4H053.1	12	18	130	9.9	7.98	9	$ 200.00	$ 26,000
4H052.1	12	18	207	7.98	12.36	10	$ 200.00	$ 41,400
5H026.1	12	18	170	12.36	14.3	13	$ 200.00	$ 34,000
5H025.1	15	21	99	14.34	15	15	$ 221.00	$ 21,879
5H027.1	15	21	214	15.01	14.53	15	$ 221.00	$ 47,294
5H028.1	15	21	129	14.52	14.02	14	$ 221.00	$ 28,509
5H087.1	15	21	400	14.12	11.83	13	$ 221.00	$ 88,400
4K114.1	10	15	158	2.6	8.39	5	$ 188.00	$ 29,704

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
4K116.1	10	15	116	8.39	11.05	10	$ 188.00	$ 21,808
4K010.1	10	15	286	11.05	12.7	12	$ 188.00	$ 53,768
4K009.1	10	15	297	12.7	20.84	17	$ 188.00	$ 55,836
4K008.1	12	15	227	20.84	19.87	20	$ 188.00	$ 42,676
4K007.1	10	15	208	19.87	13	16	$ 188.00	$ 39,104
4K006.1	10	15	347	13	10.94	12	$ 188.00	$ 65,236
4K005.1	10	15	418	10.95	6.4	9	$ 188.00	$ 78,584
5K001.1	10	15	401	8.41	3.44	6	$ 188.00	$ 75,388
5K002.1	10	15	389	3.45	3.66	4	$ 188.00	$ 73,132
5K003.1	12	15	319	3.69	14.75	9	$ 188.00	$ 59,972
5L025.1	15	21	156	7.32	7.72	8	$ 221.00	$ 34,476
5L026.1	15	21	339	7.72	5.56	7	$ 221.00	$ 74,919
5L027.1	15	21	401	5.56	7.31	6	$ 221.00	$ 88,621
5L028.1	15	21	7	7.31	7.32	7	$ 221.00	$ 1,547
5G160.1	18	36	189	7.88	6.88	7	$ 381.00	$ 72,009
5G045.1	18	36	63	6.95	6.93	7	$ 381.00	$ 24,003
5G142.1	18	36	158	7.05	5.75	6	$ 381.00	$ 60,198
5G046.1	18	36	184	5.83	6.62	6	$ 381.00	$ 70,104
5G048.1	18	36	125	6.68	6.359	7	$ 381.00	$ 47,625
5G067.1	18	36	150	6.359	6.78	7	$ 381.00	$ 57,150
5G049.1	18	36	192	6.78	7.23	7	$ 381.00	$ 73,152
5G130.1	18	36	87	7.23	6.95	7	$ 381.00	$ 33,147
5G051.1	18	36	102	7.05	9.57	8	$ 381.00	$ 38,862
5G099.1	18	36	171	9.57	6.51	8	$ 381.00	$ 65,151
5G100.1	18	36	64	6.51	6.32	6	$ 381.00	$ 24,384
5G153.1	30	36	371	6.41	8.89	8	$ 381.00	$ 141,351
5G106.1	30	36	126	9.04	10.39	10	$ 381.00	$ 48,006
5G154.1	30	36	138	10.59	11.57	11	$ 381.00	$ 52,578
5G155.1	30	36	238	11.75	8.93	10	$ 381.00	$ 90,678
5G156.1	30	36	266	8.98	8.05	9	$ 381.00	$ 101,346
5G157.1	30	36	145	8.37	9.01	9	$ 381.00	$ 55,245
5G158.1	30	36	216	9.32	8.24	9	$ 381.00	$ 82,296
5H104.1	30	36	82	8.48	8.87	9	$ 381.00	$ 31,242
5H086.1	24	36	204	9.08	7.4	8	$ 381.00	$ 77,724
5H004.1	24	36	400	7.39	7.92	8	$ 381.00	$ 152,400
5H008.1	24	36	507	8.08	11.06	10	$ 381.00	$ 193,167
5H010.1	24	36	101	10.88	9.7	10	$ 381.00	$ 38,481
5H011.1	24	36	401	9.85	10.75	10	$ 381.00	$ 152,781
5H012.1	21	36	170	11.18	15.28	13	$ 381.00	$ 64,770
5H014.1	21	36	94	15.28	16.944	16	$ 381.00	$ 35,814
5H015.1	21	36	103	16.944	17.698	17	$ 381.00	$ 39,243
5H016.1	21	36	125	17.698	11.83	15	$ 381.00	$ 47,625
5H018.1	21	36	171	11.93	10.495	11	$ 381.00	$ 65,151
5H019.1	21	36	223	10.495	9.61	10	$ 381.00	$ 84,963
5H020.1	21	36	247	9.61	12.32	11	$ 381.00	$ 94,107
5H088.1	21	36	62	12.36	8.63	10	$ 381.00	$ 23,622
5I035.1	21	36	57	8.97	7.07	8	$ 381.00	$ 21,717
5I033.1	21	36	101	7.04	7.97	8	$ 381.00	$ 38,481
5I032.1	21	36	83	8.05	7.19	8	$ 381.00	$ 31,623
5I031.1	21	36	246	7.32	7.857	8	$ 381.00	$ 93,726
5I030.1	21	36	338	7.857	8.71	8	$ 381.00	$ 128,778
5I029.1	21	36	146	8.73	8.23	8	$ 381.00	$ 55,626
5I027.1	21	36	197	8.23	9.11	9	$ 381.00	$ 75,057
5I026.1	21	36	246	9.11	8.06	9	$ 381.00	$ 93,726
5I120.1	21	36	364	8.2	8.84	9	$ 381.00	$ 138,684
5I024.1	21	36	87	8.84	9.658	9	$ 381.00	$ 33,147
5I105.1	21	36	447	9.658	8.012	9	$ 381.00	$ 170,307
5I132.1	21	36	121	8.012	7.46	8	$ 381.00	$ 46,101
5I107.1	21	36	46	7.38	7.56	7	$ 381.00	$ 17,526
5I104.1	21	36	279	7.56	6.78	7	$ 381.00	$ 106,299
5I103.1	21	36	86	6.72	7.72	7	$ 381.00	$ 32,766
5J001.1	21	36	401	7.72	8.76	8	$ 381.00	$ 152,781
5J002.1	21	36	597	8.8	7.36	8	$ 381.00	$ 227,457
5J003.1	21	36	255	7.34	9.1	8	$ 381.00	$ 97,155
5J075.1	24	36	213	9.14	6.61	8	$ 381.00	$ 81,153

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5J007.1	24	36	199	6.54	9.99	8	$ 381.00	$ 75,819
5J016.1	24	36	491	10.04	9.21	10	$ 381.00	$ 187,071
5J018.1	24	36	492	9.22	15.18	12	$ 381.00	$ 187,452
5J019.1	24	36	216	15.26	14.44	15	$ 381.00	$ 82,296
5J074.1	24	36	17	14.55	15.16	15	$ 381.00	$ 6,477
5K004.1	24	36	207	15.2	13.53	14	$ 381.00	$ 78,867
5K005.1	24	36	243	13.53	11.52	13	$ 381.00	$ 92,583
5K006.1	24	36	223	11.52	9.73	11	$ 381.00	$ 84,963
5K007.1	24	36	271	9.65	10.87	10	$ 381.00	$ 103,251
5K022.1	24	36	432	10.86	10.89	11	$ 381.00	$ 164,592
5K025.1	24	36	315	10.9	12.54	12	$ 381.00	$ 120,015
5K029.1	24	36	159	12.54	8.37	10	$ 381.00	$ 60,579
5K095.1	24	36	323	8.37	9.45	9	$ 381.00	$ 123,063
5K030.1	24	36	348	9.45	11.44	10	$ 381.00	$ 132,588
5K031.1	24	36	394	11.44	5.35	8	$ 381.00	$ 150,114
5L044.1	24	36	140	5.27	9.11	7	$ 381.00	$ 53,340
5L043.1	24	36	82	9.27	10.01	10	$ 381.00	$ 31,242
5L040.1	24	36	149	9.94	6	8	$ 381.00	$ 56,769
5L038.1	24	36	160	6	6.57	6	$ 381.00	$ 60,960
5L036.1	24	36	333	6.56	7.61	7	$ 381.00	$ 126,873

Total: $ 8,014,600

ESTIMATED PIPELINE CONSTRUCTION COST -- COUNTRY CLUB

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:...	Country Club
LOCATION:..	Cantrell Road, Rebsamen Park Rd
BRIEF PROJECT DESCRIPTION:........................	7500 feet, 30-54 inch pipe
ESTIMATED COST:..	$ 3,205,850
ASSUMPTIONS:..	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:...	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
8E049.1	24	30	337	8.44	8.14	8	$ 320.00	$ 107,840
8E063.1	24	30	495	8.14	11.54	10	$ 320.00	$ 158,400
8F017.1	24	30	327	11.54	9.9	11	$ 320.00	$ 104,640
8F019.1	24	30	73	9.9	13.48	12	$ 320.00	$ 23,360
8F020.1	24	30	368	13.48	14.56	14	$ 320.00	$ 117,760
8F021.1	24	36	111	14.56	14.16	14	$ 381.00	$ 42,291
8F022.1	24	36	117	14.16	14.4	14	$ 381.00	$ 44,577
8F105.1	24	36	20	14.4	14.85	15	$ 381.00	$ 7,620
8F104.1	24	36	530	14.85	14.262	15	$ 381.00	$ 201,930
8F098.1	24	36	539	14.262	13.873	14	$ 381.00	$ 205,359
9F034.1	24	36	21	13.873	23.15	19	$ 381.00	$ 8,001
9F061.1	24	36	129	23.15	14.21	19	$ 381.00	$ 49,149
9F033.1	24	36	246	14.21	12.645	13	$ 381.00	$ 93,726
9F032.1	24	36	95	12.645	13.01	13	$ 381.00	$ 36,195
9F031.1	24	36	198	13	13.6	13	$ 381.00	$ 75,438
9F030.1	24	36	143	14.04	7.42	11	$ 381.00	$ 54,483
9F029.1	24	36	381	7.98	6.865	7	$ 381.00	$ 145,161
9F028.1	27	36	376	6.865	19	13	$ 381.00	$ 143,256
9F026.1	27	36	427	18.999	24.001	22	$ 381.00	$ 162,687
9F025.1	27	36	66	24.05	21.78	23	$ 381.00	$ 25,146
9F058.1	27	36	66	21.78	22.5	22	$ 381.00	$ 25,146
9F024.1	27	36	90	22.5	23.49	23	$ 381.00	$ 34,290
9F059.1	27	36	213	23.49	13.82	19	$ 381.00	$ 81,153
9F023.1	27	36	20	13.82	32.58	23	$ 381.00	$ 7,620
9F022.1	42	54	300	34.51	37.39	36	$ 603.00	$ 180,900
9F053.1	42	54	670	37.42	37.98	38	$ 603.00	$ 404,010
10F005.1	42	54	596	38.03	36.4	37	$ 603.00	$ 359,388
10G070.1	42	54	131	36.45	34.09	35	$ 603.00	$ 78,993
10G069.1	42	54	377	34.12	41	38	$ 603.00	$ 227,331

Total: $ 3,205,850

ESTIMATED PIPELINE CONSTRUCTION COST -- DISTRICT 119

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. District 119
LOCATION:.. W 34th St, Mary St, Boulevard Ave, W 22nd St
BRIEF PROJECT DESCRIPTION:......................... 5500 feet, 24 inch pipe
ESTIMATED COST:.. $ 1,568,103
ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
6J005.1	15	24	53	8.55	8.01	8	$ 283.00	$ 14,999
6J134.1	15	24	105	8.13	7.75	8	$ 283.00	$ 29,715
6J135.1	15	24	66	8	8.47	8	$ 283.00	$ 18,678
6J011.1	15	24	153	8.56	9.77	9	$ 283.00	$ 43,299
6J166.1	15	24	4	9.77	9.73	10	$ 283.00	$ 1,132
6J012.1	15	24	73	9.73	9.388	10	$ 283.00	$ 20,659
6J016.1	15	24	59	9.388	9.056	9	$ 283.00	$ 16,697
6J133.1	15	24	89	9.056	8.96	9	$ 283.00	$ 25,187
6J018.1	15	24	10	8.96	9.12	9	$ 283.00	$ 2,830
6J132.1	15	24	324	9.22	6.08	8	$ 283.00	$ 91,692
6J028.1	15	24	207	6.11	4.15	5	$ 283.00	$ 58,581
6J031.1	15	24	42	4.3	5.78	5	$ 283.00	$ 11,886
6J032.1	15	24	50	5.8	5.06	5	$ 283.00	$ 14,150
6J033.1	15	24	65	5.11	6.5	6	$ 283.00	$ 18,395
6J034.1	15	24	303	6.5	6.818	7	$ 283.00	$ 85,749
6J082.1	15	24	236	6.818	6.56	7	$ 283.00	$ 66,788
6J081.1	15	24	307	6.56	5.8	6	$ 283.00	$ 86,881
6J080.1	15	24	357	7.36	4.66	6	$ 283.00	$ 101,031
6J079.1	15	24	298	4.68	5.5	5	$ 283.00	$ 84,334
6K009.1	15	24	161	5.46	4.74	5	$ 283.00	$ 45,563
6K010.1	15	24	155	4.9	8.58	7	$ 283.00	$ 43,865
6K119.1	15	24	176	8.62	16.93	13	$ 283.00	$ 49,808
6K011.1	15	24	295	17.06	11.42	14	$ 283.00	$ 83,485
6K014.1	15	24	147	11.44	4.94	8	$ 283.00	$ 41,601
6K015.1	15	24	71	4.95	4.4	5	$ 283.00	$ 20,093
6K016.1	15	24	57	4.42	6.05	5	$ 283.00	$ 16,131
6K017.1	15	24	170	6.05	4.79	5	$ 283.00	$ 48,110
6K018.1	15	24	33	4.79	4.68	5	$ 283.00	$ 9,339
6K019.1	15	24	201	4.87	5.23	5	$ 283.00	$ 56,883
6K144.1	15	24	197	5.29	6.66	6	$ 283.00	$ 55,751
6K020.1	15	24	225	7.62	10.15	9	$ 283.00	$ 63,675
6K022.1	15	24	163	10.18	11.34	11	$ 283.00	$ 46,129
6K023.1	15	24	351	11.45	13.53	12	$ 283.00	$ 99,333
6K026.1	15	24	179	13.62	14.34	14	$ 283.00	$ 50,657
6K028.1	15	24	150	14.45	13.92	14	$ 283.00	$ 42,450
6K029.1	15	24	9	14.03	13.66	14	$ 283.00	$ 2,547

Total: $ 1,568,103

ESTIMATED PIPELINE CONSTRUCTION COST -- GRANITE MOUNTAIN

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Granite Mountain
LOCATION:.. Springer Blvd
BRIEF PROJECT DESCRIPTION:......................... 2900 feet, 18 inch pipe
ESTIMATED COST:.. $ 571,800
ASSUMPTIONS:.. (i) New diameter based on pipe replacement
(ii) Pipeline costs based on gravity construction in congested urban installations
(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation
(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
15L002.1	12	18	295	9.73	7.22	8	$ 200.00	$ 59,000
15L001.1	12	18	302	7.22	9.33	8	$ 200.00	$ 60,400
14L005.1	12	18	130	9.33	10.73	10	$ 200.00	$ 26,000
14L024.1	12	18	146	10.73	10.86	11	$ 200.00	$ 29,200
14L004.1	12	18	404	10.86	12.91	12	$ 200.00	$ 80,800
14L003.1	12	18	398	12.91	14.7	14	$ 200.00	$ 79,600
14L002.1	12	18	324	14.7	6.69	11	$ 200.00	$ 64,800
14L026.1	12	18	221	6.69	5.3	6	$ 200.00	$ 44,200
14L001.1	12	18	71	5.3	5.46	5	$ 200.00	$ 14,200
14L025.1	12	18	65	5.46	10.51	8	$ 200.00	$ 13,000
14K059.1	12	18	338	10.51	12.01	11	$ 200.00	$ 67,600
14K058.1	12	18	165	12.01	19.1	16	$ 200.00	$ 33,000
							Total:	**$ 571,800**

ESTIMATED PIPELINE CONSTRUCTION COST -- District 19

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. District 19
LOCATION:... Near Security Ave, Bolton St
BRIEF PROJECT DESCRIPTION:........................ 7500 feet, 15 inch pipe
ESTIMATED COST:... $ 1,416,204
ASSUMPTIONS:.. (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
15I018.1	10	15	323	6.71	5.52	6	$ 188.00	$ 60,724
15I016.1	10	15	326	5.55	5.53	6	$ 188.00	$ 61,288
15I003.1	10	15	259	5.84	6.05	6	$ 188.00	$ 48,692
15J038.1	10	15	295	6.32	6.2	6	$ 188.00	$ 55,460
15J024.1	10	15	146	6.27	5.79	6	$ 188.00	$ 27,448
15J022.1	10	15	160	5.91	5.23	6	$ 188.00	$ 30,080
15J021.1	10	15	47	5.45	6.79	6	$ 188.00	$ 8,836
15J011.1	10	15	252	6.82	5.72	6	$ 188.00	$ 47,376
15J010.1	10	15	346	5.9	8.39	7	$ 188.00	$ 65,048
15J009.1	10	15	159	8.39	8.16	8	$ 188.00	$ 29,892
15J008.1	10	15	333	8.16	10.87	10	$ 188.00	$ 62,604
15J004.1	10	15	39	10.87	7.33	9	$ 188.00	$ 7,332
15J003.1	10	15	315	7.41	8.01	8	$ 188.00	$ 59,220
15J002.1	10	15	304	8.04	12.29	10	$ 188.00	$ 57,152
15J001.1	10	15	163	12.38	15.6	14	$ 188.00	$ 30,644
15J057.1	10	15	24	15.66	15.8	16	$ 188.00	$ 4,512
15K034.1	10	15	69	15.8	14.53	15	$ 188.00	$ 12,972
15K022.1	10	15	213	14.53	12.95	14	$ 188.00	$ 40,044
15K021.1	12	15	50	13.03	10.36	12	$ 188.00	$ 9,400
15K020.1	12	15	433	10.36	10.44	10	$ 188.00	$ 81,404
15K019.1	12	15	295	10.44	24.82	18	$ 188.00	$ 55,460
15K018.1	12	15	36	24.82	24.84	25	$ 188.00	$ 6,768
15K017.1	12	15	417	24.84	22.09	23	$ 188.00	$ 78,396
15K013.1	12	15	434	22.09	20.35	21	$ 188.00	$ 81,592
15J045.1	10	15	92	8.18	8.42	8	$ 188.00	$ 17,296
16J014.1	10	15	229	8.42	9.35	9	$ 188.00	$ 43,052
16J013.1	10	15	320	9.35	10.25	10	$ 188.00	$ 60,160
16J010.1	10	15	317	10.25	10.89	11	$ 188.00	$ 59,596
16K015.1	10	15	317	10.89	13.12	12	$ 188.00	$ 59,596
16K014.1	10	15	135	13.12	12.49	13	$ 188.00	$ 25,380
16K018.1	10	15	182	12.49	12.38	12	$ 188.00	$ 34,216
16K013.1	10	15	135	12.38	15.14	14	$ 188.00	$ 25,380
16K021.1	10	15	120	15.14	15.27	15	$ 188.00	$ 22,560
16K012.1	10	15	248	15.27	23.43	19	$ 188.00	$ 46,624

Total: $ 1,416,204

ESTIMATED PIPELINE CONSTRUCTION COST -- JIMERSON CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Jimerson Creek

LOCATION:.. Near Foxcroft Rd, Tallyho Ln, Youngblood Rd, Pine Valley Rc

BRIEF PROJECT DESCRIPTION:........................ 11,500 feet, 15-36 inch pipe

ESTIMATED COST:.. $ 3,064,014

ASSUMPTIONS:.. (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
3D118.1	10	15	251	7.02	2.67	5	$ 188.00	$ 47,188
3D119.1	10	15	242	4.64	6.68	6	$ 188.00	$ 45,496
3D120.1	10	15	206	6.8	3.14	5	$ 188.00	$ 38,728
3D066.1	10	15	368	5.43	4.53	5	$ 188.00	$ 69,184
3D065.1	10	15	185	5.48	6.9	6	$ 188.00	$ 34,780
3D064.1	10	15	215	6.99	4.8	6	$ 188.00	$ 40,420
3D108.1	10	15	400	4.74	3.84	4	$ 188.00	$ 75,200
3D109.1	10	15	371	3.83	2.8	3	$ 188.00	$ 69,748
3D110.1	10	15	438	2.87	3.58	3	$ 188.00	$ 82,344
3D111.1	12	18	227	3.58	5.44	5	$ 200.00	$ 45,400
3D113.1	16	21	127	5.42	6.89	6	$ 221.00	$ 28,067
3D114.1	16	21	130	7.55	6.03	7	$ 221.00	$ 28,730
3C096.1	16	21	213	5.95	4.72	5	$ 221.00	$ 47,073
3C095.1	16	21	76	7.71	7.16	7	$ 221.00	$ 16,796
3C097.1	16	21	145	7.24	6.08	7	$ 221.00	$ 32,045
3C098.1	16	21	30	6.08	4.58	5	$ 221.00	$ 6,630
3C103.1	16	21	190	4.7	4.6	5	$ 221.00	$ 41,990
3C104.1	16	21	97	4.71	4.09	4	$ 221.00	$ 21,437
3C105.1	16	21	380	5.68	4.12	5	$ 221.00	$ 83,980
3C124.1	16	21	73	4.21	3.11	4	$ 221.00	$ 16,133
3C123.1	16	21	83	4.96	5.79	5	$ 221.00	$ 18,343
3C122.1	16	21	86	5.9	7.29	7	$ 221.00	$ 19,006
3C159.1	16	21	120	7.29	11.91	10	$ 221.00	$ 26,520
3C136.1	16	21	69	12.13	6.35	9	$ 221.00	$ 15,249
3C137.1	16	21	82	12.51	6.92	10	$ 221.00	$ 18,122
3C138.1	16	21	93	7	5.93	6	$ 221.00	$ 20,553
3C139.1	18	24	371	6.37	7.28	7	$ 283.00	$ 104,993
2C113.1	18	24	255	7.41	4.51	6	$ 283.00	$ 72,165
2C112.1	18	24	104	4.55	4.63	5	$ 283.00	$ 29,432
2C111.1	18	24	236	4.74	4.63	5	$ 283.00	$ 66,788
2C110.1	18	24	119	4.66	5.26	5	$ 283.00	$ 33,677
2C114.1	18	24	184	5.26	4.63	5	$ 283.00	$ 52,072
2C115.1	18	24	222	4.91	5.09	5	$ 283.00	$ 62,826
2C120.1	18	24	192	5.23	6.26	6	$ 283.00	$ 54,336
2C121.1	18	24	206	6.28	5.14	6	$ 283.00	$ 58,298
2C127.1	18	24	328	5.86	5.38	6	$ 283.00	$ 92,824
2C128.1	18	24	89	5.57	5.17	5	$ 283.00	$ 25,187
2C129.1	18	24	314	6.12	5.8	6	$ 283.00	$ 88,862
2C006.1	18	24	312	5.78	4.68	5	$ 283.00	$ 88,296
2C005.1	18	24	391	4.73	4.78	5	$ 283.00	$ 110,653
2C001.1	18	24	199	4.73	4.61	5	$ 283.00	$ 56,317
1B023.1	18	24	216	4.45	4.49	4	$ 283.00	$ 61,128
1B021.1	18	24	83	5.55	3.96	5	$ 283.00	$ 23,489
1B020.1	18	24	104	3.95	6.17	5	$ 283.00	$ 29,432
1B078.1	18	24	95	6.17	4.68	5	$ 283.00	$ 26,885
1B019.1	18	24	282	5.95	5.39	6	$ 283.00	$ 79,806
1B018.1	18	24	193	5.5	5.81	6	$ 283.00	$ 54,619

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
1B017.1	24	36	187	6.14	7.24	7	$ 381.00	$ 71,247
1B016.1	24	36	107	7.14	6.07	7	$ 381.00	$ 40,767
1B015.1	24	36	268	6.24	9.94	8	$ 381.00	$ 102,108
1B079.1	24	36	75	9.94	15.62	13	$ 381.00	$ 28,575
1B014.1	24	36	222	15.71	13.5	15	$ 381.00	$ 84,582
1B072.1	24	36	41	13.5	12.51	13	$ 381.00	$ 15,621
1B013.1	24	36	454	12.48	15.88	14	$ 381.00	$ 172,974
2B007.1	24	36	200	15.9	13.63	15	$ 381.00	$ 76,200
2B006.1	24	36	140	13.62	14.1	14	$ 381.00	$ 53,340
2B002.1	24	36	413	14.1	11.2	13	$ 381.00	$ 157,353
							Total:	**$ 3,064,014**

ESTIMATED PIPELINE CONSTRUCTION COST -- MAUMELLE

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Maumelle
LOCATION:.. Near Hinson Rd, Jennifer Dr
BRIEF PROJECT DESCRIPTION:........................ 24,500 feet, 15-36 inch pipe
ESTIMATED COST:.. $ 6,536,535
ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:.. Significant infiltration and inflow reduction in Upper Hinson are

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-4E002.1	10	15	259	6.171	6.949	7	$ 188.00	$ 48,692
-5C136.1	10	15	269	4.97	4.071	5	$ 188.00	$ 50,572
-5C068.1	10	15	361	5.01	8.068	7	$ 188.00	$ 67,868
-5C069.1	10	15	253	8.068	8.771	8	$ 188.00	$ 47,564
-5C130.1	10	15	108	8.771	5.659	7	$ 188.00	$ 20,304
-5C074.1	10	15	404	5.659	6.25	6	$ 188.00	$ 75,952
-5C075.1	10	15	161	6.25	5.409	6	$ 188.00	$ 30,268
-5C076.1	12	15	194	5.409	5.058	5	$ 188.00	$ 36,472
-4E035.1	10	15	308	7.259	8.35	8	$ 188.00	$ 57,904
-4E037.1	10	15	440	8.35	6.949	8	$ 188.00	$ 82,720
-4E001.1	10	15	200	7.061	8.34	8	$ 188.00	$ 37,600
-5D021.1	10	15	123	8.442	7.65	8	$ 188.00	$ 23,124
-5D018.1	10	15	163	7.65	7.251	7	$ 188.00	$ 30,644
-5D017.1	10	15	39	7.251	7.809	8	$ 188.00	$ 7,332
-5D079.1	10	15	59	7.871	9.14	9	$ 188.00	$ 11,092
-5D016.1	10	15	224	9.14	6.41	8	$ 188.00	$ 42,112
-5D117.1	10	15	105	6.41	5.139	6	$ 188.00	$ 19,740
-5D015.1	10	15	56	7.18	9.38	8	$ 188.00	$ 10,528
-5D115.1	10	15	164	9.38	8.791	9	$ 188.00	$ 30,832
-5D014.1	10	15	203	8.791	11.131	10	$ 188.00	$ 38,164
-5D013.1	10	18	56	11.131	7.97	10	$ 200.00	$ 11,200
-5D061.1	10	18	243	7.97	7.66	8	$ 200.00	$ 48,600
-5D012.1	10	18	151	7.709	9.068	8	$ 200.00	$ 30,200
-5D085.1	10	18	194	9.068	12.8	11	$ 200.00	$ 38,800
-5D011.1	10	18	174	12.98	6.458	10	$ 200.00	$ 34,800
-5D010.1	10	18	128	6.458	7.768	7	$ 200.00	$ 25,600
-5D009.1	10	18	220	7.768	6.928	7	$ 200.00	$ 44,000
-5D008.1	10	18	404	7.909	6.469	7	$ 200.00	$ 80,800
-5D007.1	10	18	269	6.538	4.579	6	$ 200.00	$ 53,800
-5D006.1	10	18	249	4.668	6.49	6	$ 200.00	$ 49,800
-5D005.1	10	18	210	6.588	9.339	8	$ 200.00	$ 42,000
-5D004.1	10	18	423	9.608	4.458	7	$ 200.00	$ 84,600
-5C096.1	12	18	279	5.058	4.407	5	$ 200.00	$ 55,800
-5C095.1	12	18	72	4.407	7.096	6	$ 200.00	$ 14,400
-5C094.1	12	18	390	7.149	8.637	8	$ 200.00	$ 78,000
-5C093.1	12	18	92	8.657	3.028	6	$ 200.00	$ 18,400
-5C092.1	12	18	200	3.068	7.076	5	$ 200.00	$ 40,000
-5C109.1	12	18	112	7.076	5.667	6	$ 200.00	$ 22,400
-5C110.1	12	18	75	5.907	5.417	6	$ 200.00	$ 15,000
-5C111.1	12	18	174	5.417	6.217	6	$ 200.00	$ 34,800
-5C113.1	12	18	36	6.466	6.978	7	$ 200.00	$ 7,200
-5C114.1	12	18	207	6.978	8.247	8	$ 200.00	$ 41,400
-5C116.1	12	18	397	8.506	7.147	8	$ 200.00	$ 79,400
-5C030.1	15	18	197	7.147	5.127	6	$ 200.00	$ 39,400
-5C029.1	15	18	256	5.127	8.996	7	$ 200.00	$ 51,200
-5C026.1	20	27	121	9.596	9.168	9	$ 302.00	$ 36,542

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-5C028.1	20	27	184	9.177	8.626	9	$ 302.00	$ 55,568
-6C033.1	20	27	338	8.835	8.496	9	$ 302.00	$ 102,076
-6C029.1	20	27	279	8.565	9.735	9	$ 302.00	$ 84,258
-6C028.1	20	27	217	9.896	14.167	12	$ 302.00	$ 65,534
-6B012.1	20	27	335	14.285	9.156	12	$ 302.00	$ 101,170
-6B009.1	20	27	328	9.205	7.477	8	$ 302.00	$ 99,056
-6B008.1	20	27	141	7.506	8.827	8	$ 302.00	$ 42,582
-6B007.1	20	27	367	8.876	8.716	9	$ 302.00	$ 110,834
-6B006.1	20	27	95	8.995	10.517	10	$ 302.00	$ 28,690
-6B005.1	20	27	69	10.585	9.71	10	$ 302.00	$ 20,838
-6B140.1	20	27	49	9.71	7.9	9	$ 302.00	$ 14,798
-6B139.1	20	27	76	7.9	7.182	8	$ 302.00	$ 22,952
-6B138.1	20	27	38	7.182	10.324	9	$ 302.00	$ 11,476
-6B137.1	20	27	292	10.324	9.234	10	$ 302.00	$ 88,184
-6B003.1	20	27	318	9.306	7.565	8	$ 302.00	$ 96,036
-6B002.1	20	27	56	7.614	7.906	8	$ 302.00	$ 16,912
-6B080.1	20	27	266	7.906	9.366	9	$ 302.00	$ 80,332
-6B001.1	20	27	49	9.366	9.435	9	$ 302.00	$ 14,798
-7B011.1	20	27	118	9.563	8.616	9	$ 302.00	$ 35,636
-7B010.1	20	27	154	8.964	11.574	10	$ 302.00	$ 46,508
-7B009.1	20	27	292	11.856	11.593	12	$ 302.00	$ 88,184
-7B008.1	20	27	141	11.603	12.605	12	$ 302.00	$ 42,582
-7B061.1	21	27	236	12.786	15.583	14	$ 302.00	$ 71,272
-7B060.1	21	27	66	15.685	13.283	14	$ 302.00	$ 19,932
-7B059.1	21	27	59	13.614	15.165	14	$ 302.00	$ 17,818
-7B043.1	21	27	374	15.454	13.864	15	$ 302.00	$ 112,948
-7B044.1	21	27	269	14.114	13.826	14	$ 302.00	$ 81,238
-7A028.1	21	27	384	14.003	12.625	13	$ 302.00	$ 115,968
-7A029.1	21	27	397	12.795	12.765	13	$ 302.00	$ 119,894
-7A030.1	21	27	253	13.024	13.435	13	$ 302.00	$ 76,406
-7A031.1	21	27	364	13.514	12.585	13	$ 302.00	$ 109,928
-7A032.1	21	27	157	12.864	12.025	12	$ 302.00	$ 47,414
-7A033.1	21	27	390	12.334	13.302	13	$ 302.00	$ 117,780
-7A034.1	21	27	276	13.433	15.913	15	$ 302.00	$ 83,352
-7A035.1	21	27	256	16.034	13.472	15	$ 302.00	$ 77,312
-8A011.1	21	27	62	13.472	13.764	14	$ 302.00	$ 18,724
-8A001.1	21	27	30	13.793	13.954	14	$ 302.00	$ 9,060
-8A020.1	21	27	220	13.954	13.093	14	$ 302.00	$ 66,440
-8A002.1	21	27	354	13.264	14.332	14	$ 302.00	$ 106,908
-8A003.1	21	27	341	14.584	13.442	14	$ 302.00	$ 102,982
-8A004.1	21	27	207	13.574	13.204	13	$ 302.00	$ 62,514
-8A005.1	21	27	276	13.433	13.093	13	$ 302.00	$ 83,352
-8A006.1	21	27	115	13.234	12.982	13	$ 302.00	$ 34,730
-8A007.1	21	27	66	13.392	12.302	13	$ 302.00	$ 19,932
-8A027.1	21	27	331	12.302	14.582	13	$ 302.00	$ 99,962
-8A008.1	21	27	203	14.982	14.252	15	$ 302.00	$ 61,306
-8A009.1	21	27	174	14.383	12.422	13	$ 302.00	$ 52,548
-8A081.1	21	27	115	12.422	13.203	13	$ 302.00	$ 34,730
-8A010.1	21	27	141	13.291	14.403	14	$ 302.00	$ 42,582
-8-A001.1	21	27	108	14.502	13.883	14	$ 302.00	$ 32,616
-8-A002.1	21	27	148	13.923	12.423	13	$ 302.00	$ 44,696
-8-A003.1	21	27	400	12.623	11.952	12	$ 302.00	$ 120,800
-8-A004.1	21	27	28	12.054	12.191	12	$ 302.00	$ 8,456
-8-A016.1	21	27	395	12.191	11.851	12	$ 302.00	$ 119,290
-8-A005.1	21	27	256	11.952	11.122	12	$ 302.00	$ 77,312
-8-A012.1	21	27	52	11.122	11.912	12	$ 302.00	$ 15,704
-8-A006.1	21	27	180	11.912	14.333	13	$ 302.00	$ 54,360
-8-A007.1	21	27	157	14.451	15.061	15	$ 302.00	$ 47,414
-8-A008.1	21	27	285	15.192	25.013	20	$ 302.00	$ 86,070
-8-A009.1	21	27	266	25.112	20.49	23	$ 302.00	$ 80,332
-8-A010.1	21	27	194	20.69	18.103	19	$ 302.00	$ 58,588
-8-A011.1	21	27	351	18.201	17.522	18	$ 302.00	$ 106,002
-8-B001.1	24	36	154	17.702	15.231	16	$ 381.00	$ 58,674
-8-B002.1	24	36	367	15.783	17.902	17	$ 381.00	$ 139,827
-8-B003.1	24	36	282	18.201	20.582	19	$ 381.00	$ 107,442
-8-B004.1	24	36	394	20.73	24.193	22	$ 381.00	$ 150,114
-8-B012.1	24	36	394	24.452	24.411	24	$ 381.00	$ 150,114

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-8-B005.1	24	36	302	24.411	22.851	24	$ 381.00	$ 115,062
							Total:	**$ 6,536,535**

ESTIMATED PIPELINE CONSTRUCTION COST -- ROCK CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:..	Rock Creek
LOCATION:..	Rooney Parham Rd, Cunningham Lake Rd, Barrow Rd, Serenit Dr, Grassy Flat Creek
BRIEF PROJECT DESCRIPTION:.........................	57,800 feet, 21-60 inch pipe
ESTIMATED COST:...	$ 23,644,942
ASSUMPTIONS:...	(i) New diameter based on pipe replacement, assumes some parallel pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:..	Replace parallel pipes with single, larger pipe

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-2D011.1	15	21	18	13.12	13.78	13	$ 221.00	$ 3,978
-2D012.1	18	21	60	13.9	7.5	11	$ 221.00	$ 13,260
-2E001.1	18	21	82	7.81	7.52	8	$ 221.00	$ 18,122
-2E002.1	18	21	244	7.52	3.39	5	$ 221.00	$ 53,924
-2E003.1	18	21	65	3.39	8.11	6	$ 221.00	$ 14,365
-3E025.1	18	21	292	8.53	3.31	6	$ 221.00	$ 64,532
-2E029.1	18	21	575	3.31	4.28	4	$ 221.00	$ 127,075
-2E033.1	18	24	182	4.28	9.3	7	$ 283.00	$ 51,506
-2E035.1	18	24	72	9.8	11.3	11	$ 283.00	$ 20,376
-2E036.1	18	24	267	11.3	8.97	10	$ 283.00	$ 75,561
-2E037.1	18	24	410	8.97	10.77	10	$ 283.00	$ 116,030
-2E038.1	18	24	356	10.77	13.26	12	$ 283.00	$ 100,748
-2E039.1	18	24	46	13.26	12.25	13	$ 283.00	$ 13,018
-2E093.1	18	24	350	12.25	12.48	12	$ 283.00	$ 99,050
-2E094.1	18	24	130	12.48	13.31	13	$ 283.00	$ 36,790
-2E040.1	18	24	111	13.31	11.63	12	$ 283.00	$ 31,413
-2E041.1	18	24	144	11.63	11.85	12	$ 283.00	$ 40,752
-2F031.1	18	24	334	11.85	12.85	12	$ 283.00	$ 94,522
-2F030.1	18	24	353	12.85	14.92	14	$ 283.00	$ 99,899
-2F038.1	18	24	388	14.92	10.42	13	$ 283.00	$ 109,804
-2F036.1	18	24	382	10.42	10.55	10	$ 283.00	$ 108,106
-2E006.1	15	21	230	10.56	8.5	10	$ 221.00	$ 50,830
-2E007.1	15	21	70	8.5	9	9	$ 221.00	$ 15,470
-2E008.1	15	21	150	9	8.91	9	$ 221.00	$ 33,150
-2E009.1	15	21	430	8.91	6.2	8	$ 221.00	$ 95,030
-2E010.1	15	21	260	6.32	7.1	7	$ 221.00	$ 57,460
-2E012.1	15	21	215	7.1	6.96	7	$ 221.00	$ 47,515
-2E013.1	15	21	135	6.96	7.5	7	$ 221.00	$ 29,835
-2E107.1	15	21	118	7.73	6.202	7	$ 221.00	$ 26,078
-2E014.1	15	21	220	6.202	7.63	7	$ 221.00	$ 48,620
-2E015.1	15	21	292	7.63	6.8	7	$ 221.00	$ 64,532
-2E016.1	15	21	306	6.97	9.7	8	$ 221.00	$ 67,626
-2F024.1	15	21	337	9.89	9.74	10	$ 221.00	$ 74,477
-2F023.1	15	21	327	9.74	7.4	9	$ 221.00	$ 72,267
-2F039.1	15	21	387	7.52	7	7	$ 221.00	$ 85,527
-2F037.1	15	21	389	7	6.5	7	$ 221.00	$ 85,969
-2F035.1	15	21	474	6.7	6.5	7	$ 221.00	$ 104,754
-1F014.1	24	30	55	6.73	8.5	8	$ 320.00	$ 17,600
-1F013.1	24	30	230	8.5	9.29	9	$ 320.00	$ 73,600
-1F012.1	24	30	405	9.29	6.81	8	$ 320.00	$ 129,600
-1F051.1	24	30	211	6.81	13.07	10	$ 320.00	$ 67,520
-1F046.1	24	30	17	13.57	14.39	14	$ 320.00	$ 5,440
-1F047.1	24	30	226	14.39	10.95	13	$ 320.00	$ 72,320
-1F044.1	24	30	339	10.95	10.48	11	$ 320.00	$ 108,480

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-1E046.1	24	30	266	10.48	9.29	10	$ 320.00	$ 85,120
-1F086.1	24	30	258	9.29	10.32	10	$ 320.00	$ 82,560
0F001.1	24	30	319	10.32	10.1	10	$ 320.00	$ 102,080
0F002.1	24	36	160	10.1	9.82	10	$ 381.00	$ 60,960
0F003.1	24	36	218	9.82	12.87	11	$ 381.00	$ 83,058
0F004.1	24	36	99	12.87	8.75	11	$ 381.00	$ 37,719
0F005.1	24	36	477	8.75	14.99	12	$ 381.00	$ 181,737
0F026.1	24	36	346	14.99	11.8	13	$ 381.00	$ 131,826
0F137.1	24	36	216	11.8	11.2	12	$ 381.00	$ 82,296
0F135.1	24	36	310	11.45	9.4	10	$ 381.00	$ 118,110
0F136.1	24	36	328	9.4	9.29	9	$ 381.00	$ 124,968
0E080.1	24	36	308	9.29	9.53	9	$ 381.00	$ 117,348
0E079.1	24	36	347	9.53	10.01	10	$ 381.00	$ 132,207
0E078.1	24	36	272	10.11	12.04	11	$ 381.00	$ 103,632
0E168.1	24	36	177	12.14	16.26	14	$ 381.00	$ 67,437
0E169.1	24	36	235	16.31	11.26	14	$ 381.00	$ 89,535
1E140.1	24	36	24	11.29	16.02	14	$ 381.00	$ 9,144
1E116.1	24	36	223	16.12	12.12	14	$ 381.00	$ 84,963
1E115.1	24	36	78	12.22	12.1	12	$ 381.00	$ 29,718
1E114.1	30	36	483	12.48	10.33	11	$ 381.00	$ 184,023
1E113.1	30	36	479	10.36	6.6	8	$ 381.00	$ 182,499
1E112.1	30	36	319	7.6	12.79	10	$ 381.00	$ 121,539
1E111.1	30	36	131	13.02	19.1	16	$ 381.00	$ 49,911
1F049.1	30	36	330	19.15	15.6	17	$ 381.00	$ 125,730
1F048.1	30	36	251	15.62	16.81	16	$ 381.00	$ 95,631
1F047.1	30	36	319	16.82	12.15	14	$ 381.00	$ 121,539
1F046.1	30	36	405	14.32	9.48	12	$ 381.00	$ 154,305
1F044.1	30	36	87	9.48	10.44	10	$ 381.00	$ 33,147
1F129.1	30	36	121	10.44	11.09	11	$ 381.00	$ 46,101
1F043.1	30	36	241	11.1	9.85	10	$ 381.00	$ 91,821
1F041.1	30	36	411	11.9	11.38	12	$ 381.00	$ 156,591
1F040.1	30	36	146	11.4	13.02	12	$ 381.00	$ 55,626
1F039.1	30	36	486	13.06	14.47	14	$ 381.00	$ 185,166
1G068.1	30	36	371	14.5	13.58	14	$ 381.00	$ 141,351
1G065.1	30	42	343	13.6	12.8	13	$ 414.00	$ 142,002
1G064.1	30	42	348	12.87	15	14	$ 414.00	$ 144,072
1G019.1	30	42	90	15.06	15.65	15	$ 414.00	$ 37,260
1G149.1	30	42	120	15.65	16.6	16	$ 414.00	$ 49,680
1G017.1	30	42	70	16.65	14.62	16	$ 414.00	$ 28,980
1G014.1	30	42	451	14.68	17.19	16	$ 414.00	$ 186,714
1G012.1	30	42	183	17.21	13.61	15	$ 414.00	$ 75,762
1G009.1	30	42	167	13.65	10.88	12	$ 414.00	$ 69,138
-1F014.2	8	24	51	6.7	8.7	8	$ 283.00	$ 14,433
-1F039.1	15	24	313	8.81	7.69	8	$ 283.00	$ 88,579
-1F040.1	15	24	303	7.69	7	7	$ 283.00	$ 85,749
-1F041.1	15	24	246	7.18	10.96	9	$ 283.00	$ 69,618
-1F042.1	15	24	140	10.96	9	10	$ 283.00	$ 39,620
-1F043.1	15	24	171	9.13	8	9	$ 283.00	$ 48,393
-1F054.1	15	24	240	8	8.6	8	$ 283.00	$ 67,920
-1F055.1	15	24	299	8.6	7.5	8	$ 283.00	$ 84,617
-1F071.1	15	24	75	7.5	8.4	8	$ 283.00	$ 21,225
-1F072.1	15	36	126	8.56	6.17	7	$ 381.00	$ 48,006
-1F073.1	15	36	100	6.17	5	6	$ 381.00	$ 38,100
-1F074.1	15	36	100	5	7.12	6	$ 381.00	$ 38,100
0F139.1	15	36	245	7.13	7.8	7	$ 381.00	$ 93,345
0F140.1	15	36	324	7.94	9.5	9	$ 381.00	$ 123,444
0F011.1	15	36	70	9.64	11.49	11	$ 381.00	$ 26,670
0F012.1	15	36	210	11.49	6.6	9	$ 381.00	$ 80,010
0F013.1	15	36	268	6.61	6.5	7	$ 381.00	$ 102,108
0F014.1	15	36	282	6.69	7.65	7	$ 381.00	$ 107,442
0F015.1	15	36	50	7.65	7.91	8	$ 381.00	$ 19,050
0F018.1	15	36	283	7.91	8.38	8	$ 381.00	$ 107,823
0F019.1	15	36	70	8.38	7.75	8	$ 381.00	$ 26,670
0F020.1	18	36	67	8.11	8.03	8	$ 381.00	$ 25,527
0F145.1	18	36	281	8.03	6	7	$ 381.00	$ 107,061
0E069.1	18	36	250	6	9.5	8	$ 381.00	$ 95,250

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
0E070.1	18	36	250	9.63	8.1	9	$ 381.00	$ 95,250
0E071.1	18	36	293	8.1	12.8	10	$ 381.00	$ 111,633
0E072.1	18	36	137	13	8	11	$ 381.00	$ 52,197
0E073.1	18	36	170	8	7.73	8	$ 381.00	$ 64,770
0E074.1	18	36	268	7.73	9.3	9	$ 381.00	$ 102,108
0E076.1	18	36	45	9.45	12.7	11	$ 381.00	$ 17,145
1E117.1	18	36	339	12.7	8.6	11	$ 381.00	$ 129,159
1E118.1	18	36	96	8.74	8.15	8	$ 381.00	$ 36,576
1E149.1	18	36	129	8.15	8.2	8	$ 381.00	$ 49,149
1E119.1	18	36	261	8.26	5.8	7	$ 381.00	$ 99,441
1E120.1	18	36	103	5.86	6.28	6	$ 381.00	$ 39,243
1E121.1	18	36	276	6.28	6.9	7	$ 381.00	$ 105,156
1E122.1	18	36	285	6.97	6.62	7	$ 381.00	$ 108,585
1E123.1	18	36	150	6.62	9.7	8	$ 381.00	$ 57,150
1E124.1	18	36	164	9.71	8.87	9	$ 381.00	$ 62,484
1E125.1	18	36	166	8.97	10.9	10	$ 381.00	$ 63,246
1F008.1	18	36	251	10.99	7.49	9	$ 381.00	$ 95,631
1F007.1	18	36	46	7.5	7.7	8	$ 381.00	$ 17,526
1F006.1	18	36	280	7.7	11.8	10	$ 381.00	$ 106,680
1F009.1	21	36	324	12.36	5.41	9	$ 381.00	$ 123,444
1F010.1	21	36	414	5.57	9.4	7	$ 381.00	$ 157,734
1F011.1	21	36	428	9.58	12.74	11	$ 381.00	$ 163,068
1F042.1	21	36	22	12.87	8.586	11	$ 381.00	$ 8,382
1F028.1	21	36	362	8.586	6.41	7	$ 381.00	$ 137,922
1F029.1	21	36	146	6.6	9.68	8	$ 381.00	$ 55,626
1F030.1	21	36	357	9.68	9.25	9	$ 381.00	$ 136,017
1F031.1	21	36	157	9.32	5.44	7	$ 381.00	$ 59,817
1F032.1	21	36	175	5.45	8.65	7	$ 381.00	$ 66,675
1G091.1	18	36	186	9	9.45	9	$ 381.00	$ 70,866
1G090.1	18	36	305	9.45	8.82	9	$ 381.00	$ 116,205
1G089.1	18	36	215	8.82	8.08	8	$ 381.00	$ 81,915
1G088.1	18	36	201	8.08	7.32	8	$ 381.00	$ 76,581
1G087.1	18	36	278	7.32	6.65	7	$ 381.00	$ 105,918
1G086.1	18	36	50	6.65	7.11	7	$ 381.00	$ 19,050
1G074.1	21	36	529	10.91	13.2	12	$ 381.00	$ 201,549
1G016.1	24	36	111	13.2	9.85	12	$ 381.00	$ 42,291
1G015.1	24	36	296	10.03	7.57	9	$ 381.00	$ 112,776
1G013.1	24	36	300	7.65	7.26	7	$ 381.00	$ 114,300
1G011.1	24	36	164	7.27	5.2	6	$ 381.00	$ 62,484
1G010.1	24	36	287	5.45	6.54	6	$ 381.00	$ 109,347
1G006.1	24	36	352	6.56	6.96	7	$ 381.00	$ 134,112
1G005.1	24	36	71	6.98	7.35	7	$ 381.00	$ 27,051
1G002.1	24	36	265	7.39	5.24	6	$ 381.00	$ 100,965
1G001.1	24	36	167	5.26	6.09	6	$ 381.00	$ 63,627
2H031.1	24	36	450	6.14	11.08	9	$ 381.00	$ 171,450
2H030.1	24	36	345	11.08	12.78	12	$ 381.00	$ 131,445
2H029.1	24	36	347	12.78	12.12	12	$ 381.00	$ 132,207
2H028.1	24	36	8	12.15	12.38	12	$ 381.00	$ 3,048
2H027.1	24	36	138	13.04	12.08	13	$ 381.00	$ 52,578
2H026.1	24	36	279	12.38	11.72	12	$ 381.00	$ 106,299
2H025.1	24	36	47	11.83	11.72	12	$ 381.00	$ 17,907
2H024.1	30	36	58	11.81	10.8	11	$ 381.00	$ 22,098
2H023.1	30	36	228	10.8	7.5	9	$ 381.00	$ 86,868
2H022.1	30	36	155	7.5	7.5	8	$ 381.00	$ 59,055
2H021.1	30	36	55	7.5	10.21	9	$ 381.00	$ 20,955
2H020.1	30	36	234	10.21	11	11	$ 381.00	$ 89,154
2H019.1	30	36	250	11	5.6	8	$ 381.00	$ 95,250
2H018.1	30	36	475	5.6	7.23	6	$ 381.00	$ 180,975
2H017.1	30	36	350	7.23	8.08	8	$ 381.00	$ 133,350
2H016.1	30	36	200	8.08	8.65	8	$ 381.00	$ 76,200
2H015.1	24	36	473	8.79	8.43	9	$ 381.00	$ 180,213
3H094.1	24	36	295	8.43	9.4	9	$ 381.00	$ 112,395
3H068.1	24	36	250	9.4	10.57	10	$ 381.00	$ 95,250
3H081.1	24	36	300	10.57	12	11	$ 381.00	$ 114,300
3H069.1	24	36	200	12	7.9	10	$ 381.00	$ 76,200
3H070.1	24	36	30	7.9	10.17	9	$ 381.00	$ 11,430
3H074.2	24	36	375	10.53	11.4	11	$ 381.00	$ 142,875

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
3H076.1	24	36	179	11.4	11.98	12	$ 381.00	$ 68,199
3H078.1	24	36	233	11.98	11.8	12	$ 381.00	$ 88,773
3H079.1	24	36	336	11.8	12.8	12	$ 381.00	$ 128,016
3I025.1	24	36	318	12.8	9.11	11	$ 381.00	$ 121,158
3I028.1	24	36	318	9.11	8.24	9	$ 381.00	$ 121,158
3I027.1	24	36	201	8.24	14.68	11	$ 381.00	$ 76,581
3I035.1	24	36	52	14.78	14.96	15	$ 381.00	$ 19,812
3I034.1	24	36	112	14.96	14.64	15	$ 381.00	$ 42,672
3I033.1	24	36	170	14.82	5.64	10	$ 381.00	$ 64,770
3I022.1	24	36	138	5.64	11.3	8	$ 381.00	$ 52,578
3I021.1	24	36	125	11.3	11.57	11	$ 381.00	$ 47,625
3I020.1	24	36	65	11.57	10.8	11	$ 381.00	$ 24,765
3I019.1	24	36	334	10.8	8.97	10	$ 381.00	$ 127,254
3I018.1	24	36	334	8.97	11.11	10	$ 381.00	$ 127,254
3I016.1	24	36	98	11.11	11.52	11	$ 381.00	$ 37,338
3I039.1	42	54	168	16.01	16.21	16	$ 603.00	$ 101,304
3I037.1	42	54	177	16.24	13.86	15	$ 603.00	$ 106,731
3I038.1	42	54	252	13.95	15.37	15	$ 603.00	$ 151,956
3I007.1	42	54	459	15.86	15.26	16	$ 603.00	$ 276,777
3J002.1	42	54	12	15.41	12.68	14	$ 603.00	$ 7,236
3J003.1	42	54	11	12.68	15.93	14	$ 603.00	$ 6,633
3J004.1	42	54	137	16	15.91	16	$ 603.00	$ 82,611
3J005.1	42	54	392	15.96	14.29	15	$ 603.00	$ 236,376
3J006.1	42	54	402	14.39	16.32	15	$ 603.00	$ 242,406
3J007.1	42	54	472	16.39	16.65	17	$ 603.00	$ 284,616
3J008.1	42	54	279	16.72	13.14	15	$ 603.00	$ 168,237
3J009.1	42	54	465	13.22	10.89	12	$ 603.00	$ 280,395
3J010.1	42	54	197	11.07	13.1	12	$ 603.00	$ 118,791
3J011.1	42	54	342	13.16	18.47	16	$ 603.00	$ 206,226
3J012.1	42	54	366	18.54	19.88	19	$ 603.00	$ 220,698
3J013.1	42	54	21	20.09	20.19	20	$ 603.00	$ 12,663
3J014.1	42	54	823	20.22	12.86	17	$ 603.00	$ 496,269
3K069.1	42	54	221	12.89	13.15	13	$ 603.00	$ 133,263
3K068.1	42	54	612	13.19	13.62	13	$ 603.00	$ 369,036
3K064.1	42	54	828	13.66	11.42	13	$ 603.00	$ 499,284
3K061.1	42	54	824	11.53	15.9	14	$ 603.00	$ 496,872
3L078.1	42	54	30	16.18	15.41	16	$ 603.00	$ 18,090
3L080.1	42	54	455	15.48	5.76	11	$ 603.00	$ 274,365
3L081.1	42	54	399	5.83	14.55	10	$ 603.00	$ 240,597
3L082.1	42	54	156	14.79	14.49	15	$ 603.00	$ 94,068
3L083.1	42	54	135	14.6	13.2	14	$ 603.00	$ 81,405
3L106.1	42	54	407	13.38	18.75	16	$ 603.00	$ 245,421
3L084.1	42	54	402	18.81	18.83	19	$ 603.00	$ 242,406
3L052.1	48	60	35	18.9	18.67	19	$ 663.30	$ 23,216
3L053.1	48	60	461	18.81	17.57	18	$ 663.30	$ 305,781
3L054.1	48	60	180	17.49	17.29	17	$ 663.30	$ 119,394
3L055.1	48	60	357	17.33	13.72	16	$ 663.30	$ 236,798
3L056.1	48	60	497	13.76	12.39	13	$ 663.30	$ 329,660
4L018.1	48	60	825	12.42	15.39	14	$ 663.30	$ 547,223
4L017.1	48	60	875	15.39	18.53	17	$ 663.30	$ 580,388
4L016.1	48	60	451	18.58	21.4	20	$ 663.30	$ 299,148

Total: $ 23,644,942

PRELIMINARY COST ESTIMATES - LITTLE ROCK SEWER STUDY

Crist Engineers, Inc. October 19, 2001

1. 72" Gravity Sewer from Adams Field WWTP site (begin at South 60" at Station 4+50, south edge of plant grounds) to connect to existing Interceptor approx. 500' west of University Ave. (no rock excavation)

   45,771 l.f. Hobas FRP pipe w/ Hobas tee manholes, 5 gate structures

   Estimated Project Cost: $30,360,000.00

2. 60" Gravity Sewer from Adams Field WWTP site (begin at South 60" at Station 4+50, south edge of plant grounds) to connect to existing Interceptor approx. 500' west of University Ave. (no rock excavation)

   45,771 l.f. Hobas FRP pipe w/ Hobas tee manholes, 5 gate structures

   Estimated Project Cost: $26,153,000.00

3. Estimated "per lineal foot" project costs for gravity construction in congested urban installations, including manholes, surface restoration and incidental costs (no rock excavation):

Diameter, In.	Trench Depth, Ft.	Cost, $/l.f.
12" PVC	8	172.00
15" PVC	8	188.00
18" PVC	8	200.00
21" PVC	8	221.00
24" PVC	12	283.00
27" PVC	12	302.00
30" PVC	12	320.00
36" PVC	12	381.00
42" PVC	12	414.00
48" Hobas	12	547.00
54" Hobas	12	603.00

4. Estimated "per lineal foot" project costs for force main construction in congested urban installations, including surface restoration and incidental costs, assumes 4' cover (no rock excavation):

Diameter, In.	Cost, $/l.f.
12" D.I.	108.00
16" D.I.	117.00
18" D.I.	122.00
24" D.I.	140.00
30" D.I.	156.00
36" D.I.	178.00
42" D.I.	198.00
48" D.I.	236.00

"Project Costs" are 2001 estimated construction costs plus a 25% engineering and contingency factor.

CRIST ENGINEERS, INC.

PRELIMINARY COST ESTIMATE SUMMARY SHEET

PROJECT: Little Rock - 45,771 l.f. 60" Sewer Main (Hobas Pipe) (No Rock Excavation)

DATE: 10/19/01 JOB NO.: 0036 BY: JEG

Item No.	Description	Unit	Estimated		
			Quantity	Unit Cost	Total Cost
1	60" sewer 0' - 10' deep	l.f.	0	$242.51	$0.00
2	60" sewer 10' - 12' deep	l.f.	536	$247.71	$132,772.56
3	60" sewer 12' - 14' deep	l.f.	3662	$254.07	$930,404.34
4	60" sewer 14' - 16' deep	l.f.	8348	$261.63	$2,184,087.24
5	60" sewer 16' - 18' deep	l.f.	6088	$270.35	$1,645,890.80
6	60" sewer 18' - 20' deep	l.f.	7563	$301.37	$2,279,261.31
7	60" sewer 20' - 22' deep	l.f.	1779	$312.49	$555,919.71
8	60" sewer 22' - 24' deep	l.f.	925	$324.81	$300,449.25
9	60" sewer 24' - 26' deep	l.f.	2675	$338.29	$904,925.75
10	60" sewer 26' - 28' deep	l.f.	1544	$352.93	$544,923.92
11	60" sewer 28' - 30' deep	l.f.	5089	$368.81	$1,876,874.09
12	60" sewer 30' - 32' deep	l.f.	1627	$385.57	$627,322.39
13	60" sewer 32' - 34' deep	l.f.	1976	$403.97	$798,244.72
14	60" sewer 34' - 36' deep	l.f.	1389	$423.57	$588,338.73
15	60" sewer over 36' deep	l.f.	0	$443.97	$0.00
16	60" sewer in 96" encase	l.f.	2420	$1,450.00	$3,509,000.00
17	straight sewer manhole 0' - 12' deep	ea.	37	$27,000.00	$999,000.00
18	angle sewer manhole 0' - 12' deep	ea.	46	$30,000.00	$1,380,000.00
19	add'l depth in manholes	v.f.	714	$1,200.00	$856,800.00
20	special structures	ea.	5	$100,000.00	$500,000.00
21	asphalt pavement cut & replaced	s.y.	4366	$50.00	$218,300.00
22	levee crossing	l.f.	150	$600.00	$90,000.00
	Engineering and Contingencies @ 25%				$5,230,628.70
	Total this sheet				$26,153,143.51

CRIST ENGINEERS, INC.

PRELIMINARY COST ESTIMATE SUMMARY SHEET

PROJECT: Little Rock - 45,771 l.f. 72" Sewer Main (Hobas Pipe) (No Rock Excavation)

DATE: 10/19/01 JOB NO.: 0036 BY: JEG

Item No.	Description	Unit	Estimated		
			Quantity	Unit Cost	Total Cost
1	72" sewer 10' - 12' deep	l.f.	536	$301.49	$161,598.64
2	72" sewer 12' - 14' deep	l.f.	3662	$307.57	$1,126,321.34
3	72" sewer 14' - 16' deep	l.f.	8348	$314.81	$2,628,033.88
4	72" sewer 16' - 18' deep	l.f.	6088	$323.29	$1,968,189.52
5	72" sewer 18' - 20' deep	l.f.	7563	$383.89	$2,903,360.07
6	72" sewer 20' - 22' deep	l.f.	1779	$394.73	$702,224.67
7	72" sewer 22' - 24' deep	l.f.	925	$406.73	$376,225.25
8	72" sewer 24' - 26' deep	l.f.	2675	$419.89	$1,123,205.75
9	72" sewer 26' - 28' deep	l.f.	1544	$434.29	$670,543.76
10	72" sewer 28' - 30' deep	l.f.	5089	$449.81	$2,289,083.09
11	72" sewer 30' - 32' deep	l.f.	1627	$466.57	$759,109.39
12	72" sewer 32' - 34' deep	l.f.	1976	$484.49	$957,352.24
13	72" sewer 34' - 36' deep	l.f.	1389	$503.61	$699,514.29
14	72" sewer over 36' deep	l.f.	0	$523.89	$0.00
15	72" sewer in 96" encase	l.f.	2420	$1,500.00	$3,630,000.00
16	straight sewer manhole 0' - 12' deep	ea.	37	$30,000.00	$1,110,000.00
17	angle sewer manhole 0' - 12' deep	ea.	46	$33,000.00	$1,518,000.00
18	add'l depth in manholes	v.f.	714	$1,200.00	$856,800.00
19	special structures	ea.	5	$100,000.00	$500,000.00
20	asphalt pavement cut & replaced	s.y.	4366	$50.00	$218,300.00
21	levee crossing	l.f.	150	$600.00	$90,000.00
	Engineering and Contingencies @ 25%				$6,071,965.47
	TOTAL				$30,359,827.36

OPTION A1

Item Description	Preliminary Cost Eqn	Qty	# of Units	Cost @ Original ENR[A]	Cost @ Current ENR[B]
Line Work					
Utility Trunk Sewer Upgrades					$ 53,080,000
72" Parallel to Upper Twin 60" Trunks					
	$=663.30 * L.F.	45772			$ 30,400,000
Force Main Improvements (24" @ 6000 L.F.)					
	$=140.00*L.F.	6000			$ 840,000
Force Main Improvements (30" @ 41,500 L.F.)[C]					$ 9,720,000
Pump Stations					
Cantrell - 25MGD to 40 MGD					
Lift Station Upgrade	$=391,980 * Q^0.6700 (MGD)	40	1	$4,641,348	$ 4,600,000
Arch - 35 MGD to 60 MGD[C]					$ 2,920,000
Jimerson - 12 MGD					
Lift Station Upgrade	$=391,980 * Q^0.6700 (MGD)	12	1	$2,072,000	$ 2,540,000
I-430 Booster Sta - 1 MGD					
Lift Station Upgrade	$=391,980 * Q^0.6700 (MGD)	1	1	$391,980	$ 400,000
Treatment					
Little Maumelle 4 MGD WWTP (w/ 30 MG Storage)[D]					$ 21,900,000
Adam WWTP Upgrades (94 MGD w/ 25 MG Storage)[E]					$ 24,000,000
Fourche WWTP Upgrade (from 38 MGD to 60 MGD)[C]					$ 23,420,000
				Total:	**$ 173,820,000**

Notes: A. Original ENR Based on Los Angeles 1994 Construction Cost Index (CCI)
B. Current ENR Based on National Average of CCI as of Oct. 2001
C. Costs developed from information in Appendix F
D. Cost developed from information in Appendix G
E. Cost developed from information in Appendix E

City of Little Rock Wastewater Utility System Evaluation & Capacity Assurance Plan

Citizens Advisory Group

CAG

Little Rock Wastewater Utility

City of Little Rock Wastewater Utility System Evaluation & Capacity Assurance Plan

Citizens Advisory Group

CAG

Table of Contents

CAG

Section 1
Introduction

Stakeholder	CAG Designate	Phone number(s)	Street Address	City	Postal Code
Regulators					
Ark Department of Health	Raymond Haeggons	(B) 501.280.3154 (FX)501.280.3308	Pulaski County Central Health Unit Environmental Health Protection 3915 West 8th Street	LR	72204
Ark Dept. of Environ. Quality	Gary Griffin	(B) 501.682.0613 (H) 501.262.4918 (FX) 501.682.0910	Permits Branch Arkansas Dept.of Environmental Quality PO Box 8913	LR	72219
Neigborhood Coalitions					
SW LR United for Progress	Troy Laha	(B) 501.565.7384	6602 Baseline Road	LR	72209
Coalition of LR Neighborhoods	Jim Lynch	(B) 501.569.8744 (H) 501.661.0406	16 Lenon Dr.	LR	72207
West Central LR Neighborhoods	George Brown	(H) 501.225.3549	2823 Lehigh Drive	LR	72204
Neighborhood Connections	Mike Kumpuris	(H) 501.562.1288	7606 Westwood Avenue	LR	72207
Industrial/Commercial Users					
LR Industrial Users	Pete Christiansen	(B) 501.372.5254 (FX) 501.210.0478	Falcon Jet Corp P.O. Box 967	LR	72203
LR Commercial Users	Charles Mathis	(B) 501.202.2696 (FX) 501.202.1184	Baptist Health, Director of Facilities Mgmt. 9607 Interstate 630, Exit 7	LR	72205
Board/Committees					
CLR Board of Directors	Director Willie Hinton	501-529-8993 (cell) 501.371.4516 Megan Steinbeck	LR City Hall 500 West Markham, Room 203	LR	72201
LR Sanitary Sewer Committee	Pat Miller	(B) 501.975.0250 (H) 501.664.9220 (FX) 501.376.6256	Millennieum Capital Advisors LLC 425 West Captiol, Suite 300	LR	72201
Environmental Groups					
Sierra Club	Laura Clift	(H) 501-664-7914	14 Alpine Ct.	LR	72205
Stormwater Utility					
CLR Public Works	Bob Turner	(B)501.371.4720 (F) 371-4843	CLR Public Work Department 701 West Markham	LR	72201

CAG

Little Rock
Wastewater Utility

Citizens Advisory Group
Overview

A Citizen's Advisory Group (CAG) will be used to ensure that community values are reflected the decisions and recommendations of the System Evaluation & Capacity Assurance Plan for Little Rock. The CAG should reflect the community and provide representation for environmental, tax/rate payer, environmental justice, and other special interest groups.

Roles & Objectives of Group

- To serve as a communication link between the community and the Little Rock Wastewater Utility
- To assist in educating the public about the issues, proposed solutions and the decision-making process
- To define and prioritize community-related issues related to wastewater
- To articulate community values and opinions
- To review studies results and help evaluate alternatives using agreed-upon criteria
- To issue recommendations to the Wastewater Utility
- To become familiar with the issues and take identified issues back to their constituents
- To provide input on the cost-effectiveness of the program
- To identify potential public concerns regarding wastewater-related issues and solutions facing the City of Little Rock and the Utility
- To identify potential community impacts including noise, access limitations, and traffic disruptions
- To assist the city in shaping policies and making specific recommendations for the prioritization of the elements of the Wastewater master

It is anticipated that the CAG will meet four times with an additional tour of wastewater facilities. The initial meetings should include tours of existing wastewater facilities. It is anticipated that the meetings will be open to the public and will be announced in the local media. The group members will be provided with prior notice of the meetings and as a meeting agenda. A copy of the minutes summarizing recommendations made and action taken will be provided following each meeting.

CAG

Section 2
Meeting Agendas

CAG

Citizens Advisory Group
Program Overview

The Citizen Advisory Group program will consist of four meetings and a facility tour culminating in final recommendations to the Little Rock Wastewater Utility:

Workshop 1 - Overview and Organization
a) Introduction of group members, facilitator, Engineering team
b) Overview of the role of the Group
c) Teambuilding exercise
d) Overview of Little Rock's wastewater system and the issues facing the Utility
e) Overview of the master planning project and accomplishments to date
f) Development of the Group's mission and objective
g) Development of Group policies and procedures
h) Agenda and schedules for future meetings
i) Facility Tour
   - Wastewater Pump Station
   - Wastewater Treatment Plant

Workshop 2 – Study Results
a) Opening and general question/answer forum
b) Background information on collection systems
c) Presentation on the results of the collection system study
d) Identification of specific issues and problems to be addressed in the master plan
e) Discussion of community issues and concerns

Workshop 3 – Alternatives and Evaluation Criteria
a) Overview of progress to date
b) Presentation and discussion of planning alternatives
c) Development of evaluation criteria

Workshop 4 – Group Recommendations
a) Review of alternatives and criteria
b) Results of technical evaluations
c) Group evaluation process
d) Development of recommended alternatives
e) Prioritization of recommended alternatives

CAG

Section 3
Meeting #1

Thursday
5:30pm-7:30pm
September 6, 2001

Location: Main Library, 100 Rock St.-
East Room 1st Floor

Parking @ the lot across from the Main entrance on Rock Street.

Little Rock Wastewater Utility
Citizens Advisory Group

Meeting I
September 6, 2001
5:30-7:30 PM
Main Library East Room

AGENDA

Introduction of group members, facilitator, and engineering team
Overview of the role of the group
Overview of Little Rock's wastewater system and issues
Overview of the master planning project and accomplishments
Development of the Group's mission and objectives
Development of the Group's policies and procedures
Discussion of Agenda and schedules for future meetings
Facility tour.

MEETING SCHEDULE

Meeting II
DATE: Thursday, September 13, 2001
TIME: 5:30-7:30 PM
PLACE: UALR Campus, Donaghey Student Center, Dogwood Room
PARKING: University Parking Deck – additional information will be provided at the first meeting.

Meeting III
DATE: Thursday, September 27, 2001
TIME: 5:30-7:30 PM
PLACE: Main Library, 100 Rock St. – East Room, 1st Floor
PARKING: Public lot across from the Main entrance on Rock St.

Meeting IV
DATE: Thursday, October 25, 2001
TIME: 5:30-7:30 PM
PLACE: Main Library, 100 Rock St. – East Room, 1st Floor
PARKING: Public lot across from the Main entrance on Rock St.

Little Rock Wastewater

Citizens Advisory Group

The September 13th meeting will be held on the UALR Campus from 5:30-7:30 PM in the Dogwood Room of the Donaghey Student Center.

Directions to UALR:
Approach campus from Fair Park Blvd. Traveling South on Fair Park, make a right on 32nd Street. You will see signs on 32nd Street for the Parking Deck. Make a left to enter the parking deck. Parking in the "Visitors Section." You can get to the Donaghey Student Center (the most central building on campus) on a walkway from the Parking Deck.

You will receive a parking pass at the meeting.

Directions to the Dogwood Room:
Enter the Student Center through the first door. Take the stairs to the second floor. Follow the hallway to the other end of the building. At the end of the hall, make a left into the cafeteria area. Past the cash registers, you will see a hall to your left. The Dogwood Room is off that hall. If you get lost, ask someone.

A campus map is on the back of these instructions.

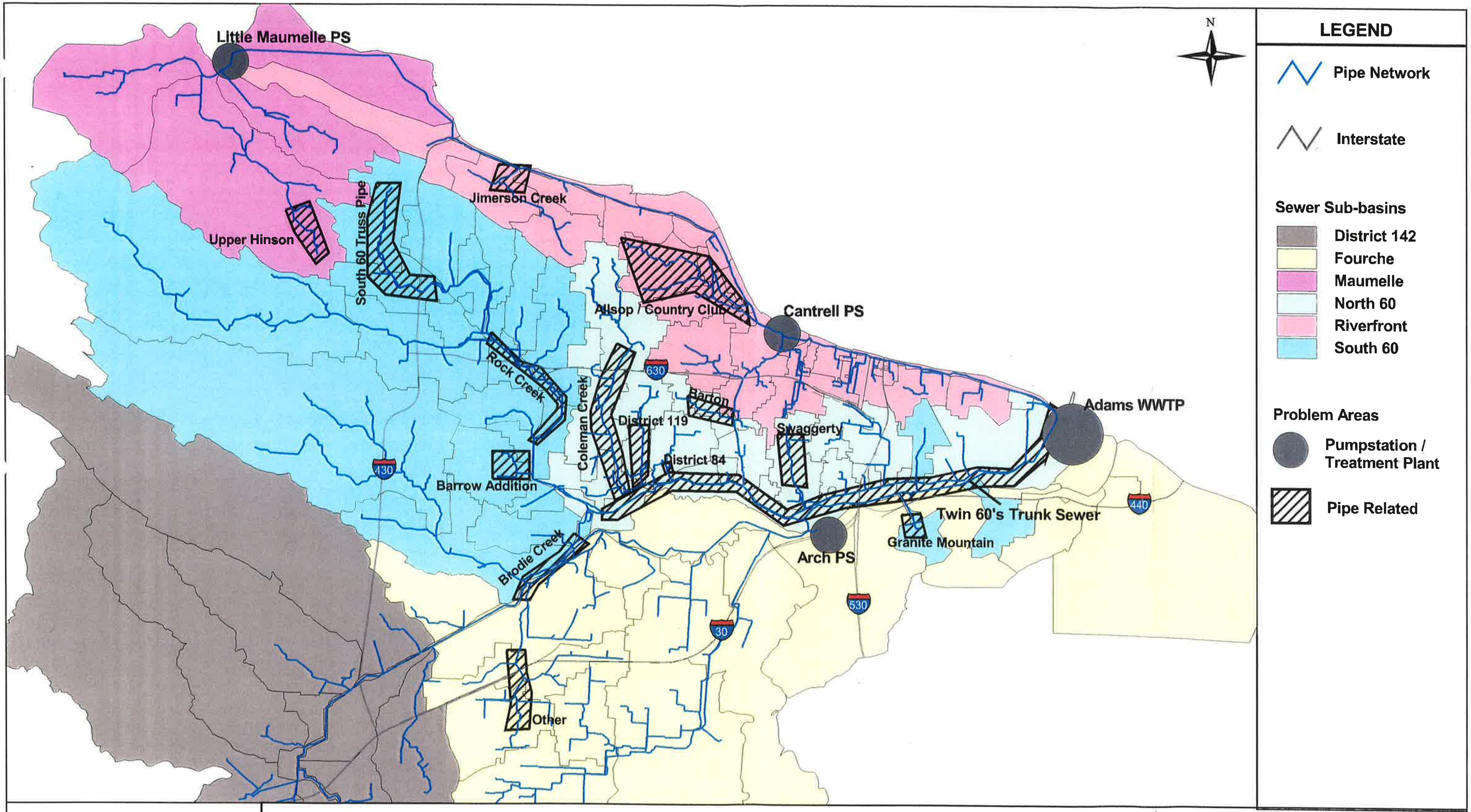
CAG

Section 4
Meeting #2

Thursday
5:30pm-7:30pm
September 27, 2001

Location: Main Library, 100 Rock St.-
East Room 1st Floor

Parking @ the lot across from the Main entrance on Rock Street.



MWH
MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

SYSTEM PROBLEM AREAS

September 2001

D:/Projects/LRWU/apr/littlerock.apr

Citizen Advisory Group Workshop #2
Little Rock System Evaluation and Capacity Assurance Plan
September 27, 2001

Problem Areas:

Riverfront:

- **Allsop/Country Club**
  - worst recorded I/I
  - inline rehab possible (but low reduction of I/I)
- **Country Club**
  - bottom of creek
  - needs new pipe
  - infiltration of adjacent stream
  - capacity issue
  - very difficult construction R/W issues
  - exact locations of infiltration unknown
  - possible solution: in-line rehab and new lines
- **Jimerson Creek**
  - lines surcharging
  - may be due to under capacity downstream
  - elimination of Maumelle PS flow could solve problems
- **Cantrell PS**
  - may not need to upsize if new WWTP added in at Maumelle
  - increase in wet-well size could add volume to reduce upstream water levels

South 60:

- **Barrow Addition (FM010)**
  - system backing up, overflows recorded
  - possible problems will be eliminated when interceptor relief is in place
- **South 60 Truss Pipe (U/S FM002, FM001)**
  - truss pipe, thin-walled pipe
  - damaged lines and leaking system
  - no overflows recorded, system experiencing huge I/I
- **Rock Creek**
  - pipe surcharge / overflow conditions
  - cross connection
- **Granite Mountain (FM062)**
  - line back-up localized problem
  - plant improvements may affect need for line improvements

North 60:

- **Swaggerty (FM025)**
  - overflow caused by 24-inch into 18-inch line
  - recommend upsizing 18-inch to 24-inch
- **Barton North (FM029)**
  - localized surcharge
  - major I/I/
  - 8th highest ranking on I/I list
- **District 84 (D/S of FM100)**
  - 36-inch experiences overflows, line back up from North 60

- **District 119 (FM031)**
  – rehab review
  – survey of existing pipe
  – significant I/I
  – CCTV showed pipe missing
- **Coleman Creek (FM032/034)**
  – upper end – rehab complete, 20% I/I reduction
  – high I/I, rehab underway in area
- **Twin 60's Relief Interceptor**
  – largest project
  – options include
    wet-weather facility (storage)
    remove and replace one of existing pipes with larger pipe
    parallel line for added capacity

Fourche:
- **Brodie Creek**
  - problem area, cross connection to South 60
  - problem may be relieved by parallel interceptor
- **Other Areas**
  - capacity problems
  - problem may be relieved by parallel interceptor

Maumelle:
- Major growth
- PS built in 1982
- Experiencing capacity problems
- **Maumelle WWTP**
  – possible solution, WWTP located upstream of riverfront
  – wet weather facility near Maumelle PS
  Upper Hinson
  – very high I/I due to old Truss Pipe
  – expect truss pipe to continue to deteriorate; pipe 25 years old

Adams WWTP:
- Planning capacity upgrade (72 MGD present capacity)
- Have land available for wet weather facility or plant improvements

Arch St PS:
- Future upgrade to Fourche WWTP expected
- To maintain effective peak capacity for system Arch needs upgrade

Cheat Sheet of Terminology

I/I Inflow and Infiltration

- Storm water inflow may enter sewers from surface areas through open manhole lids, damaged manhole in streets or near drainage structures, or river/creek beds.
- Groundwater infiltration may enter sewers through separated line joints, cracked pipe, old / damaged service connections, cracked or damaged manholes, and eroded / deteriorated pipe.

Surcharge Condition

- Once line capacity has been reached, the system will begin to backup into the upstream system and raise water levels in manholes. The system is said to be in a surcharge condition until water levels recede and pipe flow is contained in the parameters of the line.

SSO Sanitary Sewer Overflow

- Any discharge of untreated sewage in to a body of water or ground surface that has not been permitted by the regulatory agency.

Overflows

- (for our purposes) Discharges of untreated sewage from any manhole, sewer line, or wastewater facility that has not been permitted by the regulatory agency. It should be noted that most discharges occur from manholes during surcharge conditions caused by storm events.

Permit Conditions

- Little Rock currently has discharge permits for 2 wastewater treatment plants, Adams and Fourche. Permits (NPDES) are regulated by the State and require that all discharged flows either meet or exceed limits for contaminant levels and amount of wastewater discharged from designated locations.

NPDES National Pollutant Discharge Elimination System

- Permit issued and regulated by the State under the authority of the EPA in order to comply with the Clean Water Act.

Wet Weather Facility

- Structure whose primary function is to provide off-line storage for combined storm water / wastewater flows that exceed sewer system capacity during a storm /wet weather event due to excessive I/I. Once the storm surcharge has passed through the system, stored flow will be returned to the sewer system for eventual treatment. Treatment capabilities must be designed into the wet weather facility in the event storage capacity is exceeded and a discharge is required.

Lift Station

- A facility whose primary purpose is to convey wastewater by means of pumping where conveyance can not be accomplished by means of a gravity system.

Force Main

- Pipeline used to convey flow from a lift station to a discharge point. Force main usually carries flow under pressure.

Gravity Line

- Pipeline that conveys flow by means of gravity. Line has a positive slope from downstream to upstream and requires intermittent manholes for maintenance access and line cleaning.

Remove and Replace

- Occurs when existing pipelines are found to be under capacity or deteriorated badly enough that total line replacement must occur. This option for repair does not include pipe rehabilitation.

Pipeline Rehabilitation

- Usually a trenchless technology for pipeline repair. Cured-in-place, fold and form, slip lining, and pipe bursting are several options available.

Dry Weather Flow Condition

- Flow rate that is experienced under normal conditions. Where there is no I/I associated with storm activity and high groundwater conditions.

Wet Weather Flow Condition

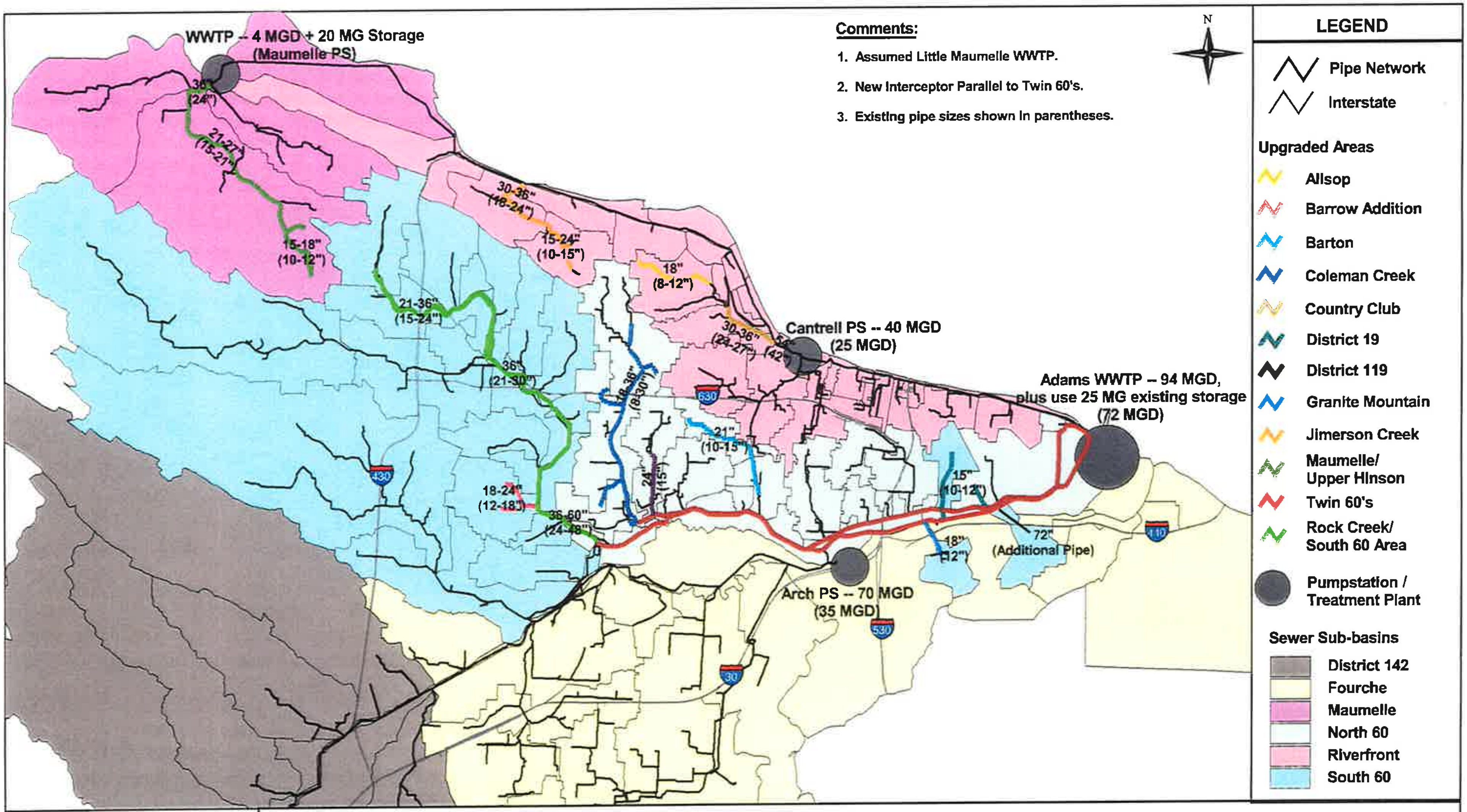
- Flow rate usually experienced during storm activity. Where rainfall causes groundwater levels to rise above level of buried pipes and infiltration begins through damaged or corroded lines. Surface water also enters system through opened or damaged manholes.

Section 5
Meeting #3

Thursday
5:30pm-7:30pm
October 25, 2001

Location: Main Library, 100 Rock St.-
East Room 1st Floor

Parking @ the lot across from the Main entrance on Rock Street.



Comments:

1. Assumed Little Maumelle WWTP.
2. New Interceptor Parallel to Twin 60's.
3. Existing pipe sizes shown in parentheses.

MWH
MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

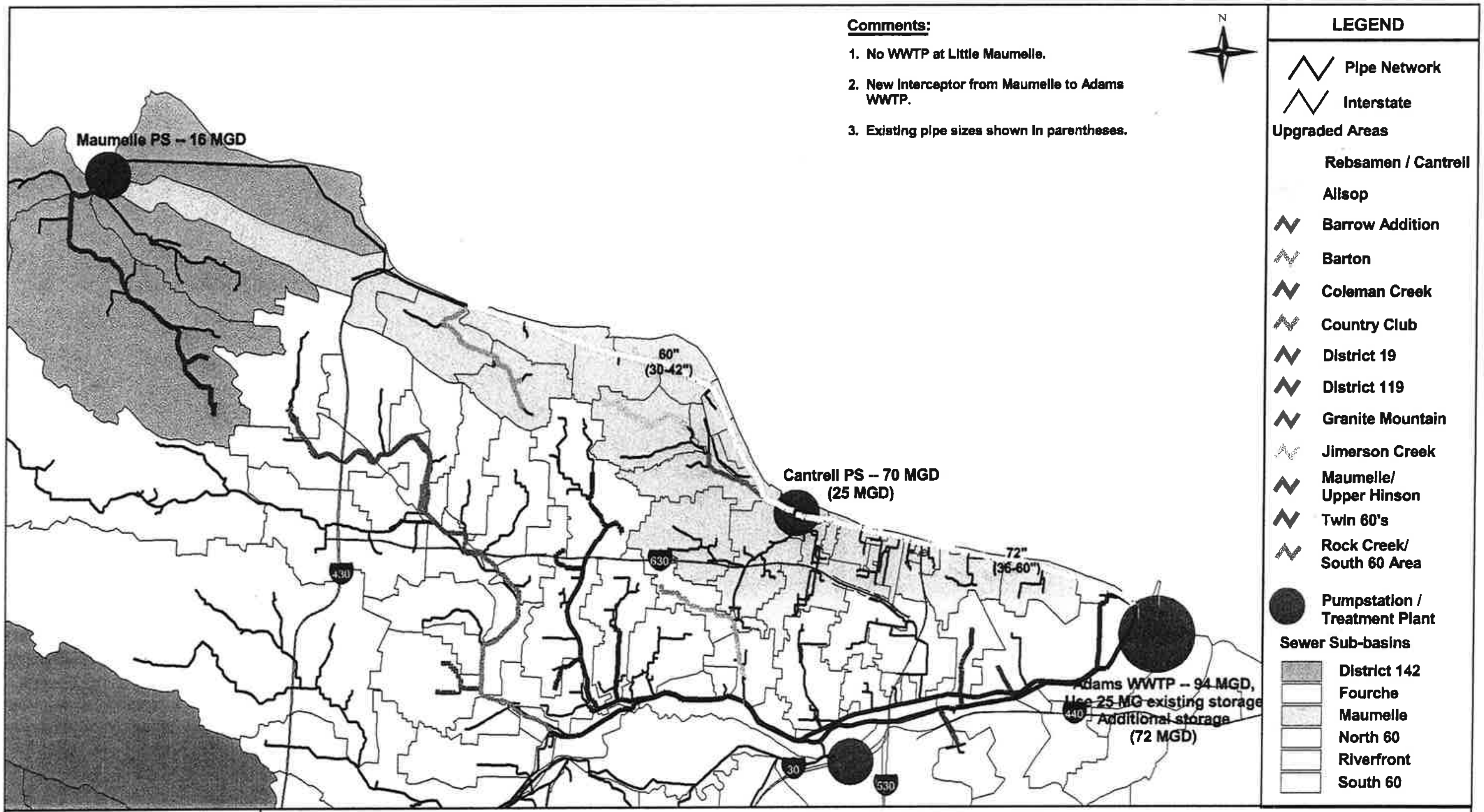
PROPOSED SYSTEM UPGRADES -- 1

October 2001

D:/Projects/LRWU/apr/littlerock.apr

OPTION 1

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
72" Parallel to Twin 60" Trunks	$30.4	Million
36" Force Main (42,000 LF) from Arch	$7.5	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD	$2.3	Million
Arch - 35 MGD to 60 MGD	$6.6	Million
Treatment		
Little Maumelle 4 MGD WWTP with 20 MG Storage	$18.9	Million
Adam WWTP Upgrades	$24.0	Million
Total:	$142.8	Million



Comments:

1. No WWTP at Little Maumelle.
2. New Interceptor from Maumelle to Adams WWTP.
3. Existing pipe sizes shown in parentheses.

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

PROPOSED SYSTEM UPGRADES -- 2

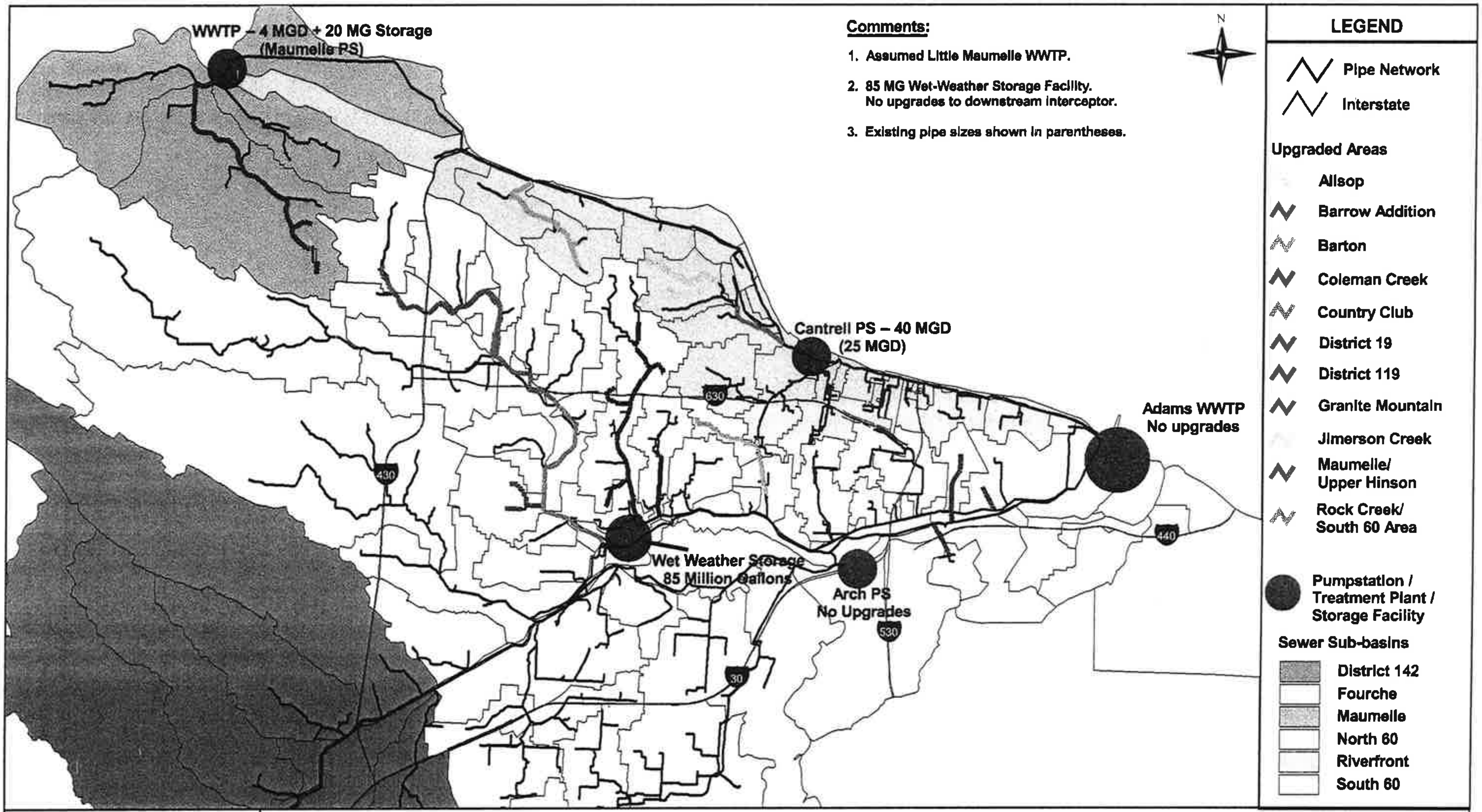
October 2001

MWH
MONTGOMERY WATSON HARZA

D:/Projects/LRWU/apr/littlerock.apr

OPTION 2

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
72" Parallel to Twin 60" Trunks	$30.4	Million
30" Force Main from Little Maumelle LS to Gravity Line	$13.3	Million
60" Gravity Line from Little Maumelle FM to Cantrell LS	$18.6	Million
Twin 30" Force Main from Cantrell LS to Gravity Line	$1.0	Million
72" Gravity Line from Cantrell	$17.5	Million
36" Force Main (42,000 LF) from Arch	$7.5	Million
Pump Stations		
Cantrell - 25MGD to 70 MGD	$6.6	Million
Arch - 35 MGD to 60 MGD	$6.6	Million
Little Maumelle to 16 MGD	$2.4	Million
Treatment		
Adam WWTP Upgrades	$24.0	Million
Total:	$181.0	Million



Comments:

1. Assumed Little Maumelle WWTP.
2. 85 MG Wet-Weather Storage Facility.
   No upgrades to downstream interceptor.
3. Existing pipe sizes shown in parentheses.

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

PROPOSED SYSTEM UPGRADES -- 3

October 2001

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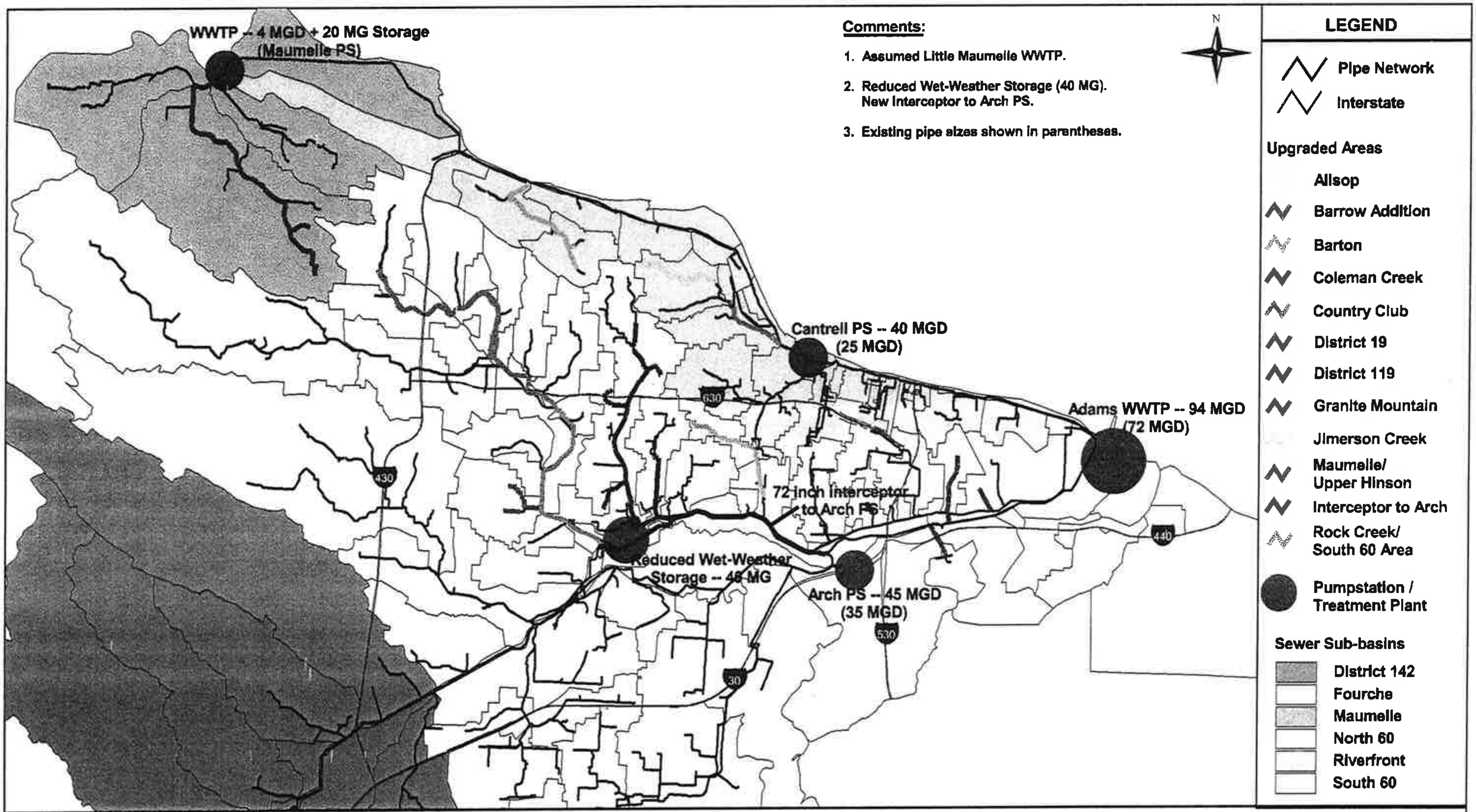
MONTGOMERY WATSON HARZA

D:/Projects/LRWU/apr/littlerock.apr

OPTION 3

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD	$2.3	Million
Storage		
65 MG Sewer Surge Storage	$36.8	Million
Treatment		
Little Maumelle 4 MGD WWTP with 20 MG Storage	$18.9	Million
Total:	$111.1	Million



Comments:

1. Assumed Little Maumelle WWTP.
2. Reduced Wet-Weather Storage (40 MG). New Interceptor to Arch PS.
3. Existing pipe sizes shown in parentheses.

MWH MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

PROPOSED SYSTEM UPGRADES -- 4

October 2001

D:/Projects/LRWU/apr/littlerock.apr

OPTION 4

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
72" Parallel to Twin 60" Trunks	$15.2	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD	$2.3	Million
Arch - 35 MGD to 45 MGD	$1.8	Million
Storage		
40 MG Sewer Surge Storage	$22.2	Million
Treatment		
Adam WWTP Upgrades	$24.0	Million
Little Maumelle 4 MGD WWTP with 20 MG Storage	$18.9	Million
Total:	$137.5	Million

40 MG Sewer Surge Storage		**$22.2 M**
Flow Equalization Storage	$17.7 M	
Lift Station Construction	$4.5 M	
85 MG Sewer Surge Storage		**$36.8 M**
Flow Equalization Storage	$29.3 M	
Lift Station Construction	$7.5 M	
Cantrell Pump Station Upgrades		
25 MGD to 40 MGD		**$2.3M**
25 MGD to 70 MGD (Includes $ for)		**$25 M**
Pump Station Upgrade	$6.6 M	
Force Main Upgrade to Twin 30" parallels	$1.0 M	
Gravity Line Upgrade to 72" DIA	$17.5 M	
Little Maumelle Pump Station Upgrades		
Upgrade Pump Station to 16 MGD (Includes $ for)		**$34.3 M**
Pump Station Upgrade	$2.4 M	
Upgrade Force Main to 30" DIA	$13.3 M	
Upgrade Gravity Line to 60" DIA	$18.6 M	
Arch Pump Station Upgrades		
Upgrade Pump Station 35 MGD to 45 MGD		**$1.8 M**
Upgrade Pump Station 35 MGD to 70 MGD (Includes $ for)		**$14.1 M**
Upgrade to Pump Station	$6.6 M	
36" Force Main (42,000 lf)	$7.5 M	
Upgrade Adams WWTP		**$24.0 M**
Little Maumelle 4 MGD WWTP w/ 20MG Storage Capacity		**$18.9 M**
Utility Trunk Sewer Upgrades		**$53.1 M**
72" Parallel to Twin 60" Trunks		**$30.4 M**

ESTIMATED PIPELINE CONSTRUCTION COST -- ALLSOP

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Allsop
LOCATION:.. Hawthorne Rd, Van Buren St, Country Club Blvd, Spruce S
BRIEF PROJECT DESCRIPTION:......................... 7800 ft, 18 inch pipe
ESTIMATED COST:.. $ 1,551,600
ASSUMPTIONS:.. (i) New diameter based on pipe replacement
(ii) Pipeline costs based on gravity construction in congested urban installations
(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation
(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:.. none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5D096.1	10	18	28	9.16	9.06	9	$ 200.00	$ 5,600
5D095.1	10	18	158	9.06	14.92	12	$ 200.00	$ 31,600
5D094.1	10	18	264	14.92	12.97	14	$ 200.00	$ 52,800
5D093.1	10	18	358	12.97	7.79	10	$ 200.00	$ 71,600
5D092.1	10	18	346	7.79	4.23	6	$ 200.00	$ 69,200
6D031.1	8	18	292	4.23	2.4	3	$ 200.00	$ 58,400
6D028.1	8	18	138	2.48	3.27	3	$ 200.00	$ 27,600
6D026.1	8	18	175	3.3	4.08	4	$ 200.00	$ 35,000
6D032.1	8	18	174	4.08	9.08	7	$ 200.00	$ 34,800
6D035.1	8	18	189	9.05	4.58	7	$ 200.00	$ 37,800
6D036.1	8	18	235	4.62	5.48	5	$ 200.00	$ 47,000
6D040.1	8	18	197	5.55	6.54	6	$ 200.00	$ 39,400
6D048.1	8	18	25	7.04	6.25	7	$ 200.00	$ 5,000
6D050.1	8	18	273	6.41	9.27	8	$ 200.00	$ 54,600
6D064.1	8	18	355	9.35	2.81	6	$ 200.00	$ 71,000
6D065.1	8	18	84	3.04	6.5	5	$ 200.00	$ 16,800
6D094.1	8	18	81	6.85	4.09	5	$ 200.00	$ 16,200
6D095.1	8	18	153	4.33	7.01	6	$ 200.00	$ 30,600
6D073.1	8	18	134	7.01	2.94	5	$ 200.00	$ 26,800
6D092.1	8	18	105	2.94	3.41	3	$ 200.00	$ 21,000
6D074.1	8	18	211	3.41	4.85	4	$ 200.00	$ 42,200
6E156.1	12	18	97	4.85	4.11	4	$ 200.00	$ 19,400
6E155.1	12	18	55	4.11	3.98	4	$ 200.00	$ 11,000
6E144.1	12	18	193	4.09	4.27	4	$ 200.00	$ 38,600
6E143.1	10	18	344	4.27	4.13	4	$ 200.00	$ 68,800
7E055.1	8	18	62	4.13	5.97	5	$ 200.00	$ 12,400
7E121.1	8	18	45	5.97	3.12	5	$ 200.00	$ 9,000
7E057.1	8	18	195	3.34	4.14	4	$ 200.00	$ 39,000
7E058.1	8	18	179	4.32	3.25	4	$ 200.00	$ 35,800
7E059.1	8	18	73	3.28	6.99	5	$ 200.00	$ 14,600
7E120.1	8	18	30	6.99	2.9	5	$ 200.00	$ 6,000
7E060.1	8	18	142	3.04	4.67	4	$ 200.00	$ 28,400
7E061.1	8	18	237	4.91	7.31	6	$ 200.00	$ 47,400
7E062.1	8	18	119	7.35	3.7	6	$ 200.00	$ 23,800
7E063.1	9	18	64	3.7	5.972	5	$ 200.00	$ 12,800
7D030.1	9	18	106	5.972	5.03	6	$ 200.00	$ 21,200
7D023.1	12	18	97	5.03	7.4	6	$ 200.00	$ 19,400
7D028.1	12	18	133	7.44	6.38	7	$ 200.00	$ 26,600
7D026.1	10	18	152	6.5	5.03	6	$ 200.00	$ 30,400
7D022.1	10	18	154	5.12	4.98	5	$ 200.00	$ 30,800
7D021.1	10	18	330	5.23	3.58	4	$ 200.00	$ 66,000
7D020.1	10	18	339	3.65	3.89	4	$ 200.00	$ 67,800
7D019.1	12	18	168	3.89	6.017	5	$ 200.00	$ 33,600
7D029.1	12	18	282	6.017	3.58	5	$ 200.00	$ 56,400
7E001.1	12	18	187	3.58	4.29	4	$ 200.00	$ 37,400
							Total:	**$ 1,551,600**

ESTIMATED PIPELINE CONSTRUCTION COST -- BARROW ADDITION

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Barrow Addition
LOCATION:.. W 35th St, W 36th St, Potter St, Walker St, Gilman St
BRIEF PROJECT DESCRIPTION:......................... 5600 feet, 18-24 inch pipe
ESTIMATED COST:.. $ 1,223,420
ASSUMPTIONS:.. (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
1K120.1	12	18	327	10.85	5.79	8	$ 200.00	$ 65,400
2K006.1	12	18	331	10.52	8.96	10	$ 200.00	$ 66,200
2K007.1	12	18	320	12.03	5.55	9	$ 200.00	$ 64,000
2K042.1	12	18	333	9.28	7.29	8	$ 200.00	$ 66,600
1K138.1	12	18	337	8.8	8.66	9	$ 200.00	$ 67,400
2K021.1	12	18	313	8.66	7.37	8	$ 200.00	$ 62,600
2K028.1	12	18	180	7.37	8.35	8	$ 200.00	$ 36,000
2K029.1	12	18	130	8.35	17.55	13	$ 200.00	$ 26,000
2K030.1	12	18	334	17.55	7.21	12	$ 200.00	$ 66,800
2K057.1	12	18	327	8.48	10.79	10	$ 200.00	$ 65,400
2K058.1	12	18	177	10.79	8.85	10	$ 200.00	$ 35,400
2K080.1	12	18	329	8.85	8.27	9	$ 200.00	$ 65,800
2K078.1	12	18	156	8.27	4.51	6	$ 200.00	$ 31,200
2K077.1	12	18	335	4.51	15.72	10	$ 200.00	$ 67,000
2K076.1	12	18	292	15.72	10.63	13	$ 200.00	$ 58,400
2K075.1	18	24	156	10.63	8.08	9	$ 283.00	$ 44,148
2K145.1	18	24	220	8.08	6.08	7	$ 283.00	$ 62,260
2K144.1	18	24	346	6.08	4.03	5	$ 283.00	$ 97,918
2K143.1	18	24	387	4.03	5.3	5	$ 283.00	$ 109,521
2K142.1	18	24	231	5.3	4.86	5	$ 283.00	$ 65,373
							Total:	**$ 1,223,420**

ESTIMATED PIPELINE CONSTRUCTION COST -- BARTON

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:..	Barton
LOCATION:...	W 17th St, W 15th St, W 14th St, Maple St
BRIEF PROJECT DESCRIPTION:........................	10,600 feet, 15-21 inch pipe
ESTIMATED COST:.....................................	$ 2,289,448
ASSUMPTIONS:..	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:..	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
7I007.1	10	15	320	11	4	8	$ 188.00	$ 60,160
7I008.1	10	15	29	4	4	4	$ 188.00	$ 5,452
7I009.1	10	15	149	4	10	7	$ 188.00	$ 28,012
7I039.1	12	18	3	10	10	10	$ 200.00	$ 600
7I035.1	12	18	342	10	11	11	$ 200.00	$ 68,400
7I156.1	12	18	174	12	15	13	$ 200.00	$ 34,800
7I041.1	12	18	315	15	10	12	$ 200.00	$ 63,000
7I044.1	12	18	173	10	11	10	$ 200.00	$ 34,600
7I045.1	12	18	160	11	9	10	$ 200.00	$ 32,000
7I046.1	12	18	150	9	4	7	$ 200.00	$ 30,000
7I047.1	12	21	176	4	6	5	$ 221.00	$ 38,896
7I048.1	10	21	159	6	6	6	$ 221.00	$ 35,139
7I050.1	10	21	323	6	7	6	$ 221.00	$ 71,383
8I006.1	10	21	303	7	7	7	$ 221.00	$ 66,963
8I170.1	10	21	263	7	4	5	$ 221.00	$ 58,123
8I069.1	10	21	145	5	4	5	$ 221.00	$ 32,045
8I066.1	10	21	256	5	5	5	$ 221.00	$ 56,576
8I176.1	10	21	33	5	5	5	$ 221.00	$ 7,293
8I062.1	10	21	360	5	5	5	$ 221.00	$ 79,560
8I060.1	12	21	155	5	6	5	$ 221.00	$ 34,255
8I059.1	12	21	154	6	5	5	$ 221.00	$ 34,034
8I053.1	10	21	152	5	5	5	$ 221.00	$ 33,592
8I080.1	12	21	13	5	4	4	$ 221.00	$ 2,873
8I051.1	10	21	133	4	4	4	$ 221.00	$ 29,393
8I050.1	10	21	13	5	6	6	$ 221.00	$ 2,873
8I049.1	12	21	182	6	7	7	$ 221.00	$ 40,222
8I048.1	12	21	196	7	7	7	$ 221.00	$ 43,316
8I145.1	12	21	154	7	6	6	$ 221.00	$ 34,034
8I047.1	12	21	104	6	7	7	$ 221.00	$ 22,984
8I046.1	12	21	298	7	7	7	$ 221.00	$ 65,858
8I045.1	12	21	32	7	7	7	$ 221.00	$ 7,072
8I044.1	12	21	280	7	7	7	$ 221.00	$ 61,880
8I043.1	12	21	386	7	9	8	$ 221.00	$ 85,306
9I072.1	12	21	271	9	7	8	$ 221.00	$ 59,891
9I071.1	12	21	277	7	9	8	$ 221.00	$ 61,217
9I070.1	15	21	130	9	9	9	$ 221.00	$ 28,730
9I065.1	15	21	92	9	8	8	$ 221.00	$ 20,332
9I064.1	15	21	237	8	12	10	$ 221.00	$ 52,377
9J070.1	15	21	289	12	13	12	$ 221.00	$ 63,869
9J069.1	15	21	113	13	16	15	$ 221.00	$ 24,973
9J068.1	15	21	235	16	16	16	$ 221.00	$ 51,935
9J067.1	15	21	426	16	8	12	$ 221.00	$ 94,146
9J066.1	15	21	362	8	15	12	$ 221.00	$ 80,002
9J065.1	15	21	404	15	17	16	$ 221.00	$ 89,284
9J064.1	15	21	432	17	9	13	$ 221.00	$ 95,472
9J058.1	15	21	297	9	18	13	$ 221.00	$ 65,637
9J057.1	15	21	126	23	7	15	$ 221.00	$ 27,846
9J026.1	15	21	187	7	8	7	$ 221.00	$ 41,327

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
9K036.1	15	21	297	8	6	7	$ 221.00	$ 65,637
9K035.1	18	21	129	6	9	8	$ 221.00	$ 28,509
9K034.1	18	21	170	9	9	9	$ 221.00	$ 37,570
							Total:	**$ 2,289,448**

ESTIMATED PIPELINE CONSTRUCTION COST -- COLEMAN CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:...	Coleman Creek
LOCATION:..	Coleman Creek, Polk St, W 10th St, W 28th St, Asher Ave
BRIEF PROJECT DESCRIPTION:........................	26,200 feet, 18-36 inch pipe
ESTIMATED COST:...	$ 8,014,600
ASSUMPTIONS:...	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:..	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5F159.1	12	18	301	9.4	7.32	8	$ 200.00	$ 60,200
5F158.1	12	18	155	7.41	7.37	7	$ 200.00	$ 31,000
5F162.1	12	18	33	7.43	7.45	7	$ 200.00	$ 6,600
5F116.1	10	18	132	7.56	6.71	7	$ 200.00	$ 26,400
5F115.1	10	18	195	7.05	6.92	7	$ 200.00	$ 39,000
5F114.1	10	18	175	7.23	13.44	10	$ 200.00	$ 35,000
5F113.1	16	21	174	13.44	5.1	9	$ 221.00	$ 38,454
5F145.1	16	21	166	5.1	6.61	6	$ 221.00	$ 36,686
5F112.1	16	21	168	7.01	5.87	6	$ 221.00	$ 37,128
5F111.1	16	21	186	5.97	5.39	6	$ 221.00	$ 41,106
5F110.1	16	21	111	5.39	7.22	6	$ 221.00	$ 24,531
5F152.1	16	21	39	8.6	9.98	9	$ 221.00	$ 8,619
6G088.1	10	15	74	5.18	5.92	6	$ 188.00	$ 13,912
6G124.1	10	15	175	6.38	6.84	7	$ 188.00	$ 32,900
6G123.1	10	15	183	6.9	9	8	$ 188.00	$ 34,404
6G122.1	10	15	199	9.08	6.19	8	$ 188.00	$ 37,412
6G121.1	10	15	178	6.33	5.84	6	$ 188.00	$ 33,464
6G120.1	8	15	129	6.2	4.57	5	$ 188.00	$ 24,252
6G073.1	8	15	131	7.55	5.24	6	$ 188.00	$ 24,628
6G072.1	8	15	331	5.23	3.8	5	$ 188.00	$ 62,228
6G011.1	8	15	197	3.8	3.39	4	$ 188.00	$ 37,036
4H047.1	10	15	91	8.95	11.04	10	$ 188.00	$ 17,108
4H041.1	10	15	10	11.04	10.39	11	$ 188.00	$ 1,880
4H040.1	12	18	224	10.39	15.45	13	$ 200.00	$ 44,800
4H039.1	12	18	291	15.45	10.3	13	$ 200.00	$ 58,200
4H038.1	10	18	129	10.4	13.28	12	$ 200.00	$ 25,800
4H037.1	16	18	299	13.28	19.6	16	$ 200.00	$ 59,800
4H062.1	12	18	22	19.6	19.716	20	$ 200.00	$ 4,400
4H061.1	12	18	84	19.716	18.16	19	$ 200.00	$ 16,800
4H060.1	12	18	144	18.26	13.58	16	$ 200.00	$ 28,800
4H059.1	12	18	94	13.68	7.398	11	$ 200.00	$ 18,800
4H149.1	12	18	14	7.398	5.93	7	$ 200.00	$ 2,800
4H058.1	12	18	136	6	16.75	11	$ 200.00	$ 27,200
4H057.1	12	18	58	17.1	13.6	15	$ 200.00	$ 11,600
4H056.1	16	18	210	14.05	7.7	11	$ 200.00	$ 42,000
4H055.1	16	18	56	7.85	10.3	9	$ 200.00	$ 11,200
4H054.1	12	18	84	10.4	9.78	10	$ 200.00	$ 16,800
4H053.1	12	18	130	9.9	7.98	9	$ 200.00	$ 26,000
4H052.1	12	18	207	7.98	12.36	10	$ 200.00	$ 41,400
5H026.1	12	18	170	12.36	14.3	13	$ 200.00	$ 34,000
5H025.1	15	21	99	14.34	15	15	$ 221.00	$ 21,879
5H027.1	15	21	214	15.01	14.53	15	$ 221.00	$ 47,294
5H028.1	15	21	129	14.52	14.02	14	$ 221.00	$ 28,509
5H087.1	15	21	400	14.12	11.83	13	$ 221.00	$ 88,400
4K114.1	10	15	158	2.6	8.39	5	$ 188.00	$ 29,704

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
4K116.1	10	15	116	8.39	11.05	10	$ 188.00	$ 21,808
4K010.1	10	15	286	11.05	12.7	12	$ 188.00	$ 53,768
4K009.1	10	15	297	12.7	20.84	17	$ 188.00	$ 55,836
4K008.1	12	15	227	20.84	19.87	20	$ 188.00	$ 42,676
4K007.1	10	15	208	19.87	13	16	$ 188.00	$ 39,104
4K006.1	10	15	347	13	10.94	12	$ 188.00	$ 65,236
4K005.1	10	15	418	10.95	6.4	9	$ 188.00	$ 78,584
5K001.1	10	15	401	8.41	3.44	6	$ 188.00	$ 75,388
5K002.1	10	15	389	3.45	3.66	4	$ 188.00	$ 73,132
5K003.1	12	15	319	3.69	14.75	9	$ 188.00	$ 59,972
5L025.1	15	21	156	7.32	7.72	8	$ 221.00	$ 34,476
5L026.1	15	21	339	7.72	5.56	7	$ 221.00	$ 74,919
5L027.1	15	21	401	5.56	7.31	6	$ 221.00	$ 88,621
5L028.1	15	21	7	7.31	7.32	7	$ 221.00	$ 1,547
5G160.1	18	36	189	7.88	6.88	7	$ 381.00	$ 72,009
5G045.1	18	36	63	6.95	6.93	7	$ 381.00	$ 24,003
5G142.1	18	36	158	7.05	5.75	6	$ 381.00	$ 60,198
5G046.1	18	36	184	5.83	6.62	6	$ 381.00	$ 70,104
5G048.1	18	36	125	6.68	6.359	7	$ 381.00	$ 47,625
5G067.1	18	36	150	6.359	6.78	7	$ 381.00	$ 57,150
5G049.1	18	36	192	6.78	7.23	7	$ 381.00	$ 73,152
5G130.1	18	36	87	7.23	6.95	7	$ 381.00	$ 33,147
5G051.1	18	36	102	7.05	9.57	8	$ 381.00	$ 38,862
5G099.1	18	36	171	9.57	6.51	8	$ 381.00	$ 65,151
5G100.1	18	36	64	6.51	6.32	6	$ 381.00	$ 24,384
5G153.1	30	36	371	6.41	8.89	8	$ 381.00	$ 141,351
5G106.1	30	36	126	9.04	10.39	10	$ 381.00	$ 48,006
5G154.1	30	36	138	10.59	11.57	11	$ 381.00	$ 52,578
5G155.1	30	36	238	11.75	8.93	10	$ 381.00	$ 90,678
5G156.1	30	36	266	8.98	8.05	9	$ 381.00	$ 101,346
5G157.1	30	36	145	8.37	9.01	9	$ 381.00	$ 55,245
5G158.1	30	36	216	9.32	8.24	9	$ 381.00	$ 82,296
5H104.1	30	36	82	8.48	8.87	9	$ 381.00	$ 31,242
5H086.1	24	36	204	9.08	7.4	8	$ 381.00	$ 77,724
5H004.1	24	36	400	7.39	7.92	8	$ 381.00	$ 152,400
5H008.1	24	36	507	8.08	11.06	10	$ 381.00	$ 193,167
5H010.1	24	36	101	10.88	9.7	10	$ 381.00	$ 38,481
5H011.1	24	36	401	9.85	10.75	10	$ 381.00	$ 152,781
5H012.1	21	36	170	11.18	15.28	13	$ 381.00	$ 64,770
5H014.1	21	36	94	15.28	16.944	16	$ 381.00	$ 35,814
5H015.1	21	36	103	16.944	17.698	17	$ 381.00	$ 39,243
5H016.1	21	36	125	17.698	11.83	15	$ 381.00	$ 47,625
5H018.1	21	36	171	11.93	10.495	11	$ 381.00	$ 65,151
5H019.1	21	36	223	10.495	9.61	10	$ 381.00	$ 84,963
5H020.1	21	36	247	9.61	12.32	11	$ 381.00	$ 94,107
5H088.1	21	36	62	12.36	8.63	10	$ 381.00	$ 23,622
5I035.1	21	36	57	8.97	7.07	8	$ 381.00	$ 21,717
5I033.1	21	36	101	7.04	7.97	8	$ 381.00	$ 38,481
5I032.1	21	36	83	8.05	7.19	8	$ 381.00	$ 31,623
5I031.1	21	36	246	7.32	7.857	8	$ 381.00	$ 93,726
5I030.1	21	36	338	7.857	8.71	8	$ 381.00	$ 128,778
5I029.1	21	36	146	8.73	8.23	8	$ 381.00	$ 55,626
5I027.1	21	36	197	8.23	9.11	9	$ 381.00	$ 75,057
5I026.1	21	36	246	9.11	8.06	9	$ 381.00	$ 93,726
5I120.1	21	36	364	8.2	8.84	9	$ 381.00	$ 138,684
5I024.1	21	36	87	8.84	9.658	9	$ 381.00	$ 33,147
5I105.1	21	36	447	9.658	8.012	9	$ 381.00	$ 170,307
5I132.1	21	36	121	8.012	7.46	8	$ 381.00	$ 46,101
5I107.1	21	36	46	7.38	7.56	7	$ 381.00	$ 17,526
5I104.1	21	36	279	7.56	6.78	7	$ 381.00	$ 106,299
5I103.1	21	36	86	6.72	7.72	7	$ 381.00	$ 32,766
5J001.1	21	36	401	7.72	8.76	8	$ 381.00	$ 152,781
5J002.1	21	36	597	8.8	7.36	8	$ 381.00	$ 227,457
5J003.1	21	36	255	7.34	9.1	8	$ 381.00	$ 97,155
5J075.1	24	36	213	9.14	6.61	8	$ 381.00	$ 81,153

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
5J007.1	24	36	199	6.54	9.99	8	$ 381.00	$ 75,819
5J016.1	24	36	491	10.04	9.21	10	$ 381.00	$ 187,071
5J018.1	24	36	492	9.22	15.18	12	$ 381.00	$ 187,452
5J019.1	24	36	216	15.26	14.44	15	$ 381.00	$ 82,296
5J074.1	24	36	17	14.55	15.16	15	$ 381.00	$ 6,477
5K004.1	24	36	207	15.2	13.53	14	$ 381.00	$ 78,867
5K005.1	24	36	243	13.53	11.52	13	$ 381.00	$ 92,583
5K006.1	24	36	223	11.52	9.73	11	$ 381.00	$ 84,963
5K007.1	24	36	271	9.65	10.87	10	$ 381.00	$ 103,251
5K022.1	24	36	432	10.86	10.89	11	$ 381.00	$ 164,592
5K025.1	24	36	315	10.9	12.54	12	$ 381.00	$ 120,015
5K029.1	24	36	159	12.54	8.37	10	$ 381.00	$ 60,579
5K095.1	24	36	323	8.37	9.45	9	$ 381.00	$ 123,063
5K030.1	24	36	348	9.45	11.44	10	$ 381.00	$ 132,588
5K031.1	24	36	394	11.44	5.35	8	$ 381.00	$ 150,114
5L044.1	24	36	140	5.27	9.11	7	$ 381.00	$ 53,340
5L043.1	24	36	82	9.27	10.01	10	$ 381.00	$ 31,242
5L040.1	24	36	149	9.94	6	8	$ 381.00	$ 56,769
5L038.1	24	36	160	6	6.57	6	$ 381.00	$ 60,960
5L036.1	24	36	333	6.56	7.61	7	$ 381.00	$ 126,873
							Total:	**$ 8,014,600**

ESTIMATED PIPELINE CONSTRUCTION COST -- COUNTRY CLUB

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Country Club
LOCATION:... Cantrell Road, Rebsamen Park Rd
BRIEF PROJECT DESCRIPTION:........................ 7500 feet, 30-54 inch pipe
ESTIMATED COST:... $ 3,205,850
ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
8E049.1	24	30	337	8.44	8.14	8	$ 320.00	$ 107,840
8E063.1	24	30	495	8.14	11.54	10	$ 320.00	$ 158,400
8F017.1	24	30	327	11.54	9.9	11	$ 320.00	$ 104,640
8F019.1	24	30	73	9.9	13.48	12	$ 320.00	$ 23,360
8F020.1	24	30	368	13.48	14.56	14	$ 320.00	$ 117,760
8F021.1	24	36	111	14.56	14.16	14	$ 381.00	$ 42,291
8F022.1	24	36	117	14.16	14.4	14	$ 381.00	$ 44,577
8F105.1	24	36	20	14.4	14.85	15	$ 381.00	$ 7,620
8F104.1	24	36	530	14.85	14.262	15	$ 381.00	$ 201,930
8F098.1	24	36	539	14.262	13.873	14	$ 381.00	$ 205,359
9F034.1	24	36	21	13.873	23.15	19	$ 381.00	$ 8,001
9F061.1	24	36	129	23.15	14.21	19	$ 381.00	$ 49,149
9F033.1	24	36	246	14.21	12.645	13	$ 381.00	$ 93,726
9F032.1	24	36	95	12.645	13.01	13	$ 381.00	$ 36,195
9F031.1	24	36	198	13	13.6	13	$ 381.00	$ 75,438
9F030.1	24	36	143	14.04	7.42	11	$ 381.00	$ 54,483
9F029.1	24	36	381	7.98	6.865	7	$ 381.00	$ 145,161
9F028.1	27	36	376	6.865	19	13	$ 381.00	$ 143,256
9F026.1	27	36	427	18.999	24.001	22	$ 381.00	$ 162,687
9F025.1	27	36	66	24.05	21.78	23	$ 381.00	$ 25,146
9F058.1	27	36	66	21.78	22.5	22	$ 381.00	$ 25,146
9F024.1	27	36	90	22.5	23.49	23	$ 381.00	$ 34,290
9F059.1	27	36	213	23.49	13.82	19	$ 381.00	$ 81,153
9F023.1	27	36	20	13.82	32.58	23	$ 381.00	$ 7,620
9F022.1	42	54	300	34.51	37.39	36	$ 603.00	$ 180,900
9F053.1	42	54	670	37.42	37.98	38	$ 603.00	$ 404,010
10F005.1	42	54	596	38.03	36.4	37	$ 603.00	$ 359,388
10G070.1	42	54	131	36.45	34.09	35	$ 603.00	$ 78,993
10G069.1	42	54	377	34.12	41	38	$ 603.00	$ 227,331
							Total:	**$ 3,205,850**

ESTIMATED PIPELINE CONSTRUCTION COST -- DISTRICT 119

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:..	District 119
LOCATION:..	W 34th St, Mary St, Boulevard Ave, W 22nd St
BRIEF PROJECT DESCRIPTION:........................	5500 feet, 24 inch pipe
ESTIMATED COST:..	$ 1,568,103
ASSUMPTIONS:..	(i) New diameter based on pipe replacement (ii) Pipeline costs based on gravity construction in congested urban installations (iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation (iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:..	none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
6J005.1	15	24	53	8.55	8.01	8	$ 283.00	$ 14,999
6J134.1	15	24	105	8.13	7.75	8	$ 283.00	$ 29,715
6J135.1	15	24	66	8	8.47	8	$ 283.00	$ 18,678
6J011.1	15	24	153	8.56	9.77	9	$ 283.00	$ 43,299
6J166.1	15	24	4	9.77	9.73	10	$ 283.00	$ 1,132
6J012.1	15	24	73	9.73	9.388	10	$ 283.00	$ 20,659
6J016.1	15	24	59	9.388	9.056	9	$ 283.00	$ 16,697
6J133.1	15	24	89	9.056	8.96	9	$ 283.00	$ 25,187
6J018.1	15	24	10	8.96	9.12	9	$ 283.00	$ 2,830
6J132.1	15	24	324	9.22	6.08	8	$ 283.00	$ 91,692
6J028.1	15	24	207	6.11	4.15	5	$ 283.00	$ 58,581
6J031.1	15	24	42	4.3	5.78	5	$ 283.00	$ 11,886
6J032.1	15	24	50	5.8	5.06	5	$ 283.00	$ 14,150
6J033.1	15	24	65	5.11	6.5	6	$ 283.00	$ 18,395
6J034.1	15	24	303	6.5	6.818	7	$ 283.00	$ 85,749
6J082.1	15	24	236	6.818	6.56	7	$ 283.00	$ 66,788
6J081.1	15	24	307	6.56	5.8	6	$ 283.00	$ 86,881
6J080.1	15	24	357	7.36	4.66	6	$ 283.00	$ 101,031
6J079.1	15	24	298	4.68	5.5	5	$ 283.00	$ 84,334
6K009.1	15	24	161	5.46	4.74	5	$ 283.00	$ 45,563
6K010.1	15	24	155	4.9	8.58	7	$ 283.00	$ 43,865
6K119.1	15	24	176	8.62	16.93	13	$ 283.00	$ 49,808
6K011.1	15	24	295	17.06	11.42	14	$ 283.00	$ 83,485
6K014.1	15	24	147	11.44	4.94	8	$ 283.00	$ 41,601
6K015.1	15	24	71	4.95	4.4	5	$ 283.00	$ 20,093
6K016.1	15	24	57	4.42	6.05	5	$ 283.00	$ 16,131
6K017.1	15	24	170	6.05	4.79	5	$ 283.00	$ 48,110
6K018.1	15	24	33	4.79	4.68	5	$ 283.00	$ 9,339
6K019.1	15	24	201	4.87	5.23	5	$ 283.00	$ 56,883
6K144.1	15	24	197	5.29	6.66	6	$ 283.00	$ 55,751
6K020.1	15	24	225	7.62	10.15	9	$ 283.00	$ 63,675
6K022.1	15	24	163	10.18	11.34	11	$ 283.00	$ 46,129
6K023.1	15	24	351	11.45	13.53	12	$ 283.00	$ 99,333
6K026.1	15	24	179	13.62	14.34	14	$ 283.00	$ 50,657
6K028.1	15	24	150	14.45	13.92	14	$ 283.00	$ 42,450
6K029.1	15	24	9	14.03	13.66	14	$ 283.00	$ 2,547
							Total:	**$ 1,568,103**

ESTIMATED PIPELINE CONSTRUCTION COST -- GRANITE MOUNTAIN

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Granite Mountain
LOCATION:.. Springer Blvd
BRIEF PROJECT DESCRIPTION:......................... 2900 feet, 18 inch pipe
ESTIMATED COST:.. $ 571,800
ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:... none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
15L002.1	12	18	295	9.73	7.22	8	$ 200.00	$ 59,000
15L001.1	12	18	302	7.22	9.33	8	$ 200.00	$ 60,400
14L005.1	12	18	130	9.33	10.73	10	$ 200.00	$ 26,000
14L024.1	12	18	146	10.73	10.86	11	$ 200.00	$ 29,200
14L004.1	12	18	404	10.86	12.91	12	$ 200.00	$ 80,800
14L003.1	12	18	398	12.91	14.7	14	$ 200.00	$ 79,600
14L002.1	12	18	324	14.7	6.69	11	$ 200.00	$ 64,800
14L026.1	12	18	221	6.69	5.3	6	$ 200.00	$ 44,200
14L001.1	12	18	71	5.3	5.46	5	$ 200.00	$ 14,200
14L025.1	12	18	65	5.46	10.51	8	$ 200.00	$ 13,000
14K059.1	12	18	338	10.51	12.01	11	$ 200.00	$ 67,600
14K058.1	12	18	165	12.01	19.1	16	$ 200.00	$ 33,000
							Total:	**$ 571,800**

ESTIMATED PIPELINE CONSTRUCTION COST -- District 19

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. District 19
LOCATION:... Near Security Ave, Bolton St
BRIEF PROJECT DESCRIPTION:........................ 7500 feet, 15 inch pipe
ESTIMATED COST:.. $ 1,416,204
ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:.. none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
15I018.1	10	15	323	6.71	5.52	6	$ 188.00	$ 60,724
15I016.1	10	15	326	5.55	5.53	6	$ 188.00	$ 61,288
15I003.1	10	15	259	5.84	6.05	6	$ 188.00	$ 48,692
15J038.1	10	15	295	6.32	6.2	6	$ 188.00	$ 55,460
15J024.1	10	15	146	6.27	5.79	6	$ 188.00	$ 27,448
15J022.1	10	15	160	5.91	5.23	6	$ 188.00	$ 30,080
15J021.1	10	15	47	5.45	6.79	6	$ 188.00	$ 8,836
15J011.1	10	15	252	6.82	5.72	6	$ 188.00	$ 47,376
15J010.1	10	15	346	5.9	8.39	7	$ 188.00	$ 65,048
15J009.1	10	15	159	8.39	8.16	8	$ 188.00	$ 29,892
15J008.1	10	15	333	8.16	10.87	10	$ 188.00	$ 62,604
15J004.1	10	15	39	10.87	7.33	9	$ 188.00	$ 7,332
15J003.1	10	15	315	7.41	8.01	8	$ 188.00	$ 59,220
15J002.1	10	15	304	8.04	12.29	10	$ 188.00	$ 57,152
15J001.1	10	15	163	12.38	15.6	14	$ 188.00	$ 30,644
15J057.1	10	15	24	15.66	15.8	16	$ 188.00	$ 4,512
15K034.1	10	15	69	15.8	14.53	15	$ 188.00	$ 12,972
15K022.1	10	15	213	14.53	12.95	14	$ 188.00	$ 40,044
15K021.1	12	15	50	13.03	10.36	12	$ 188.00	$ 9,400
15K020.1	12	15	433	10.36	10.44	10	$ 188.00	$ 81,404
15K019.1	12	15	295	10.44	24.82	18	$ 188.00	$ 55,460
15K018.1	12	15	36	24.82	24.84	25	$ 188.00	$ 6,768
15K017.1	12	15	417	24.84	22.09	23	$ 188.00	$ 78,396
15K013.1	12	15	434	22.09	20.35	21	$ 188.00	$ 81,592
15J045.1	10	15	92	8.18	8.42	8	$ 188.00	$ 17,296
16J014.1	10	15	229	8.42	9.35	9	$ 188.00	$ 43,052
16J013.1	10	15	320	9.35	10.25	10	$ 188.00	$ 60,160
16J010.1	10	15	317	10.25	10.89	11	$ 188.00	$ 59,596
16K015.1	10	15	317	10.89	13.12	12	$ 188.00	$ 59,596
16K014.1	10	15	135	13.12	12.49	13	$ 188.00	$ 25,380
16K018.1	10	15	182	12.49	12.38	12	$ 188.00	$ 34,216
16K013.1	10	15	135	12.38	15.14	14	$ 188.00	$ 25,380
16K021.1	10	15	120	15.14	15.27	15	$ 188.00	$ 22,560
16K012.1	10	15	248	15.27	23.43	19	$ 188.00	$ 46,624
							Total:	**$ 1,416,204**

ESTIMATED PIPELINE CONSTRUCTION COST -- JIMERSON CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Jimerson Creek

LOCATION:... Near Foxcroft Rd, Tallyho Ln, Youngblood Rd, Pine Valley Rc

BRIEF PROJECT DESCRIPTION:........................ 11,500 feet, 15-36 inch pipe

ESTIMATED COST:.. $ 3,064,014

ASSUMPTIONS:... (i) New diameter based on pipe replacement

(ii) Pipeline costs based on gravity construction in congested urban installations

(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation

(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies

ALTERNATIVES:.. none

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
3D118.1	10	15	251	7.02	2.67	5	$ 188.00	$ 47,188
3D119.1	10	15	242	4.64	6.68	6	$ 188.00	$ 45,496
3D120.1	10	15	206	6.8	3.14	5	$ 188.00	$ 38,728
3D066.1	10	15	368	5.43	4.53	5	$ 188.00	$ 69,184
3D065.1	10	15	185	5.48	6.9	6	$ 188.00	$ 34,780
3D064.1	10	15	215	6.99	4.8	6	$ 188.00	$ 40,420
3D108.1	10	15	400	4.74	3.84	4	$ 188.00	$ 75,200
3D109.1	10	15	371	3.83	2.8	3	$ 188.00	$ 69,748
3D110.1	10	15	438	2.87	3.58	3	$ 188.00	$ 82,344
3D111.1	12	18	227	3.58	5.44	5	$ 200.00	$ 45,400
3D113.1	16	21	127	5.42	6.89	6	$ 221.00	$ 28,067
3D114.1	16	21	130	7.55	6.03	7	$ 221.00	$ 28,730
3C096.1	16	21	213	5.95	4.72	5	$ 221.00	$ 47,073
3C095.1	16	21	76	7.71	7.16	7	$ 221.00	$ 16,796
3C097.1	16	21	145	7.24	6.08	7	$ 221.00	$ 32,045
3C098.1	16	21	30	6.08	4.58	5	$ 221.00	$ 6,630
3C103.1	16	21	190	4.7	4.6	5	$ 221.00	$ 41,990
3C104.1	16	21	97	4.71	4.09	4	$ 221.00	$ 21,437
3C105.1	16	21	380	5.68	4.12	5	$ 221.00	$ 83,980
3C124.1	16	21	73	4.21	3.11	4	$ 221.00	$ 16,133
3C123.1	16	21	83	4.96	5.79	5	$ 221.00	$ 18,343
3C122.1	16	21	86	5.9	7.29	7	$ 221.00	$ 19,006
3C159.1	16	21	120	7.29	11.91	10	$ 221.00	$ 26,520
3C136.1	16	21	69	12.13	6.35	9	$ 221.00	$ 15,249
3C137.1	16	21	82	12.51	6.92	10	$ 221.00	$ 18,122
3C138.1	16	21	93	7	5.93	6	$ 221.00	$ 20,553
3C139.1	18	24	371	6.37	7.28	7	$ 283.00	$ 104,993
2C113.1	18	24	255	7.41	4.51	6	$ 283.00	$ 72,165
2C112.1	18	24	104	4.55	4.63	5	$ 283.00	$ 29,432
2C111.1	18	24	236	4.74	4.63	5	$ 283.00	$ 66,788
2C110.1	18	24	119	4.66	5.26	5	$ 283.00	$ 33,677
2C114.1	18	24	184	5.26	4.63	5	$ 283.00	$ 52,072
2C115.1	18	24	222	4.91	5.09	5	$ 283.00	$ 62,826
2C120.1	18	24	192	5.23	6.26	6	$ 283.00	$ 54,336
2C121.1	18	24	206	6.28	5.14	6	$ 283.00	$ 58,298
2C127.1	18	24	328	5.86	5.38	6	$ 283.00	$ 92,824
2C128.1	18	24	89	5.57	5.17	5	$ 283.00	$ 25,187
2C129.1	18	24	314	6.12	5.8	6	$ 283.00	$ 88,862
2C006.1	18	24	312	5.78	4.68	5	$ 283.00	$ 88,296
2C005.1	18	24	391	4.73	4.78	5	$ 283.00	$ 110,653
2C001.1	18	24	199	4.73	4.61	5	$ 283.00	$ 56,317
1B023.1	18	24	216	4.45	4.49	4	$ 283.00	$ 61,128
1B021.1	18	24	83	5.55	3.96	5	$ 283.00	$ 23,489
1B020.1	18	24	104	3.95	6.17	5	$ 283.00	$ 29,432
1B078.1	18	24	95	6.17	4.68	5	$ 283.00	$ 26,885
1B019.1	18	24	282	5.95	5.39	6	$ 283.00	$ 79,806
1B018.1	18	24	193	5.5	5.81	6	$ 283.00	$ 54,619

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
1B017.1	24	36	187	6.14	7.24	7	$ 381.00	$ 71,247
1B016.1	24	36	107	7.14	6.07	7	$ 381.00	$ 40,767
1B015.1	24	36	268	6.24	9.94	8	$ 381.00	$ 102,108
1B079.1	24	36	75	9.94	15.62	13	$ 381.00	$ 28,575
1B014.1	24	36	222	15.71	13.5	15	$ 381.00	$ 84,582
1B072.1	24	36	41	13.5	12.51	13	$ 381.00	$ 15,621
1B013.1	24	36	454	12.48	15.88	14	$ 381.00	$ 172,974
2B007.1	24	36	200	15.9	13.63	15	$ 381.00	$ 76,200
2B006.1	24	36	140	13.62	14.1	14	$ 381.00	$ 53,340
2B002.1	24	36	413	14.1	11.2	13	$ 381.00	$ 157,353
							Total:	**$ 3,064,014**

ESTIMATED PIPELINE CONSTRUCTION COST -- MAUMELLE

TRUNK SEWER SYSTEM PROJECT DESCRIPTION

PROJECT ID:.. Maumelle
LOCATION:... Near Hinson Rd, Jennifer Dr
BRIEF PROJECT DESCRIPTION:......................... 24,500 feet, 15-36 inch pipe
ESTIMATED COST:... $ 6,536,535
ASSUMPTIONS:... (i) New diameter based on pipe replacement
(ii) Pipeline costs based on gravity construction in congested urban installations
(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation
(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:.. Significant infiltration and inflow reduction in Upper Hinson are

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-4E002.1	10	15	259	6.171	6.949	7	$ 188.00	$ 48,692
-5C136.1	10	15	269	4.97	4.071	5	$ 188.00	$ 50,572
-5C068.1	10	15	361	5.01	8.068	7	$ 188.00	$ 67,868
-5C069.1	10	15	253	8.068	8.771	8	$ 188.00	$ 47,564
-5C130.1	10	15	108	8.771	5.659	7	$ 188.00	$ 20,304
-5C074.1	10	15	404	5.659	6.25	6	$ 188.00	$ 75,952
-5C075.1	10	15	161	6.25	5.409	6	$ 188.00	$ 30,268
-5C076.1	12	15	194	5.409	5.058	5	$ 188.00	$ 36,472
-4E035.1	10	15	308	7.259	8.35	8	$ 188.00	$ 57,904
-4E037.1	10	15	440	8.35	6.949	8	$ 188.00	$ 82,720
-4E001.1	10	15	200	7.061	8.34	8	$ 188.00	$ 37,600
-5D021.1	10	15	123	8.442	7.65	8	$ 188.00	$ 23,124
-5D018.1	10	15	163	7.65	7.251	7	$ 188.00	$ 30,644
-5D017.1	10	15	39	7.251	7.809	8	$ 188.00	$ 7,332
-5D079.1	10	15	59	7.871	9.14	9	$ 188.00	$ 11,092
-5D016.1	10	15	224	9.14	6.41	8	$ 188.00	$ 42,112
-5D117.1	10	15	105	6.41	5.139	6	$ 188.00	$ 19,740
-5D015.1	10	15	56	7.18	9.38	8	$ 188.00	$ 10,528
-5D115.1	10	15	164	9.38	8.791	9	$ 188.00	$ 30,832
-5D014.1	10	15	203	8.791	11.131	10	$ 188.00	$ 38,164
-5D013.1	10	18	56	11.131	7.97	10	$ 200.00	$ 11,200
-5D061.1	10	18	243	7.97	7.66	8	$ 200.00	$ 48,600
-5D012.1	10	18	151	7.709	9.068	8	$ 200.00	$ 30,200
-5D085.1	10	18	194	9.068	12.8	11	$ 200.00	$ 38,800
-5D011.1	10	18	174	12.98	6.458	10	$ 200.00	$ 34,800
-5D010.1	10	18	128	6.458	7.768	7	$ 200.00	$ 25,600
-5D009.1	10	18	220	7.768	6.928	7	$ 200.00	$ 44,000
-5D008.1	10	18	404	7.909	6.469	7	$ 200.00	$ 80,800
-5D007.1	10	18	269	6.538	4.579	6	$ 200.00	$ 53,800
-5D006.1	10	18	249	4.668	6.49	6	$ 200.00	$ 49,800
-5D005.1	10	18	210	6.588	9.339	8	$ 200.00	$ 42,000
-5D004.1	10	18	423	9.608	4.458	7	$ 200.00	$ 84,600
-5C096.1	12	18	279	5.058	4.407	5	$ 200.00	$ 55,800
-5C095.1	12	18	72	4.407	7.096	6	$ 200.00	$ 14,400
-5C094.1	12	18	390	7.149	8.637	8	$ 200.00	$ 78,000
-5C093.1	12	18	92	8.657	3.028	6	$ 200.00	$ 18,400
-5C092.1	12	18	200	3.068	7.076	5	$ 200.00	$ 40,000
-5C109.1	12	18	112	7.076	5.667	6	$ 200.00	$ 22,400
-5C110.1	12	18	75	5.907	5.417	6	$ 200.00	$ 15,000
-5C111.1	12	18	174	5.417	6.217	6	$ 200.00	$ 34,800
-5C113.1	12	18	36	6.466	6.978	7	$ 200.00	$ 7,200
-5C114.1	12	18	207	6.978	8.247	8	$ 200.00	$ 41,400
-5C116.1	12	18	397	8.506	7.147	8	$ 200.00	$ 79,400
-5C030.1	15	18	197	7.147	5.127	6	$ 200.00	$ 39,400
-5C029.1	15	18	256	5.127	8.996	7	$ 200.00	$ 51,200
-5C026.1	20	27	121	9.596	9.168	9	$ 302.00	$ 36,542

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-5C028.1	20	27	184	9.177	8.626	9	$ 302.00	$ 55,568
-6C033.1	20	27	338	8.835	8.496	9	$ 302.00	$ 102,076
-6C029.1	20	27	279	8.565	9.735	9	$ 302.00	$ 84,258
-6C028.1	20	27	217	9.896	14.167	12	$ 302.00	$ 65,534
-6B012.1	20	27	335	14.285	9.156	12	$ 302.00	$ 101,170
-6B009.1	20	27	328	9.205	7.477	8	$ 302.00	$ 99,056
-6B008.1	20	27	141	7.506	8.827	8	$ 302.00	$ 42,582
-6B007.1	20	27	367	8.876	8.716	9	$ 302.00	$ 110,834
-6B006.1	20	27	95	8.995	10.517	10	$ 302.00	$ 28,690
-6B005.1	20	27	69	10.585	9.71	10	$ 302.00	$ 20,838
-6B140.1	20	27	49	9.71	7.9	9	$ 302.00	$ 14,798
-6B139.1	20	27	76	7.9	7.182	8	$ 302.00	$ 22,952
-6B138.1	20	27	38	7.182	10.324	9	$ 302.00	$ 11,476
-6B137.1	20	27	292	10.324	9.234	10	$ 302.00	$ 88,184
-6B003.1	20	27	318	9.306	7.565	8	$ 302.00	$ 96,036
-6B002.1	20	27	56	7.614	7.906	8	$ 302.00	$ 16,912
-6B080.1	20	27	266	7.906	9.366	9	$ 302.00	$ 80,332
-6B001.1	20	27	49	9.366	9.435	9	$ 302.00	$ 14,798
-7B011.1	20	27	118	9.563	8.616	9	$ 302.00	$ 35,636
-7B010.1	20	27	154	8.964	11.574	10	$ 302.00	$ 46,508
-7B009.1	20	27	292	11.856	11.593	12	$ 302.00	$ 88,184
-7B008.1	20	27	141	11.603	12.605	12	$ 302.00	$ 42,582
-7B061.1	21	27	236	12.786	15.583	14	$ 302.00	$ 71,272
-7B060.1	21	27	66	15.685	13.283	14	$ 302.00	$ 19,932
-7B059.1	21	27	59	13.614	15.165	14	$ 302.00	$ 17,818
-7B043.1	21	27	374	15.454	13.864	15	$ 302.00	$ 112,948
-7B044.1	21	27	269	14.114	13.826	14	$ 302.00	$ 81,238
-7A028.1	21	27	384	14.003	12.625	13	$ 302.00	$ 115,968
-7A029.1	21	27	397	12.795	12.765	13	$ 302.00	$ 119,894
-7A030.1	21	27	253	13.024	13.435	13	$ 302.00	$ 76,406
-7A031.1	21	27	364	13.514	12.585	13	$ 302.00	$ 109,928
-7A032.1	21	27	157	12.864	12.025	12	$ 302.00	$ 47,414
-7A033.1	21	27	390	12.334	13.302	13	$ 302.00	$ 117,780
-7A034.1	21	27	276	13.433	15.913	15	$ 302.00	$ 83,352
-7A035.1	21	27	256	16.034	13.472	15	$ 302.00	$ 77,312
-8A011.1	21	27	62	13.472	13.764	14	$ 302.00	$ 18,724
-8A001.1	21	27	30	13.793	13.954	14	$ 302.00	$ 9,060
-8A020.1	21	27	220	13.954	13.093	14	$ 302.00	$ 66,440
-8A002.1	21	27	354	13.264	14.332	14	$ 302.00	$ 106,908
-8A003.1	21	27	341	14.584	13.442	14	$ 302.00	$ 102,982
-8A004.1	21	27	207	13.574	13.204	13	$ 302.00	$ 62,514
-8A005.1	21	27	276	13.433	13.093	13	$ 302.00	$ 83,352
-8A006.1	21	27	115	13.234	12.982	13	$ 302.00	$ 34,730
-8A007.1	21	27	66	13.392	12.302	13	$ 302.00	$ 19,932
-8A027.1	21	27	331	12.302	14.582	13	$ 302.00	$ 99,962
-8A008.1	21	27	203	14.982	14.252	15	$ 302.00	$ 61,306
-8A009.1	21	27	174	14.383	12.422	13	$ 302.00	$ 52,548
-8A081.1	21	27	115	12.422	13.203	13	$ 302.00	$ 34,730
-8A010.1	21	27	141	13.291	14.403	14	$ 302.00	$ 42,582
-8-A001.1	21	27	108	14.502	13.883	14	$ 302.00	$ 32,616
-8-A002.1	21	27	148	13.923	12.423	13	$ 302.00	$ 44,696
-8-A003.1	21	27	400	12.623	11.952	12	$ 302.00	$ 120,800
-8-A004.1	21	27	28	12.054	12.191	12	$ 302.00	$ 8,456
-8-A016.1	21	27	395	12.191	11.851	12	$ 302.00	$ 119,290
-8-A005.1	21	27	256	11.952	11.122	12	$ 302.00	$ 77,312
-8-A012.1	21	27	52	11.122	11.912	12	$ 302.00	$ 15,704
-8-A006.1	21	27	180	11.912	14.333	13	$ 302.00	$ 54,360
-8-A007.1	21	27	157	14.451	15.061	15	$ 302.00	$ 47,414
-8-A008.1	21	27	285	15.192	25.013	20	$ 302.00	$ 86,070
-8-A009.1	21	27	266	25.112	20.49	23	$ 302.00	$ 80,332
-8-A010.1	21	27	194	20.69	18.103	19	$ 302.00	$ 58,588
-8-A011.1	21	27	351	18.201	17.522	18	$ 302.00	$ 106,002
-8-B001.1	24	36	154	17.702	15.231	16	$ 381.00	$ 58,674
-8-B002.1	24	36	367	15.783	17.902	17	$ 381.00	$ 139,827
-8-B003.1	24	36	282	18.201	20.582	19	$ 381.00	$ 107,442
-8-B004.1	24	36	394	20.73	24.193	22	$ 381.00	$ 150,114
-8-B012.1	24	36	394	24.452	24.411	24	$ 381.00	$ 150,114

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-8-B005.1	24	36	302	24.411	22.851	24	$ 381.00	$ 115,062
							Total:	**$ 6,536,535**

ESTIMATED PIPELINE CONSTRUCTION COST -- ROCK CREEK

TRUNK SEWER SYSTEM PROJECT DESCRIPTION	
PROJECT ID:..	Rock Creek
LOCATION:...	Rooney Parham Rd, Cunningham Lake Rd, Barrow Rd, Serenit Dr, Grassy Flat Creek
BRIEF PROJECT DESCRIPTION:.......................	57,800 feet, 21-60 inch pipe
ESTIMATED COST:...	$ 23,644,942
ASSUMPTIONS:...	(i) New diameter based on pipe replacement, assumes some parallel pipe replacement
	(ii) Pipeline costs based on gravity construction in congested urban installations
	(iii) Costs include manholes, surface restoration and incidental costs, assuming no rock excavation
	(iv) Costs are 2001 $ and include 25 percent for engineering and contingencies
ALTERNATIVES:...	Replace parallel pipes with single, larger pipe

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-2D011.1	15	21	18	13.12	13.78	13	$ 221.00	$ 3,978
-2D012.1	18	21	60	13.9	7.5	11	$ 221.00	$ 13,260
-2E001.1	18	21	82	7.81	7.52	8	$ 221.00	$ 18,122
-2E002.1	18	21	244	7.52	3.39	5	$ 221.00	$ 53,924
-2E003.1	18	21	65	3.39	8.11	6	$ 221.00	$ 14,365
-3E025.1	18	21	292	8.53	3.31	6	$ 221.00	$ 64,532
-2E029.1	18	21	575	3.31	4.28	4	$ 221.00	$ 127,075
-2E033.1	18	24	182	4.28	9.3	7	$ 283.00	$ 51,506
-2E035.1	18	24	72	9.8	11.3	11	$ 283.00	$ 20,376
-2E036.1	18	24	267	11.3	8.97	10	$ 283.00	$ 75,561
-2E037.1	18	24	410	8.97	10.77	10	$ 283.00	$ 116,030
-2E038.1	18	24	356	10.77	13.26	12	$ 283.00	$ 100,748
-2E039.1	18	24	46	13.26	12.25	13	$ 283.00	$ 13,018
-2E093.1	18	24	350	12.25	12.48	12	$ 283.00	$ 99,050
-2E094.1	18	24	130	12.48	13.31	13	$ 283.00	$ 36,790
-2E040.1	18	24	111	13.31	11.63	12	$ 283.00	$ 31,413
-2E041.1	18	24	144	11.63	11.85	12	$ 283.00	$ 40,752
-2F031.1	18	24	334	11.85	12.85	12	$ 283.00	$ 94,522
-2F030.1	18	24	353	12.85	14.92	14	$ 283.00	$ 99,899
-2F038.1	18	24	388	14.92	10.42	13	$ 283.00	$ 109,804
-2F036.1	18	24	382	10.42	10.55	10	$ 283.00	$ 108,106
-2E006.1	15	21	230	10.56	8.5	10	$ 221.00	$ 50,830
-2E007.1	15	21	70	8.5	9	9	$ 221.00	$ 15,470
-2E008.1	15	21	150	9	8.91	9	$ 221.00	$ 33,150
-2E009.1	15	21	430	8.91	6.2	8	$ 221.00	$ 95,030
-2E010.1	15	21	260	6.32	7.1	7	$ 221.00	$ 57,460
-2E012.1	15	21	215	7.1	6.96	7	$ 221.00	$ 47,515
-2E013.1	15	21	135	6.96	7.5	7	$ 221.00	$ 29,835
-2E107.1	15	21	118	7.73	6.202	7	$ 221.00	$ 26,078
-2E014.1	15	21	220	6.202	7.63	7	$ 221.00	$ 48,620
-2E015.1	15	21	292	7.63	6.8	7	$ 221.00	$ 64,532
-2E016.1	15	21	306	6.97	9.7	8	$ 221.00	$ 67,626
-2F024.1	15	21	337	9.89	9.74	10	$ 221.00	$ 74,477
-2F023.1	15	21	327	9.74	7.4	9	$ 221.00	$ 72,267
-2F039.1	15	21	387	7.52	7	7	$ 221.00	$ 85,527
-2F037.1	15	21	389	7	6.5	7	$ 221.00	$ 85,969
-2F035.1	15	21	474	6.7	6.5	7	$ 221.00	$ 104,754
-1F014.1	24	30	55	6.73	8.5	8	$ 320.00	$ 17,600
-1F013.1	24	30	230	8.5	9.29	9	$ 320.00	$ 73,600
-1F012.1	24	30	405	9.29	6.81	8	$ 320.00	$ 129,600
-1F051.1	24	30	211	6.81	13.07	10	$ 320.00	$ 67,520
-1F046.1	24	30	17	13.57	14.39	14	$ 320.00	$ 5,440
-1F047.1	24	30	226	14.39	10.95	13	$ 320.00	$ 72,320
-1F044.1	24	30	339	10.95	10.48	11	$ 320.00	$ 108,480

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
-1E046.1	24	30	266	10.48	9.29	10	$ 320.00	$ 85,120
-1F086.1	24	30	258	9.29	10.32	10	$ 320.00	$ 82,560
0F001.1	24	30	319	10.32	10.1	10	$ 320.00	$ 102,080
0F002.1	24	36	160	10.1	9.82	10	$ 381.00	$ 60,960
0F003.1	24	36	218	9.82	12.87	11	$ 381.00	$ 83,058
0F004.1	24	36	99	12.87	8.75	11	$ 381.00	$ 37,719
0F005.1	24	36	477	8.75	14.99	12	$ 381.00	$ 181,737
0F026.1	24	36	346	14.99	11.8	13	$ 381.00	$ 131,826
0F137.1	24	36	216	11.8	11.2	12	$ 381.00	$ 82,296
0F135.1	24	36	310	11.45	9.4	10	$ 381.00	$ 118,110
0F136.1	24	36	328	9.4	9.29	9	$ 381.00	$ 124,968
0E080.1	24	36	308	9.29	9.53	9	$ 381.00	$ 117,348
0E079.1	24	36	347	9.53	10.01	10	$ 381.00	$ 132,207
0E078.1	24	36	272	10.11	12.04	11	$ 381.00	$ 103,632
0E168.1	24	36	177	12.14	16.26	14	$ 381.00	$ 67,437
0E169.1	24	36	235	16.31	11.26	14	$ 381.00	$ 89,535
1E140.1	24	36	24	11.29	16.02	14	$ 381.00	$ 9,144
1E116.1	24	36	223	16.12	12.12	14	$ 381.00	$ 84,963
1E115.1	24	36	78	12.22	12.1	12	$ 381.00	$ 29,718
1E114.1	30	36	483	12.48	10.33	11	$ 381.00	$ 184,023
1E113.1	30	36	479	10.36	6.6	8	$ 381.00	$ 182,499
1E112.1	30	36	319	7.6	12.79	10	$ 381.00	$ 121,539
1E111.1	30	36	131	13.02	19.1	16	$ 381.00	$ 49,911
1F049.1	30	36	330	19.15	15.6	17	$ 381.00	$ 125,730
1F048.1	30	36	251	15.62	16.81	16	$ 381.00	$ 95,631
1F047.1	30	36	319	16.82	12.15	14	$ 381.00	$ 121,539
1F046.1	30	36	405	14.32	9.48	12	$ 381.00	$ 154,305
1F044.1	30	36	87	9.48	10.44	10	$ 381.00	$ 33,147
1F129.1	30	36	121	10.44	11.09	11	$ 381.00	$ 46,101
1F043.1	30	36	241	11.1	9.85	10	$ 381.00	$ 91,821
1F041.1	30	36	411	11.9	11.38	12	$ 381.00	$ 156,591
1F040.1	30	36	146	11.4	13.02	12	$ 381.00	$ 55,626
1F039.1	30	36	486	13.06	14.47	14	$ 381.00	$ 185,166
1G068.1	30	36	371	14.5	13.58	14	$ 381.00	$ 141,351
1G065.1	30	42	343	13.6	12.8	13	$ 414.00	$ 142,002
1G064.1	30	42	348	12.87	15	14	$ 414.00	$ 144,072
1G019.1	30	42	90	15.06	15.65	15	$ 414.00	$ 37,260
1G149.1	30	42	120	15.65	16.6	16	$ 414.00	$ 49,680
1G017.1	30	42	70	16.65	14.62	16	$ 414.00	$ 28,980
1G014.1	30	42	451	14.68	17.19	16	$ 414.00	$ 186,714
1G012.1	30	42	183	17.21	13.61	15	$ 414.00	$ 75,762
1G009.1	30	42	167	13.65	10.88	12	$ 414.00	$ 69,138
-1F014.2	8	24	51	6.7	8.7	8	$ 283.00	$ 14,433
-1F039.1	15	24	313	8.81	7.69	8	$ 283.00	$ 88,579
-1F040.1	15	24	303	7.69	7	7	$ 283.00	$ 85,749
-1F041.1	15	24	246	7.18	10.96	9	$ 283.00	$ 69,618
-1F042.1	15	24	140	10.96	9	10	$ 283.00	$ 39,620
-1F043.1	15	24	171	9.13	8	9	$ 283.00	$ 48,393
-1F054.1	15	24	240	8	8.6	8	$ 283.00	$ 67,920
-1F055.1	15	24	299	8.6	7.5	8	$ 283.00	$ 84,617
-1F071.1	15	24	75	7.5	8.4	8	$ 283.00	$ 21,225
-1F072.1	15	36	126	8.56	6.17	7	$ 381.00	$ 48,006
-1F073.1	15	36	100	6.17	5	6	$ 381.00	$ 38,100
-1F074.1	15	36	100	5	7.12	6	$ 381.00	$ 38,100
0F139.1	15	36	245	7.13	7.8	7	$ 381.00	$ 93,345
0F140.1	15	36	324	7.94	9.5	9	$ 381.00	$ 123,444
0F011.1	15	36	70	9.64	11.49	11	$ 381.00	$ 26,670
0F012.1	15	36	210	11.49	6.6	9	$ 381.00	$ 80,010
0F013.1	15	36	268	6.61	6.5	7	$ 381.00	$ 102,108
0F014.1	15	36	282	6.69	7.65	7	$ 381.00	$ 107,442
0F015.1	15	36	50	7.65	7.91	8	$ 381.00	$ 19,050
0F018.1	15	36	283	7.91	8.38	8	$ 381.00	$ 107,823
0F019.1	15	36	70	8.38	7.75	8	$ 381.00	$ 26,670
0F020.1	18	36	67	8.11	8.03	8	$ 381.00	$ 25,527
0F145.1	18	36	281	8.03	6	7	$ 381.00	$ 107,061
0E069.1	18	36	250	6	9.5	8	$ 381.00	$ 95,250

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
0E070.1	18	36	250	9.63	8.1	9	$ 381.00	$ 95,250
0E071.1	18	36	293	8.1	12.8	10	$ 381.00	$ 111,633
0E072.1	18	36	137	13	8	11	$ 381.00	$ 52,197
0E073.1	18	36	170	8	7.73	8	$ 381.00	$ 64,770
0E074.1	18	36	268	7.73	9.3	9	$ 381.00	$ 102,108
0E076.1	18	36	45	9.45	12.7	11	$ 381.00	$ 17,145
1E117.1	18	36	339	12.7	8.6	11	$ 381.00	$ 129,159
1E118.1	18	36	96	8.74	8.15	8	$ 381.00	$ 36,576
1E149.1	18	36	129	8.15	8.2	8	$ 381.00	$ 49,149
1E119.1	18	36	261	8.26	5.8	7	$ 381.00	$ 99,441
1E120.1	18	36	103	5.86	6.28	6	$ 381.00	$ 39,243
1E121.1	18	36	276	6.28	6.9	7	$ 381.00	$ 105,156
1E122.1	18	36	285	6.97	6.62	7	$ 381.00	$ 108,585
1E123.1	18	36	150	6.62	9.7	8	$ 381.00	$ 57,150
1E124.1	18	36	164	9.71	8.87	9	$ 381.00	$ 62,484
1E125.1	18	36	166	8.97	10.9	10	$ 381.00	$ 63,246
1F008.1	18	36	251	10.99	7.49	9	$ 381.00	$ 95,631
1F007.1	18	36	46	7.5	7.7	8	$ 381.00	$ 17,526
1F006.1	18	36	280	7.7	11.8	10	$ 381.00	$ 106,680
1F009.1	21	36	324	12.36	5.41	9	$ 381.00	$ 123,444
1F010.1	21	36	414	5.57	9.4	7	$ 381.00	$ 157,734
1F011.1	21	36	428	9.58	12.74	11	$ 381.00	$ 163,068
1F042.1	21	36	22	12.87	8.586	11	$ 381.00	$ 8,382
1F028.1	21	36	362	8.586	6.41	7	$ 381.00	$ 137,922
1F029.1	21	36	146	6.6	9.68	8	$ 381.00	$ 55,626
1F030.1	21	36	357	9.68	9.25	9	$ 381.00	$ 136,017
1F031.1	21	36	157	9.32	5.44	7	$ 381.00	$ 59,817
1F032.1	21	36	175	5.45	8.65	7	$ 381.00	$ 66,675
1G091.1	18	36	186	9	9.45	9	$ 381.00	$ 70,866
1G090.1	18	36	305	9.45	8.82	9	$ 381.00	$ 116,205
1G089.1	18	36	215	8.82	8.08	8	$ 381.00	$ 81,915
1G088.1	18	36	201	8.08	7.32	8	$ 381.00	$ 76,581
1G087.1	18	36	278	7.32	6.65	7	$ 381.00	$ 105,918
1G086.1	18	36	50	6.65	7.11	7	$ 381.00	$ 19,050
1G074.1	21	36	529	10.91	13.2	12	$ 381.00	$ 201,549
1G016.1	24	36	111	13.2	9.85	12	$ 381.00	$ 42,291
1G015.1	24	36	296	10.03	7.57	9	$ 381.00	$ 112,776
1G013.1	24	36	300	7.65	7.26	7	$ 381.00	$ 114,300
1G011.1	24	36	164	7.27	5.2	6	$ 381.00	$ 62,484
1G010.1	24	36	287	5.45	6.54	6	$ 381.00	$ 109,347
1G006.1	24	36	352	6.56	6.96	7	$ 381.00	$ 134,112
1G005.1	24	36	71	6.98	7.35	7	$ 381.00	$ 27,051
1G002.1	24	36	265	7.39	5.24	6	$ 381.00	$ 100,965
1G001.1	24	36	167	5.26	6.09	6	$ 381.00	$ 63,627
2H031.1	24	36	450	6.14	11.08	9	$ 381.00	$ 171,450
2H030.1	24	36	345	11.08	12.78	12	$ 381.00	$ 131,445
2H029.1	24	36	347	12.78	12.12	12	$ 381.00	$ 132,207
2H028.1	24	36	8	12.15	12.38	12	$ 381.00	$ 3,048
2H027.1	24	36	138	13.04	12.08	13	$ 381.00	$ 52,578
2H026.1	24	36	279	12.38	11.72	12	$ 381.00	$ 106,299
2H025.1	24	36	47	11.83	11.72	12	$ 381.00	$ 17,907
2H024.1	30	36	58	11.81	10.8	11	$ 381.00	$ 22,098
2H023.1	30	36	228	10.8	7.5	9	$ 381.00	$ 86,868
2H022.1	30	36	155	7.5	7.5	8	$ 381.00	$ 59,055
2H021.1	30	36	55	7.5	10.21	9	$ 381.00	$ 20,955
2H020.1	30	36	234	10.21	11	11	$ 381.00	$ 89,154
2H019.1	30	36	250	11	5.6	8	$ 381.00	$ 95,250
2H018.1	30	36	475	5.6	7.23	6	$ 381.00	$ 180,975
2H017.1	30	36	350	7.23	8.08	8	$ 381.00	$ 133,350
2H016.1	30	36	200	8.08	8.65	8	$ 381.00	$ 76,200
2H015.1	24	36	473	8.79	8.43	9	$ 381.00	$ 180,213
3H094.1	24	36	295	8.43	9.4	9	$ 381.00	$ 112,395
3H068.1	24	36	250	9.4	10.57	10	$ 381.00	$ 95,250
3H081.1	24	36	300	10.57	12	11	$ 381.00	$ 114,300
3H069.1	24	36	200	12	7.9	10	$ 381.00	$ 76,200
3H070.1	24	36	30	7.9	10.17	9	$ 381.00	$ 11,430
3H074.2	24	36	375	10.53	11.4	11	$ 381.00	$ 142,875

LINK REFERENCE	EXISTING DIAMETER (inches)	NEW DIAMETER (inches)	LENGTH (feet)	U/S DEPTH (feet)	D/S DEPTH (feet)	AVG. DEPTH (feet)	UNIT COST ($/lf)	COST
3H076.1	24	36	179	11.4	11.98	12	$ 381.00	$ 68,199
3H078.1	24	36	233	11.98	11.8	12	$ 381.00	$ 88,773
3H079.1	24	36	336	11.8	12.8	12	$ 381.00	$ 128,016
3I025.1	24	36	318	12.8	9.11	11	$ 381.00	$ 121,158
3I028.1	24	36	318	9.11	8.24	9	$ 381.00	$ 121,158
3I027.1	24	36	201	8.24	14.68	11	$ 381.00	$ 76,581
3I035.1	24	36	52	14.78	14.96	15	$ 381.00	$ 19,812
3I034.1	24	36	112	14.96	14.64	15	$ 381.00	$ 42,672
3I033.1	24	36	170	14.82	5.64	10	$ 381.00	$ 64,770
3I022.1	24	36	138	5.64	11.3	8	$ 381.00	$ 52,578
3I021.1	24	36	125	11.3	11.57	11	$ 381.00	$ 47,625
3I020.1	24	36	65	11.57	10.8	11	$ 381.00	$ 24,765
3I019.1	24	36	334	10.8	8.97	10	$ 381.00	$ 127,254
3I018.1	24	36	334	8.97	11.11	10	$ 381.00	$ 127,254
3I016.1	24	36	98	11.11	11.52	11	$ 381.00	$ 37,338
3I039.1	42	54	168	16.01	16.21	16	$ 603.00	$ 101,304
3I037.1	42	54	177	16.24	13.86	15	$ 603.00	$ 106,731
3I038.1	42	54	252	13.95	15.37	15	$ 603.00	$ 151,956
3I007.1	42	54	459	15.86	15.26	16	$ 603.00	$ 276,777
3J002.1	42	54	12	15.41	12.68	14	$ 603.00	$ 7,236
3J003.1	42	54	11	12.68	15.93	14	$ 603.00	$ 6,633
3J004.1	42	54	137	16	15.91	16	$ 603.00	$ 82,611
3J005.1	42	54	392	15.96	14.29	15	$ 603.00	$ 236,376
3J006.1	42	54	402	14.39	16.32	15	$ 603.00	$ 242,406
3J007.1	42	54	472	16.39	16.65	17	$ 603.00	$ 284,616
3J008.1	42	54	279	16.72	13.14	15	$ 603.00	$ 168,237
3J009.1	42	54	465	13.22	10.89	12	$ 603.00	$ 280,395
3J010.1	42	54	197	11.07	13.1	12	$ 603.00	$ 118,791
3J011.1	42	54	342	13.16	18.47	16	$ 603.00	$ 206,226
3J012.1	42	54	366	18.54	19.88	19	$ 603.00	$ 220,698
3J013.1	42	54	21	20.09	20.19	20	$ 603.00	$ 12,663
3J014.1	42	54	823	20.22	12.86	17	$ 603.00	$ 496,269
3K069.1	42	54	221	12.89	13.15	13	$ 603.00	$ 133,263
3K068.1	42	54	612	13.19	13.62	13	$ 603.00	$ 369,036
3K064.1	42	54	828	13.66	11.42	13	$ 603.00	$ 499,284
3K061.1	42	54	824	11.53	15.9	14	$ 603.00	$ 496,872
3L078.1	42	54	30	16.18	15.41	16	$ 603.00	$ 18,090
3L080.1	42	54	455	15.48	5.76	11	$ 603.00	$ 274,365
3L081.1	42	54	399	5.83	14.55	10	$ 603.00	$ 240,597
3L082.1	42	54	156	14.79	14.49	15	$ 603.00	$ 94,068
3L083.1	42	54	135	14.6	13.2	14	$ 603.00	$ 81,405
3L106.1	42	54	407	13.38	18.75	16	$ 603.00	$ 245,421
3L084.1	42	54	402	18.81	18.83	19	$ 603.00	$ 242,406
3L052.1	48	60	35	18.9	18.67	19	$ 663.30	$ 23,216
3L053.1	48	60	461	18.81	17.57	18	$ 663.30	$ 305,781
3L054.1	48	60	180	17.49	17.29	17	$ 663.30	$ 119,394
3L055.1	48	60	357	17.33	13.72	16	$ 663.30	$ 236,798
3L056.1	48	60	497	13.76	12.39	13	$ 663.30	$ 329,660
4L018.1	48	60	825	12.42	15.39	14	$ 663.30	$ 547,223
4L017.1	48	60	875	15.39	18.53	17	$ 663.30	$ 580,388
4L016.1	48	60	451	18.58	21.4	20	$ 663.30	$ 299,148
							Total:	**$ 23,644,942**

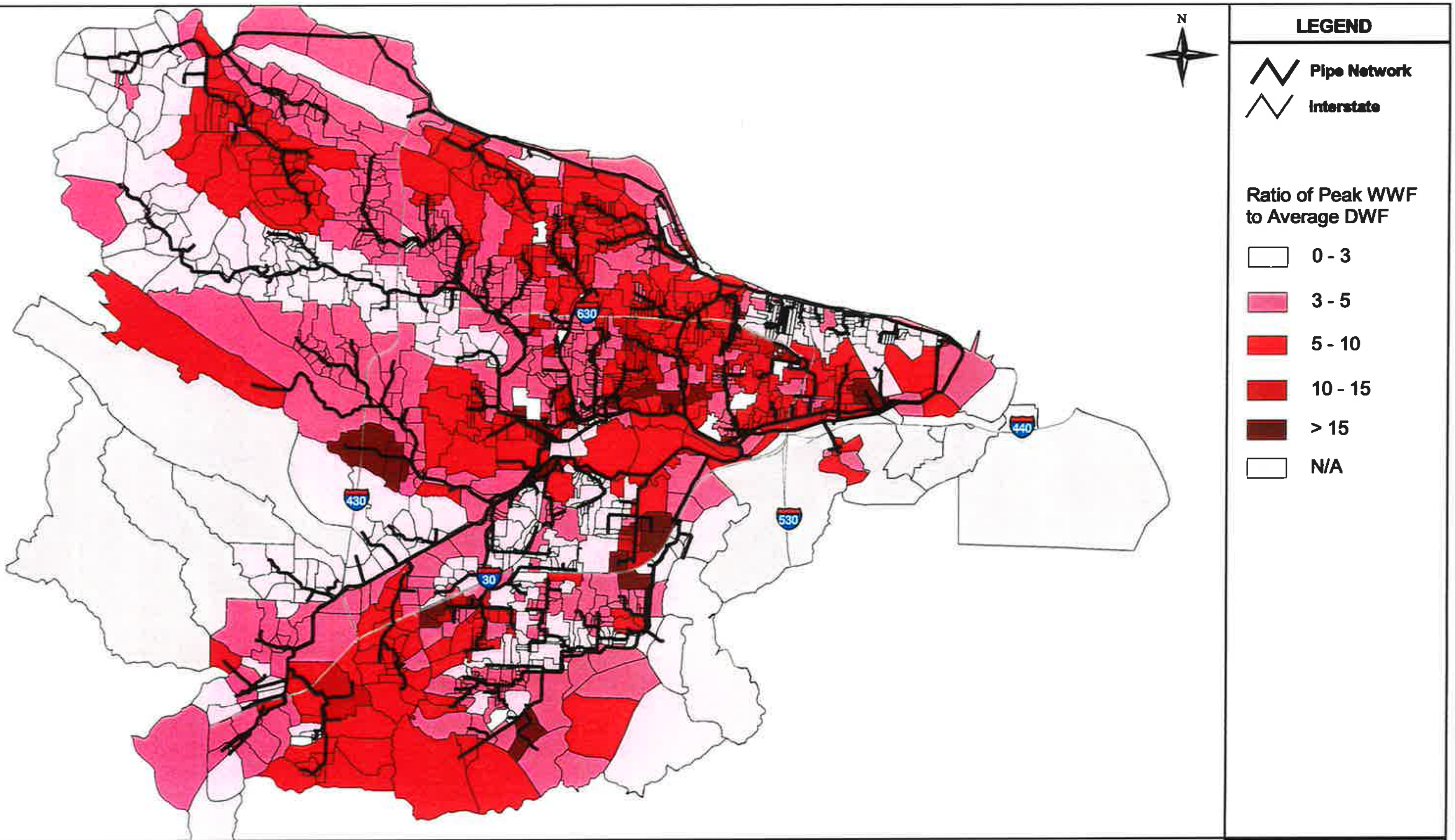
CAG

Section 6
Meeting #4

Thursday
5:30pm-7:30pm
November 8, 2001

Location: Main Library, 100 Rock St.-
East Room 1st Floor

Parking @ the lot across from the Main entrance on Rock Street.



LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

RATIO OF PEAK WWF TO AVERAGE DWF
STORM EVENT A: MARCH 15, 2000 - MARCH 23, 2000

November 2001

MWH
MONTGOMERY WATSON HARZA

D:/Projects/LRWU/apr/littlerock.apr

OPTION 1

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
72" Parallel to Twin 60" Trunks	$30.4	Million
36" Force Main (42,000 LF) from Arch LS to Fourche WWTP	$7.5	Million
42" Force Main (3,100 LF) from Cantrell LS to Gravity Line	$0.6	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD (New Station)	$5.7	Million
Arch - 35 MGD to 60 MGD (New Station)	$7.5	Million
Treatment		
Little Maumelle 4 MGD WWTP with 10 MG Storage	$18.9	Million
Adam WWTP Upgrades	$24.0	Million
Fourche WWTP Upgrades	$29.3	Million
Total:	$177.0	Million

OPTION 2

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
72" Parallel to Twin 60" Trunks	$30.4	Million
30" Force Main from Little Maumelle LS to Gravity Line	$13.3	Million
60" Gravity Line from Little Maumelle FM to Cantrell LS	$18.6	Million
Twin 36" Force Main from Cantrell LS to Gravity Line	$1.1	Million
72" Gravity Line from Cantrell FM to Adams WWTP	$17.5	Million
36" Force Main (42,000 LF) from Arch LS to Fourche WWTP	$7.5	Million
Pump Stations		
Cantrell - 25MGD to 70 MGD (New Station)	$8.3	Million
Arch - 35 MGD to 60 MGD (New Station)	$7.5	Million
Little Maumelle to 16 MGD (New Station)	$3.1	Million
Treatment		
Adam WWTP Upgrades	$24.0	Million
Fourche WWTP Upgrades	$29.3	Million
Total:	$213.7	Million

OPTION 3

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
42" Force Main (3,100 LF) from Cantrell LS to Gravity Line	$0.6	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD (New Station)	$5.7	Million
Storage		
65 MG Sewer Surge Storage	$43.6	Million
Treatment		
Little Maumelle 4 MGD WWTP with 10 MG Storage	$18.9	Million
Total:	$121.9	Million

OPTION 4

	Price ($)	
Line Work		
Utility Trunk Sewer Upgrades	$53.1	Million
60" Parallel to Twin 60" Trunks	$13.1	Million
Pump Stations		
Cantrell - 25MGD to 40 MGD (New Station)	$5.7	Million
Arch - 35 MGD to 45 MGD (LS Upgrade)	$2.2	Million
Storage		
35 MG Sewer Surge Storage	$30.6	Million
Treatment		
Adam WWTP Upgrades	$24.0	Million
Little Maumelle 4 MGD WWTP with 10 MG Storage	$18.9	Million
Fourche WWTP Upgrade to 50 MGD	$12.0	Million
Total:	$159.6	Million

35 MG Sewer Surge Storage		**$30.6 M**
Flow Equalization Storage	$20.2 M	
Lift Station Construction	$5.2 M	
60" Gravity Collection Line	$5.2 M	
65 MG Sewer Surge Storage		**$43.7 M**
Flow Equalization Storage	$30.6 M	
Lift Station Construction	$7.9 M	
60" Gravity Collection Line	$5.2 M	
Cantrell Pump Station Upgrades		
25 MGD to 40 MGD		**$5.7 M**
25 MGD to 70 MGD (Includes $ for)		**$26.9 M**
New Pump Station	$8.3 M	
Force Main Upgrade to Twin 36" parallels	$1.1 M	
Gravity Line Upgrade to 72" DIA	$17.5 M	
Little Maumelle Pump Station Upgrades		
Upgrade Pump Station to 16 MGD (Includes $ for)		**$35.0 M**
Pump Station Upgrade	$3.1 M	
Upgrade Force Main to 30" DIA	$13.3 M	
Upgrade Gravity Line to 60" DIA	$18.6 M	
Arch Pump Station Upgrades		
Upgrade Pump Station 35 MGD to 45 MGD		**$2.2 M**
Upgrade Pump Station 35 MGD to 60 MGD (Includes $ for)		**$15.0 M**
Upgrade to Pump Station	$7.5 M	
36" Force Main (42,000 lf)	$7.5 M	
Upgrade Adams WWTP		**$24.0 M**
Little Maumelle 4 MGD WWTP w/ 10MG Storage Capacity		**$18.9 M**
Utility Trunk Sewer Upgrades		**$53.1 M**
72" Parallel along Twin 60" Trunks (45,772 LF)		**$30.4 M**
60" Parallel along Twin 60" Trunks (22,886 LF)		**$13.1 M**

CAG

Section 7
Meeting Minutes

CRIST ENGINEERS, INC.
1405 North Pierce Street, Suite 301
Little Rock, Arkansas 72207
Telephone (501) 664-1552 Fax (501) 664-8579
crist@aristotle.net

Donald R. Nutt
Larry D. Gaddis

Stewart W. Noland
Leslie B. Price

September 12, 2001

Brian Williams
Montgomery Watson Harza
811 Lamar, Suite 210
Ft. Worth, TX 76102

Dear Brian:

Attached are 3 copies of the minutes from our CAG Workshop 1.

Yours truly,

Stewart Noland

Stewart Noland

cc: John Holloway
Mary Eicholtz

WORKSHOP 1 MINUTES
LITTLE ROCK WASTEWATER UTILITY
CITIZENS ADVISORY GROUP

SEPTEMBER 6, 2001
5:30 - 7:30 PM
MAIN LIBRARY EAST ROOM

Attendees: Gary Griffin, Reggie Corbitt, Willie Hinton, Troy Laha, Jim Lynch, Pat Miller, Charles Mathis, Mary Eicholtz, Brian Williams, Stewart Noland

1. Reggie Corbitt opened the meeting with remarks concerning the mission of the Little Rock Wastewater Utility (LRWU) and the ramifications of the Clean Water Act. Reggie thanked the members for serving on the Citizens Advisory Group (CAG) and cited the importance of the CAG input in the wastewater collection system master plan work.

2. Brian Williams explained how input from the CAG would be used and provided information about the collection system master plan study. The CAG will be asked to review alternative solutions to collection system deficiencies. The review will include monetary, non-monetary and time considerations in respect to implementing any capital improvement program.

3. Stewart Noland explained the relationship of individual service lines, gravity collection system lines, pump stations, force mains, wastewater treatment plants, and effluent discharge limits into receiving streams as elements associated with providing sewer service to all sewer system customers. The point was made that individual service lines that are not owned by the LRWU are known to contribute up to 50 percent of the total infiltration and inflow (I/I) to the sewer collection system.

4. Brian Williams further discussed service lines and the potential impact of various approaches to addressing service lines. A brief description of the electronic model being prepared by Montgomery Watson Harza for the sewer system master plan was provided. Further explanation was given with regards to model input for system, rainfall activity and groundwater conditions and how this data relates to model calibration and prediction of system overflows.

5. Mary Eicholtz led a discussion of group missions and objectives which resulted in the following issues being identified:

    1.1 Address service line issues
    1.2 Develop a broad strategy and plan of public engagement
    1.3 Provide feedback to problems in the utility
    1.4 Address means of financing the improvements, particularly new treatment facilities
    1.5 Address unsewered areas
    1.6 Address rehabilitation of existing sewers

6. The meeting concluded with a visit to the Cantrell Road pump station and the Adams Field Wastewater Treatment Plant.

WORKSHOP 2 MINUTES
LITTLE ROCK WASTEWATER UTILITY
CITIZENS ADVISORY GROUP
SEPTEMBER 27, 2001
5:00 - 7:30 P.M.
MAIN LIBRARY EAST ROOM

Attendees: Peter Christiansen, Raymond Heaggans, Laura Clift, Bob Turner, Gary Griffin, Willie Hinton, Charles Mathis, George Brown, Brian Williams, Mary Eicholtz, Stewart Noland

1. The meeting started at 5:00 p.m. for the benefit of those members that could not attend the first meeting. Stewart reviewed the mission of the Little Rock Wastewater Utility (LRWU) and how the wastewater collection and treatment system relates to the Clean Water Act. Stewart explained how the current study is part of an ongoing effort by the LRWU to address collection system issues, and he discussed the relationship of various components of the wastewater collection and treatment system.

2. Brian Williams explained the importance of the CAG input to the collection system planning effort, and he explained that the CAG will be asked to review alternative solutions to collection system deficiencies.

3. Shortly after 5:30 Mary Eicholtz opened the meeting to the full group and encouraged participation among all members.

4. Brian Williams distributed a list of terms, a list of problem areas identified by the collection system study, and a map showing the location of the problem areas. Brian led a discussion of the problem areas and explained that alternative solutions will be provided at the next meeting.

5. Brian showed a video on the Houston Wastewater Program that featured wet weather facilities, and he gave a power point presentation on sewer line problems and rehabilitation technologies.

6. Mary Eicholtz led a discussion concerning a group mission statement that culminated in the following:

> Mission is to understand, evaluate, and recommend through citizen input cost effective and environmentally sound long range alternatives.

7. Mary led a discussion that identified issues and concerns. The issues and concerns were grouped into 5 major issues with the following priorities.

Priority	Major Issues	Concerns
1	Environmental	Effect on community Public health and safety Odor Land use Noise Energy
1	Citizen Awareness	Cost to citizens Location of facilities Effect on property value Public announcement of discharges Recreation impact Stay ahead of regulators Alternate uses of easements Aesthetics
2	Technical/Ongoing	Long term effectiveness Life expectancy Ability to be expanded How and why recommendation Condition of current system Growth limits Policy issue on service line Operation and maintenance
3	Regulatory	Effect on floodplains Water quality Discharge limits Regulatory
4	Construction	Disturbance and duration Time to complete Materials of construction Risks

WORKSHOP 3 MINUTES
LITTLE ROCK WASTEWATER UTILITY
CITIZENS ADVISORY GROUP
OCTOBER 25, 2001
5:30 - 7:30 P.M.
MAIN LIBRARY EAST ROOM

Attendees: Willie Hinton, Pat Miller, Jim Lynch, Charles Mathis, George Brown, Laura Clift, Mary Eicholtz, Troy Laha, Bob Turner, Brian Williams, Peter Christiansen, John D'Antoni, Stewart Noland

1. Mary Eicholtz opened the meeting by reviewing the progress made to date by the group.

2. Brian Williams presented four alternatives for overall collection and conveyance system rehabilitation / improvements, each of which was followed by detailed discussion. A cost of $30 million was added to Options1 and 2 for upgrading the Fourche Creek Wastewater Treatment Plant. A summary sheet and map for each alternative was presented. Brian emphasized to the group that a combination of options from the four alternatives could be mixed and matched to create additional alternatives. Brian provided a cost basis for both the rehabilitation work in individual areas and other larger elements of the work.

3. Brian explained that for purposes of simplifying possible combinations for alternatives the group should look at splitting the City into two areas, north and south. For the northern portion of the City look at a new treatment plant in Maumelle versus conveyance to Adams WWTP, and for the south, look at varying levels of storage / treatment (along the twin 60's) with no, or partial conveyance versus total conveyance through the Twin 60's and parallel relief to Adams WWTP.

4. Jim Lynch discussed the Sierra Club lawsuit and its effect on the collection system planning. Brian explained that the lawsuit is related by subject matter only and that the Utility's current planning effort is the second phase of a +10-year plan undertaken as part of an ongoing effort to correct existing system deficiencies and maintain the system in an efficient and cost effective manner.

5. Bob Turner suggested stacking / paralleling lines to gain the needed additional capacity as an alternate to removing and replacing with increased diameter lines.

6. Mary discussed an Alternatives Evaluation Matrix that was initially developed at the second Workshop. Based on the group's input the matrix was modified according to the following categories and weights.

WORKSHOP 4 MINUTES
LITTLE ROCK WASTEWATER UTILITY
CITIZENS ADVISORY GROUP
NOVEMBER 8, 2001
5:30 - 7:30 PM
MAIN LIBRARY EAST ROOM

Attendees: Pat Miller, Willie Hinton, Charles Mathis, Laura Clift, George Brown, Gary Griffin, Mary Eicholtz, Jim Lynch, Troy Laha, Bob Turner, Pete Christiansen, John D'Antoni, Brian Williams, Stewart Noland

1. Mary Eicholtz opened the meeting by reviewing the agenda as provided in Section 2 of the binder.

2. Jim Lynch stated that he is not opposed to the Maumelle WWTP, but that it is a huge issue for the City. Jim reiterated the issue of how will the Maumelle WWTP be financed; who will pay for it? Jim distributed a letter he sent to Brian Williams and Brian's response and asked that they be included as part of the meeting minutes (see attached). Jim stated that construction of the Maumelle WWTP will impact the future development of the City. Jim said that the City is facing a relocation issue, not growth. Jim recommended that the group continue to meet and that LRWU staff be present at the meetings. Jim recommended that the Committee review the MWH report and recommendations as they are developed.

3. Brian Williams reviewed the four options including the revised cost estimates (see attached). Brian encouraged the group to evaluate the options based on the north and south parts of the City summarized as follows.

South	**North**
Storage and Adams WWTP	Maumelle WWTP
Partial Storage and Fourche WWTP	Conveyance
72 inch line and Adams WWTP	

Brian also distributed a map (see attached) showing the severity of infiltration/inflow problems in the City according to a ratio of wet weather flow to dry weather flow.

4. Mary Eicholtz distributed the Evaluation Criteria and Evaluation Matrix.

5. Peter Christiansen distributed and discussed an alternative option (see attached). An important element of the alternative includes assessing a monthly fee to address service lines with the work to be performed by licensed plumbers.

"Jim Lynch" <jrlynch@ualr.edu> on 11/02/2001 12:24:41 PM

To: brian.a.williams@mwhglobal.com
cc: mmeicholtz@ualr.edu, griffing@adeq.state.ar.us, lahaengrsis@msn.com, cmathis@baptist-health.org, pmiller@msfrost.com, tluther@lrwu.com

Subject: Little Rock Wastewater / Advisory Group Planning

MR. WILLIAMS:

I am writing as a member of the LRWWU Citizens Advisory Group. I have read and reflected on the documents you distributed at the meetings including the latest meeting where the four long-term options for systems upgrade were discussed at some length. As I noted to you and the Advisory Group during the meeting on Oct. 25th, three of the four options include the construction of the Maumelle Wastewater Treatment Plant at a cost of $18.9 million.

I also noted during previous meetings that (in the longer-term planning scenario sense) the construction of the system's third wastewater treatment plant has enormous implications for the future of the community. This plant will effectively set the stage for the ultimate "sewering" of the Little Maumelle Basin, an area of approximately 80 square miles. This area is capable of supporting a second city equal in size to the present population of Little Rock.

While we have been empaneled to assist LRWWU in its long-term planning, I am troubled that the advisory group's discussions have ignored these long term implications. Our current approach is not "long-range planning," in my judgement. Rather, the advisory meetings seem designed to narrowly define LRWWU's long-term problem only as a stormwater or "infiltration" issue. No doubt this is true as far as it goes, however, my point is that this is not the ONLY issue that LRWWU and the advisory group ought to be discussing.

LRWWU HISTORY WE SHOULD BE DISCUSSING

I have lived in LR for 30 years, formerly worked at City Hall (1970s) and try to stay informed on community issues. Based on my knowledge and that of others with whom I have talked, the wastewater options you and the MWH team have developed are a predictable consequence of municipal and LRWWU policies that have finally caught up with all of us. Candidly, the riverfront interceptor was never designed to accept the sewer flows it is now transporting. The original design had the interceptor stopping (as a western terminus) somewhere in the vicinity of Jimerson Creek. Yet, because of intense community and EPA formal opposition to a treatment plant in the mid-1970s (1976), the LRWWU continued to approve all subsequent development proposals in the Little Maumelle Basin.

Much to its credit, the LRWWU Commission in 1980 actually adopted a policy resolution noting the lack sewer capacity in the Maumelle Basin and said it would limit new hookups not to exceed 11,000 persons (new customers to the LRWWU system). Apparently the policy had a very short shelf-life. My understanding is that all new projects have been approved by the LRWWU and its staff since this time in the Maumelle Basin. Of course, this direction has led to the SSO's you have been hired to study and analyze. Yet, there has been no mention of this cause-and-effect in our meetings.

(The above information is readily available in the "site study" you mentioned to the Advisory Group but which has not been distributed to the Advisory Group. This study is titled "Little Maumelle River Subbasin Sewerage Study" and is dated May, 2001. This study contains as an appendix the 'Sewer Service Study for Northwest Little Rock, April, 1980. It seems to me that our group ought to read this study and be made fully aware of what has already happened, why it happened, and thus be more able to make a judgement about how to proceed. This approaches real planning, in my judgement, not the superficial exercise currently underway on Thursday evenings.)

My general point is this -- no one can solve a problem unless we understand and can correctly define what the problem is the in the first place.

Does LR have an infiltration problem? Yes. Does LR have a problem approving new additions to the system with no idea how to serve the new areas while simultaneously complying with state and federal public health and environmental laws, rules and regulations? Yes. Does LR ever raise this issue when a key vote is on the evening's policy agenda? Not that I can remember.

LITTLE ROCK HISTORY WE SHOULD BE DISCUSSING

You should know that this issue of ignoring the real costs of development has been aired on countless occasions at City Hall and in other forums. The official response has been -- all this growth "pays for itself" and "no problem" exists anywhere. Now of course, you reveal that LR ratepayers should contribute $18.9 million for a treatment plant that has never been mentioned in the countless discussions of project approvals in the Little Maumelle Basin.

With great respect to Mr. Bob Turner, his comment last week about "it is impossible to direct or manage growth" is not correct but very symptomatic of the problem in Little Rock. Where public infrastructre is sited, financed, etc. has a tremendous affect on growth patterns. Every engineer, urban planner and politician knows this. LR simply cannot bring itself to discuss it, however.

We have an enormous growth problem -- actually LR has very little "net" growth" because the city (and the LRWWU) is losing customers in the East and Central part of LR (the 6,000 absent residents I noted in the last advisory meeting) -- because the scenario you have outlined proposes tens of millions for new treatment and collection capacity while we actually have excess capacity in the established regions of the city. An amateur could conclude this is not efficient and we ought to try to "do something different."

When the real costs of development are ignored, an effective subsidy of the development is the obvious result. Someone is paying the cost, somewhere -- i.e., We have constant SSOs in LR. Very predictable. In addition, we lowball the costs of locating in the suburbs, thus undermining an announced City Hall strategy to "invest in the existing city, revitalize neighborhoods, etc." Instead, city residents find they can move out of a less-fashionable neighborhood and pay only a fraction of the cost that their new home site really costs.

The relocation problem of LR from east to west (rather than an actual growth problem) can be affected -- despite Mr. Turner's assertion to the contrary -- if we thoughtfully look at our history and thread our way through a discussion of real planning issues in our community. Where wastewater infrastructure is built, how it is paid for, etc., greatly affects development patterns. Sewer is vital for urban development, period. It ought to be a tool to achieve the kind of city we want to live and work in, rather than viewed as a passive service to satisfy whatever the latest demand is for a real estate project.

WHAT IS NEXT ?

This letter already is too long and so I will conclude with these specific requests:

(1) The Advisory Group should receive copies of the previously-mentioned Little Maumelle River Subbasin Study, May 2001. (I might add that the cover page says the study is "Prepared for

the Water/Wastewater Advisory Committee.")

(2) The Advisory Group needs to meet on a continuing calendar. I don't know from where the idea came that we would meet only "five times." This notion falls far short of the problems LRWWU is confronting. This ought to be a decision of the Advisory Group, not a consultant.

(3) The Advisory group should request to hear directly from City Hall about its response to the Sierra litigation. Bob Turner said he "would not discuss it," however, it is the municipal government that is the party, the allegations of clean water violations are serious and the Advisory Group needs to know what the policy options are. I know that Sierra has proposed that City Hall conduct a comprehensive "urban development impact study" of the entire Little Maumelle Basin, a proposal which helps avoid repeating the planning (lack of planning, actually) mistakes of the past. Is City Hall again refusing to acknowledge the real costs of development? How can our Advisory group 'advise' on anything substantive if we are ignorant of the options, the nuances, etc.?

Thank you for your efforts to date. However, if you and MWH are really going to assist Little Rock, we need an added focus to your work and that of the Advisory Group. Anything less will result in largely superficial product and an enormous waste of everyone's good intentions and time.

Best Regards,

JIM LYNCH

Member
LRWWU Citizens Advisory Group

P.S.

Below is a web address for the "decentralized wastewater" project now underway in Austin, TX.
I recommend your checking it out and including this "option" in future discussions with the Advisory Group. As I understand the approach, smaller decentralized treatment facilities do offer advantages --- perhaps even lower cost with the same effectiveness. In addition, in these new times of possible external threats, might it not be worth discussing new treatment facilities that were not a single, "big plant" and thus relatively more vulnerable to sabotage? Food for thought.

Alternative Wastewater Management Program, City of Austin, Texas

http://www.ci.austin.tx.us/wri/altern.htm

Mr. Lynch,

Our vision for the Citizen's Advisory Group (CAG) was to create a forum where a diverse group of Little Rock community members would be able to learn the basic elements for installation, maintenance and operation of the City's wastewater system. We also wanted to brief the group on the electronic model we created to simulate how the wastewater system functions during the design storm event. More importantly, it was our desire to get the group to exchange this knowledge amongst themselves, as well as others in the community, and provide recommendations on the information and data presented at the workshops. Ultimately, CAG recommendations were intended to assist us in completing the second phase of the City's continuing program that is being performed to provide a practical, cost effective and efficient approach for solving existing and future wastewater problems.

Admittedly, our success with the CAG relies on each member's active participation in discussing issues and providing recommendations. Since the first workshop, we have openly encouraged CAG members, during and after their involvement with the CAG, acting either as a group or separately, to continue their interaction with the City and its related departments to assist with editing and adopting a new wastewater master plan. Towards this end, your correspondence stands testament that, in some measure, we have been successful in achieving our goal. Your opinions, concerns and ideas are very important and should in no way be restricted to the venue that the CAG offers. We fully intend to include all recommendations agreed to by the CAG membership into our final report for the "System Evaluation and Capacity Assurance Plan". In response to the 3 items you requested:

1) A copy of the "Little Maumelle River Subbasin Sewerage Study", Final Draft, September 2001, will be available at the next CAG Workshop for review by any member of the group should they wish to do so. It should be noted that draft copies (dated May 2001) of the same study were submitted by the Wastewater Utility to the State "Water/Wastewater Advisory Committee" which provides oversight for municipal funding of capital improvements. This is the first step of standard procedures for investigating funding sources for wastewater projects. Additionally, the study recommends the wastewater treatment plant as the selected alternative for the Little Maumelle Basin. Capital costs for this alternative were included in the cost options provided to the CAG during Workshop #3.

2) CAG members committed their time to participate in four (4) two-hour workshops over the course of several months. The November 8 meeting completes this commitment. Since we are unable to speak for the CAG

members, the members must be polled on their willingness to commit additional time. Should the group choose to continue meeting, the recommendation will be passed onto the Utility.

3) As with any recommendation approved by the CAG, the City can be requested to provide information regarding the Sierra Club legal proceedings.

As we explained in prior workshops, the CAG and modeling effort presently underway are being performed as part of a second phase of an ongoing wastewater program intended to provide future enhancement and correct existing problems for the City's sanitary sewer system. This second phase was not started specifically to respond to the Sierra Club issue rather, it represents one of many studies and tools the Wastewater Utility incorporates into their efforts to maintain an effective approach to handling the City's long term system needs.

Again, we appreciate and look forward to your continued input and involvement in the CAG.

Brian Williams

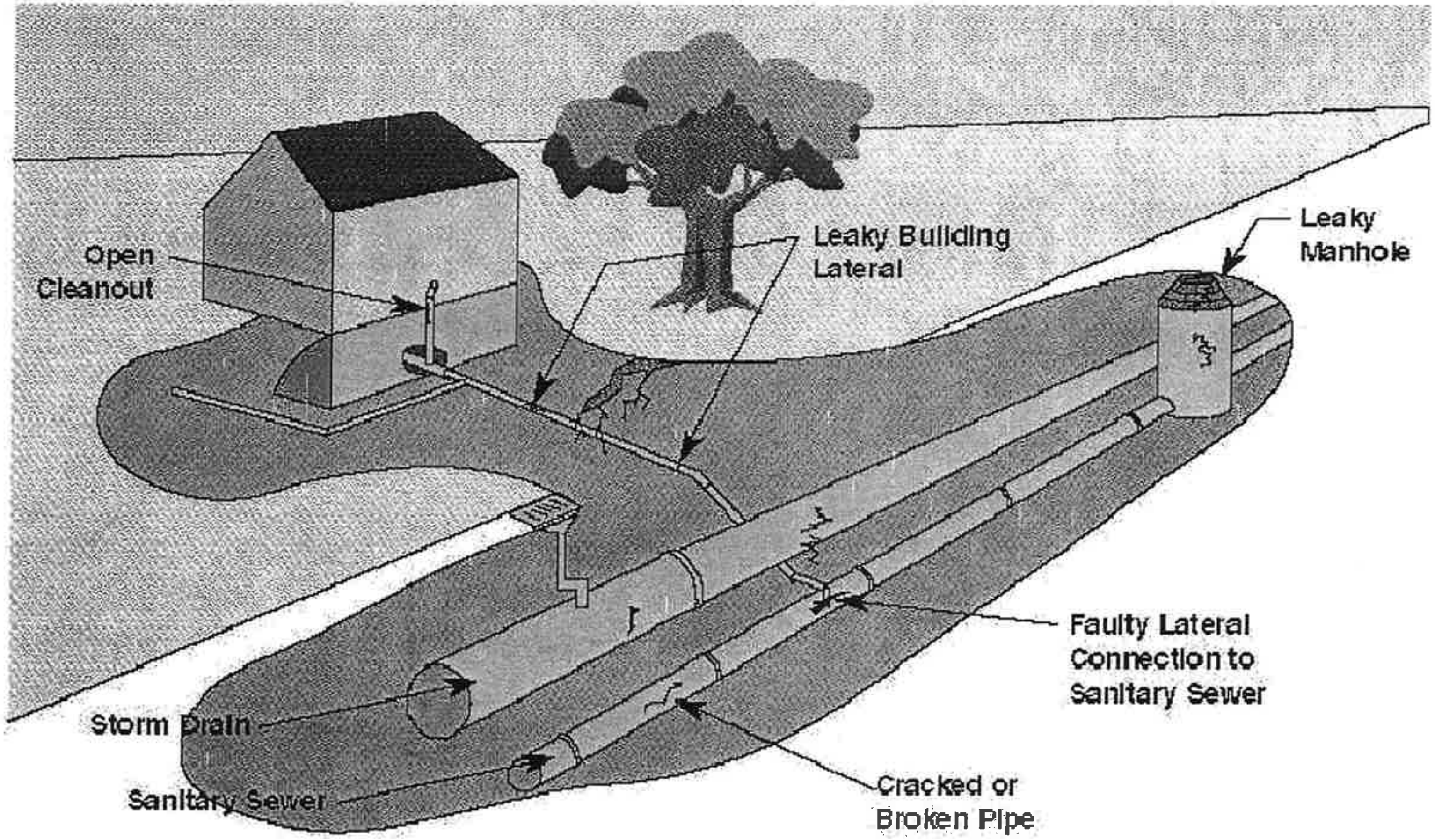
CAG

Section 8
Exhibits

The Problem

Little Rock Wastewater Utiliy
System Evaluation and Capacity
Assurance Plan (SECAP)

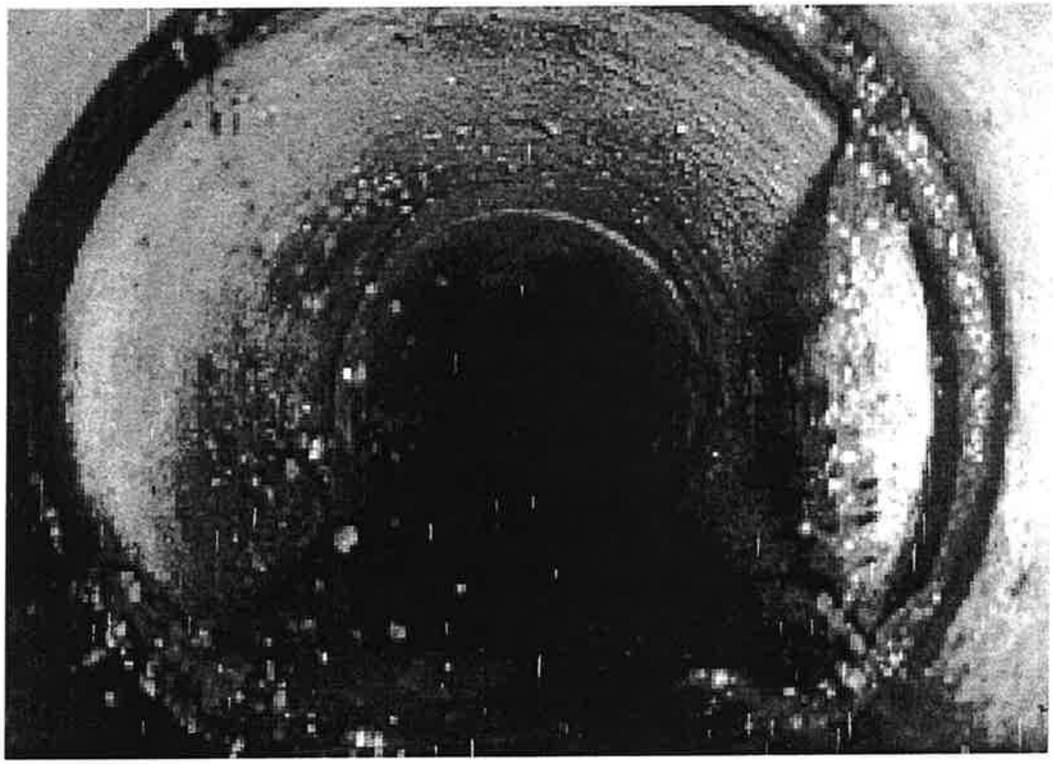
Aging Sewers can Have Many Problems



Broken Joints

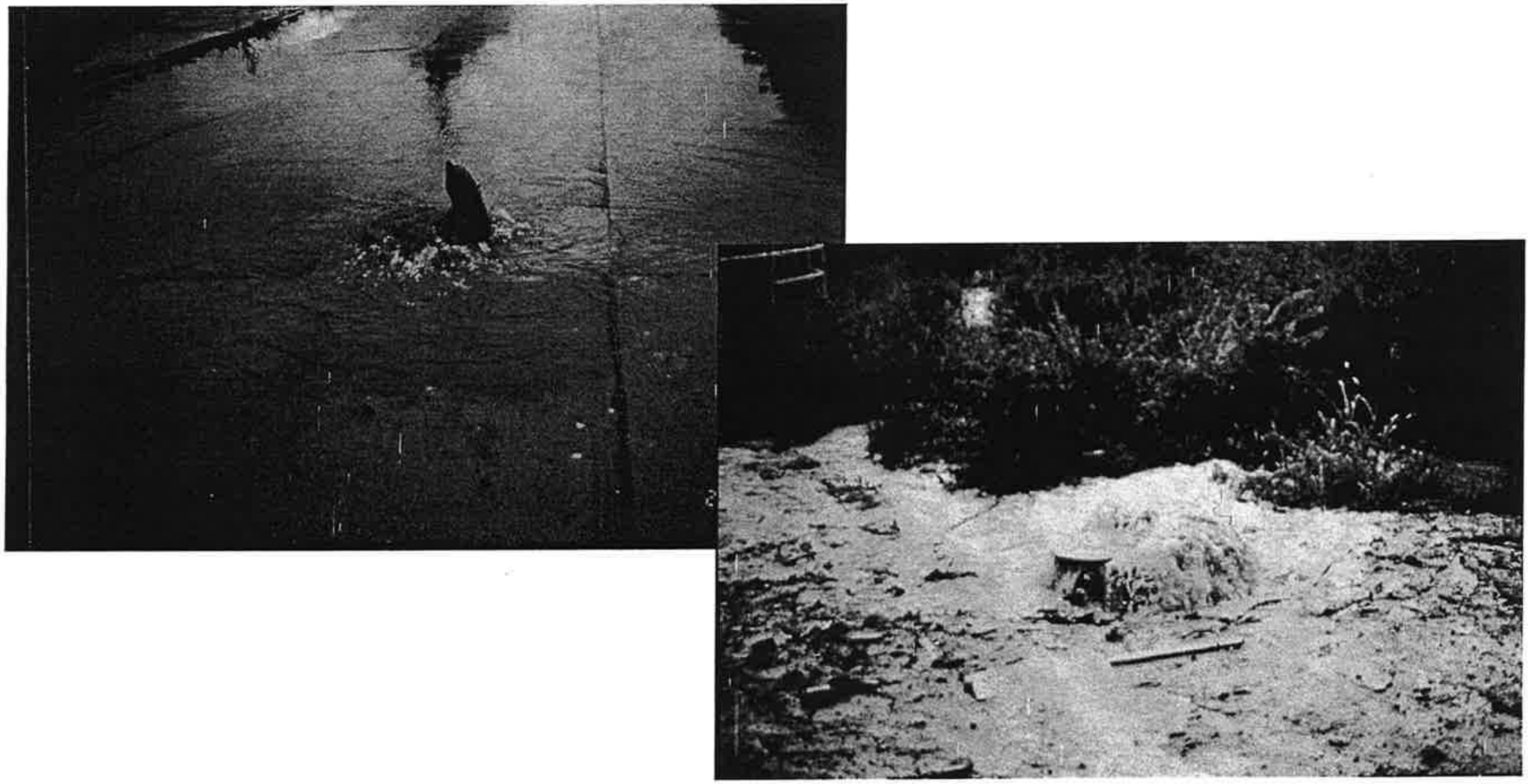
Corroded Pipes

Leaky Joints or Cracks



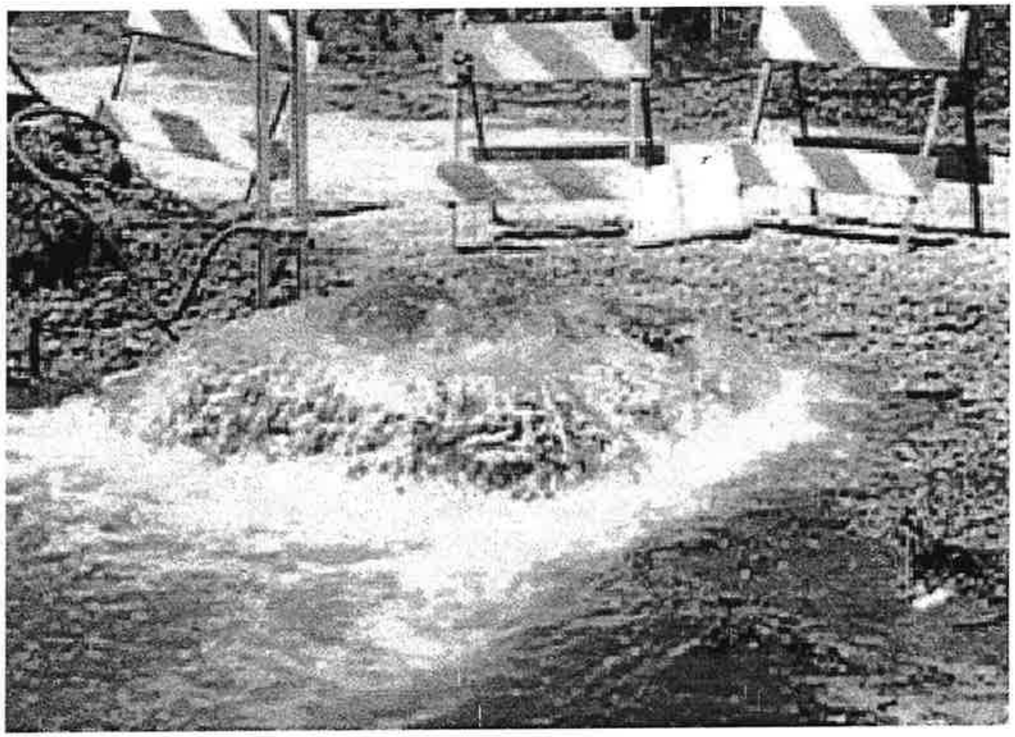
Failed Sewers can Cause Collapses

Capacity problems result in SSO's



System Overflows

More System Overflows



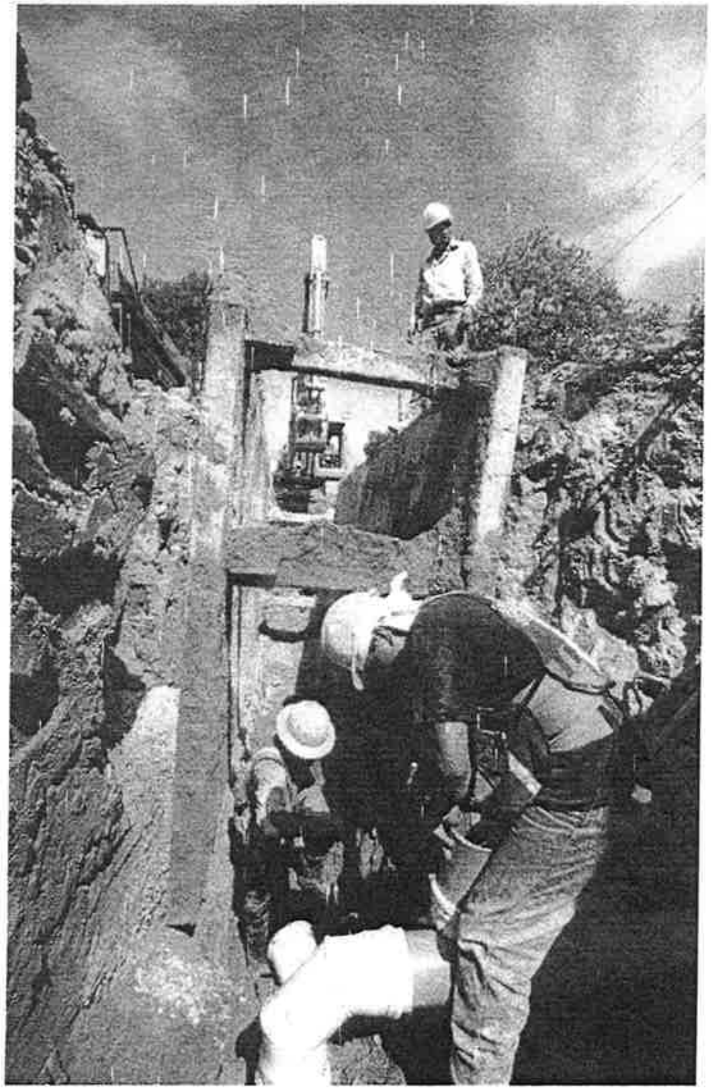
And More Overflows

Sewer Rehabilitation

Little Rock Wastewater Utility
SECAP

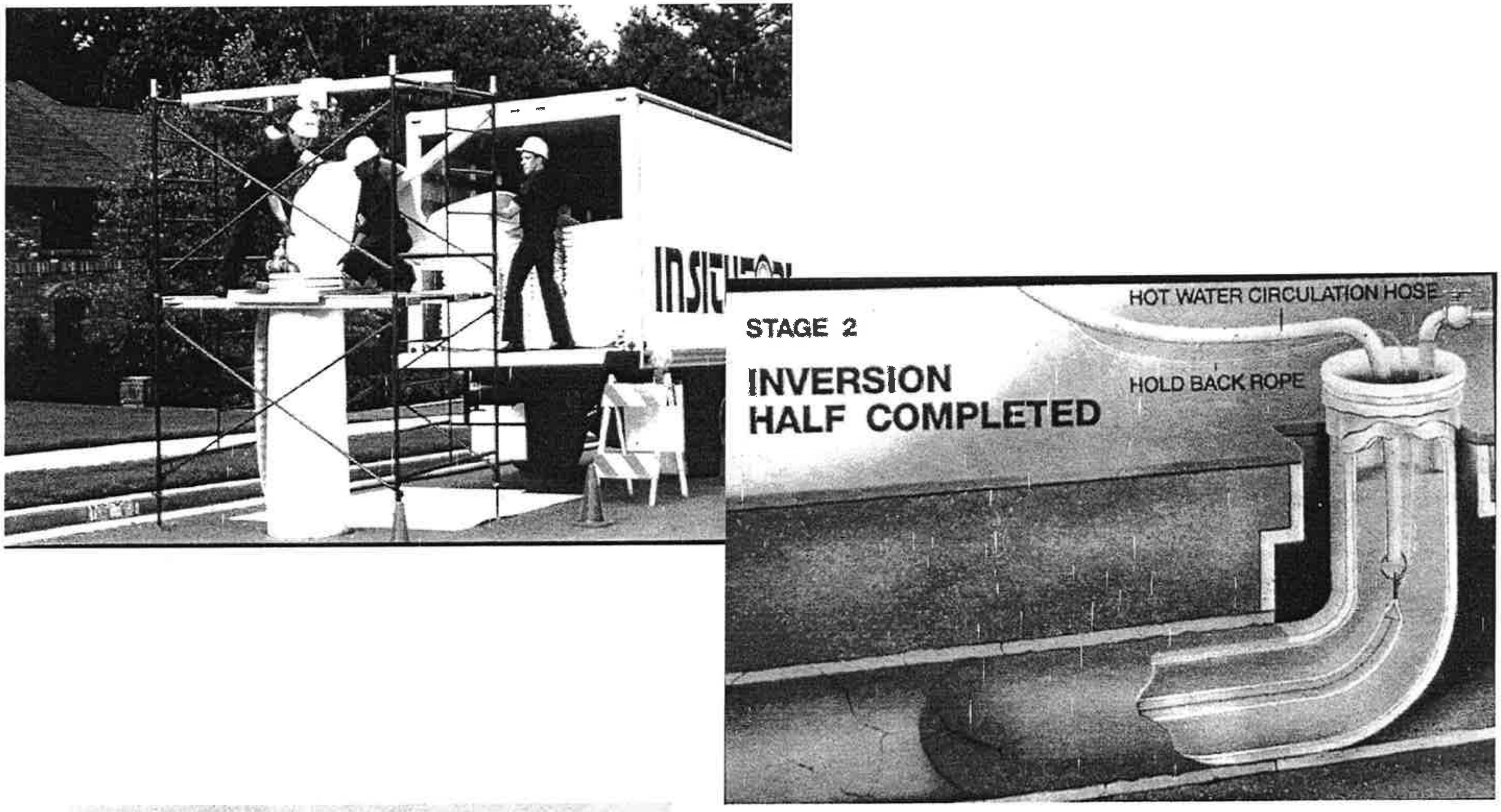
Open Trench on Private Property

Open Trench in City Streets

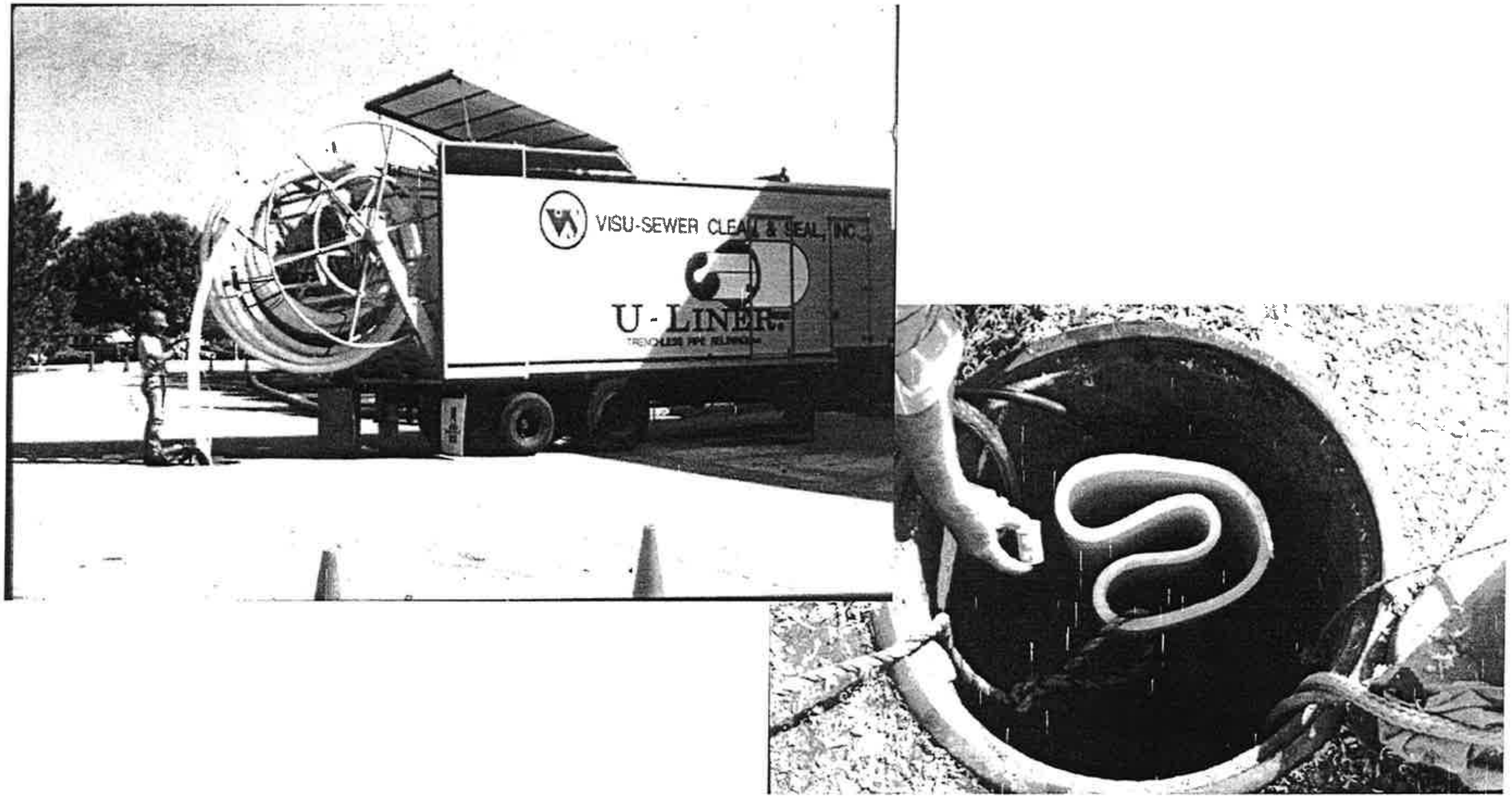


Open Trench in Neighborhoods

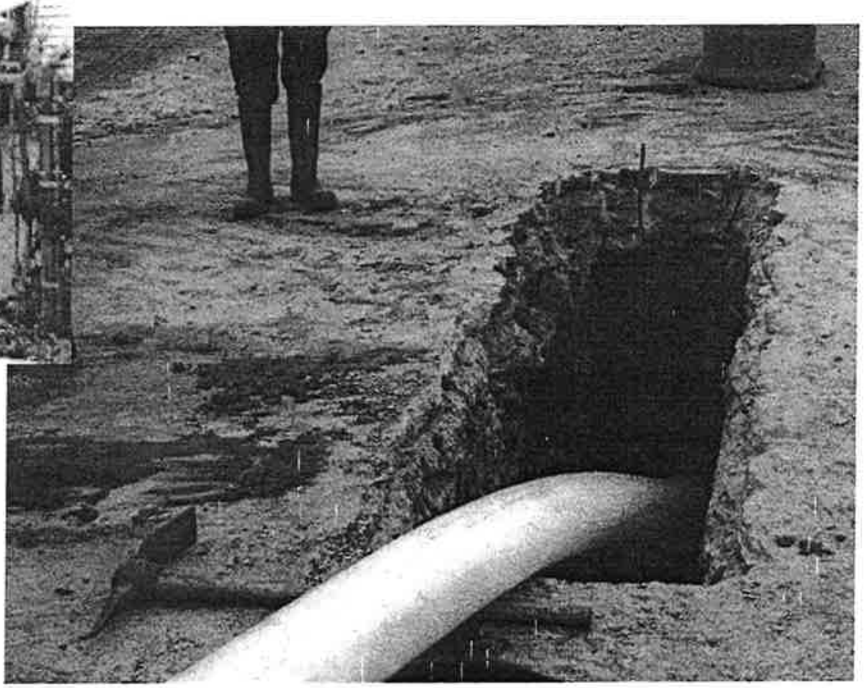
Cured In Place Inversion Lining



U-Tube or Fold & Form Lining

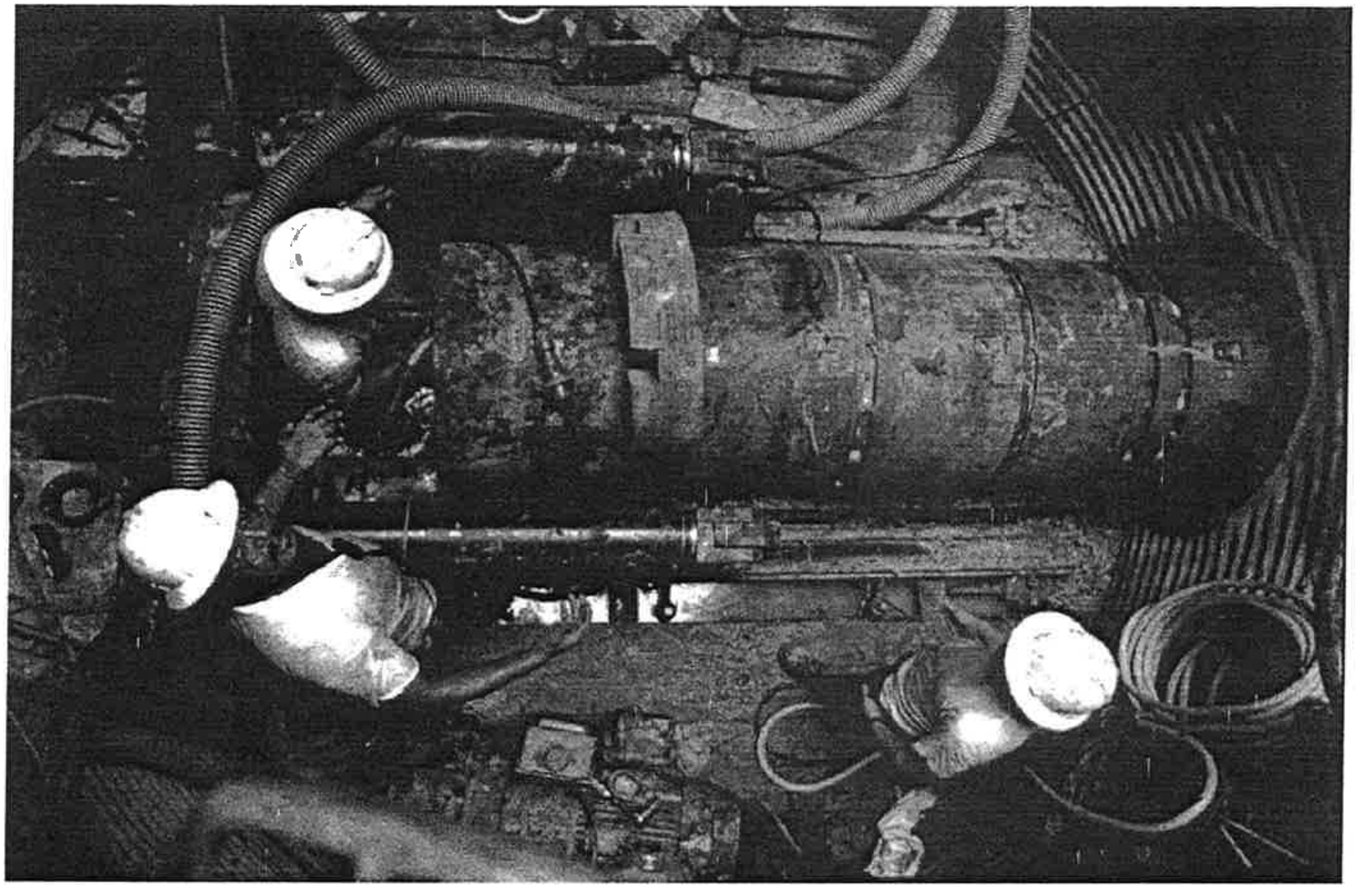


Sliplining



Pipe bursting

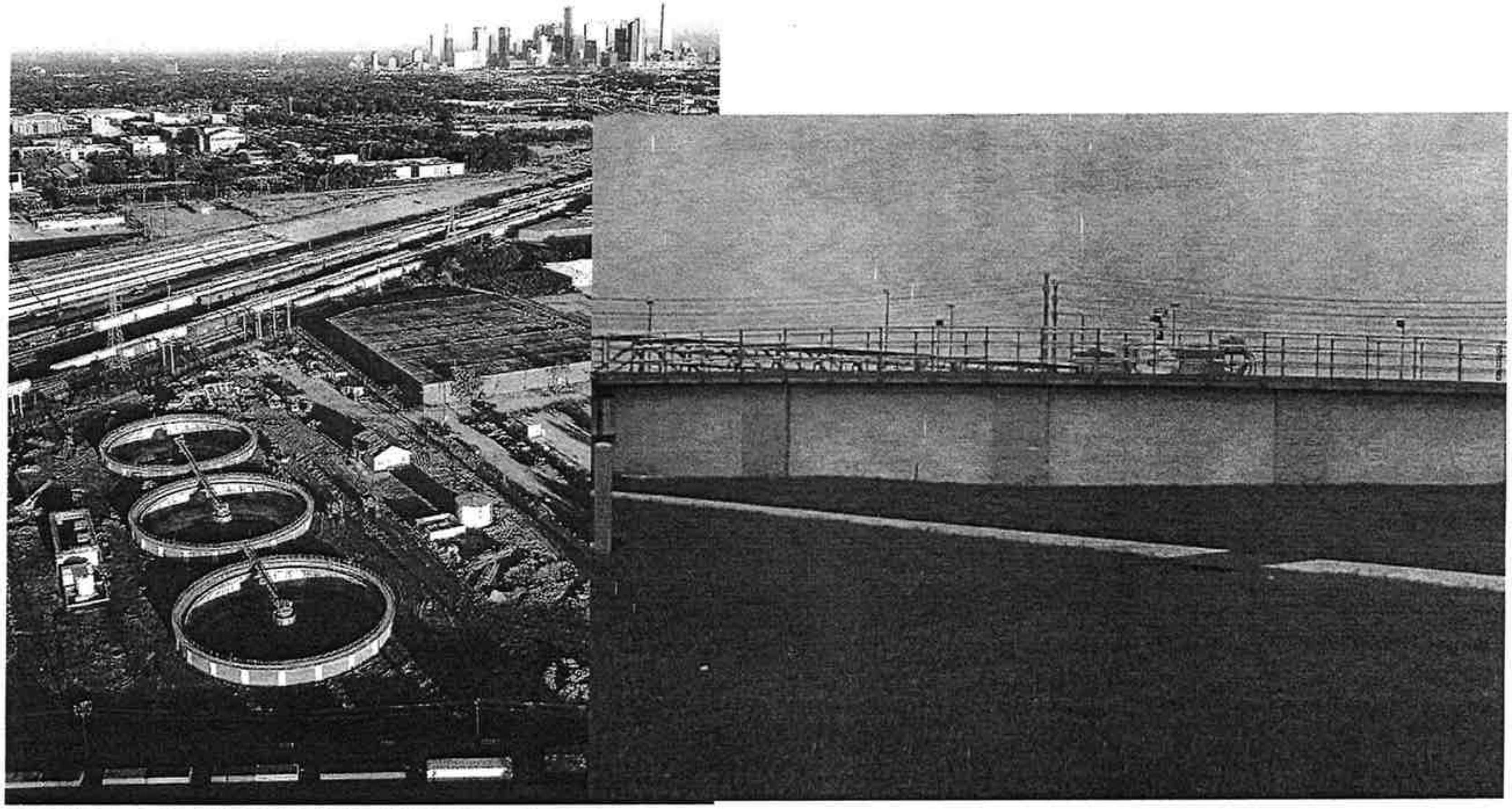
Pipe Jacking



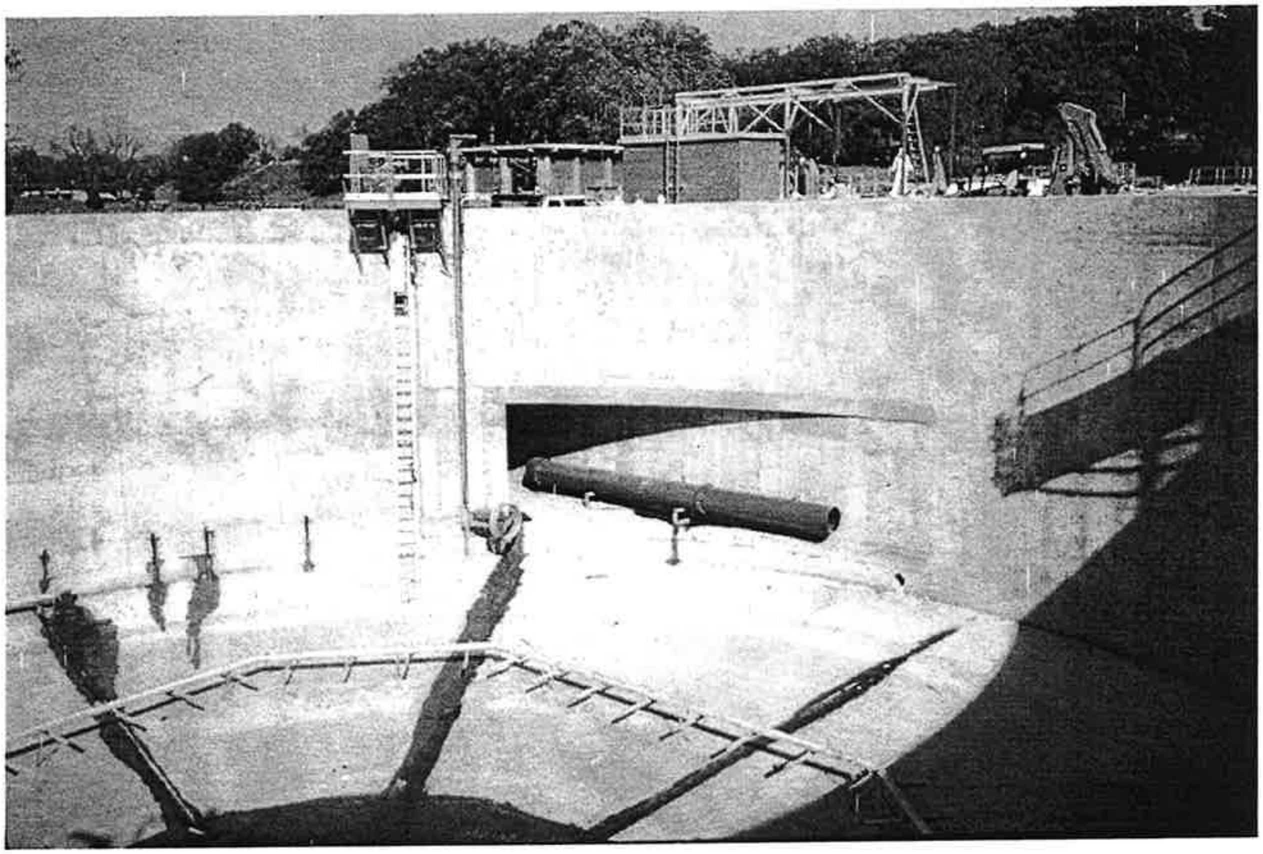
Storage & Wet Weather Facilities

Little Rock Wastewater Utility
SECAP

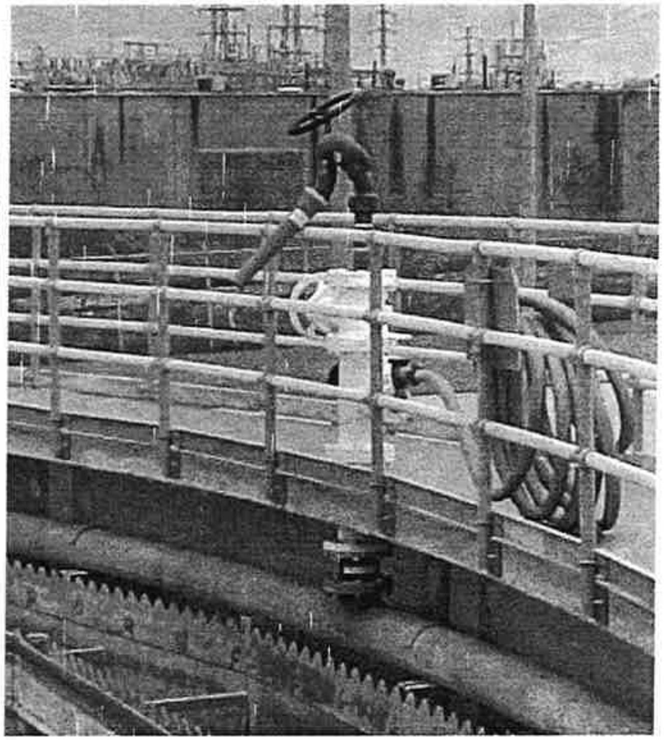
Wet Weather Facilities



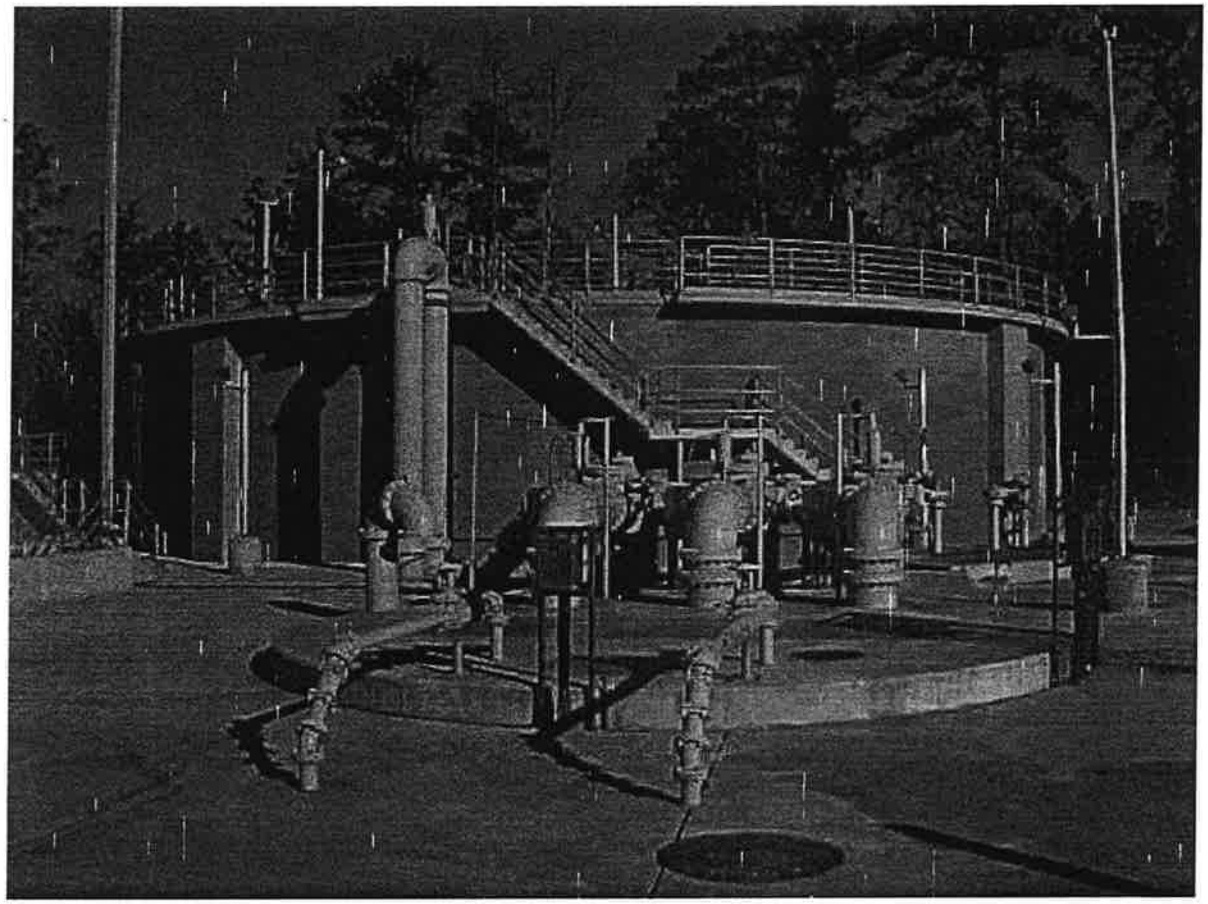
Off -Line Storage Facilities



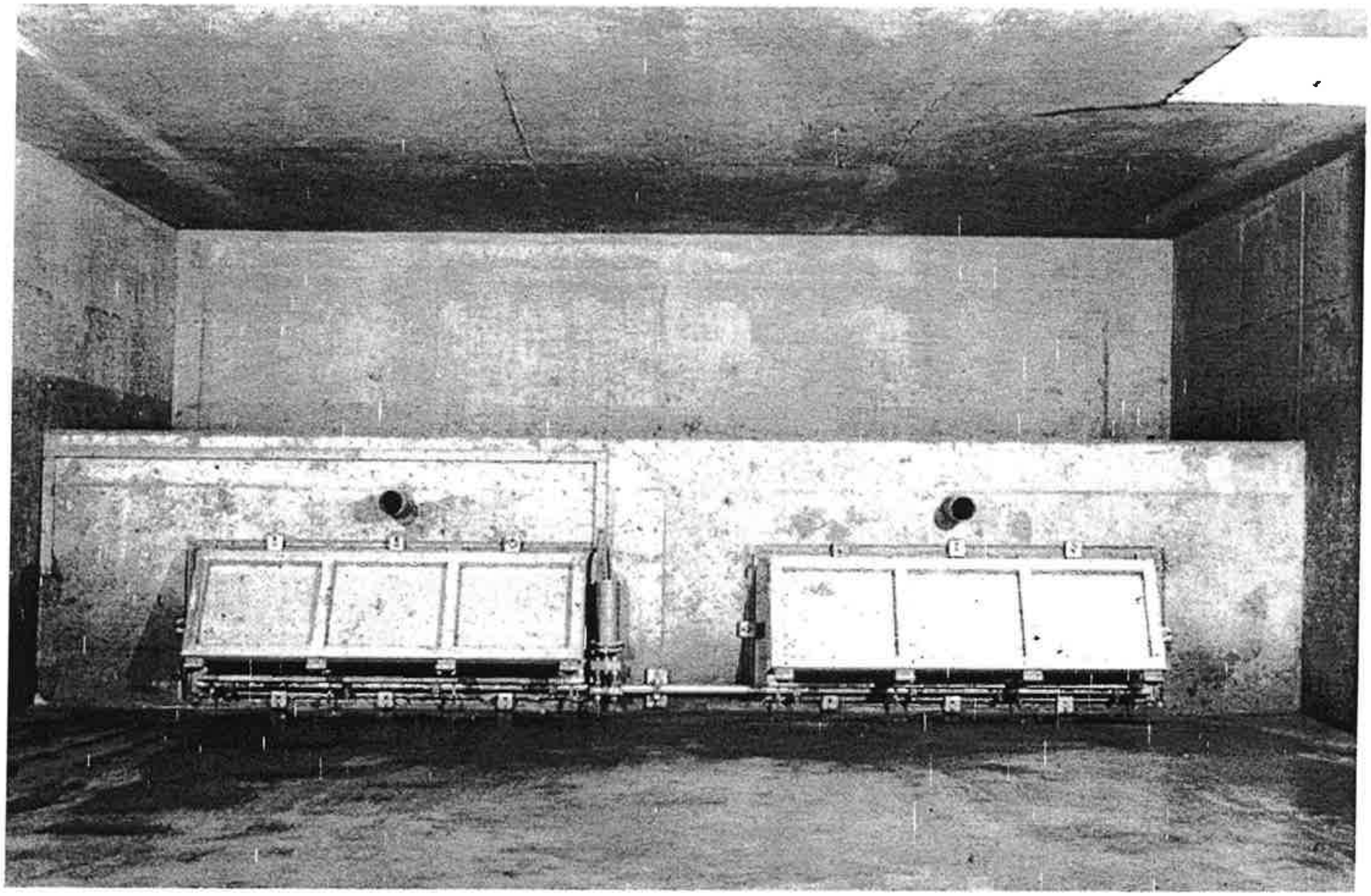
Wet Weather Facilities



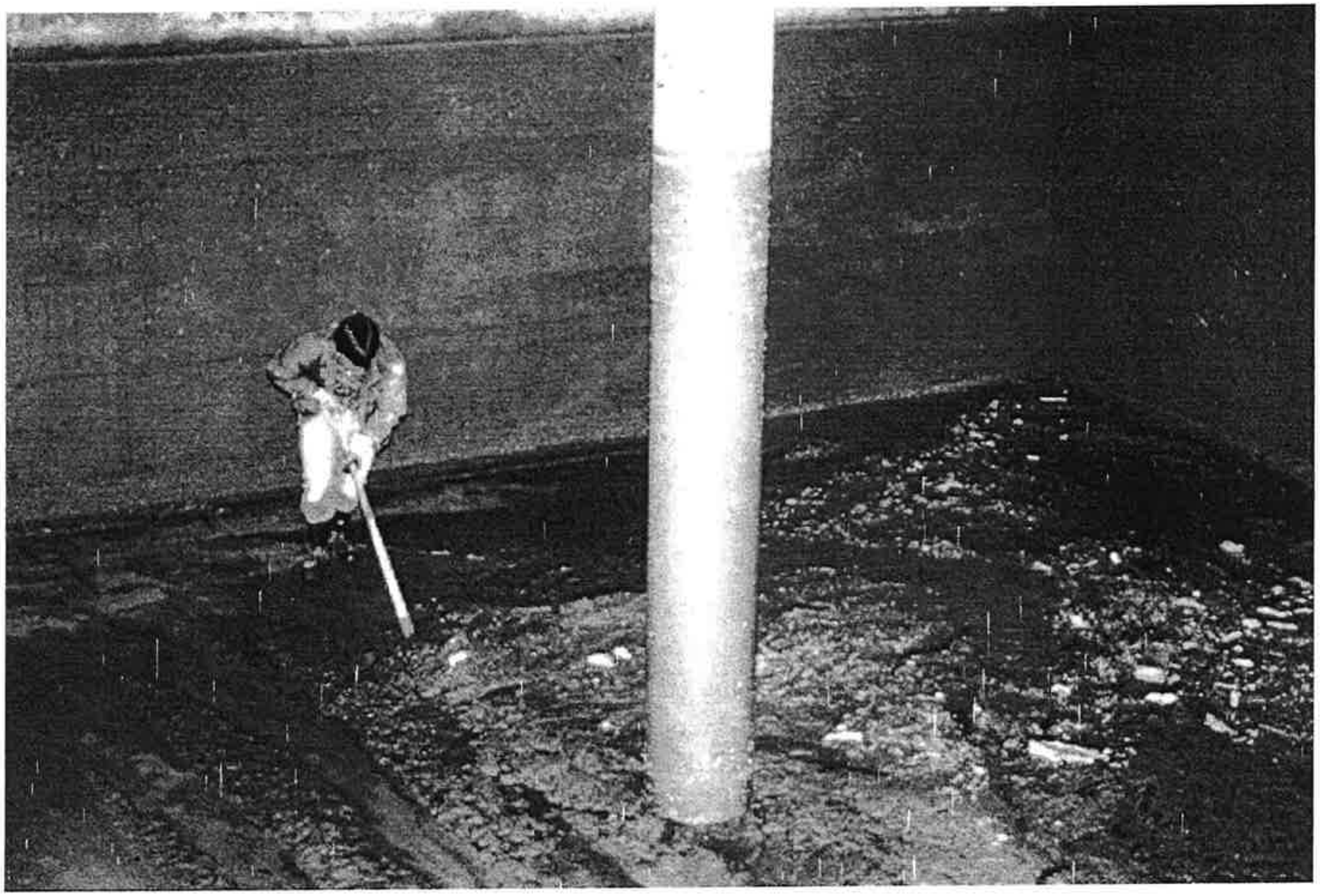
Wet Weather Facilities



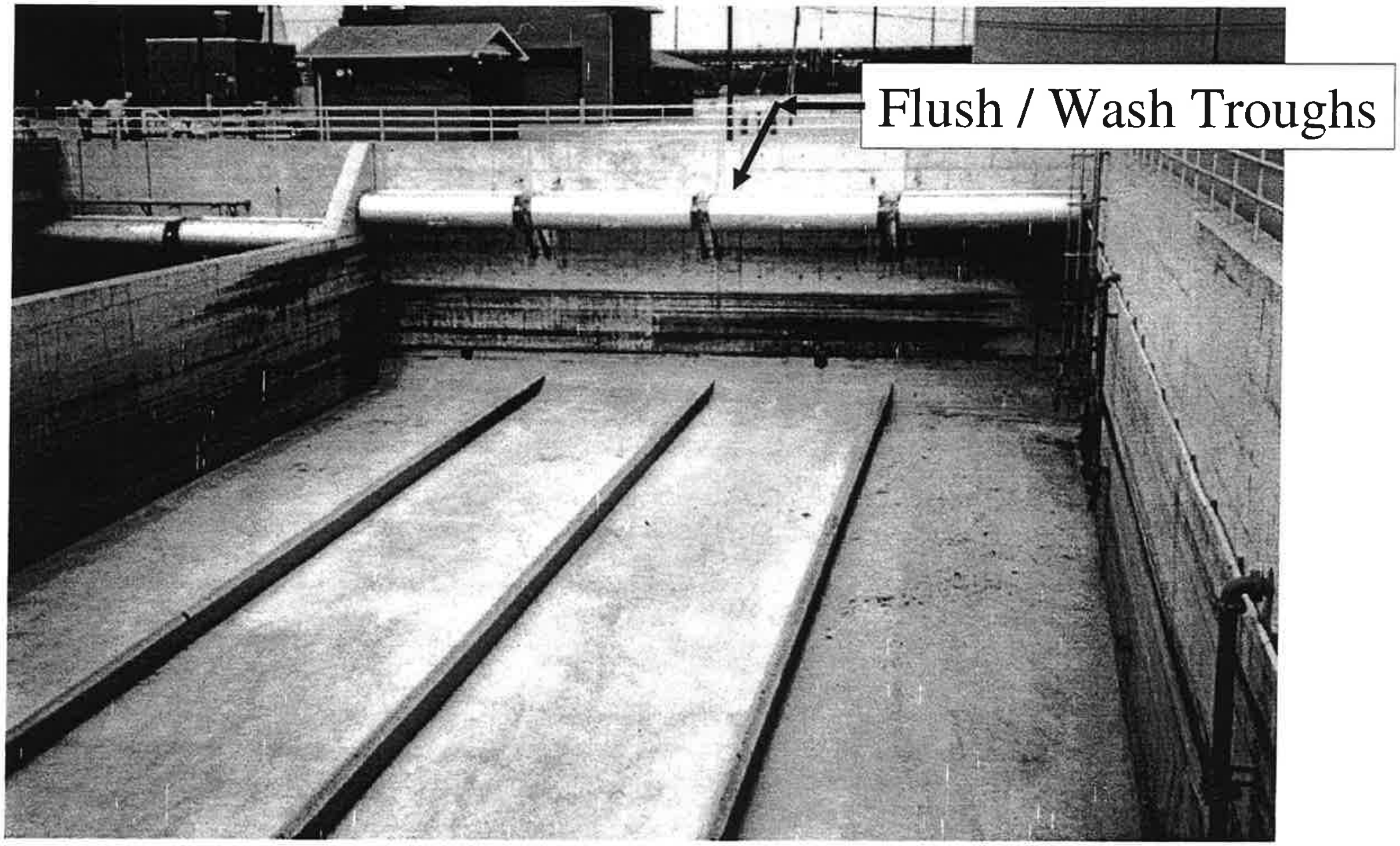
Off -Line Storage Facilities



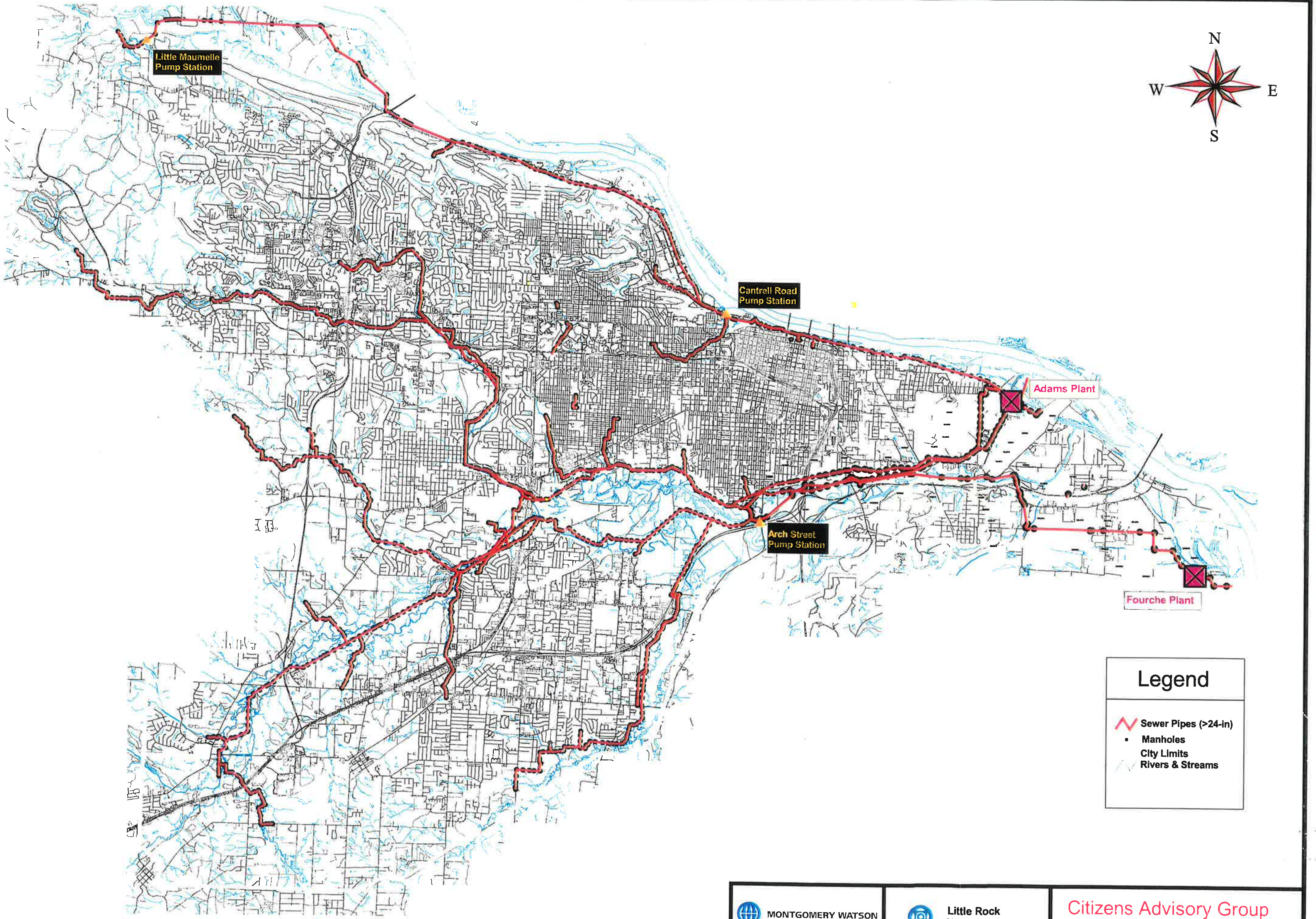
Off -Line Storage Facilities



Off -Line Storage Facilities



Flush / Wash Troughs



MONTGOMERY WATSON

Little Rock Wastewater Utility

Citizens Advisory Group
Overall System Map

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

Design Criteria

Adams Field WWTF
Summary of Unit Process Sizes and Loadings

TABLE OF CONTENTS

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Raw Wastewater (Plant Influent Values Obtained From Technical Memorandum No. 1)*					
Flow	mgd	8	30	75	94
BOD	mg/l	144	144	98	98
TSS	mg/l	173	173	111	111
NH3	mg/l	18	18	12	12
TKN	mg/l	27	27	18	18
P	mg/l	8	8	5	5
BOD	lbs/d	9,600	36,000	61,300	76,800
TSS	lbs/d	11,500	43,300	69,400	87,000
NH3	lbs/d	1,200	4,500	7,500	9,400
TKN	lbs/d	1,800	6,800	11,300	14,100
P	lbs/d	500	2,000	3,100	3,900
North Interceptor					
Percent Influent Flow	%	50%	50%	50%	50%
Flow	mgd	4.0	15.0	37.5	47.0
Diameter	in	60	60	60	60
Velocity	ft/s	0.3	1.2	3.0	3.7
South Interceptor					
Percent Influent Flow	%	50%	50%	50%	50%
Flow	mgd	4.0	15.0	37.5	47.0
Diameter	in	60	60	60	60
Velocity	ft/s	0.3	1.2	3.0	3.7
Treatment Influent					
Flow	mgd	8	30	75	94
BOD	lbs/d	9,600	36,000	61,300	76,800
TSS	lbs/d	11,500	43,300	69,400	87,000
NH3	lbs/d	1,200	4,500	7,500	9,400
TKN	lbs/d	1,800	6,800	11,300	14,100
P	lbs/d	500	2,000	3,100	3,900

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Influent Channel Distribution Box					
Length	ft	38	38	38	38
Width	ft	8	8	8	8
Wall Elevation	msl	257	257	257	257
Slab Elevation	msl	219	219	219	219
Total Volume	gal	86,409	86,409	86,409	86,409
Max WSE	msl	225	225	225	225
Available Volume	gal	13,644	13,644	13,644	13,644
Influent Screening Channels					
Number of Channels	#	1	2	3	3
Channel Flow	mgd	8.0	15.0	25.0	31.3
Length	ft	35	35	35	35
Width	ft	6	6	6	6
Wall Elevation (raise wall 2'0")	msl	227.6	227.6	227.6	227.6
Slab Elevation	msl	218.0	218.0	218.0	218.0
Max WSE	msl	223.7	223.7	223.7	223.7
Channel Velocity	ft/s	2.2	4.1	6.8	8.5
Influent Wet Well Feed Pipe					
Number of Feed Pipes	#	1	2	3	3
Flow	mgd	8.0	15.0	25.0	31.3
Diameter	in	42	42	42	42
Velocity	ft/s	1.3	2.4	4.0	5.0
Influent Wet Well					
Number of Wet Wells	#	1	2	3	3
Wet Well Flow	mgd	8.0	15.0	25.0	31.3
Length	ft	25	25	25	25
Width	ft	22	22	22	22
Wall Elevation	msl	252	252	252	252
Slab Elevation	msl	205	205	205	205
Total Wet Well Volume	gal	193,358	193,358	193,358	193,358
Max WSE	msl	225	225	225	225
Available Wet Well Volume	gal	82,280.0	82,280.0	82,280.0	82,280.0
Wet Well Detention Time	min	14.8	7.9	4.7	3.8

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Influent Pumps					
Number of Existing Pumps	#	4.0	4.0	4.0	4.0
Number of New Pumps	#	2.0	2.0	2.0	2.0
Capacity of Existing Pumps	gpm	11,800	11,800	11,800	11,800
Capacity of New Pumps	gpm	21,000	21,000	21,000	21,000
Total Pumping Capacity	gpm	89,200	89,200	89,200	89,200
Total Pumping Capacity	mgd	128.4	128.4	128.4	128.4
New Influent Pumps out of Service	#	1.0	1.0	1.0	1.0
Total Pumping Capacity	gpm	68,200	68,200	68,200	68,200
Total Pumping Capacity	mgd	98.2	98.2	98.2	98.2
Primary Clarifier Flow Control (Mag Meter)					
Number of Flow Meters	#	3	3	3	3
Flow Meters in Service	#	1	2	3	3
Flow Each Meter	mgd	8.0	15.0	25.0	31.3
Diameter	in	24	24	24	24
Velocity	ft/s	3.9	7.4	12.3	15.4
Primary Clarifier Feed Pipes					
Number of Feed Pipes	#	3	3	3	3
Number of Feed Pipes in Service	#	1	2	3	3
Flow Each Pipe	mgd	8.0	15.0	25.0	31.3
Diameter	in	42	42	42	42
Velocity	ft/s	1.3	2.4	4.0	5.0
Primary Clarifiers					
Number of Existing Clarifiers	#	3	3	3	3
Clarifiers in Service	#	1	2	3	3
Flow Each Clarifier	mgd	8.0	15.0	25.0	31.3
Clarifier Dia	ft	115	115	115	115
Clarifier Area Each	sf	10,387	10,387	10,387	10,387
Clarifier Area in Service	sf	10,387	20,774	31,161	31,161
Clarifier Hydraulic Loading	g/d/sf	770	1,444	2,407	3,017

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Primary Clarifier Removals (Based on Technical Memorandum No. 1)**					
BOD	%	28%	28%	25%	20%
TSS	%	52%	52%	49%	44%
NH	%	10%	10%	8%	6%
TKN	%	25%	25%	20%	15%
P	%	25%	25%	20%	15%
Primary Sludge at 400 gpm per clarifier in Service					
Clarifiers in Service	#	1	2	3	3
Percent Solids	%	0.12%	0.22%	0.24%	0.27%
Total Primary Sludge Flow	mgd	0.6	1.2	1.7	1.7
BOD	lbs/d	2,700	10,100	15,300	15,400
TSS	lbs/d	6,000	22,500	34,000	38,300
NH	lbs/d	100	500	600	600
TKN	lbs/d	500	1,700	2,300	2,100
P	lbs/d	100	500	600	600
Primary Scum Pumps					
Number of New Pumps	#	3	3	3	3
Pumps in service	#	1	1	1	1
Required Pumping Capacity Each	gpm	150	150	150	150
Primary Effluent					
Flow	mgd	7.4	28.8	73.3	92.3
BOD	lbs/d	6,900	25,900	46,000	61,400
TSS	lbs/d	5,500	20,800	35,400	48,700
NH	lbs/d	1,100	4,000	6,900	8,800
TKN	lbs/d	1,300	5,100	9,000	12,000
P	lbs/d	400	1,500	2,500	3,300
Primary Effluent Pipes					
Number of Effluent Pipes	#	3	3	3	3
Effluent Pipes in Service	#	1	2	3	3
Flow Each Pipe	mgd	7.4	14.4	24.4	30.8
Diameter	in	48	48	48	48
Velocity	ft/s	0.9	1.8	3.0	3.8

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Primary Effluent Mainline					
Number of Effluent Pipes	#	1	1	1	1
Flow	mgd	7.4	28.8	73.3	92.3
Diameter	in	72	72	72	72
Velocity	ft/s	0.4	1.6	4.0	5.1
Flow Equalization Overflow***					
Flow	mgd	0	0	0	19.0
BOD	lbs/d	0	0	0	12,639
TSS	lbs/d	0	0	0	10,025
NH3	lbs/d	0	0	0	1,811
TKN	lbs/d	0	0	0	2,470
P	lbs/d	0	0	0	679
Intermediate Pump Station					
Number of New Pumps	#	4	4	4	
Pumps in service	#	1	2	3	
Required Pumping Capacity Each	mgd	7.4	14.4	24.4	
Required Pumping Capacity	gpm	5,139	10,000	16,968	
Minimum Pumping Capacity	gpm	5,000	5,000	5,000	
Maximum Pumping Capacity	gpm	17,500	17,500	17,500	
Return Sludge					
Min. Ras Flow - 75% of Min.Day	mgd	5.6	n/a	n/a	
Ave. Ras Flow - 75% of Ave Day	%	n/a	21.6	n/a	
Max. Ras Flow - 50% of Peak	mgd	n/a	n/a	36.7	
Aeration Basin Mixed Liquor					
Flow (R+Q)	mgd	13.0	50.4	110.0	
BOD	lbs/d	6900	25900	46000	
TSS	lbs/d	5500	20800	35400	
NH	lbs/d	1100	4000	6900	
TKN	lbs/d	1300	5100	9000	
P	lbs/d	400	1500	2500	

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Aeration Basin Flow Control (Mag Meters)					
Number of Meters	#	6	6	6	
Flow Each Meter	mgd	2.2	8.4	18.3	
Diameter	in	24	24	24	
Velocity	ft/s	1.1	4.1	9.0	
Mag Meters out of Service	#	1	1	1	
Flow	gpm	2.6	10.1	22.0	
Velocity	ft/s	1.3	5.0	10.8	
Aeration Basin Feed Pipes					
Number of Feed Pipes	#	6	6	6	
Flow	mgd	2.2	8.4	18.3	
Diameter	in	36	36	36	
Velocity	ft/s	0.5	1.8	4.0	
Feed Pipes out of Service	#	1	1	1	
Flow	gpm	2.6	10.1	22.0	
Velocity	ft/s	0.6	2.2	4.8	
Aeration Basin Effluent Header					
Number of Headers	#	1	1	1	
Flow	mgd	13.0	50.4	110.0	
Diameter	in	72	72	72	
Velocity	ft/s	0.7	2.8	6.0	
Aeration Reactor Design					
Design Temperature	Deg. C	14	14	14	
Minimum SRT For Nitrification	Days	4.2	4.2	4.2	
Operating SRT	Days	2.5	2.5	2.5	
Design Yield (lbs/lbs BOD removed)	lbs/lbs	1.09	1.09	1.09	
System Effluent CBOD	mg/l	20	30	45	
Net Yield	lbs/d	7,521	28,231	50,140	
Aerobic MLSS	mg/l	1,800	1,800	3,200	
Aerobic Mass	lbs	18,800	70,600	125,400	
Aerobic Volume	mg	5.1	5.1	5.1	
HRT	hrs	16.5	4.3	1.7	
F/MVolume	lb/lb	0.37	0.37	0.37	

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Existing Aeration Basins (Based on Q)					
Number of Basins	#	6	6	6	
Basin Flow Each	mgd	1.2	4.8	12.2	
Length	ft	160	160	160	
Width	ft	40	40	40	
Top of Wall	msl	258.57	258.57	258.57	
Bottom of slab	msl	239.57	239.57	239.57	
Basin Volume	mg	0.91	0.91	0.91	
Maximum WSE	msl	257.25	257.25	257.25	
Available Basin Volume	mg	0.85	0.85	0.85	
Total Available Basin Volume	mg	5.08	5.08	5.08	
Basin Detention Time	hr	16.5	4.2	1.7	
Number Basins Out of Service	#	1	1	1	
Basin Flow	mgd	1.48	5.76	14.66	
Basin Detention Time	hr	13.7	3.5	1.4	
Aeration Requirements					
Daily Ave Oxygen Req	lbs/d	23,416	23,416	40,786	
Diurnal Peaking Factor		1	1.5	1.5	
P Hour Oxygen Req	lbs/d	23,416	35,124	61,179	
Transfer Efficiency	%	12%	12%	12%	
Total Oxygen Supply	lbs/d	195133	292700	509825	
Oyygen/Air	%	22%	22%	22%	
Air Supply Required	lbs/d	886,970	1,330,455	2,317,386	
Air	lbs/cf	0.064	0.064	0.064	
Air Supply	cf/d	13,859,000	20,788,000	36,209,000	
Summary Total Air Supply Req'd	scfm	9,600	14,400	25,100	
Air Flow per SF of 12" Diffuser	sfm	4.1	6.1	10.7	
WAS Sludge Yield					
WAS Yield	lbs/d	7,521	28,231	50,140	
Percent Solids	%	0.7%	0.7%	0.7%	
Flow	mgd	0.13	0.48	0.86	

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Secondary Clarifier Feed Pipes (Mixed Liquor)					
Number of Feed Pipes	#	4	4	4	
Flow	mgd	3.2	12.6	27.5	
Diameter	in	48	48	48	
Velocity	ft/s	0.4	1.6	3.4	
Feed Pipes out of Service	#	1	1	1	
Flow	gpm	4.3	16.8	36.7	
Velocity	ft/s	0.5	2.1	4.5	
Secondary Clarification					
Number of Clarifiers	#	4	4	4	
Clarifiers in Service	#	2	3	4	
Forward Flow Each	mgd	3.7	9.6	18.3	
Mixed Liquor Flow Each	mgd	6.5	16.8	27.5	
Diameter	ft	145	145	145	
Clarifier Area	sf	16513	16513	16513	
Clarifier Area in Service	sf	33,026	49,510	66,020	
Clarifier Overflow Rate	gal/d/sf	224	581	1,110	
Clarifier Solids Loading	lb/d/sf	5.9	15.3	44.4	
Clarifiers out of Service	#	1	1	1	
Forward Flow Each	mgd	7.4	14.4	24.4	
Mixed Liquor Flow Each	mgd	13.0	25.2	36.7	
Clarifier Area in Service	sf	16,513	33,026	49,539	
Clarifier Overflow Rate	gal/d/sf	448	872	1,480	
Clarifier Solids Loading	lb/d/sf	11.8	22.9	59.2	
Secondary Clarifier Effluent Pipes					
Number of Effluent Pipes	#	4	4	4	
Effluent Pipes in Service	#	2	3	4	
Flow Each Pipe	mgd	3.6	9.4	18.1	
Diameter	in	42	42	42	
Velocity	ft/s	0.6	1.5	2.9	

		Minimum Diurnal	Average Day	Secondary Max	Preliminary Max
Chlorine Contact Chambers					
Number of Existing Basins	#	1	1	1	
Flow	mgd	7.3	28.3	72.4	
Length	ft	60.3	60.3	60.3	
Width	ft	42.5	42.5	42.5	
Top of Weir	msl	249.5	249.5	249.5	
Bottom of Slab	msl	240.5	240.5	240.5	
Available Volume	mg	0.17	0.17	0.17	
Detention Time	hr	0.56	0.14	0.06	
Effluent Flow Structure					
Nuber of Flow Structures	#	1	1	1	
Flow	mgd	7.3	28.3	72.4	
Length	ft	10	10	10	
Width	ft	10	10	10	
Top of Weir	msl	242	242	242	
Bottom of Slab	msl	236	236	236	
Effluent Flow Measurement (Mag Meter)					
Nimber Effluent Meters	#	1	1	1	
Flow	mgd	7.3	28.3	72.4	
Diameter	in	42	42	42	
Velocity	ft/s	1.2	4.6	11.6	
Effluent Pipe					
Nimber Effluent Pipes	#	1	1	1	
Flow	mgd	7.3	28.3	72.4	
Diameter	in	72	72	72	
Velocity	ft/s	0.4	1.5	4.0	
Length	ft	2950	2950	2950	
Detention Time	hr	5.15	1.32	0.52	
Total Chlorination Detention Time	hr	5.71	1.47	0.57	

Notes:

*

Average Day and Dirurnal Minimum Projected Loads Based on Average Concentrations of 144 mg/L and 173 mg/L of BOD and TSS Respectively.
Secondary Max and Preliminary Max Loads Based on Peaking Factors of 1.6 and 1.7 for TSS and BOD Respectively (95 percentile).

**

Primary Clarifier Removals for Average Day Based on 28% and 52% Removal Efficiencies for BOD and TSS Respectively.

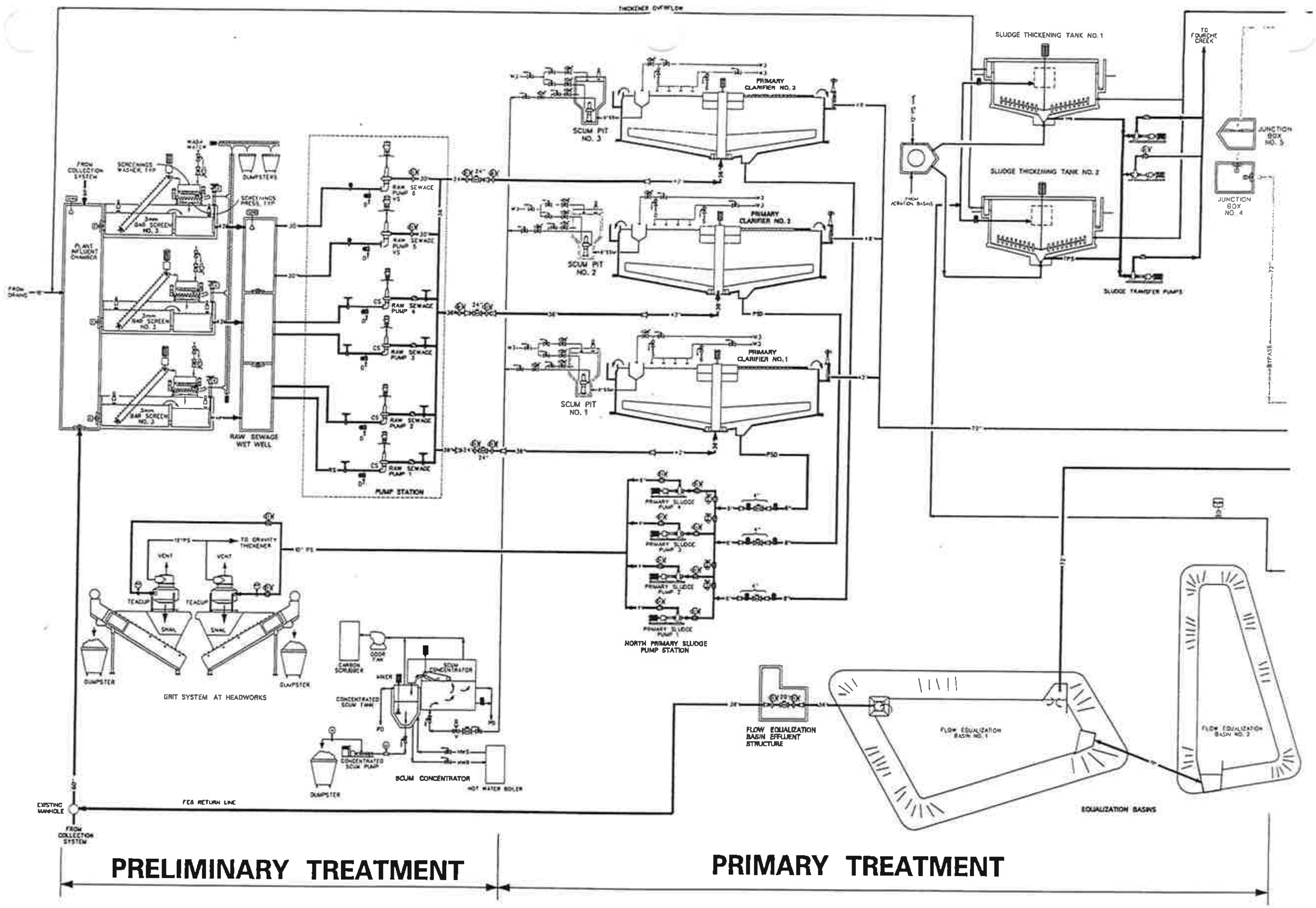
***

Maximum Primary Effluent Flow to the Secondary System is Estimated at 73.3 mgd. Primary Effluent Flows Above 73.3 mgd are Diverted to the Flow Equalization Basin.

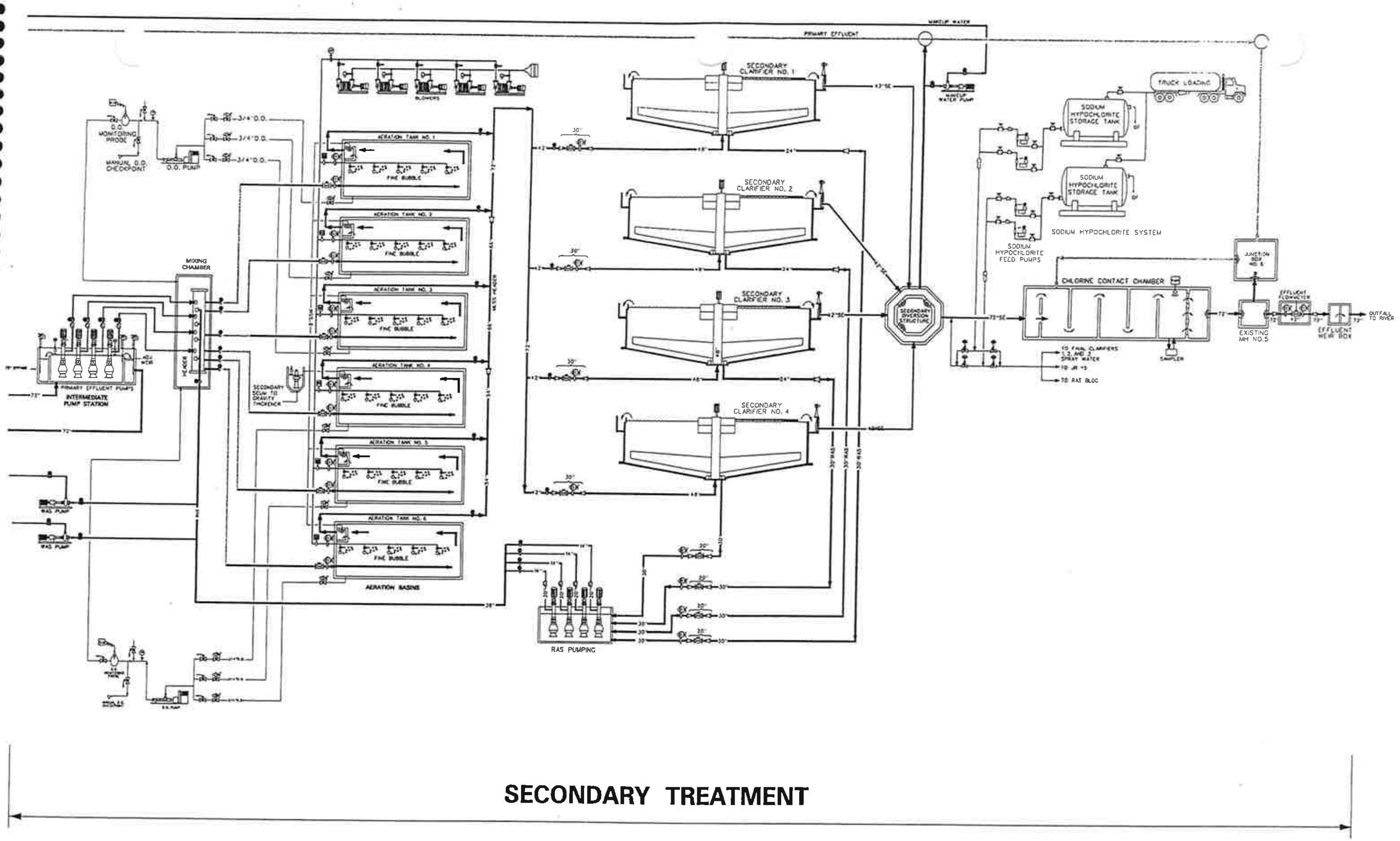
Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN
OPTIONS

Fluxogram



ADAMS FIELD WWTP FLUXOGRAM

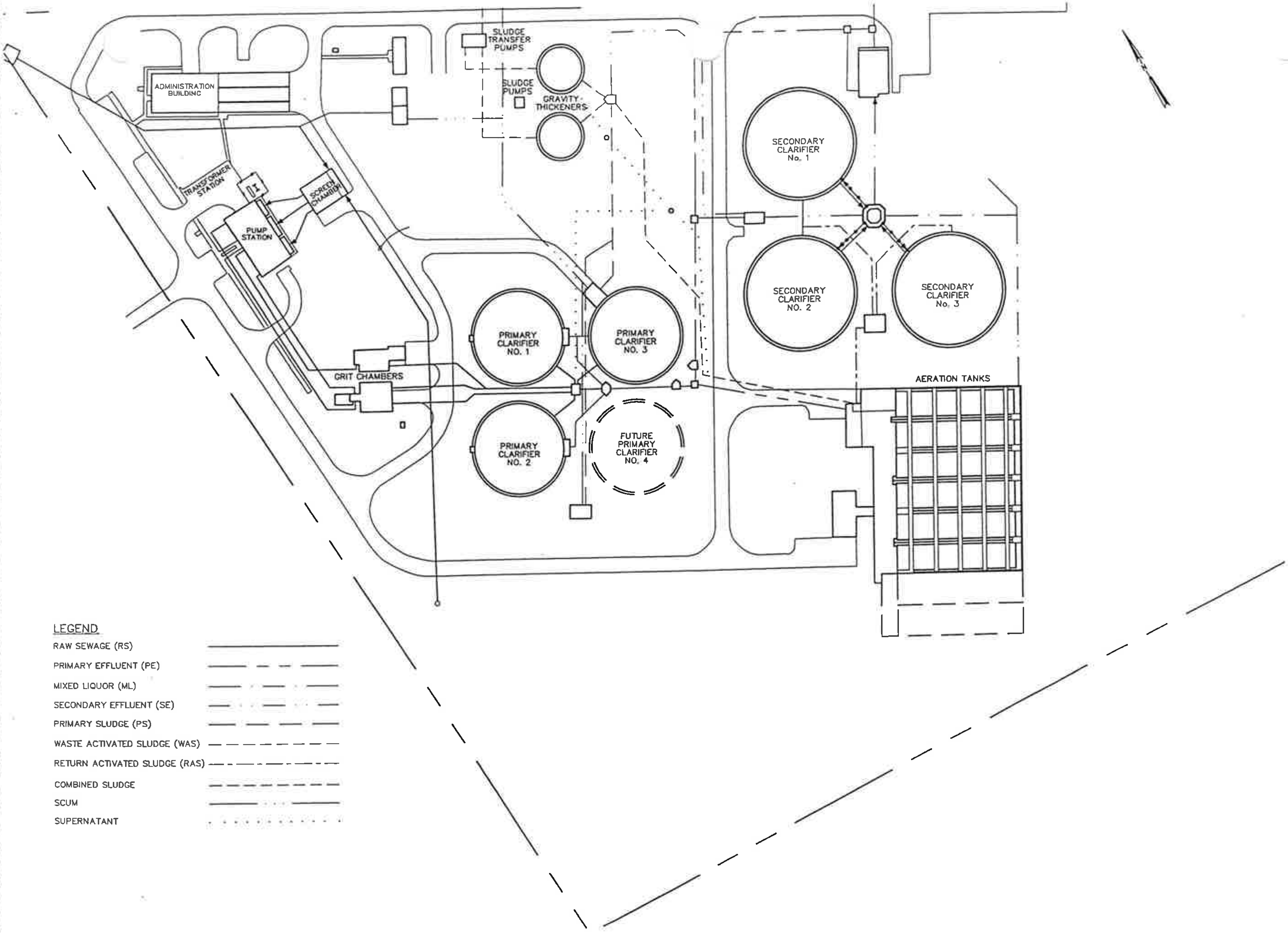


ADAMS FIELD WWTP FLUXOGRAM

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

Site Plans



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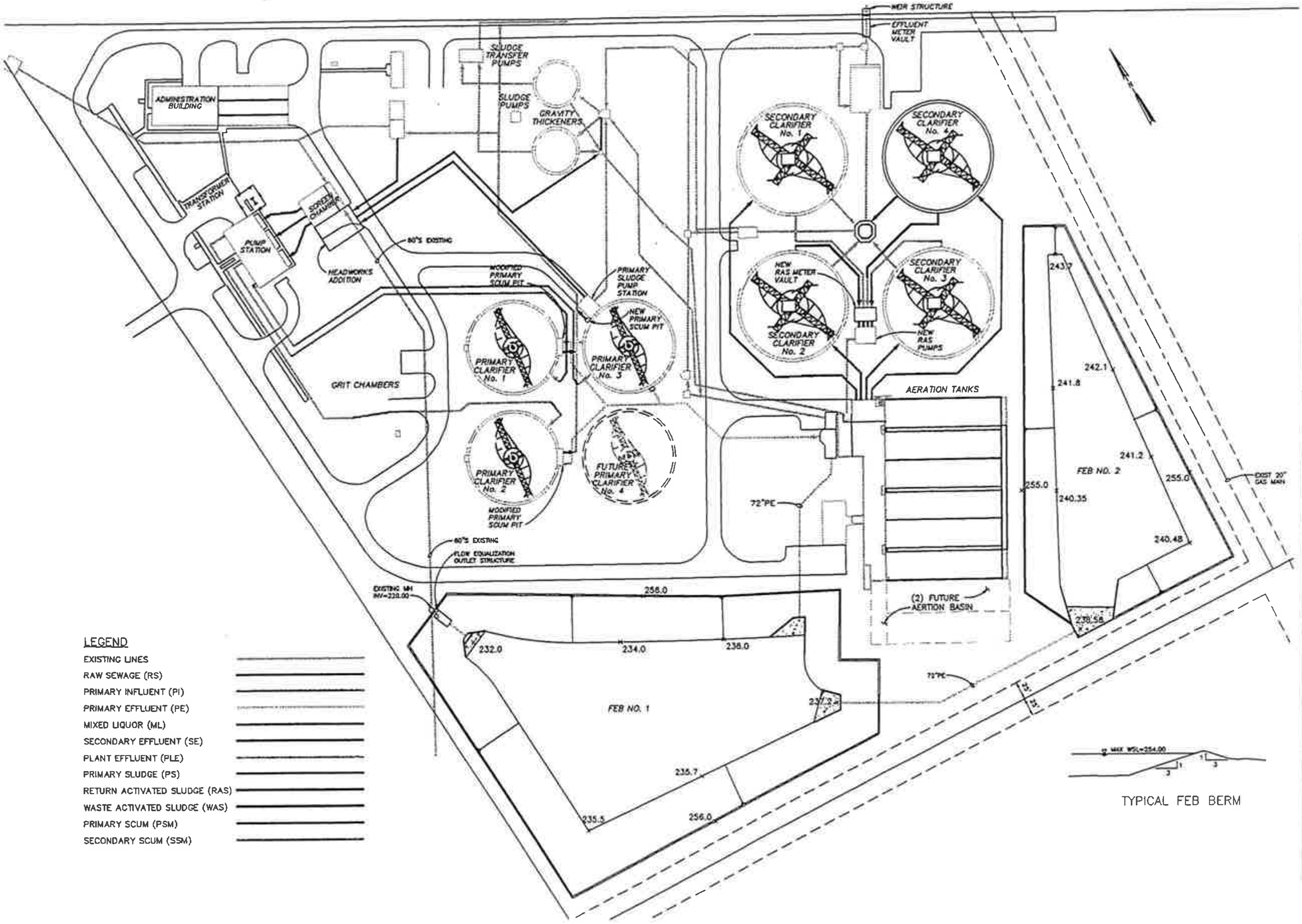
EXISTING CONDITIONS

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

September 1998

FIGURE
1



CH2MHILL

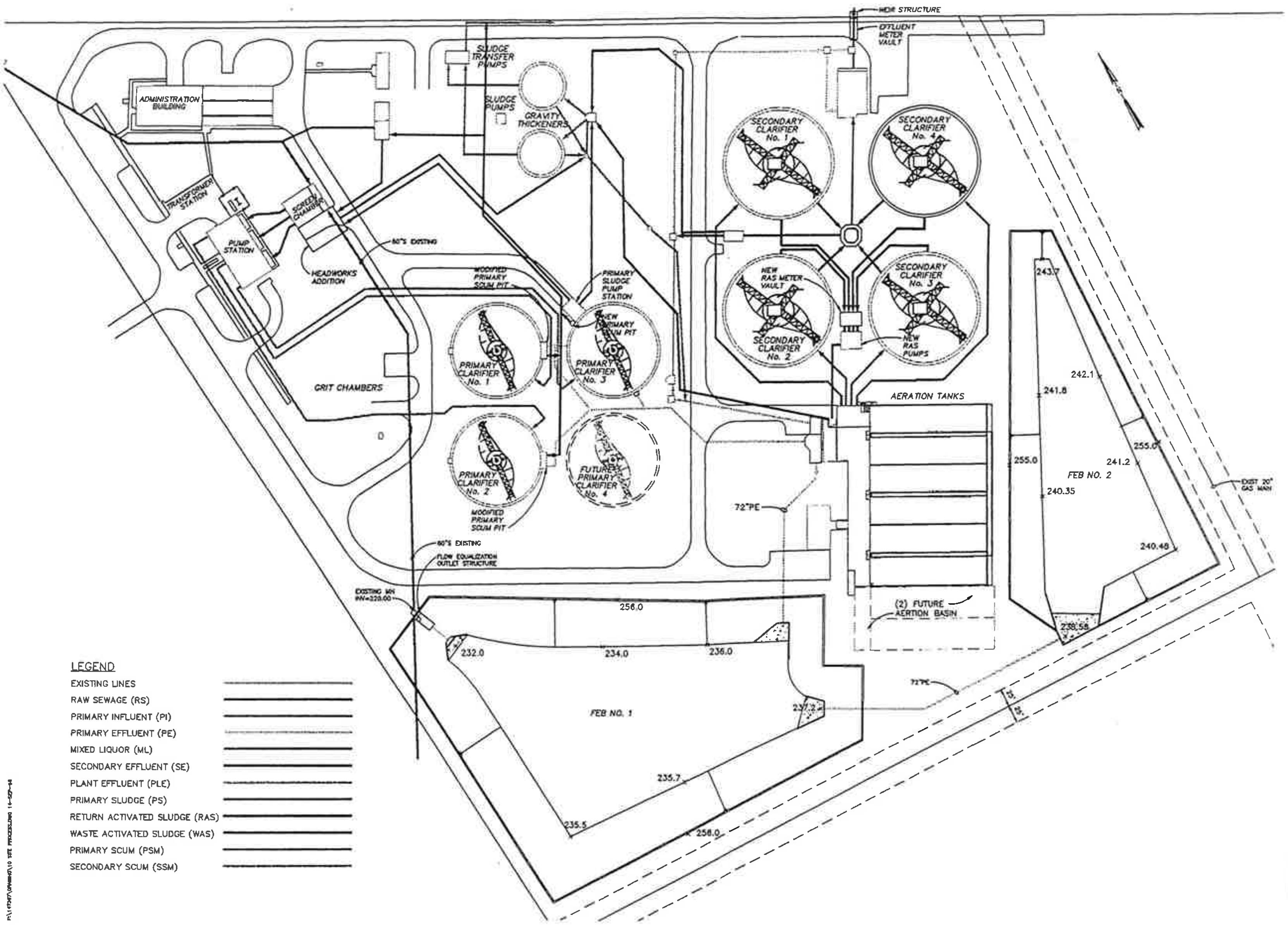
NEW MODIFICATIONS TO EXISTING

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
2



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PROCESS PIPING

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
3

Hydraulic Profile

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

TECHNICAL MEMORANDUM **CH2MHILL**

Adams Field WWTP: Capital Improvement Plan Hydraulic Summary

PREPARED FOR:	Mike Guthrie/ CH2M HILL
PREPARED BY:	William R. Leaf/ CH2M HILL
COPIES:	Shawn Clark/ CH2M HILL
DATE:	September 15, 1998

Introduction

The Capital Improvement Plan for the Adams Field Wastewater Treatment Plant (WWTP) includes various hydraulic improvements for the conveyance of the desired wastewater flow. The hydraulic analysis was completed using WinHYDRO, a computer model developed by CH2M HILL. The model produces a hydraulic profile by calculating headloss through treatment plant hydraulic structures.

The hydraulic design approach is to convey the required wastewater and recycle flows through the plant allowing for non-submergence at all unit process effluent weirs. The maximum wastewater flow through the secondary treatment units is 74 mgd. The Return Activated Sludge (RAS) flow is 50% of the wastewater flow, 37 mgd. The maximum wastewater flow through the primary clarifiers is 94 mgd. A flow equalization basin with a volume of 25 million gallons will be used to store the additional flow from the primary system.

The hydraulic analysis of the existing treatment plant is presented in a technical memorandum by CH2M HILL, "Adams Field WWTP: Hydraulic Capacity of Existing Facilities", August 20, 1998.

Hydraulic Analysis Results

Primary Treatment

For the primary treatment unit processes to convey the required maximum flow of 94 mgd, piping modifications are required. The influent pump station will include two new influent pumps and the accompanying piping. To convey the maximum flow, new influent piping to the primary clarifiers is required. New 42" primary influent piping will be tied into the existing influent piping. The existing piping under the primary clarifier foundation and influent columns are adequate in conveying the maximum flow.

The primary clarifiers do not require significant modifications for hydraulic purposes. The existing serpentine effluent weirs will be replaced with non-serpentine effluent weirs. The primary effluent launders are adequately sized to convey the maximum flow. Primary Clarifier No. 3 will require a new effluent box due to the new yard piping layout. The existing effluent boxes for Primary Clarifier No.1 and No.2 are able to pass the required flow.

New 48" primary effluent piping will run from the primary clarifiers to a new 72" primary effluent header. The primary effluent header will convey the maximum flow to the Intermediate Pump Station.

Intermediate Pumping/Flow Equalization

An intermediate pump station will be required to convey the primary effluent to the secondary treatment unit processes. The modifications to the hydraulics within the secondary treatment units result in need for the pumping of primary effluent. The intermediate pump station will include four (4) variable speed intermediate pumps as well as overflow weirs to divert addition plant influent flow. The flow will be diverted to the flow equalization basin or in an emergency to the existing plant by-pass line. The maximum hydraulic capacity of the primary unit processes is 94 mgd and the maximum hydraulic capacity of the secondary unit processes is 74 mgd. If a 94-mgd event were to occur, the additional flow over the secondary maximum capacity would be diverted to a flow equalization basin. An adjustable overflow weir is provided within the intermediate pump station to convey additional flow to the flow equalization basin.

The flow equalization basin is sized to accommodate 25 million gallons. The primary effluent diverted to the flow equalization basin is returned to the headworks. A pipeline from the flow equalization basin ties into the existing manhole (noted as MH No.2 on the 1958 Contract No.2 – Trunk Sewer drawings (Burns and McDonnell)) located within the existing 60"sewer interceptor coming into the WWTP from the south. A flowmeter and flow control valve are provided in the flow equalization basin effluent piping to control the return of the primary effluent.

In the event of a shut down of the intermediate pumps, an additional overflow weir is provided within the intermediate pump station to convey the influent flow to the existing secondary by-pass piping. The existing primary effluent piping is used to convey the flow from the Intermediate Pump Station to the by-pass diversion boxes.

Secondary Treatment

Two alternatives in conveying the flow from the intermediate pump station to the aeration basins were investigated. Alternative A consists of pumping the primary effluent into the existing mixing box and then using separate RAS and Aeration Basin Influent piping. Alternative B consists of pumping the primary effluent into an Aeration Basin Influent (ABI) header including both primary effluent and RAS.

The primary effluent will be pumped to the existing mixing box in Alternative A. The flow will then be conveyed through the existing ABI piping. Flow control assemblies will be included within the individual aeration basin influent pipes. With the modification of the aeration basin process, the influent pipes will be extended to the opposite end of the basin. The aeration basin water surface level will increase due to changes in the mixed liquor piping. Additional headloss will be generated in the ABI piping. This will result in an increase in the water surface level in the mixing box above the existing structure. The water surface increase is limited by removing the RAS from the aeration basin influent piping, but additional modifications to the mixing box structure are required. The water surface elevation is approximately 259.9 requiring an increase in the mixing box walls to an elevation of 261, assuming one foot of freeboard.

Alternative B eliminates the use of the mixing box and includes a pressurized aeration basin influent header. The RAS is mixed with the primary effluent in the ABI header. The header is connected to the six (6) existing individual ABI pipes. The ABI piping configuration going to each aeration basin will be the same as in Alternative A. This alternative will eliminate the need for an increase in the mixing box walls.

The intermediate pumps will be required to overcome the additional headloss generated with the RAS and primary effluent together. Complex coordination issues may arise during the installation of the header.

New effluent weirs and piping will be installed for the aeration basins. The effluent weirs will be moved to the end of the aeration basins connecting the gallery. To accommodate the additional headloss within the mixed liquor (ML) piping and flow control assembly, the aeration basin weirs and walls will be raised. The aeration basin walls will be increased by two feet to an elevation of 258.57. The effluent weirs will be raised to 257.25. A freeboard of 0.9 feet will exist in the aeration basins at the maximum capacity of the secondary system. A new launder will collect the aeration basin effluent and convey the flow to an effluent box.

The mixed liquor piping includes individual aeration basin effluent pipes connecting a common header. The ML header branches out to ML pipes connecting each secondary clarifier. The ML pipes to each secondary clarifier contain a magnetic flowmeter and flow control valve to optimize flow splits. The secondary clarifier influent piping requires signification modification. The existing secondary influent columns prove to be hydraulic bottlenecks in the conveyance of large flows. The annular piping used for the existing secondary influent columns will need to be replaced with 48" diameter columns. The ML pipelines are sized at 48" to limit headloss.

With the modifications to the influent piping on the secondary clarifiers and raising the aeration basin walls two feet, the existing WWTP can convey 59 mgd through the secondary processes with the three existing secondary clarifiers in service. For the WWTP to convey 74 mgd through the secondary processes, a new secondary clarifier is required. Additional hydraulic improvements may be made to convey the 74 mgd through the three existing secondary clarifiers, but the treatment capability of the WWTP would be compromised.

The maximum secondary flow of 74 mgd can be conveyed from the four (4) secondary clarifiers to the chlorine contact basin through the existing hydraulic structures with few modifications. The serpentine effluent weirs on the existing secondary clarifiers will be modified to non-serpentine weirs. The effluent weir elevation will remain the same. The existing secondary effluent launders and effluent boxes are adequate to convey the maximum secondary flow. The existing secondary effluent piping from the secondary clarifiers to the octagonal chamber can convey the required flow. The octagonal chamber can convey the maximum secondary flow given some modifications. A study of the existing facility noted vortexes forming at the outlet of the chamber at higher flows. A vortex-breaker should be installed to reduce this phenomenon.

The chlorine contact chamber (CCC) requires some structural modification to convey the maximum secondary flow. The influent channel in the chlorine contact chamber requires some structural revisions. The influent channel turns the influent flow 90-degrees from the secondary effluent line outlet. This abrupt change in direction leads to turbulent conditions. To reduce this turbulence, an 8-ft by 8-ft opening is to be cut within the baffle wall to allow the flow from the secondary effluent line to continue into the chlorine contact chamber. To accommodate the secondary maximum flow, the effluent weir is to be lowered to an elevation of 249.5. The existing effluent launder and collection box prove to be hydraulic bottlenecks. The effluent launder is to be modified by lowering the launder to an invert elevation of 243.0 and increasing the width from 3 feet to 4 feet. The effluent box is to be modified to match the 4-foot wide launder.

Plant Effluent Piping

The major modification to the plant effluent piping (PLE) is to include a magnetic flowmeter and isolation valves. A 42" magnetic flowmeter is to be installed in the 72"PLE downstream of Manhole No. 5. For the flowmeter to function properly, the 42" line must always be in a full-pipe flow condition. At low flows, the existing PLE is not pressurized. To keep the 42"PLE in a full-flow condition, an effluent weir assembly is required downstream. The structure will include a weir at elevation 242.0 and be sized to limit the headloss at larger flow events.

The effluent piping from the WWTP to the Arkansas River is reported by plant operators to be 72"with an outfall located at an approximate elevation of 220. The normal water surface level of the Arkansas River is reported to be at an elevation of 231. The hydraulic analysis is completed assuming this elevation. The WWTP unit process effluent weirs will remain non-submerged until the Arkansas River reaches a stage greater than 240 at the plant outfall. Any stage greater than 240 will lead to submerged effluent weirs with the WWTP conveying the secondary maximum capacity.

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

Preliminary Treatment

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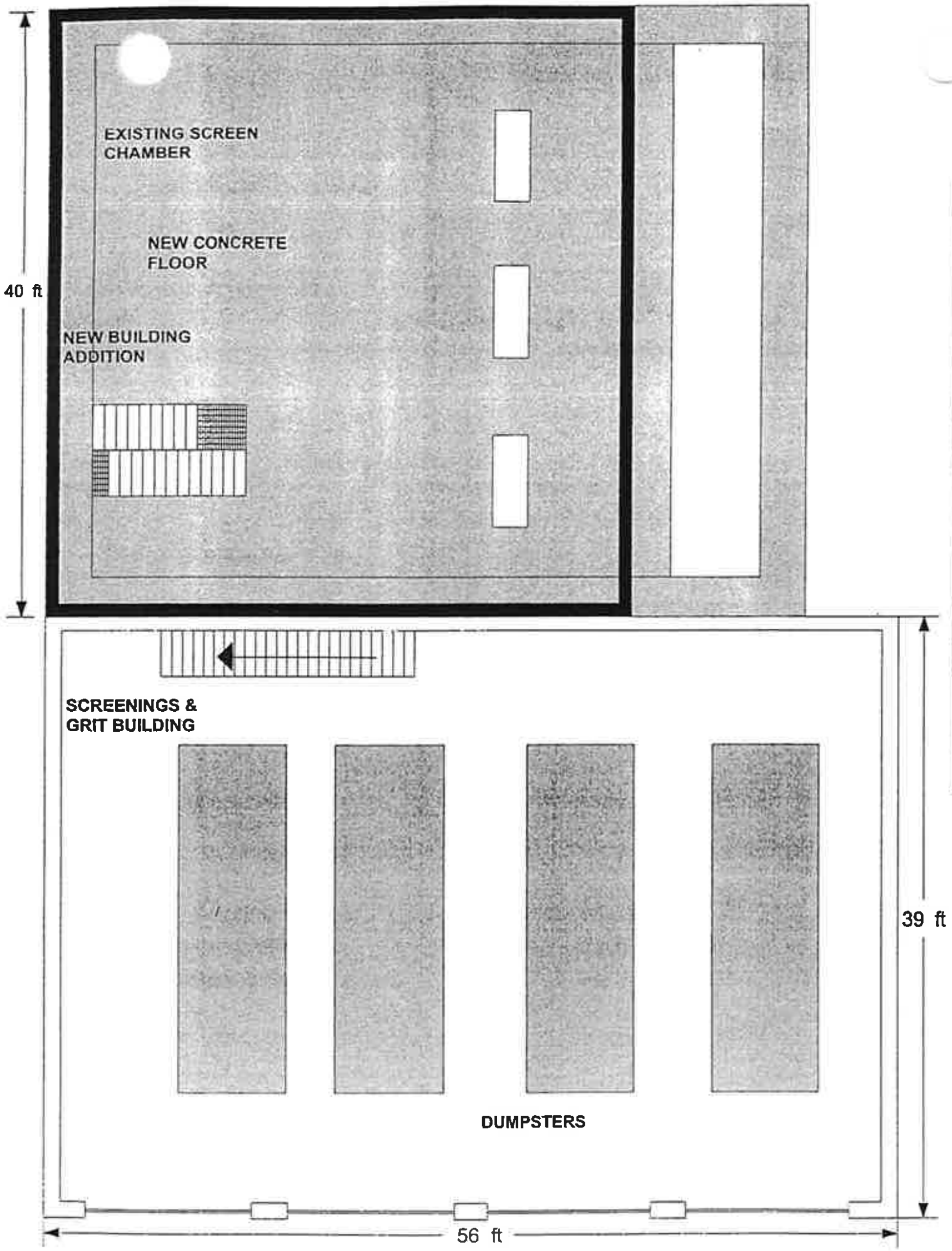
HEADWORKS BUILDING - GROUND FLOOR

Adams Field WWTP
City of Little Rock, AK

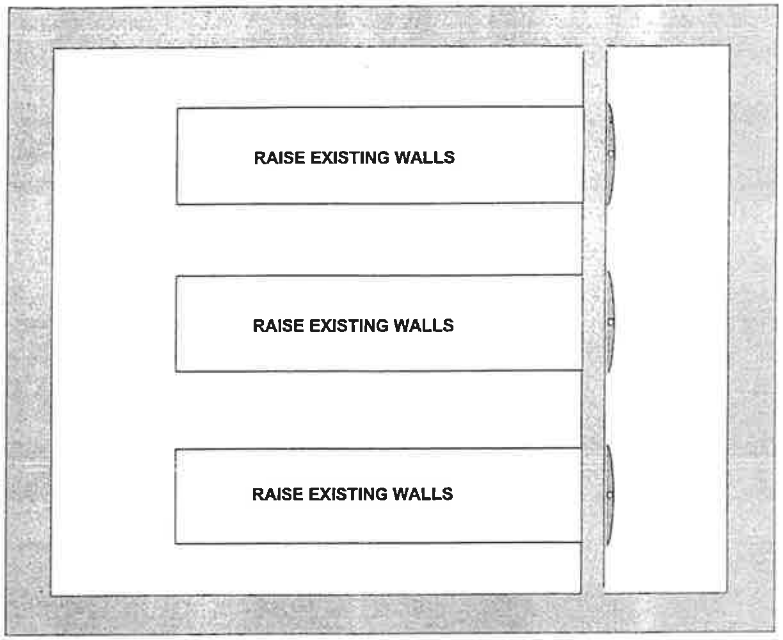
Capital Improvement Plan (Options)

September 1998

FIGURE
4



GROUND FLOOR
SCALE 1/8"=1"



LOWER FLOOR
SCALE 1/8"=1"

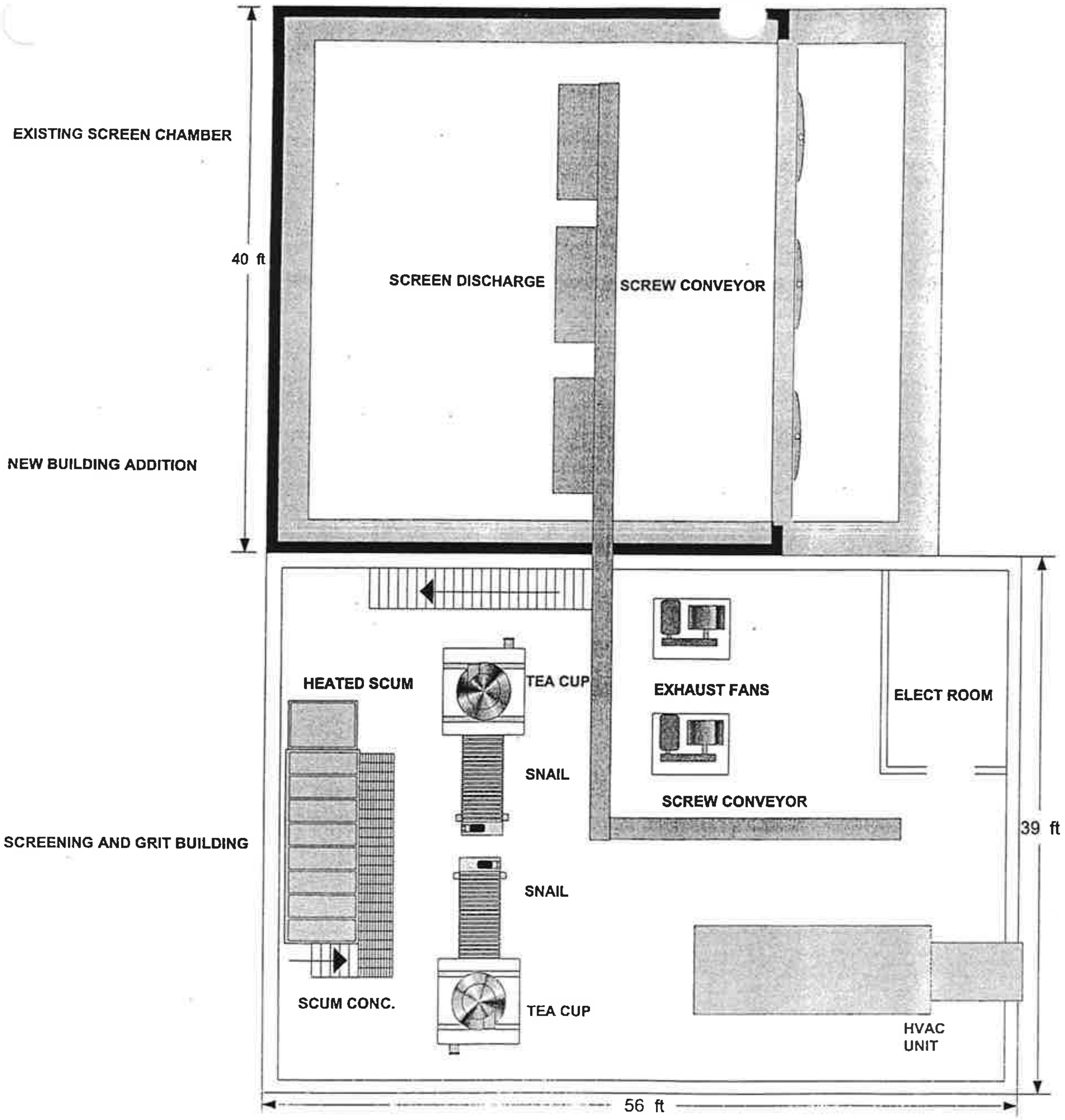
HEADWORKS BUILDING - UPPER FLOOR

Adams Field
WWTP
City of Little Rock, AK

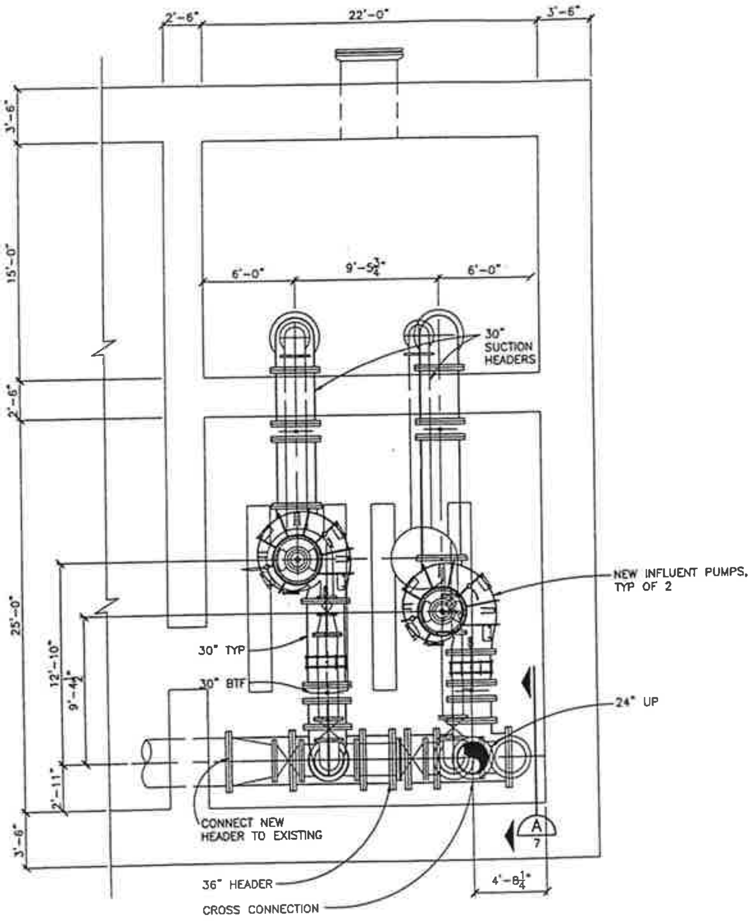
Capital Improvement Plan (Options)

September 1998

FIGURE
5



UPPER FLOOR
SCALE 1/8"=1"



PRIMARY INFLUENT PUMP STATION PLAN
1/8" = 1'-0"

H2MHILL

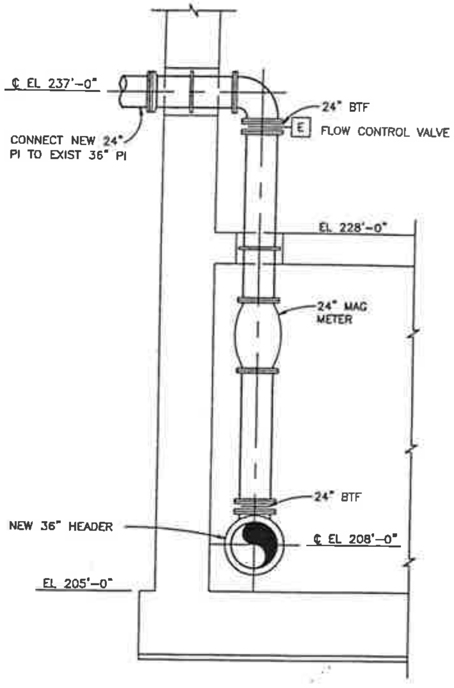
INFLUENT PUMP STATION

Adams Field WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

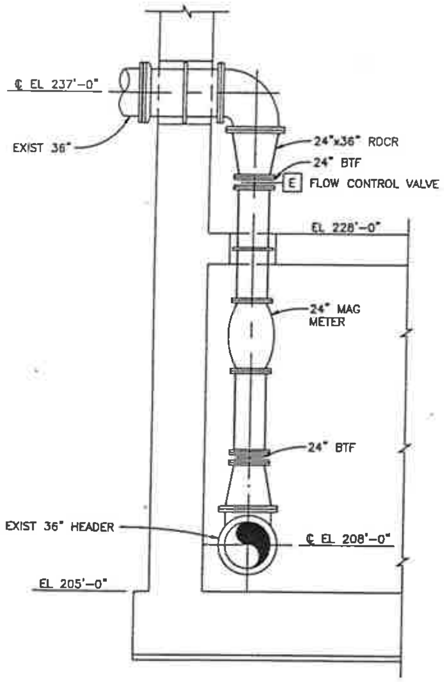
September 1998

FIGURE
6



TYPICAL OF 1

SECTION A
1/8" = 1'-0" 6



TYPICAL OF 2

SECTION B
1/8" = 1'-0" 6

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INFLUENT PUMP STATION SECTIONS

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

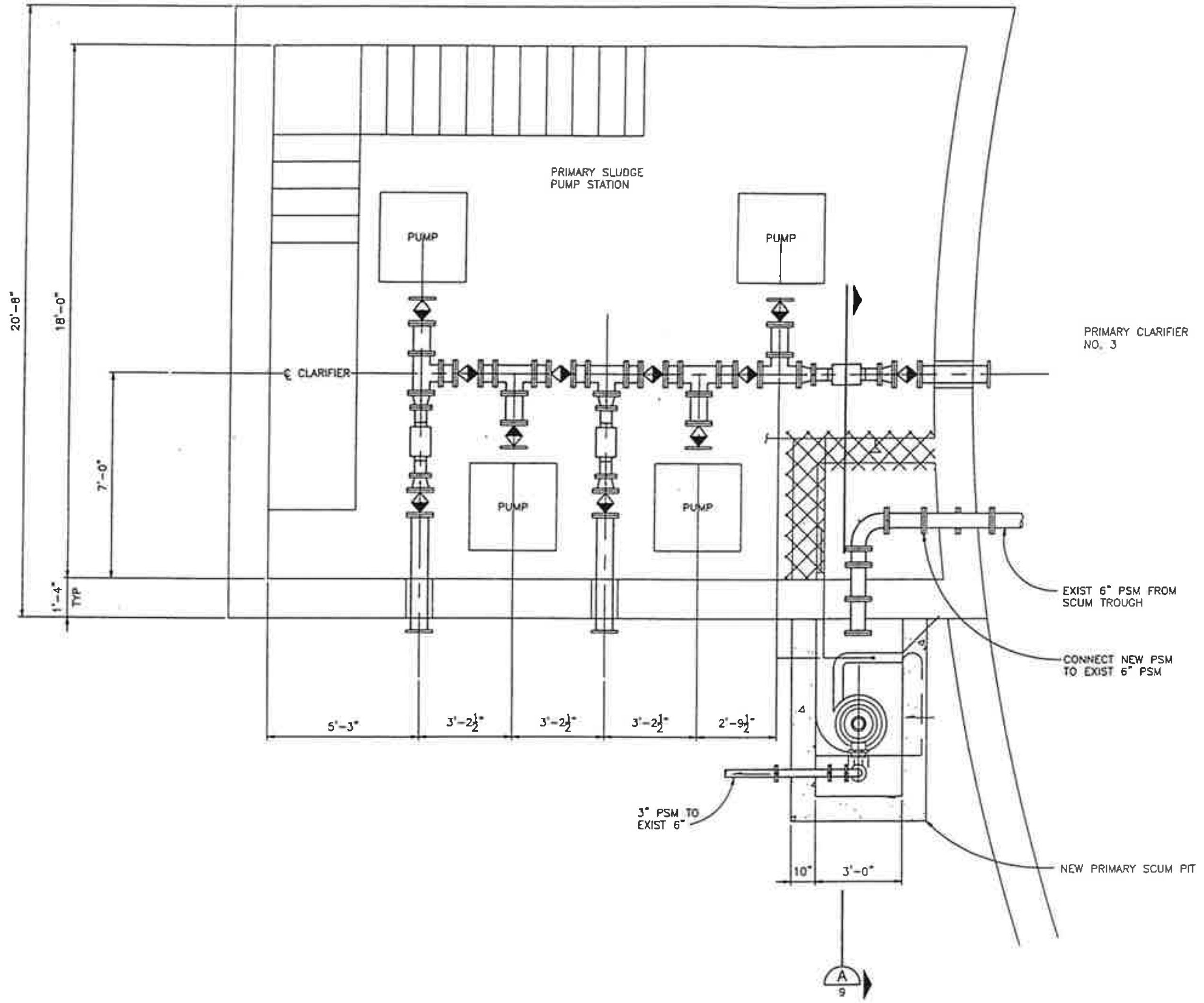
September 1998

FIGURE
7

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

Primary Treatment



NEW PRIMARY SLUDGE PUMP STATION AND PRIMARY SCUM PIT
1/4" = 1'-0"

CH2MHILL

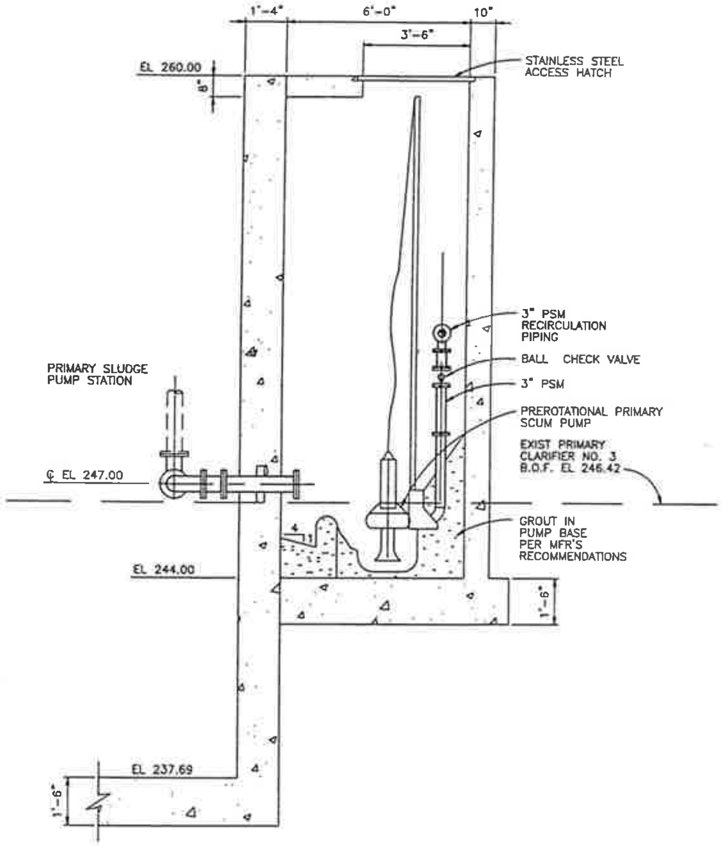
NEW PRIMARY SLUDGE PUMP STATION, SCUM PIT

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

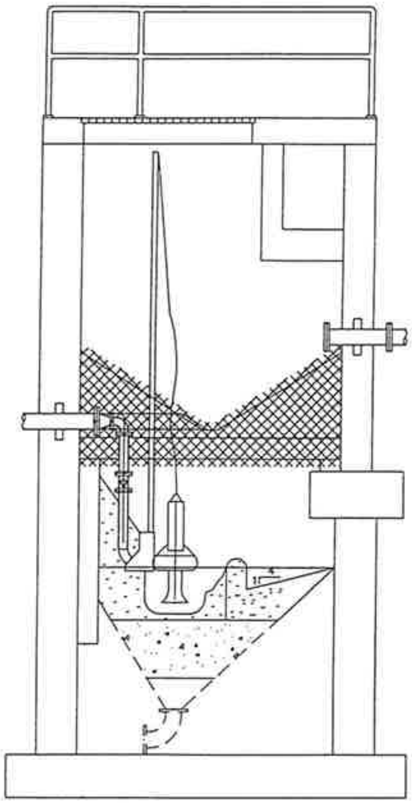
September 1998

FIGURE
8



NEW PRIMARY SCUM PIT (TYP OF1)

SECTION A/8
1/4" = 1'-0"



EXISTING PRIMARY SCUM PIT (TYP OF2)

SECTION
1/4" = 1'-0"

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PRIMARY SCUM PIT SECTIONS

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

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FIGURE
9

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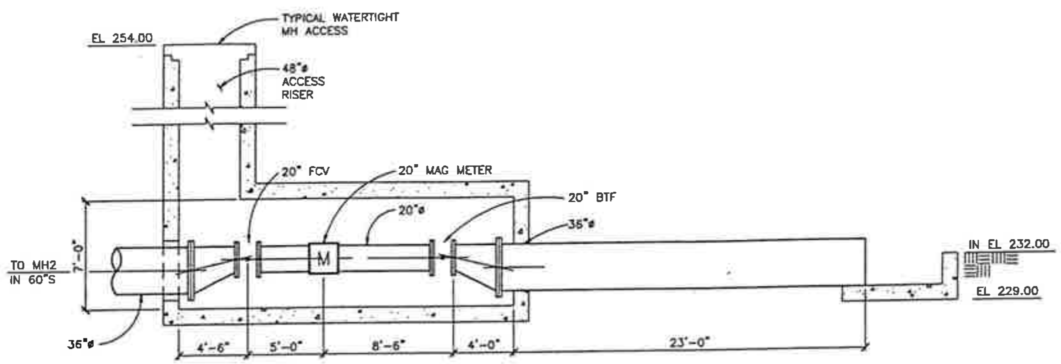
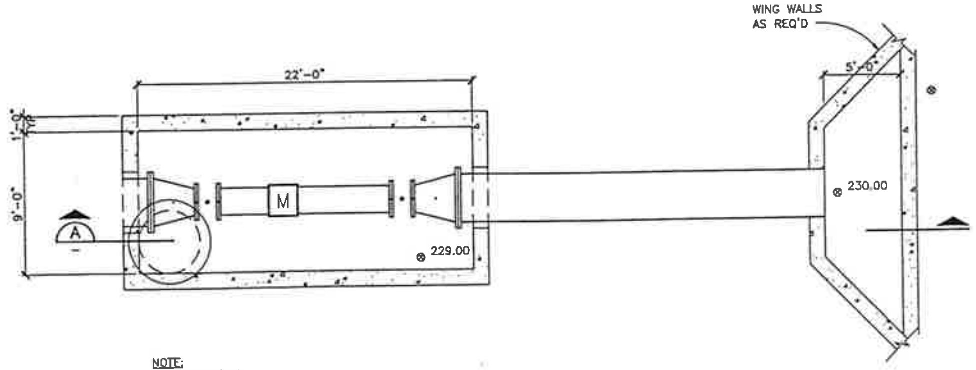
FLOW EQUALIZATON BASIN OUTLET STRUCTURE



SECTION (A)
1/8" = 1'-0"



NOTE:
SEE SITE PLAN
FOR LOCATION

FLOW EQUALIZATION BASIN OUTLET STRUCTURE
1/8" = 1'-0"

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

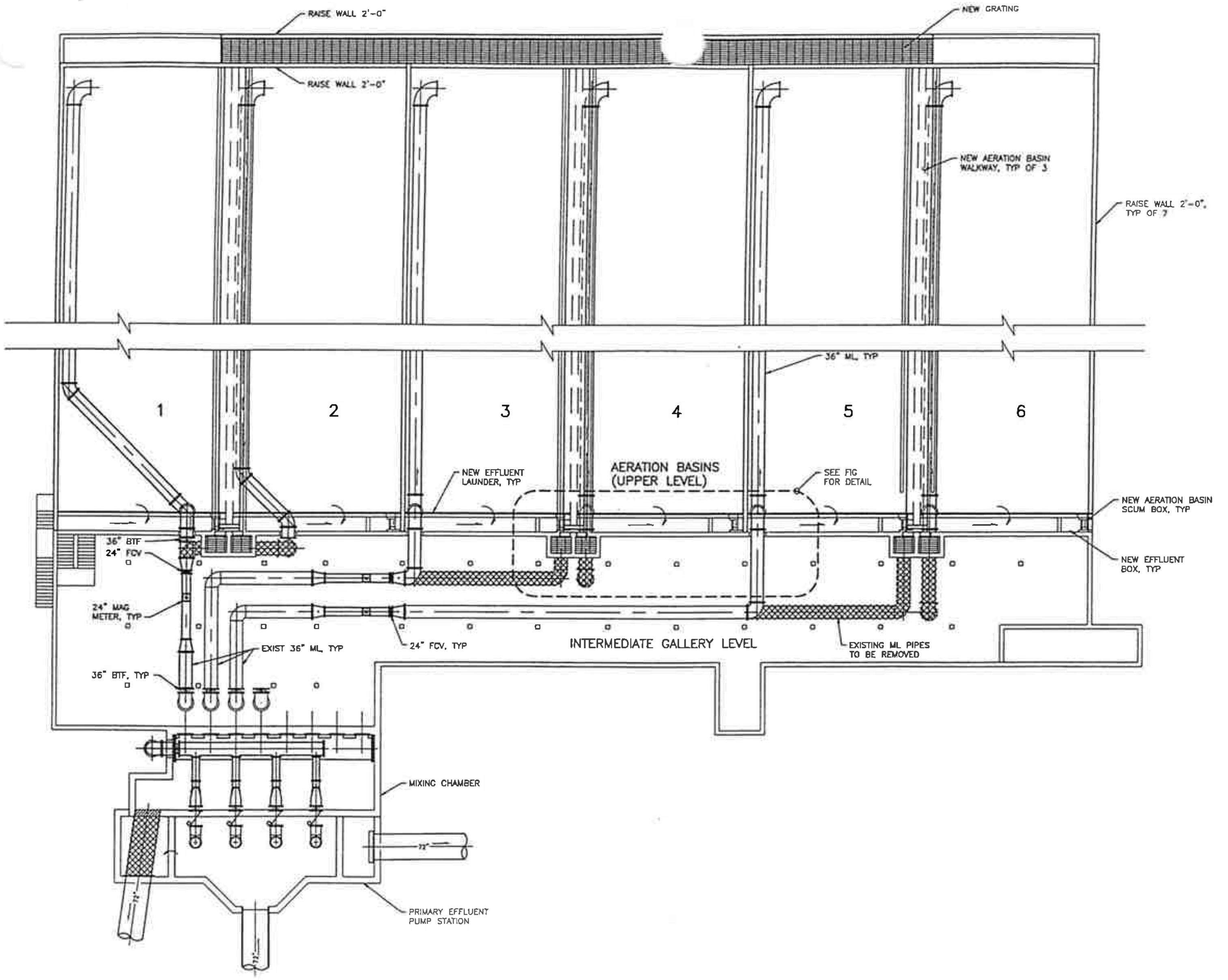
September 1998

FIGURE
10

Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN OPTIONS

Secondary Treatment



PRIMARY EFFLUENT PUMP STATION AND AERATION BASIN (UPPER AND INTERMEDIATE LEVEL PLAN)
NTS

P:\147367\DRAWING\01 PC PUMP-MIXING-AERATION.DWG 14-SEP-98

CH2MHILL

PRIMARY EFFLUENT PUMP STATION AND AERATION BASIN

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

September 1998

FIGURE
11

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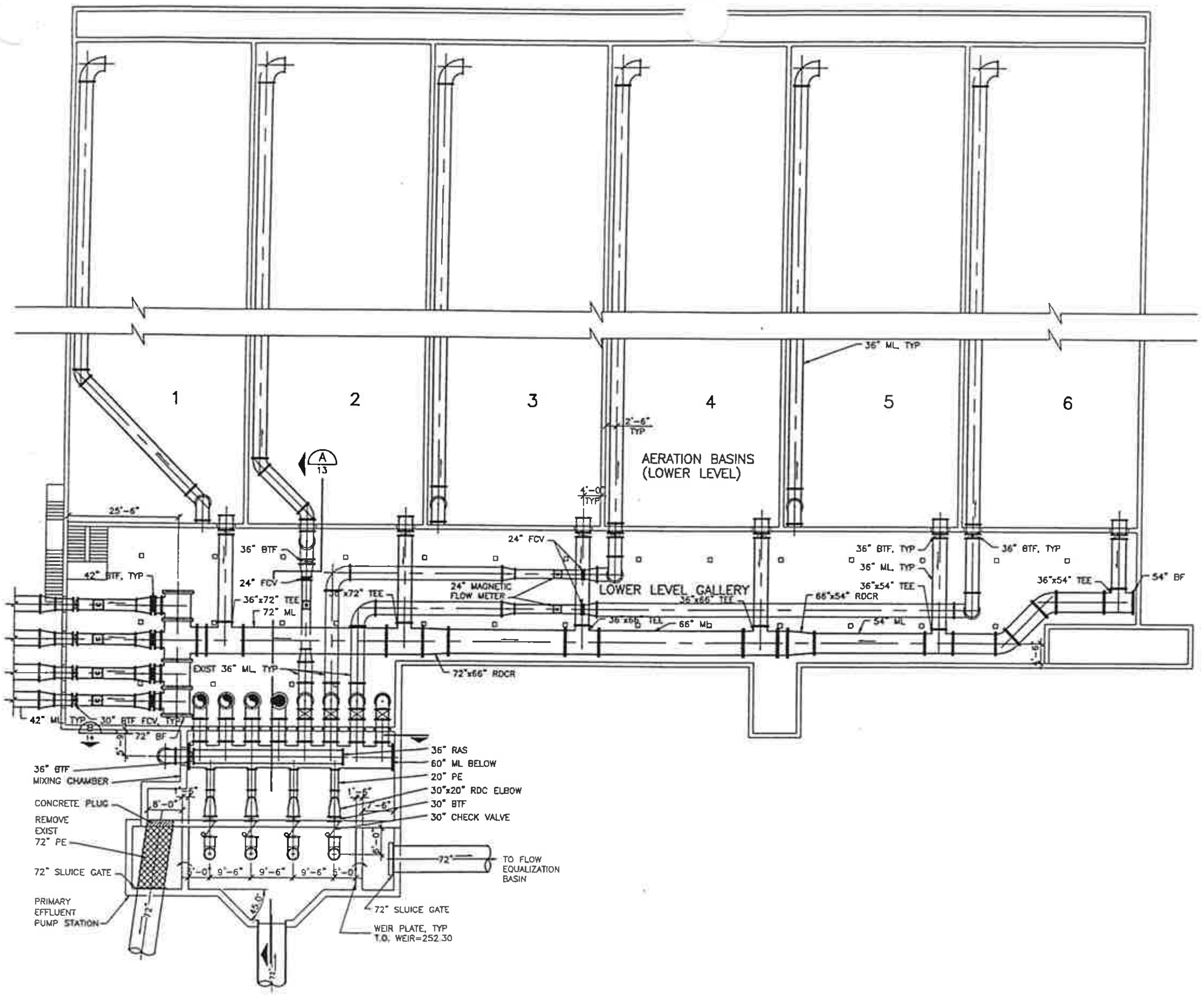
PRIMARY EFFLUENT PUMP STATION AND AERATION BASIN



PRIMARY EFFLUENT PUMP STATION AND AERATION BASIN (LOWER LEVEL PLAN)
NTS

P:\147367\DRAWING\01 PE PUMP-MIXING-AERATION.DWG 14-SEP-98

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

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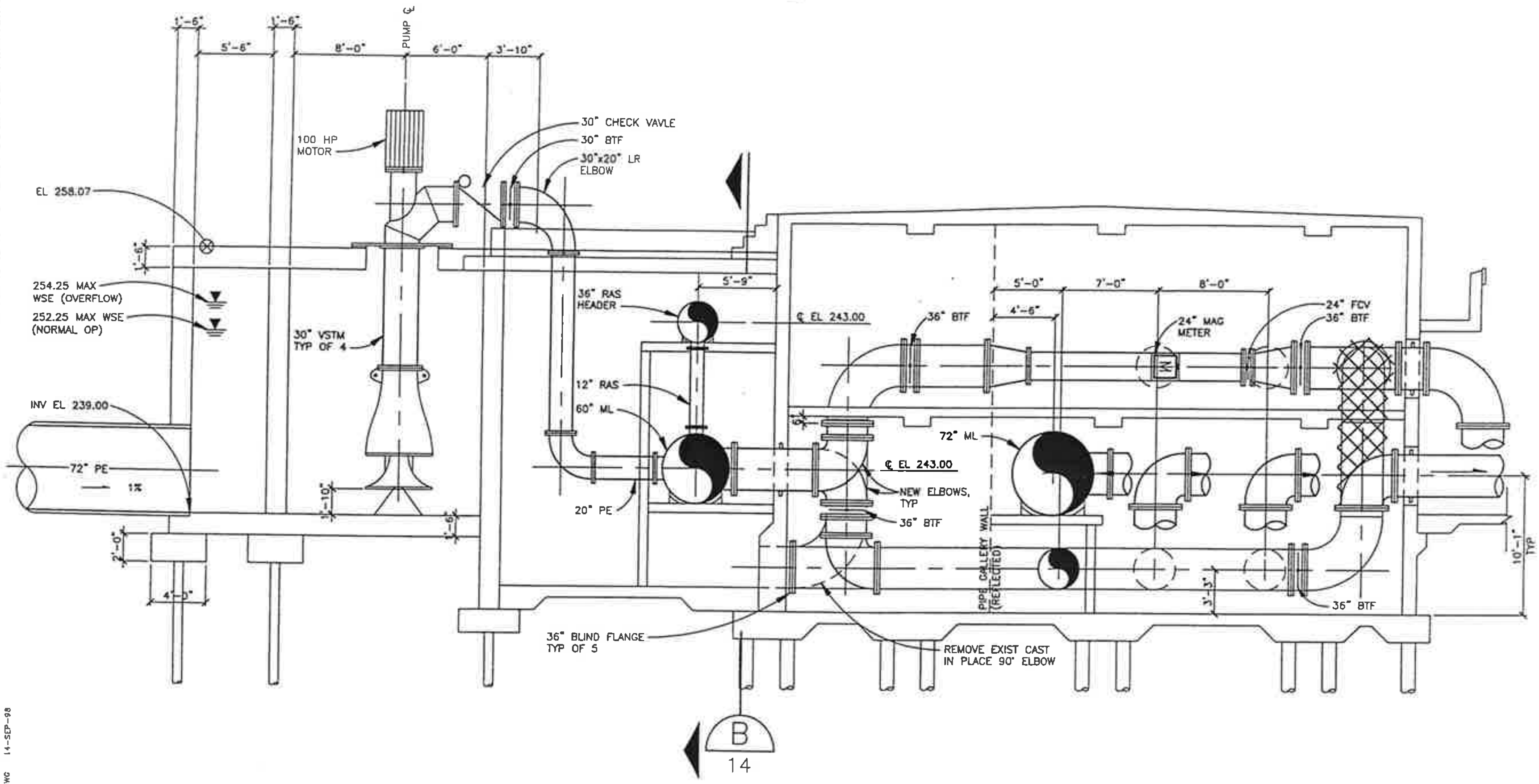
FIGURE
12

PRIMARY EFFLUENT PUMP STATION AND AERATION BASIN SECTION



SECTION A
1/8" = 1'-0" 12

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

September 1998

FIGURE
13

P:\147367\DRAWING\01 PE PUMP-MIXING-AERATION.DWG 14-SEP-98

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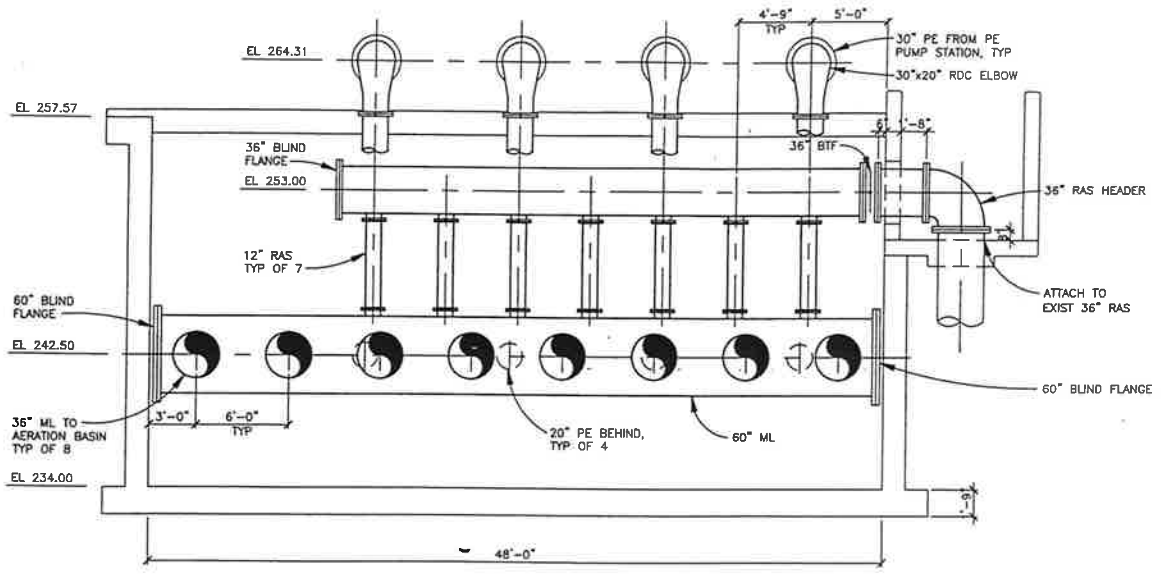
MIXING CHAMBER MODIFICATIONS SECTIONS



MIXING CHAMBER SECTION (B)
1/8" = 1'-0" 13

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
14

P:\147367\DRAWING\01 PE PUMP-MIXING-AERATION.DWG 14-SEP-98

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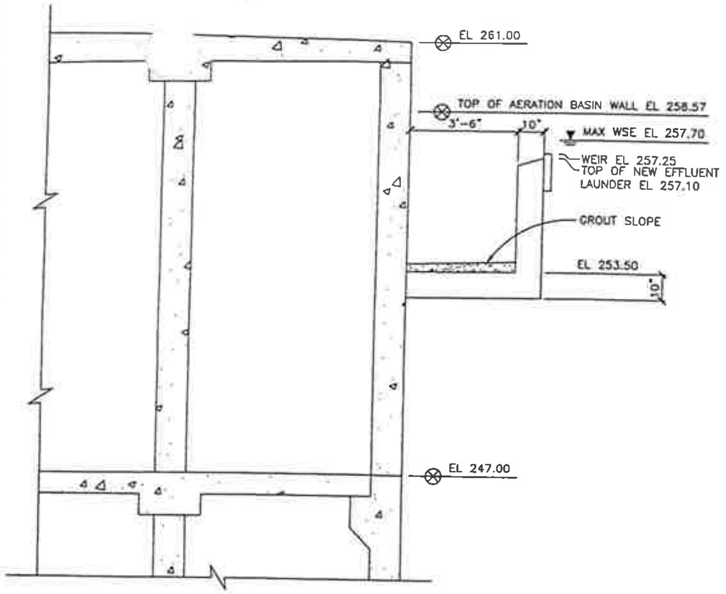
AERATION BASIN EFFLUENT LAUNDER PLAN AND SECTION

Adams Field WWTP
City of Little Rock, AK

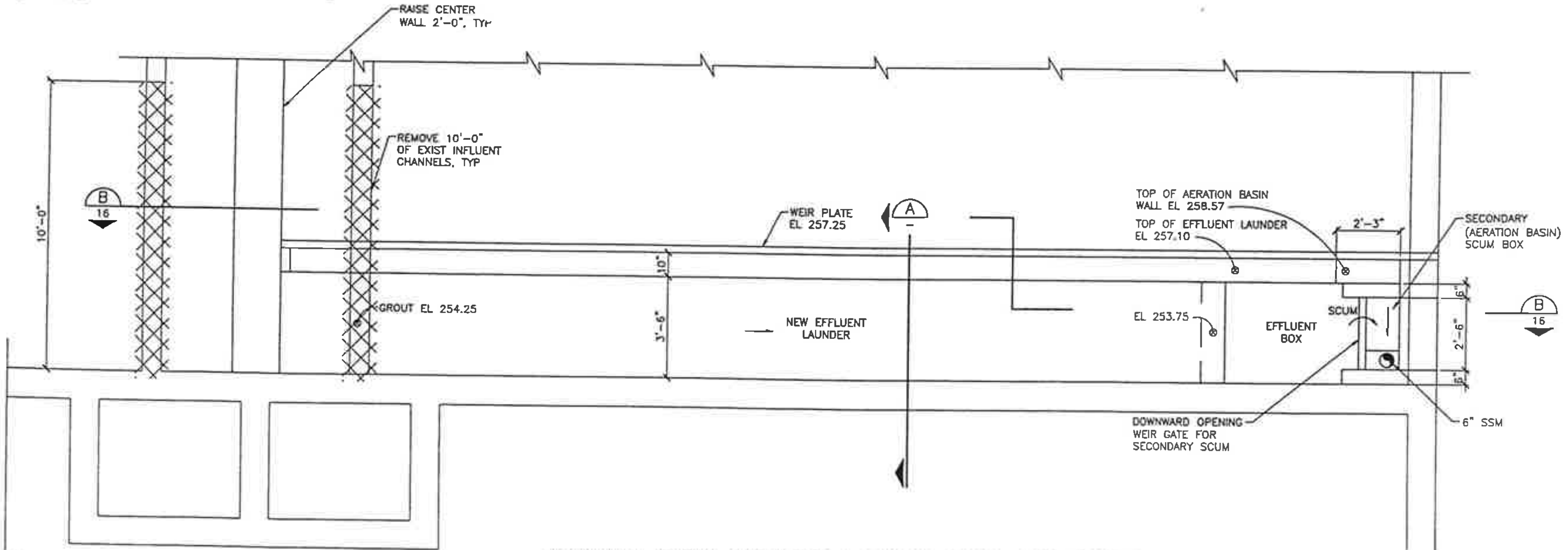
Capital Improvement Plan (Options)

September 1998

FIGURE
15



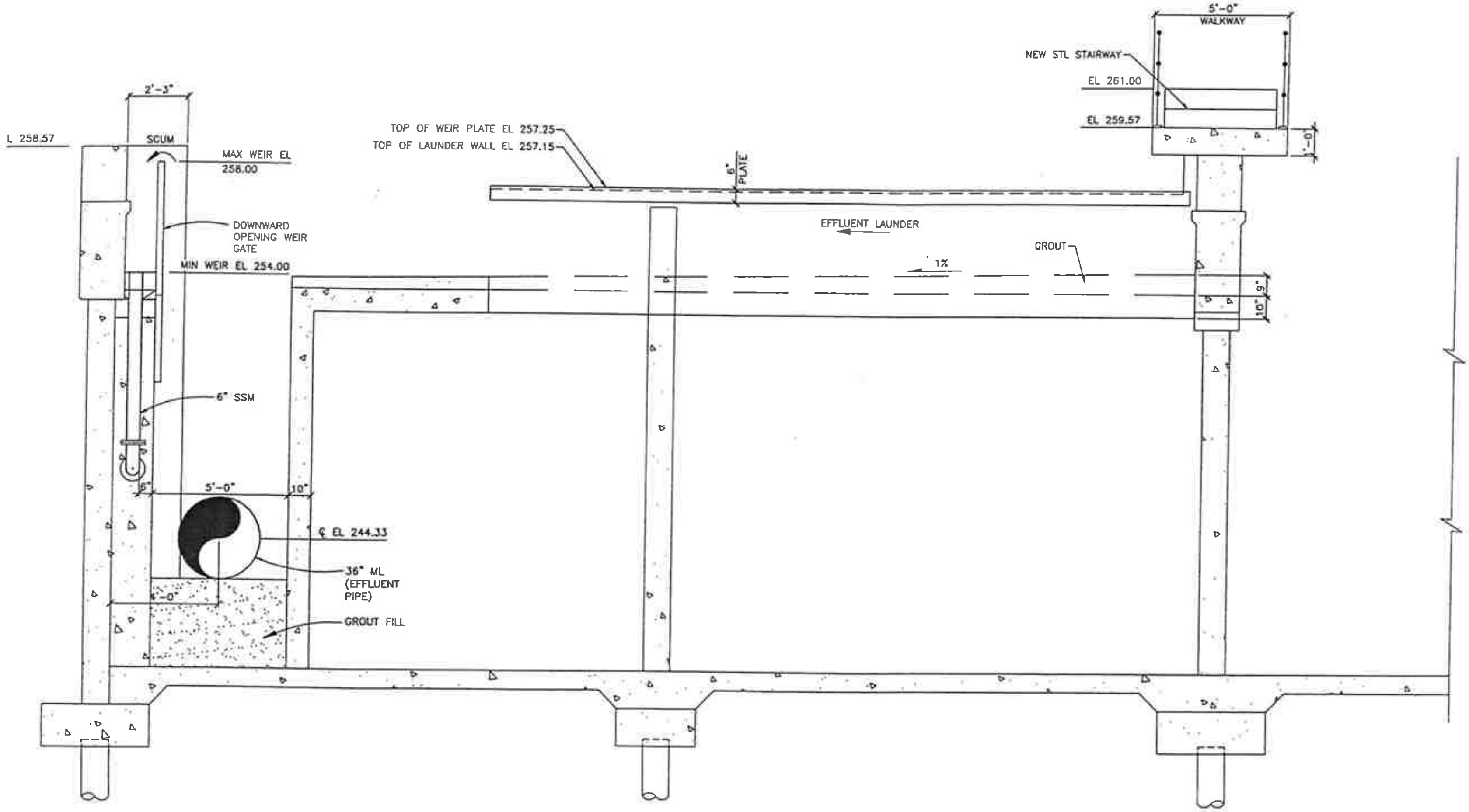
TYPICAL WALL SECTION (A)
1/4" = 1'-0"



AERATION BASIN EFFLUENT LAUNDER PLAN AND SECTION
1/4" = 1'-0"

CH2MHILL

AERATION BASIN EFFLUENT LAUNDER SECTION



WALL AND STRUT SECTION (B/15)
1/4" = 1'-0"

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
16

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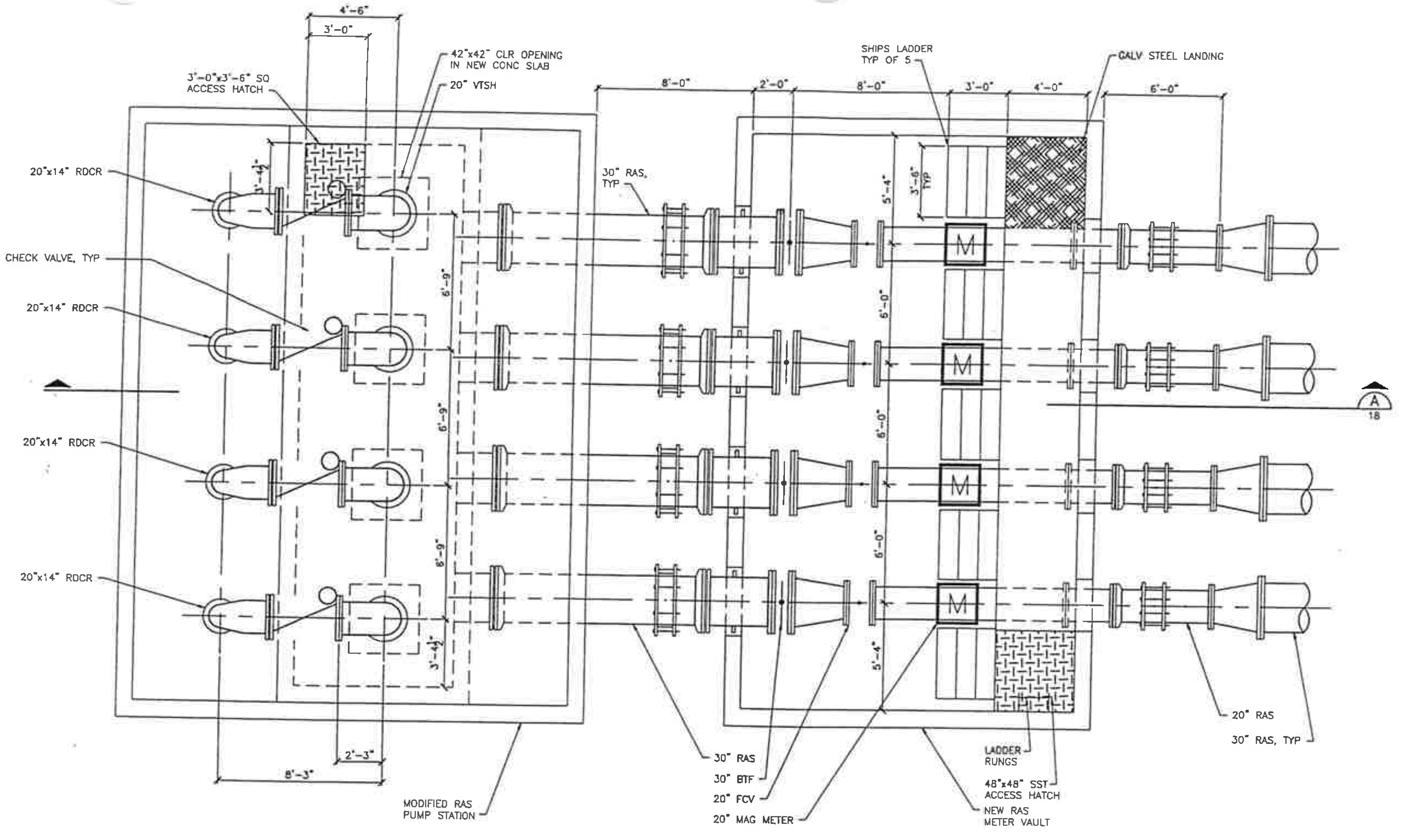
RAS PUMP STATION AND METER VAULT

Adams Field
WWTP
City of Little Rock, AK

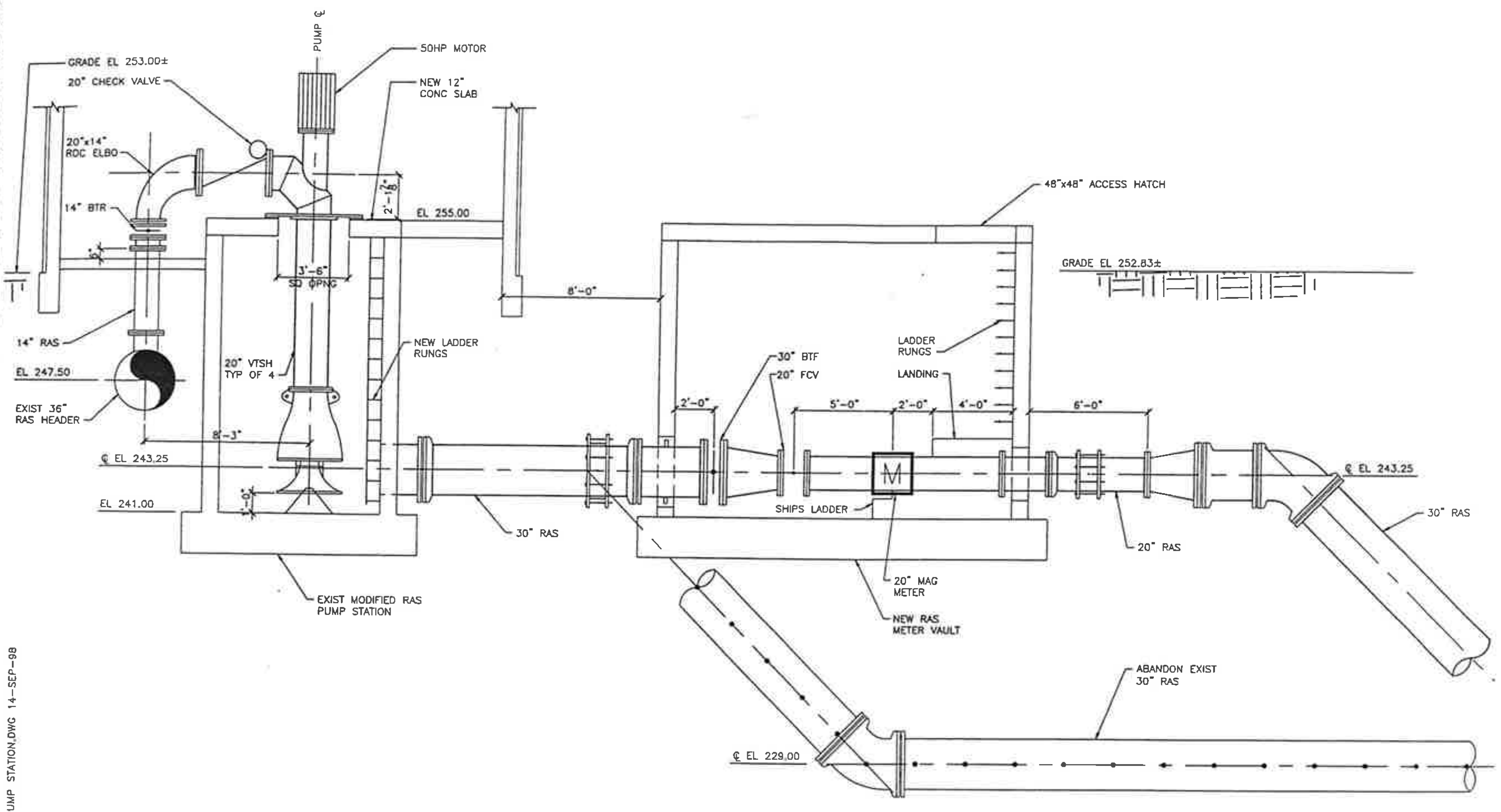
Capital Improvement Plan (Options)

September 1998

FIGURE
17



RAS PUMP STATION AND METER VAULT
3/16" = 1'-0"



RAS PUMP STATION AND METER VAULT A 17
3/16" = 1'-0"

P:\147367\DRAWING\02 RAS PUMP STATION.DWG 14-SEP-98

RAS PUMP STATION AND METER VAULT SECTION

Adams Field
WWTP
City of Little Rock, AK

Capital Improvement Plan (Options)

September 1998

FIGURE
18

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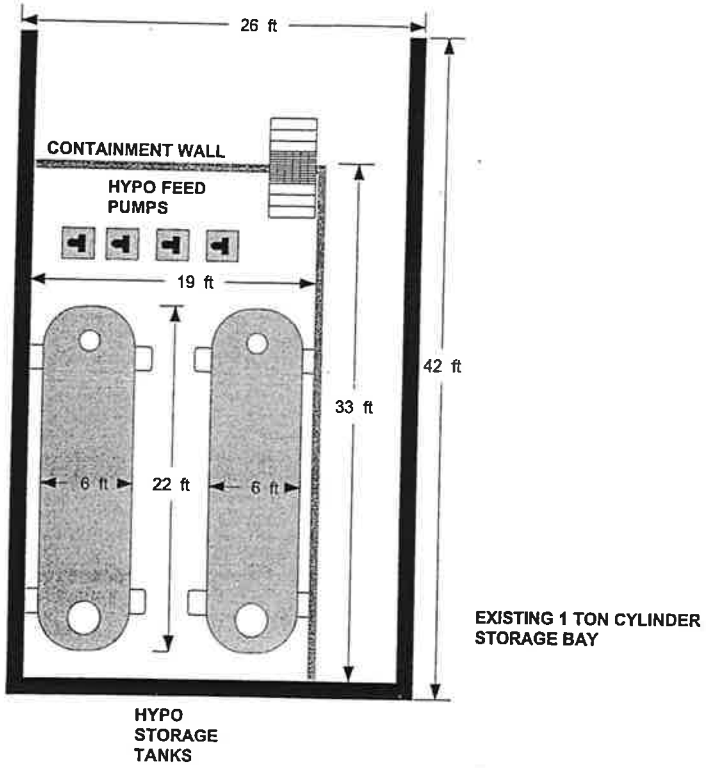
SODIUM HYPOCHLORITE FEED SYSTEM

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

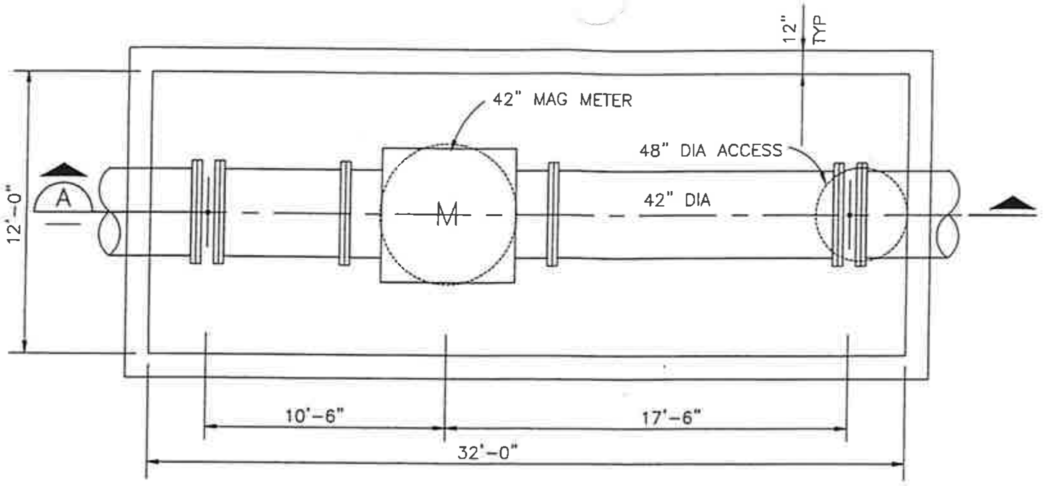
September 1998

FIGURE
19

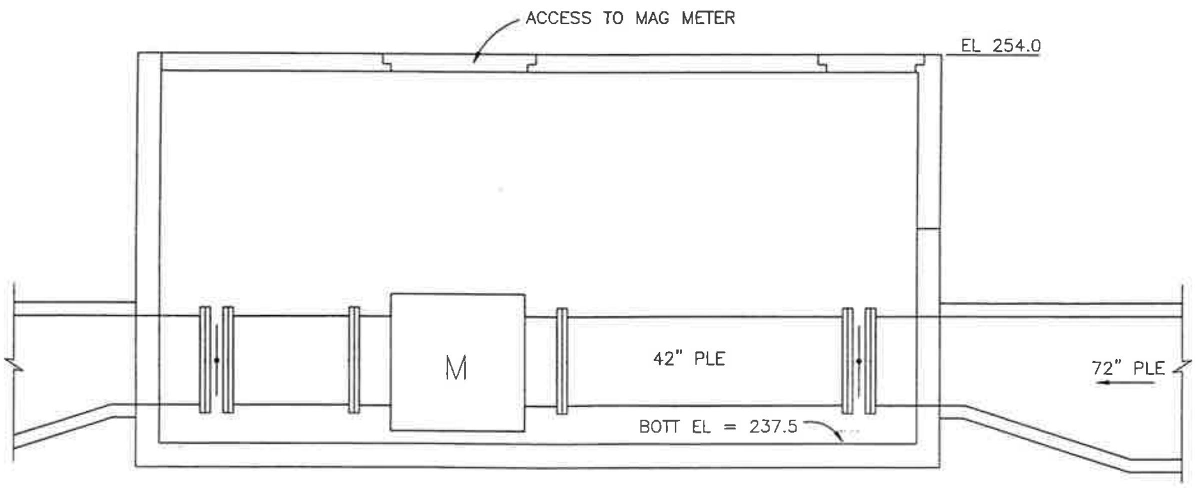


SODIUM HYPOCHLORITE
FEED SYSTEM
SCALE 1/8"=1'

PLANT EFFLUENT METER VAULT



PLAN
NTS



SECTION A
NTS

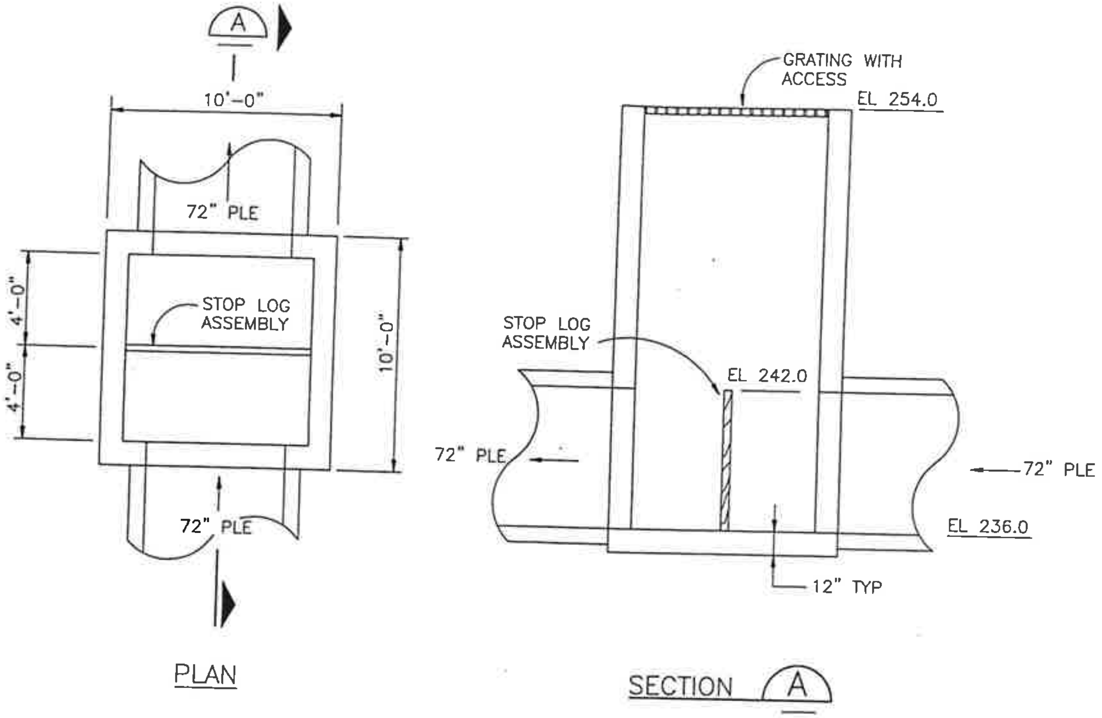
CH2MHILL

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
20



EFFLUENT WEIR BOX
NTS

CH2MHILL

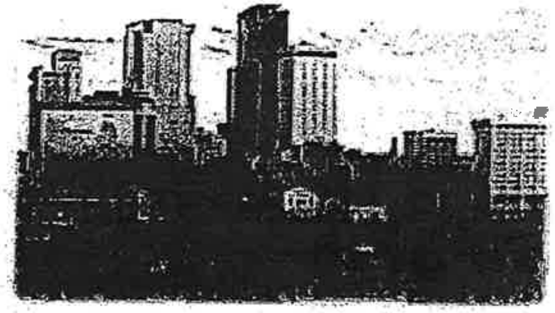
EFFLUENT WEIR BOX

Adams Field
WWTP
City of Little Rock, AK

Capital
Improvement
Plan (Options)

September 1998

FIGURE
21



Adams Field Wastewater Treatment Plant
City of Little Rock, Arkansas

CAPITAL IMPROVEMENT PLAN
OPTIONS

Cost Estimate

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Date
15-Sep-98

	Facility	$ Total			
1	Headworks Modifications	$4,043,000	A		4,043,000
2	Headworks, Building Enclosure of Existing	$291,000	A		291,000
3	Raw Sewage Pump Building Modifications	$2,061,000	B		2,061,000
4	Primary Clarifiers #1, #2 & #3 Modifications	$830,000	A		830,000
5	Pri Sludge & Scum Pump Station Modifications	$424,000	A		424,000
6	New Primary Effluent Pump Station	$2,122,000	C		
7	New Flow Equalization Basins #1 & #2	$1,527,000	B	only one basin	800,000
8	Aeration Basins & Gallery Modifications	$2,812,000	C		
9	Secondary Clarifiers #1, #2 & #3 Modifications	$1,144,000	B		
10	New Secondary Clarifier #4	$1,066,000	C		
11	RAS/WAS Pump Station Modifications & Meter Vault	$1,069,000	B		
12	Gravity Thickeners & Sludge Piping Modifications	$92,000	A		92,000
13	Chlorine Contact Chamber Modifications	$18,000	C		
14	Sodium Hypochlorite Facility	$200,000	A		200,000
15	New Effluent Meter & Weir Vaults	$256,000	C		
16	Sitework	$2,604,000	←		
	Sub-Total Estimated Capital Costs, September 1998	$20,559,000			
	Escalation of Cost to Midpoint Construction 6.1%	$1,252,000			
	Total Estimated Capital Costs w/Escalation, September 2000	$21,811,000			8,741,000

Notes:
1. "Contractors Project Operational Costs", accounts for Bonds, Permits, Insurance, Mobilization, Staffing & Running the Project, Coordination w/Engineer-Owner & Temporary Facilities required, Etc., Etc.
2. The ENR CCI for National Average (Construction Cost Index) for September 1998 is 5963.
3. Estimated costs are presented in September 1998 dollars, and then Escalated to projected Midpoint of Construction to be September 2000 at 3%/Year for 2 Years.
4. Estimated costs do not include Engineering, Legal, Administration, and or Services During Construction.

CH2M - Conceptual Design Cost Estimate

Adams Field ater Treatment Plant
Little Rock Was...ater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Headworks Facility

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Structural Excavation	632	CY		0.044	$68.32	$3.01	$1,899
Gravel Fill Under Slab 6"	34	CY	$12.60	0.200	$35.49	$19.70	$664
Confined Native Backfill	461	CY		0.250	$35.49	$8.87	$4,089
Haul Excess Material Off Site for Disposal	171	CY		0.025	$102.37	$2.56	$437
Guard Post w/Concrete Fill	5	EA	$287.00	1.600	$35.49	$343.78	$1,719
Sand Fill of Void Areas	29	CY	$12.60	0.200	$35.49	$19.70	$580
Demo/Remove Concrete Fillets w/SST Plate	2	EA		16.000	$47.74	$763.84	$1,528
Demo/Remove Concrete	1	CY		1.500	$47.74	$71.61	$44
Sandblast Exist Concrete Surface	918	SF	$0.42	0.026	$20.87	$0.97	$889
Remove Existing Grating	57	SF		0.026	$39.07	$1.03	$58
Remove Existing Stairway, 10 Riser w/HR OS	1	EA		14.025	$39.07	$547.96	$548
Remove Exist Handrail	71	LF		0.176	$39.07	$6.86	$487
Remove Exist Mechanical Cleaned Bar Screen	2	EA		650.000	$43.01	$27,956.50	$55,913
Sawcut Exist Concrete Slab 8"	36	LF	$3.04	0.336	$40.17	$16.54	$595
	5%	Allowance: Misc Materials & Items Required Etc					$3,472
	Subtotal Division 2				$72,922		
DIVISION 3 Concrete							
Exist Structure							
Raise Exist Structure Wall 8"	10.6	CY	$129.34	8.160	$22.15	$310.08	$3,289
Revised Sluice Gate Wall 12"	3.6	CY	$107.56	5.580	$22.15	$231.16	$830
New Structure Floor Slab 6"	8.3	CY	$70.60	1.280	$20.20	$96.46	$805
Structure Column Support 24" x 24"	16.6	CY	$108.96	6.080	$22.15	$243.63	$4,042
Structure Beam Support 20"w x 30"d	12.7	CY	$102.46	7.350	$22.15	$265.26	$3,363
Structure Perimeter Beam 24"w x 11"d	8.6	CY	$132.85	15.370	$22.15	$473.30	$4,064
Bldg Parapet Wall 8"	2.9	CY	$129.34	8.160	$22.15	$310.08	$892
Main Building Elev Slab 8"	42.7	CY	$95.87	3.210	$22.15	$166.97	$7,127
Structure Beam Support 18"d x 30"w	3.3	CY	$106.23	8.120	$22.15	$286.09	$954
Cover Open Pit Elev Slab 8"	7.2	CY	$95.87	3.210	$22.15	$166.97	$1,202
New Structure							
Structure Footing Slab 24"	22.1	CY	$64.16	0.460	$20.20	$73.45	$1,621
Structure Footing Wall 24"	59.9	CY	$85.49	3.250	$22.15	$157.48	$9,425
Structure Slab 12"	67.4	CY	$65.23	0.700	$20.20	$79.37	$5,350
Equipment Pad 10"	16.5	CY	$67.18	0.810	$20.20	$83.54	$1,377
Structure Column Support 24" x 24"	58.9	CY	$108.96	6.080	$22.15	$243.63	$14,347
Structure Beam Support 20"w x 30"d	93.7	CY	$102.46	7.350	$22.15	$265.26	$24,857
Main Building Elev Slab 8"	54.2	CY	$95.87	3.210	$22.15	$166.97	$9,049
Stoop Slab 6"	1.9	CY	$70.60	1.280	$20.20	$96.46	$179
Forms - 6"	176	LF	$0.20	0.060	$36.25	$2.38	$418
Forms - 10"	200	LF	$1.20	0.100	$36.25	$4.83	$965
Forms - 24"	596	LF	$1.39	0.120	$36.25	$5.74	$3,421
6" Waterstop - Horizontal	20	LF	$2.87	0.060	$36.25	$5.05	$101
6" Waterstop - Vertical	90	LF	$2.87	0.080	$36.25	$5.77	$519
Injectable/expandable Waterstop	236	LF	$4.35	0.120	$36.25	$8.70	$2,053
Drill & Dowel Exist Concrete for Rebar Anchor	384	EA	$2.87	0.080	$46.44	$6.59	$2,529
Reinforcement Steel	85,915	LB	$0.28	0.007	$46.44	$0.61	$51,985
Mechanical Placement	490.9	CY		0.075	$102.10	$7.66	$3,759
Finish - Slab	7,399	SF		0.020	$24.46	$0.49	$3,619
Finish - Wall	12,202	SF	$0.10	0.035	$24.46	$0.96	$11,666
Precast Concrete Wall Panel	3,047	SF	$2.76	0.093	$61.45	$8.47	$25,823
	5%	Allowance: Embedded Items/Cutting/Touch-Ups/Etc					$9,982
	Subtotal Division 3				$209,614		
DIVISION 4 Masonry							
Common CMU 8"	2,761	SF	$1.45	0.136	$34.95	$6.20	$17,127
Reinforcement Steel	2,485	LB	$0.28	0.008	$34.95	$0.56	$1,391
Solid Grout Fill of Cells	36	CY	$50.00	1.150	$34.95	$90.19	$3,228
Brick Veneer	2,995	SF	$2.46	0.182	$34.95	$8.82	$26,419
	5%	Allowance: Embedded Items/Cutting/Touch-Ups/Etc					$2,408
	Subtotal Division 4				$50,572		
DIVISION 5 Metals							

CH2MHILL - Conceptual Design Cost Estimate

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Headworks Facility

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Aluminum Grating 1-3/4"	44	SF	$18.05	0.035	$39.07	$19.42	$858
Aluminum Grating Support Angle	67	LF	$4.25	0.125	$39.07	$9.13	$608
Aluminum Checker Plate Covers	294	SF	$13.75	0.064	$39.07	$16.25	$4,778
Aluminum Checker Plate Support Angle	168	LF	$4.25	0.125	$39.07	$9.13	$1,534
Aluminum Stairway 6 Riser w/HR OS w/Platform	1	EA	$1,262.50	13.220	$39.07	$1,779.01	$1,779
Aluminum Stairway 7 Riser w/HR OS w/Landing	1	EA	$1,612.25	15.490	$39.07	$2,217.44	$2,217
Aluminum Stairway 28 Riser w/HR OS w/Landing	1	EA	$5,681.00	54.760	$39.07	$7,820.47	$7,820
Aluminum 3-Rail Handrail w/Toe Plate	11	LF	$30.75	0.359	$39.07	$44.78	$493
Aluminum 1-Rail Wallrail	47	LF	$9.85	0.150	$39.07	$15.71	$742
Aluminum Access Hatch 8-0 x 8-0	1	EA	$2,600.00	12.000	$39.07	$3,068.84	$3,069
Aluminum Access Hatch 3-0 x 3-0	1	EA	$640.00	4.000	$39.07	$796.28	$796
Aluminum Ladder 12'	1	EA	$696.00	4.512	$39.07	$872.28	$872
Roof Joist 40' Span	10	EA	$200.00	2.750	$39.07	$307.44	$3,074
Metal Floor/Roof Decking 1-1/2"	6,048	SF	$0.85	0.008	$39.07	$1.16	$7,031
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$1,784
	Subtotal Division 5				$37,457		
DIVISION 7 Thermal/Moisture Protect							
Bldg Roofing w/insulation	3,864	SF	$6.50	0.100	$25.86	$9.09	$35,108
Fiberglass Sandwich Wall Panel	1,407	SF	$15.30	0.121	$39.07	$20.03	$28,179
	5%	Allowance: Edge/Ridge/Penetrations/Mat Etc					$3,164
	Subtotal Division 7				$66,451		
DIVISION 8 Doors & Windows							
Overhead Coiling Door 11-0'w x 12-0'h	4	EA	$2,200.00	24.000	$25.86	$2,820.64	$11,283
HM Door w/Frm & Hdwr 3-0 x 7-2	6	EA	$585.00	4.500	$25.86	$701.37	$4,208
HM Door w/Frm & Hdwr 6-0 x 7-2	2	EA	$1,200.00	7.400	$25.86	$1,391.36	$2,783
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$914
	Subtotal Division 8				$19,167		
DIVISION 9 Finishes							
Painting/Coatings Allowance	1.5%					$2,698,389	$40,476
	Subtotal Division 9				$40,476		
DIVISION 11 Equipment							
Mechanical Cleaned Fine Bar Screen	3	EA	$375,000.00	870.000	$43.01	$412,418.70	$1,237,256
Screenings Washer/Compactor	3	EA	$45,000.00	210.000	$43.01	$54,032.10	$162,096
Scum Concentrator	1	EA	$45,000.00	210.000	$43.01	$54,032.10	$54,032
Primary Sludge Degritting System	1	LS	$249,900.00	580.000	$43.01	$274,845.80	$274,846
Add Motor Operator to Exist Sluice Gate	3	EA	$7,500.00	24.000	$43.01	$8,532.24	$25,597
Add Operator & Shaft to Mud Valve	3	EA	$7,875.00	24.000	$43.01	$8,907.24	$26,722
Sluice Gate w/Motor Op & Shaft 48"w x 48"h	2	EA	$12,500.00	32.000	$43.01	$13,876.32	$27,753
	5%	Allowance: Misc Attachment Materials & Items Etc					$90,415
	Subtotal Division 11				$1,898,716		
DIVISION 13 Special Construction							
I & C Allowance	2%					$2,475,586	$49,512
	Subtotal Division 13				$49,512		
DIVISION 14 Conveying Systems							
Screw Conveyor 25'	1	EA	$37,500.00	18.750	$43.01	$38,306.44	$38,306
Screw Conveyor 50'	1	EA	$75,000.00	37.500	$43.01	$76,612.88	$76,613
	5%	Allowance: Misc Attachment Materials & Items Etc					$5,746
	Subtotal Division 14				$120,665		
DIVISION 15 Mechanical							
Mechanical/HVAC Allowance	3%					$2,475,586	$74,268
	Subtotal Division 15				$74,268		
DIVISION 16 Electrical							
Electrical Allowance	4%					$2,475,586	$99,023

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Project No: 147367.A0.CP

Original Date	**15-Sep-98**
Revised Date	**15-Sep-98**

Headworks Facility

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
	Subtotal Division 16				**$99,023**		
Tax on Materials	1	LS	$97,127.34			$97,127.34	$97,127
			Subtotal Tax on Materials		**$97,127**		
Subtotal This Facility							**$2,835,992**
Contractors Project Operational Costs			**10%**				**$283,599**
Allowance for Unidentified Items			**20%**				**$623,918**
Contractors Profit			**8%**				**$299,481**
Estimated Facility Cost							**$4,043,000**

CH2M - *Conceptual Design Cost Estimate*

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Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Headworks Building
Enclosure of Existing

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sandblast Exist Concrete Surface	158	SF	$0.42	0.026	$20.87	$0.97	$153
Remove Existing Stairway, 7 Riser w/HR BS	2	EA		9.818	$39.07	$383.57	$767
Remove Exist Handrail	164	LF		0.176	$39.07	$6.86	$1,125
	5%	Allowance: Misc Materials & Items Required Etc					$102
	Subtotal Division 2				**$2,147**		
DIVISION 3 Concrete							
Structure Column Support 24" x 24"	16.6	CY	$108.96	6.080	$22.15	$243.63	$4,042
Structure Beam Support 20"w x 30"d	12.7	CY	$102.46	7.350	$22.15	$265.26	$3,363
Structure Perimeter Beam 24"w x 11"d	8.6	CY	$132.85	15.370	$22.15	$473.30	$4,064
Bldg Parapet Wall 8"	2.9	CY	$129.34	8.160	$22.15	$310.08	$892
Main Building Elev Slab 8"	42.7	CY	$95.87	3.210	$22.15	$166.97	$7,127
Stoop Slab 6"	0.7	CY	$70.60	1.280	$20.20	$96.46	$71
Forms - 6"	36	LF	$0.20	0.060	$36.25	$2.38	$86
Drill & Dowel Exist Concrete for Rebar Anchor	158	EA	$2.87	0.080	$46.44	$6.59	$1,040
Reinforcement Steel	14,728	LB	$0.28	0.007	$46.44	$0.61	$8,911
Mechanical Placement	84.2	CY		0.075	$102.10	$7.66	$644
Finish - Slab	1,760	SF		0.020	$24.46	$0.49	$861
Finish - Wall	2,159	SF	$0.10	0.035	$24.46	$0.96	$2,064
	5%	Allowance: Embedded Items/Cutting/Touch-Ups/Etc					$1,658
	Subtotal Division 3				**$34,825**		
DIVISION 4 Masonry							
Common CMU 8"	3,076	SF	$1.45	0.136	$34.95	$6.20	$19,083
Reinforcement Steel	2,769	LB	$0.28	0.008	$34.95	$0.56	$1,549
Solid Grout Fill of Cells	40	CY	$50.00	1.150	$34.95	$90.19	$3,597
Brick Veneer	3,076	SF	$2.46	0.182	$34.95	$8.82	$27,135
	5%	Allowance: Embedded Items/Cutting/Touch-Ups/Etc					$2,568
	Subtotal Division 4				**$53,932**		
DIVISION 5 Metals							
Roof Joist 40' Span	8	EA	$200.00	2.750	$39.07	$307.44	$2,460
Metal Floor/Roof Decking 1-1/2"	1,680	SF	$0.85	0.008	$39.07	$1.16	$1,953
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$221
	Subtotal Division 5				**$4,633**		
DIVISION 7 Thermal/Moisture Protect							
Bldg Roofing w/insulation	3,864	SF	$6.50	0.100	$25.86	$9.09	$35,108
Fiberglass Sandwich Wall Panel	1,407	SF	$15.30	0.121	$39.07	$20.03	$28,179
	5%	Allowance: Edge/Ridge/Penetrations/Matl Etc					$3,164
	Subtotal Division 7				**$66,451**		
DIVISION 8 Doors & Windows							
HM Door w/Frm & Hdwr 3-0 x 7-2	2	EA	$585.00	4.500	$25.86	$701.37	$1,403
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$70
	Subtotal Division 8				**$1,473**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	1.5%					$196,153	$2,942
	Subtotal Division 9				**$2,942**		
DIVISION 15 Mechanical							
Mechanical/HVAC Allowance	15%					$163,461	$24,519
	Subtotal Division 15				**$24,519**		
DIVISION 16 Electrical							
Electrical Allowance	5%					$163,461	$8,173
	Subtotal Division 16				**$8,173**		

CH2MHILL - *Conceptual Design Cost Estimate*

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Origin[illegible]ate 15-Sep-98
Revised Date 15-Sep-98

Headworks Building
Enclosure of Existing

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Tax on Materials	1	LS	$4,761.11			$4,761.11	$4,761
	Subtotal Tax on Materials				**$4,761**		
Subtotal This Facility							$203,857
Contractors Project Operational Costs			10%				$20,386
Allowance for Unidentified Items			20%				$44,848
Contractors Profit			8%				$21,527
Estimated Facility Cost							$291,000

CH2M' - *Conceptual Design Cost Estimate*

Adams Field W ater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Raw Sewage Pump Building
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sawcut Exist Concrete Wall 8"	72	LF	$3.28	1.600	$20.29	$35.74	$2,574
Demo/Remove Concrete	4	CY		1.500	$47.74	$71.61	$269
Sandblast Exist Concrete Surface	90	SF	$0.42	0.026	$20.87	$0.97	$87
Remove Existing Grating	421	SF		0.026	$39.07	$1.03	$432
Remove Exist Raw Sewage Pump/Shaft/Motor	2	EA		170.000	$43.01	$7,311.70	$14,623
Sawcut Exist Concrete Slab 8"	36	LF	$3.36	0.232	$40.17	$12.68	$456
Remove Existing Piping, Listed Below							
12" RS DI Piping							
Flgd 90 Elbow	2	EA		3.375	$37.58	$126.83	$254
Flgd Plug Valve	2	EA		10.589	$37.58	$397.92	$796
16" RS DI Piping							
Flgd 90 Elbow	2	EA		5.025	$37.58	$188.84	$378
x 12" Flgd Reducer	4	EA		5.025	$37.58	$188.84	$755
Flgd Gate Valve	4	EA		18.000	$37.58	$676.44	$2,706
Flex Coupling w/Thrust Ties	4	EA		5.063	$37.58	$190.25	$761
x 1'- 6" F x PE Spool	2	EA		3.591	$37.58	$134.95	$270
x 2'- 0" F x PE Spool	4	EA		3.708	$37.58	$139.35	$557
x 3'- 0" F x PE Spool	2	EA		3.942	$37.58	$148.14	$296
x 3'- 0" F x Bell Spool	2	EA		3.942	$37.58	$148.14	$296
24" RS DI Piping							
Flgd 90 Elbow	1	EA		13.771	$37.58	$517.50	$518
x 16" Flgd 90 Elbow	2	EA		13.771	$37.58	$517.50	$1,035
Flgd Tee	2	EA		23.087	$37.58	$867.59	$1,735
Flgd Gate Valve	2	EA		36.000	$37.58	$1,352.88	$2,706
x 2'- 0" F x F Spool	2	EA		7.023	$37.58	$263.92	$528
x 3'- 0" F x F Spool	1	EA		7.422	$37.58	$278.92	$279
x 17'- 0" F x PE Spool	1	EA		10.406	$37.58	$391.07	$391
36" RS DI Piping							
x 24" Flgd Reducer	1	EA		29.745	$37.58	$1,117.82	$1,118
	5%	Allowance: Misc Materials & Items Required Etc					$1,691
	Subtotal Division 2				**$35,510**		
DIVISION 5 Metals							
Aluminum Grating 1-3/4"	421	SF	$18.05	0.035	$39.07	$19.42	$8,170
Aluminum Grating Support Angle	150	LF	$4.25	0.125	$39.07	$9.13	$1,370
SST Fabricated Scum Pump Shield	3	EA	$2,500.00	24.000	$39.07	$3,437.68	$10,313
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$993
	Subtotal Division 5				**$20,846**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	1.5%					$1,372,781	$20,592
	Subtotal Division 9				**$20,592**		
DIVISION 11 Equipment							
Raw Sewage Pump/Shaft/Drive 30 mgd	2	EA	$200,000.00	470.000	$43.01	$220,214.70	$440,429
Raw Sewage Pump VFD Unit	2	EA	$185,000.00	430.000	$43.01	$203,494.30	$406,989
Concentrated Scum Pump w/Guide Rails	3	EA	$17,675.00	72.000	$43.01	$20,771.72	$62,315
	5%	Allowance: Misc Attachment Materials & Items Etc					$45,487
	Subtotal Division 11				**$955,220**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitt, Electromag 24"	3	EA	$21,000.00	48.000	$37.58	$22,803.84	$68,412
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$6,841.15
	Subtotal Division 13				**$75,253**		
DIVISION 15 Mechanical							
24" RS DI Piping							
Flgd Plug Valve	2	EA	$13,300.00	48.000	$37.58	$15,103.84	$30,208
Flanged Coupling Adaptor w/Thrust Ties	1	EA	$1,221.00	7.000	$37.58	$1,484.06	$1,484
x 17'- 0" F x PE Wall Spool	1	EA	$2,096.00	13.875	$37.58	$2,617.42	$2,617
30" RS DI Piping							

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Orig. ate 15-Sep-98
Revised Date 15-Sep-98

Raw Sewage Pump Building
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Flgd 90 Elbow	2	EA	$3,300.00	27.540	$37.58	$4,334.95	$8,670
x 24" Flgd 90 Elbow	2	EA	$3,100.00	27.540	$37.58	$4,134.95	$8,270
Flgd Butterfly Valve	2	EA	$4,800.00	42.000	$37.58	$6,378.36	$12,757
Flex Coupling w/Thrust Ties	2	EA	$1,440.00	6.750	$37.58	$1,693.67	$3,387
x 1'- 6" F x Bell Spool	2	EA	$1,665.60	9.098	$37.58	$2,007.50	$4,015
x 2'- 6" F x PE Spool	4	EA	$1,525.60	9.630	$37.58	$1,887.50	$7,550
x 5'- 0" F x F Wall Spool	2	EA	$3,369.60	13.700	$37.58	$3,884.45	$7,769
36" RS DI Piping							
Flgd 90 Elbow	2	EA	$4,000.00	39.660	$37.58	$5,490.42	$10,981
x 24" Flgd 90 Elbow	1	EA	$3,600.00	39.660	$37.58	$5,090.42	$5,090
x 24" Flgd Reducer	2	EA	$2,400.00	39.660	$37.58	$3,890.42	$7,781
Flgd Tee	2	EA	$5,500.00	64.270	$37.58	$7,915.27	$15,831
Flgd Butterfly Valve	4	EA	$6,500.00	54.000	$37.58	$8,529.32	$34,117
Flex Coupling w/Thrust Ties	2	EA	$1,680.00	8.100	$37.58	$1,984.40	$3,969
x 1'- 6" F x PE Spool	4	EA	$1,888.80	10.918	$37.58	$2,299.10	$9,196
x 2'- 0" F x F Spool	2	EA	$3,480.00	14.046	$37.58	$4,007.85	$8,016
x 3'- 0" F x F Spool	2	EA	$3,750.40	14.844	$37.58	$4,308.24	$8,616
Misc Washdowns/Sprays Pipe/Flgs/Valves	1	LS	$7,500.00	72.000	$37.58	$10,205.76	$10,206
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$20,053.00
	Subtotal Division 15				**$220,583**		
DIVISION 16 Electrical							
Electrical Allowance	5%					$1,307,411	$65,371
	Subtotal Division 16				**$65,371**		
Tax on Materials	1	LS	$52,119.13			$52,119.13	$52,119
		Subtotal Tax on Materials			**$52,119**		
Subtotal This Facility							$1,445,492
Contractors Project Operational Costs			10%				$144,549
Allowance for Unidentified Items			20%				$318,008
Contractors Profit			8%				$152,644
Estimated Facility Cost							$2,061,000

CH2M

Conceptual Design Cost Estimate

Adams Field Wa er Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Primary Clarifiers
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Remove Exist Clarifier Mech/Bridge/Sweep Etc	3	EA		240.000	$43.01	$10,322.40	$30,967
	5%	Allowance: Misc Materials & Items Required Etc					$1,548
	Subtotal Division 2				**$32,516**		
DIVISION 5 Metals							
Aluminum Weir & Scum Baffle	1,084	LF		0.200	$39.07	$7.81	$8,469
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$423
	Subtotal Division 5				**$8,893**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	2.5%					$548,820	$13,720
	Subtotal Division 9				**$13,720**		
DIVISION 11 Equipment							
Clarifier Mechanism w/Bridge/Sweep/Grating Column/Weirs & Baffles Etc. 115'	3	EA	$136,700.00	480.000	$43.01	$157,344.80	$472,034
	5%	Allowance: Misc Attachment Materials & Items Etc					$23,602
	Subtotal Division 11				**$495,600**		
DIVISION 15 Mechanical							
Disconnect Exist/Reconnect New Piping	3	EA	$250.00	32.000	$37.58	$1,452.56	$4,358
Misc Washdowns/Sprays Pipe/Ftgs/Valves	3	EA	$1,250.00	12.000	$37.58	$1,700.96	$5,103
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$946
	Subtotal Division 15				**$10,407**		
DIVISION 16 Electrical							
Electrical Allowance	0.25%					$547,451	$1,369
	Subtotal Division 16				**$1,369**		
Tax on Materials	1	LS	$19,801.24			$19,801.24	$19,801
		Subtotal Tax on Materials			**$19,801**		
Subtotal This Facility							**$582,341**
Contractors Project Operational Costs			**10%**				**$58,234**
Allowance for Unidentified Items			**20%**				**$128,115**
Contractors Profit			**8%**				**$61,495**
Estimated Facility Cost							**$830,000**

CH2MH - Conceptual Design Cost Estimate

Adams Field W ter Treatment Plant
Little Rock Waste er Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Primary Sludge Pump Station Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sawcut Exist Concrete Wall 10"	61	LF	$4.10	2.000	$20.29	$44.68	$2,725
Demo/Remove Concrete	6	CY		1.500	$47.74	$71.61	$455
Sandblast Exist Concrete Surface	41	SF	$0.42	0.026	$20.87	$0.97	$39
Remove Existing Grating	16	SF		0.026	$39.07	$1.03	$16
Demo/Remove Exist PS Pumps/Pipe/Fittings	1	LS		72.000	$43.01	$3,096.72	$3,097
Structural Excavation	251	CY		0.044	$44.17	$1.94	$488
Gravel Fill Under Slab	1	CY	$12.60	0.200	$35.49	$19.70	$16
Confined Native Backfill	151	CY		0.250	$35.49	$8.87	$1,336
Haul On Site Excess Excavated Material	100	CY		0.025	$102.37	$2.56	$257
Core Exist 16" Wall for New 6" Pipe	1	EA	$39.26	4.076	$19.32	$118.00	$118
	5%	Allowance: Misc Materials & Items Required Etc					$427
			Subtotal Division 2		**$8,976**		
DIVISION 3 Concrete							
Fill In Top Elev Slab 8"	0.6	CY	$95.87	3.210	$22.15	$166.97	$97
Stoop Slab 4"	0.2	CY	$74.90	1.860	$20.20	$112.47	$27
Structure Slab 18"	2.5	CY	$64.52	0.460	$22.15	$74.71	$187
Structure Wall 10"	8.2	CY	$107.56	5.580	$22.15	$231.16	$1,895
Grout Fill (All three Scum Pits)	3.0	CY	$62.00	1.750	$22.15	$100.76	$302
Slab Forms 18"	21	LF	$1.84	0.308	$36.25	$13.01	$273
Slab Forms 4"	9	LF	$0.20	0.060	$36.25	$2.38	$21
6" Waterstop - Horizontal	18	LF	$2.87	0.060	$36.25	$5.05	$91
Injectable/expandable Waterstop	36	LF	$4.35	0.120	$36.25	$8.70	$313
Drill & Dowel Exist Concrete for Rebar Anchor	90	EA	$2.87	0.080	$46.44	$6.59	$593
Reinforcment Steel	2,542	LB	$0.28	0.007	$46.44	$0.61	$1,538
Mechanical Placement	14.5	CY		0.075	$102.10	$7.66	$111
Finish - Slab	152	SF		0.020	$24.46	$0.49	$74
Finish - Wall	533	SF	$0.10	0.035	$24.46	$0.96	$510
	5%	Allowance: Embedded Items/Cutting/Touch-Ups Etc					$302
			Subtotal Division 3		**$6,336**		
DIVISION 5 Metals							
Aluminum Stairway 4 Riser w/HR OS	1	EA	$775.00	7.480	$39.07	$1,067.24	$1,067
Aluminum Access Hatch 4' x 4'	1	EA	$1,150.00	4.000	$39.07	$1,306.28	$1,306
	5%	Allowance: Misc Nuts/Bolts/Connections Etc					$119
			Subtotal Division 5		**$2,492**		
DIVISION 9 Finishes							
Coatings/Painting Allowance	2.5%					$280,393	$7,010
			Subtotal Division 9		**$7,010**		
DIVISION 11 Equipment							
Pri Sludge Pump	4	EA	$20,000.00	72.000	$43.01	$23,096.72	$92,387
Scum Pump w/Guide Rails	3	EA	$17,675.00	72.000	$43.01	$20,771.72	$62,315
	5%	Allowance: Misc Connection Materials & Items Etc					$7,735
			Subtotal Division 11		**$162,437**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitter, Electromag 4"	3	EA	$3,500.00	8.000	$37.58	$3,800.64	$11,402
P 4 Pressure Gauge	4	EA	$120.00	1.500	$37.58	$176.37	$705
P 7 Pressure Switch	4	EA	$395.00	3.000	$37.58	$507.74	$2,031
P 9 Pressure Transmitter	1	EA	$1,150.00	4.000	$37.58	$1,300.32	$1,300
P 15 Pressure Seal, Annular 6"	4	EA	$750.00	6.000	$37.58	$975.48	$3,902
Control Panel	1	EA	$3,500.00	4.000	$31.61	$3,626.44	$3,626
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$2,297
			Subtotal Division 13		**$25,264**		
DIVISION 15 Mechanical							
3" PS/PScum Piping							
Flgd 90 Elbow	3	EA	$721.00	1.270	$37.58	$768.73	$2,306

CH2MHILL - Conceptual Design Cost Estimate

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Primary Sludge Pump Station Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Flgd Ball Check Valve	3	EA	$340.00	3.556	$37.58	$473.63	$1,421
x 0'- 8" F x F Spool	2	EA	$109.94	0.933	$37.58	$145.00	$290
x 1'- 6" F x F Spool	3	EA	$117.00	0.980	$37.58	$153.83	$461
x 2'- 0" F x F Wall Spool	1	EA	$156.80	1.026	$37.58	$195.36	$195
4" PS/PScum Piping							
x 0'- 6" F x F Spool	6	EA	$122.00	1.803	$37.58	$189.76	$1,139
6" PS/PScum Piping							
Flgd 90 Elbow	1	EA	$188.80	2.650	$37.58	$288.39	$288
x 3" Flgd Reducer	2	EA	$228.80	2.650	$37.58	$328.39	$657
x 4" Flgd Reducer	6	EA	$228.80	2.650	$37.58	$328.39	$1,970
Flgd Tee	5	EA	$242.40	4.780	$37.58	$422.03	$2,110
Flgd Plug Valve	11	EA	$650.00	8.000	$37.58	$950.64	$10,457
x 0'- 6" F x F Spool	8	EA	$142.40	1.860	$37.58	$212.30	$1,698
x 1'- 0" F x F Spool	4	EA	$140.00	1.860	$37.58	$209.90	$840
x 1'- 4" F x F Spool	1	EA	$157.23	1.940	$37.58	$230.14	$230
x 2'- 4" F x F Spool	1	EA	$202.83	2.100	$37.58	$281.75	$282
x 2'- 6" F x F Spool	1	EA	$208.00	2.100	$37.58	$286.92	$287
x 4'- 0" F x F Spool	2	EA	$276.00	2.340	$37.58	$363.94	$728
6" PS/PScum Piping							
Flgd 90 Elbow	1	EA	$188.80	2.650	$37.58	$288.39	$288
x 3" Flgd Reducer	2	EA	$228.80	2.650	$37.58	$328.39	$657
x 4" Flgd Reducer	6	EA	$228.80	2.650	$37.58	$328.39	$1,970
Flgd Tee	5	EA	$242.40	4.780	$37.58	$422.03	$2,110
Flgd Plug Valve	11	EA	$650.00	8.000	$37.58	$950.64	$10,457
x 0'- 6" F x F Spool	8	EA	$142.40	1.860	$37.58	$212.30	$1,698
x 1'- 0" F x F Spool	4	EA	$140.00	1.860	$37.58	$209.90	$840
x 1'- 4" F x F Spool	1	EA	$157.23	1.940	$37.58	$230.14	$230
x 2'- 4" F x F Spool	1	EA	$202.83	2.100	$37.58	$281.75	$282
x 2'- 6" F x F Spool	1	EA	$208.00	2.100	$37.58	$286.92	$287
x 4'- 0" F x F Spool	2	EA	$276.00	2.340	$37.58	$363.94	$728
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$4,491
			Subtotal Division 15		**$49,398**		
DIVISION 16 Electrical							
Electrical Allowance - Conduit/Wiring/Items	10%					$254,902	$25,490
			Subtotal Division 16		**$25,490**		
Tax on Materials	1	LS	$9,825.76			$9,825.76	$9,826
			Subtotal Tax on Materials		**$9,826**		
Subtotal This Facility							$297,228
Contractors Project Operational Costs			10%				$29,723
Allowance for Unidentified Items			20%				$65,390
Contractors Profit			8%				$31,387
Estimated Facility Cost							$424,000

CH2MHI - *Conceptual Design Cost Estimate*

Adams Field W ter Treatment Plant
Little Rock Wast er Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Primary Effluent Pump Station
& Mixing Chamber Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sawcut Exist Concrete Pipe	53	LF	$3.28	1.600	$20.29	$35.74	$1,909
Demo/Remove Concrete Pipe 72"	1	LS		6.000	$47.74	$286.44	$286
Sandblast Exist Concrete Surface	170	SF	$0.42	0.026	$20.87	$0.97	$164
Structural Excavation	778	CY		0.044	$44.17	$1.94	$1,512
Gravel Fill Under Slab	21	CY	$12.60	0.200	$35.49	$19.70	$421
Confined Native Backfill	467	CY		0.250	$35.49	$8.87	$4,141
Haul On Site Excess Excavated Material	311	CY		0.025	$102.37	$2.56	$796
Core Exist 18" Wall for New 36" Pipe	12	EA	$255.67	31.350	$19.32	$861.35	$10,336
	5%	Allowance: Misc Materials & Items Required Etc					$978
	Subtotal Division 2				**$20,544**		
DIVISION 3 Concrete							
Structure Slab 18"	64.2	CY	$64.52	0.460	$22.15	$74.71	$4,794
Structure Wall 18"	121.0	CY	$92.90	4.220	$22.15	$186.37	$22,558
Structure Elev Slab 18"	54.3	CY	$79.50	1.850	$22.15	$120.48	$6,536
Slab Forms 18"	308	LF	$1.74	0.210	$36.25	$9.35	$2,876
6" Waterstop - Horizontal	308	LF	$2.87	0.060	$36.25	$5.05	$1,551
6" Waterstop - Vertical	136	LF	$2.87	0.080	$36.25	$5.77	$785
Injectable/Expandable Waterstop	113	LF	$4.35	0.120	$36.25	$8.70	$983
Drill & Dowel Exist Concrete for Rebar Anchor	380	EA	$2.87	0.080	$46.44	$6.59	$2,502
Reinforcment Steel	41,905	LB	$0.28	0.007	$46.44	$0.61	$25,356
Mechanical Placement	239.5	CY		0.075	$102.10	$7.66	$1,834
Finish - Slab	2,132	SF		0.020	$24.46	$0.49	$1,043
Finish - Wall	4,357	SF	$0.10	0.035	$24.46	$0.96	$4,166
	5%	Allowance: Embedded Items/Cutting/Touch-Ups Etc					$3,749
	Subtotal Division 3				**$78,733**		
DIVISION 5 Metals							
Aluminum Weir Plate	14	LF	$22.50	0.200	$39.07	$30.31	$424
Aluminum 3-Rail Handrail w/Toe Plate	109	LF	$30.50	0.359	$39.07	$44.53	$4,853
Aluminum Grating 1-3/4"	100	SF	$18.05	0.035	$39.07	$19.42	$1,942
Aluminum Grating Column 3"	58	LF	$4.18	0.068	$39.07	$6.85	$397
	5%	Allowance: Misc Nuts/Bolts/Connections Etc					$381
	Subtotal Division 5				**$7,997**		
DIVISION 9 Finishes							
Coatings/Painting Allowance	1.5%					$1,412,911	$21,194
	Subtotal Division 9				**$21,194**		
DIVISION 10 Specialties							
Pipe Marking/Labels & Room Signs	1	LS	$150.00	4.000	$24.60	$248.40	$248
	5%	Allowance: Mounting Anchors/Nuts/Bolts/Connects Etc					$12
	Subtotal Division 10				**$261**		
DIVISION 11 Equipment							
New Pri Effluent Pump 100 Hp	4	EA	$156,300.00	108.000	$43.01	$160,945.08	$643,780
New Pri Effluent Pump VFD	4	EA	$25,000.00	48.000	$43.01	$27,064.48	$108,258
Downward Opening Weir w/Dual Oper & MO 14	1	EA	$7,500.00	32.000	$43.01	$8,876.32	$8,876
Sluice Gate w/Motor Op & Shaft 72"w x 72"h	2	EA	$17,500.00	48.000	$43.01	$19,564.48	$39,129
	5%	Allowance: Misc Connection Materials & Items Etc					$40,002
	Subtotal Division 11				**$840,046**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitter, Electromag 20"	1	EA	$16,500.00	18.000	$37.58	$17,176.44	$17,176
P 4 Pressure Gauge	4	EA	$120.00	1.500	$37.58	$176.37	$705
P 7 Pressure Switch	4	EA	$395.00	3.000	$37.58	$507.74	$2,031
P 9 Pressure Transmitter	4	EA	$1,150.00	4.000	$37.58	$1,300.32	$5,201
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$2,511

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original 15-Sep-98
Revised Date 15-Sep-98

Primary Effluent Pump Station
& Mixing Chamber Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
	Subtotal Division 13				$27,626		
DIVISION 15 Mechanical							
12" RAS DI Piping							
x 6'- 0" F x F Spool	7	EA	$469.60	5.198	$37.58	$664.94	$4,655
20" PE DI Piping							
x 0'- 9" F x PE Spool	8	EA	$419.20	6.363	$37.58	$658.32	$5,267
x 4'- 6" F x F Spool	4	EA	$1,004.00	9.543	$37.58	$1,362.63	$5,451
x 12'- 9" F x F Spool	4	EA	$1,566.40	13.402	$37.58	$2,070.05	$8,280
30" PE DI Piping					$37.58		
x 20" Flgd 90 Elbow	4	EA	$3,100.00	27.540	$37.58	$4,134.95	$16,540
Flgd Butterfly Valve	4	EA	$4,800.00	42.000	$37.58	$6,378.36	$25,513
Flgd Check Valve	4	EA	$22,000.00	42.000	$37.58	$23,578.36	$94,313
x 2'- 6" PE x PE Wall Spool	2	EA	$816.80	6.019	$37.58	$1,042.99	$2,086
x 3'- 0" MJ x PE Spool	4	EA	$811.20	6.185	$37.58	$1,043.63	$4,175
x 4'- 0" F x PE Wall Spool	4	EA	$2,113.60	10.428	$37.58	$2,505.48	$10,022
x 9'- 0" MJ x PE Spool	2	EA	$2,204.80	8.180	$37.58	$2,512.20	$5,024
36" ML/RAS DI/Stl Piping	35	LF	$70.20	0.595	$37.58	$92.56	$3,240
Flgd 90 Elbow	7	EA	$4,000.00	39.660	$37.58	$5,490.42	$38,433
Blind Flange	1	EA	$1,032.00	16.500	$37.58	$1,652.07	$1,652
Flange	3	EA	$730.50	34.000	$37.58	$2,008.22	$6,025
Flgd Butterfly Valve	1	EA	$6,500.00	54.000	$37.58	$8,529.32	$8,529
x 2'- 0" F x F Wall Spool	3	EA	$3,878.40	14.046	$37.58	$4,406.25	$13,219
x 3'- 6" F x F Spool	1	EA	$3,886.40	15.243	$37.58	$4,459.23	$4,459
x 6'- 0" F x F Spool	8	EA	$4,560.80	17.238	$37.58	$5,208.60	$41,669
x 6'- 6" F x F Spool	1	EA	$4,696.80	17.637	$37.58	$5,359.60	$5,360
60" ML/RAS DI/Stl Piping	48	LF	$135.00	1.184	$37.58	$179.49	$8,615
Blind Flange	2	EA	$1,875.00	32.000	$37.58	$3,077.56	$6,155
Flange	2	EA	$1,625.00	67.000	$37.58	$4,142.86	$8,286
Misc Washdowns/Sprays Pipe/Ftgs/Valves	1	LS	$7,500.00	72.000	$37.58	$10,205.76	$10,206
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$33,252
	Subtotal Division 15				**$370,424**		
DIVISION 16 Electrical							
Electrical Allowance - Conduit/Wiring/Items	5%					$1,345,630	$67,281
	Subtotal Division 16				**$67,281**		
Tax on Materials	1	LS	$54,504.41			$54,504.41	$54,504
	Subtotal Tax on Materials				$54,504		
Subtotal This Facility							$1,488,609
Contractors Project Operational Costs			10%				$148,861
Allowance for Unidentified Items			20%				$327,494
Contractors Profit			8%				$157,197
Estimated Facility Cost							$2,122,000

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Flow Equalization Basins

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
General Grubbing & Stripping of Area	7	AC		10.000	$84.00	$840.00	$5,880
Mass Pond Excavation	113,000	CY		0.017	$85.86	$1.42	$160,086
Dike Embankment Backfill	5,000	CY		0.033	$85.86	$2.83	$14,167
Structural Excavation	350	CY		0.044	$44.17	$1.94	$680
Gravel Fill Under Slab 6"	81	CY	$12.60	0.200	$35.49	$19.70	$1,602
Confined Native Backfill	210	CY		0.250	$35.49	$8.87	$1,863
Trench Excavation	256	CY		0.044	$68.32	$3.01	$768
Pipe Bedding and Zone Material	47	CY	$12.60	0.250	$35.49	$21.47	$1,012
Confined Native Trench Backfill	194	CY		0.200	$35.49	$7.10	$1,380
Haul Excess Material On Site for Disposal	108,201	CY		0.025	$65.68	$1.64	$177,666
Sand Protection Layer for Liner	3,850	CY	$10.50	0.150	$35.49	$15.82	$60,920
HDPE Liner - 60 Mil	35,000	SY	$6.75	0.100	$24.60	$9.21	$322,350
	5%	Allowance: Misc Materials & Items Required Etc					$37,419
	Subtotal Division 2				**$785,794**		
DIVISION 3 Concrete							
Inlet/Outlet Appron Slab 18"	225.1	CY	$64.52	0.540	$20.20	$75.43	$16,982
Inlet/Outlet Structure Wall 14"	241.0	CY	$101.37	4.840	$22.15	$208.58	$50,271
Meter Vault Slab 12"	12.5	CY	$65.23	0.700	$20.20	$79.37	$994
Meter Vault Wall 12"	17.1	CY	$107.56	5.580	$22.15	$231.16	$3,955
Meter Vault Elev Slab 12"	9.2	CY	$84.82	2.180	$20.20	$128.86	$1,184
Meter Vault Access Shaft Wall 12"	12.6	CY	$107.56	5.580	$22.15	$231.16	$2,911
Forms - 12"	78	LF	$1.39	0.120	$36.25	$5.74	$448
Forms - 18"	604	LF	$1.74	0.210	$36.25	$9.35	$5,649
6" Waterstop - Horizontal	428	LF	$2.87	0.060	$36.25	$5.05	$2,161
6" Waterstop - Vertical	200	LF	$2.87	0.080	$36.25	$5.77	$1,154
Reinforcement Steel	90,574	LB	$0.28	0.007	$46.44	$0.61	$54,805
Mechanical Placement	517.6	CY		0.075	$102.10	$7.66	$3,963
Finish - Slab	4,639	SF		0.020	$24.46	$0.49	$2,269
Finish - Wall	12,728	SF	$0.10	0.035	$24.46	$0.96	$12,169
	5%	Allowance: Embedded Items/Cutting/Touch-Ups/Etc					$7,946
	Subtotal Division 3				**$166,860**		
DIVISION 5 Metals							
Aluminum Ladder 25' w/Safety Climb Rail	1	EA	$1,793.75	12.400	$39.07	$2,278.22	$2,278
Safety Climb Belt Device & Harness	1	EA	$2,500.00	1.000	$39.07	$2,539.07	$2,539
Aluminum Access Hatch 4' x 4'	1	EA	$1,150.00	4.000	$39.07	$1,306.28	$1,306
	5%	Allowance: Misc Nuts/Bolts/Connections/Etc					$306
	Subtotal Division 5				**$6,430**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	0.25%					$1,048,073	$2,620
	Subtotal Division 9				**$2,620**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitter, Electromag 20"	1	EA	$16,500.00	18.000	$37.58	$17,176.44	$17,176
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$1,718
	Subtotal Division 13				**$18,894**		
DIVISION 15 Mechanical							
20" DI Piping							
Flgd Butterfly Valve	1	EA	$1,800.00	24.000	$37.58	$2,701.92	$2,702
Flgd Butterfly Valve w/Elect Operator	1	EA	$3,300.00	42.000	$37.58	$4,878.36	$4,878
FCA w/Thrust Ties	1	EA	$1,058.00	5.850	$37.58	$1,277.84	$1,278
x 3'- 0" F x PE Spool	1	EA	$552.00	7.090	$37.58	$818.44	$818
x 5'- 0" F x F Spool	1	EA	$1,036.80	9.770	$37.58	$1,403.96	$1,404
36" DI Piping							
x 20" Flgd Reducer	2	EA	$2,400.00	39.660	$37.58	$3,890.42	$7,781
Flex Coupling w/Thrust Ties, Transition	1	EA	$1,680.00	8.100	$37.58	$1,984.40	$1,984
x 2'- 0" F x PE Wall Spool	1	EA	$2,412.80	11.556	$37.58	$2,847.07	$2,847
x 4'- 0" F x PE Wall Spool	1	EA	$2,914.40	12.514	$37.58	$3,384.68	$3,385

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Flow Equalization Basins

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
36" RCPP Oulet Piping	30	LF	$82.00	0.778	$37.58	$111.24	$3,337
Tie-In of 36" RCPP to Exist Manhole	1	EA	$450.00	16.000	$37.58	$1,051.28	$1,051
Liner Protection Vent Assembly	24	EA	$500.00	12.000	$37.58	$950.96	$22,823
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$5,429
	Subtotal Division 15				**$59,718**		
DIVISION 16 Electrical							
Electrical Allowance	1%					$1,037,696	$10,377
	Subtotal Division 16				**$10,377**		
Tax on Materials	1	LS	$20,171.99			$20,171.99	$20,172
	Subtotal Tax on Materials				**$20,172**		
Subtotal This Facility							**$1,070,865**
Contractors Project Operational Costs			10%				$107,086
Allowance for Unidentified Items			20%				$235,590
Contractors Profit			8%				$113,083
Estimated Facility Cost							**$1,527,000**

CH2MHILL **Conceptual Design Cost Estimate**

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Aeration Basins
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Demo/Remove Concrete Walkways w/Railing	222	CY		2.500	$47.74	$119.35	$26,522
Demo/Remove Concrete Columns/Stairways/Slab	30	CY		1.500	$47.74	$71.61	$2,162
Sandblast Exist Concrete Surface	2,539	SF	$0.42	0.026	$20.87	$0.97	$2,458
Remove Existing Grating	671	SF		0.026	$39.07	$1.03	$688
Core Exist 18" Wall for New 30" Pipe	4	EA	$204.53	25.080	$19.32	$689.08	$2,756
Demo/Remove Large Pipe Spools/Fittings	30	EA		29.745	$37.58	$1,117.82	$33,535
	5% Allowance: Misc Materials & Items Required Etc						$3,406
	Subtotal Division 2				**$71,526**		
DIVISION 3 Concrete							
Raise Structure Wall 20"	146.3	CY	$92.90	4.220	$22.15	$186.37	$27,274
Raise Structure Wall 12"	18.2	CY	$107.56	5.580	$22.15	$231.16	$4,212
Effluent Launder Elev Slab 10"	26.4	CY	$95.87	3.210	$22.15	$166.97	$4,401
Effluent Launder Wall 10"	49.9	CY	$107.56	5.580	$22.15	$231.16	$11,524
Effluent Launder Grout	12.8	CY	$62.00	1.750	$22.15	$100.76	$1,293
Structure Wall 18"	16.9	CY	$92.90	4.220	$22.15	$186.37	$3,153
Walkway Elev Slab 12"	93.9	CY	$84.82	2.160	$22.15	$133.11	$12,497
6" Waterstop - Horizontal	240	LF	$2.87	0.060	$36.25	$5.05	$1,211
Injectable/Expandable Waterstop	3,236	LF	$4.35	0.120	$36.25	$8.70	$28,153
Drill & Dowel Exist Concrete for Rebar Anchor	3,236	EA	$2.87	0.080	$46.44	$6.59	$21,310
Reinforcement Steel	63,772	LB	$0.28	0.007	$46.44	$0.61	$38,587
Mechanical Placement	364.4	CY		0.075	$102.10	$7.66	$2,790
Finish - Slab	4,085	SF		0.020	$24.46	$0.49	$1,999
Finish - Wall	9,264	SF	$0.10	0.035	$24.46	$0.96	$8,857
	5% Allowance: Embedded Items/Cutting/Touch-Ups/Etc						$8,363
	Subtotal Division 3				**$175,624**		
DIVISION 5 Metals							
Aluminum Weir Plate	222	LF	$22.50	0.200	$39.07	$30.31	$6,730
Aluminum Grating 1-3/4"	1,519	SF	$18.05	0.035	$39.07	$19.42	$29,499
Aluminum Grating Support Angle	480	LF	$4.25	0.125	$39.07	$9.13	$4,384
Aluminum 3-Rail Handrail w/Toe Plate	1,014	LF	$30.75	0.359	$39.07	$44.78	$45,403
Aluminum Stairway 5 Riser w/HR OS & Land	2	EA	$1,224.75	11.750	$39.07	$1,683.82	$3,368
remove/Reinstall Metal Stairs/Beams/Grating	1	LS	$500.00	160.000	$39.07	$6,751.20	$6,751
	5% Allowance: Misc Nuts/Bolts/Connections/Etc						$4,807
	Subtotal Division 5				**$100,941**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	2.5%					$1,869,937	$46,748
	Subtotal Division 9				**$46,748**		
DIVISION 11 Equipment							
Downward Opening Weir Gate 30" x 36"	6	EA	$8,500.00	24.000	$43.01	$9,532.24	$57,193
DO Monitoring Pump	2	EA	$3,500.00	32.000	$43.01	$4,876.32	$9,753
Diffuser Membrane System, Basins 1 & 2	1	LS	$46,500.00	160.000	$43.01	$53,381.60	$53,382
	5% Allowance: Misc Attachment Materials & Items Etc						$6,016
	Subtotal Division 11				**$126,344**		
DIVISION 13 Special Construction							
A 21 Dissolved Oxygen Elem & Xmitter	2	EA	$4,700.00	4.000	$37.58	$4,850.32	$9,701
F 4 Flow Elem & Xmitter, Electromag 30"	4	EA	$26,000.00	42.000	$37.58	$27,578.36	$110,313
Air Flow Meter w/Accessories, Thermal	6	EA	$3,000.00	6.000	$37.58	$3,225.48	$19,353
	10% Allowance: Clips/Hangers/Straps/Supports/Misc Etc						$13,937
	Subtotal Division 13				**$153,304**		
DIVISION 15 Mechanical							
6" Scum Piping							
Flgd 90 Elbow	6	EA	$188.80	2.650	$37.58	$288.39	$1,730
x 6'- 3" F x PE Spool	6	EA	$334.00	2.192	$37.58	$416.38	$2,498
30" ML/RAS DI/Stl Piping							

CH2MHILL - **Conceptual Design Cost Estimate**

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Aeration Basins
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Flgd Butterfly Valve w/Elect Op	4	EA	$6,600.00	73.500	$37.58	$9,362.13	$37,449
x 2'- 6" F x F Spool	4	EA	$1,049.60	9.630	$37.58	$1,411.50	$5,646
x 4'- 6" F x F Spool	4	EA	$1,215.20	10.694	$37.58	$1,617.08	$6,468
x 7'- 0" F x F Spool	4	EA	$1,423.20	12.024	$37.58	$1,875.06	$7,500
36" ML/RAS DI/Stl Piping	957	LF	$70.20	0.595	$37.58	$92.56	$88,580
Flgd 90 Elbow	15	EA	$4,000.00	39.660	$37.58	$5,490.42	$82,356
Flgd 45 Elbow	3	EA	$4,000.00	39.660	$37.58	$5,490.42	$16,471
Blind Flange	5	EA	$1,032.00	16.500	$37.58	$1,652.07	$8,260
Flange	16	EA	$730.50	34.000	$37.58	$2,008.22	$32,132
Flgd Butterfly Valve	6	EA	$6,500.00	54.000	$37.58	$8,529.32	$51,176
x 1'- 0" F x F Spool	4	EA	$3,209.60	13.248	$37.58	$3,707.46	$14,830
x 2'- 6" F x F Spool	9	EA	$3,615.20	14.445	$37.58	$4,158.04	$37,422
x 3'- 6" F x PE Spool	6	EA	$2,391.20	12.194	$37.58	$2,849.45	$17,097
x 7'- 0" F x F Spool	1	EA	$4,832.00	18.036	$37.58	$5,509.79	$5,510
x 11'- 6" F x F Spool	1	EA	$6,048.00	21.627	$37.58	$6,860.74	$6,861
x 15'- 0" F x F Spool	1	EA	$6,994.40	24.420	$37.58	$7,912.10	$7,912
x 18'- 0" F x F Spool	5	EA	$7,804.80	26.814	$37.58	$8,812.47	$44,062
42" ML/RAS DI/Stl Piping							
x 30" Flgd Reducer	8	EA	$2,800.00	46.270	$37.58	$4,538.83	$36,311
Flgd Butterfly Valve	4	EA	$8,500.00	64.000	$37.58	$10,905.12	$43,620
x 1'- 6" F x F Spool	4	EA	$3,902.27	15.922	$37.58	$4,500.60	$18,002
54" ML Stl Piping	57	LF	$121.50	1.056	$37.58	$161.19	$9,188
Fab'd 45 Elbow	2	EA	$3,712.50	31.000	$37.58	$4,877.48	$9,755
x 36" Fab'd Tee	2	EA	$5,400.00	63.000	$37.58	$7,767.54	$15,535
Blind Flange	1	EA	$1,687.50	28.000	$37.58	$2,739.74	$2,740
Flange	16	EA	$1,625.00	58.000	$37.58	$3,804.64	$60,874
66" ML Stl Piping	64	LF	$148.50	1.315	$37.58	$197.92	$12,667
x 54" Fab'd Reducer	1	EA	$4,537.50	38.000	$37.58	$5,965.54	$5,966
x 36" Fab'd Tee	2	EA	$6,600.00	74.000	$37.58	$9,380.92	$18,762
Flange	12	EA	$2,062.50	71.000	$37.58	$4,730.68	$56,768
72" ML Stl Piping	36	LF	$162.00	1.431	$37.58	$215.79	$7,768
x 66" Fab'd Reducer	1	EA	$5,400.00	42.000	$37.58	$6,978.36	$6,978
x 36" Fab'd Tee	2	EA	$7,200.00	84.000	$37.58	$10,356.72	$20,713
x 42" Fab'd Tee	3	EA	$7,350.00	84.000	$37.58	$10,506.72	$31,520
x 42" x 72" x 72" Fab'd Cross	1	EA	$9,750.00	117.600	$37.58	$14,169.41	$14,169
Blind Flange	2	EA	$2,460.00	48.000	$37.58	$4,263.84	$8,528
Flange	17	EA	$2,250.00	82.000	$37.58	$5,331.56	$90,637
Temp Remove/Replace Exist ML Pipe/Flgs/Valve	1	LS	$1,500.00	240.000	$37.58	$10,519.20	$10,519
Temp Remove/Replace Exist ALP Pipe/Flgs/Valv	1	LS	$500.00	120.000	$37.58	$5,009.60	$5,010
18" ALP SST Piping	100	LF	$65.00	0.405	$37.58	$80.20	$8,020
90 Elbow	24	EA	$850.00	7.600	$37.58	$1,135.61	$27,255
Flange	12	EA	$750.00	14.200	$37.58	$1,283.64	$15,404
	10% Allowance: Clips/Hangers/Straps/Supports/Misc Etc						$101,067
	Subtotal Division 15				**$1,111,737**		
DIVISION 16 Electrical							
Electrical Allowance	8%					$1,739,476	$130,461
	Subtotal Division 16				**$130,461**		
Tax on Materials	1	LS	$56,098.88			$56,098.88	$56,099
	Subtotal Tax on Materials				**$56,099**		
Subtotal This Facility							$1,972,784
Contractors Project Operational Costs			10%				$197,278
Allowance for Unidentified Items			20%				$434,013
Contractors Profit			8%				$208,326
Estimated Facility Cost							$2,812,000

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field W[illegible]ater Treatment Plant
Little Rock Wa[illegible]r Utility
for the City of Littl[illegible], Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Secondary Clarifiers 145'
Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sawcut Exist Concrete Slab 6"	108	LF	$3.36	0.232	$40.17	$12.68	$1,369
Demo/Remove Concrete	6	CY		1.500	$47.74	$71.61	$426
Structural Excavation, Hand	53	CY		3.333	$24.60	$81.99	$4,373
Cut/Demo/Remove Exist 24" RAS Piping	15	LF		0.227	$37.58	$8.55	$128
Sandblast Exist Concrete Surface	72	SF	$0.42	0.026	$20.87	$0.97	$70
Haul Excess Material Off Site for Disposal	53	CY		0.025	$102.37	$2.56	$136
Remove Exist Clarifier Mech/Bridge/Sweep Etc	3	EA		320.000	$43.01	$13,763.20	$41,290
	5% Allowance: Misc Materials & Items Required Etc						$2,390
	Subtotal Division 2				**$50,183**		
DIVISION 3 Concrete							
Main Slab 6" Circular/Conical	4.4	CY	$72.75	0.930	$20.20	$91.54	$407
Main Slab Grout 2"	1.5	CY	$50.00	0.375	$20.20	$57.58	$87
Concrete Encasement	50.2	CY	$55.00	1.150	$20.20	$78.23	$3,926
Injectable/expandable Waterstop	108	LF	$4.35	0.120	$36.25	$8.70	$940
Drill & Dowel Exist Concrete for Rebar Anchor	108	EA	$2.87	0.080	$46.44	$6.59	$711
Reinforcement Steel	778	LB	$0.28	0.007	$46.44	$0.61	$471
Mechanical Placement	56.1	CY		0.075	$102.10	$7.66	$430
Finish - Slab	711	SF		0.020	$24.46	$0.49	$348
	5% Allowance: Embedded Items/Cutting/Touch-Ups/Etc						$366
	Subtotal Division 3				**$7,685**		
DIVISION 5 Metals							
Aluminum Weir & Scum Baffle	1,367	LF		0.200	$39.07	$7.81	$10,679
	5% Allowance: Misc Nuts/Bolts/Connections/Etc						$534
	Subtotal Division 5				**$11,212**		
DIVISION 9 Finishes							
Painting/Coatings Allowance	2.5%					$756,436	$18,911
	Subtotal Division 9				**$18,911**		
DIVISION 11 Equipment							
Clarifier Mechanism w/Bridge/Sweep/Grating Column/Weirs & Baffles Etc. 145'	3	EA	$182,700.00	640.000	$43.01	$210,226.40	$630,679
	5% Allowance: Misc Attachment Materials & Items Etc						$31,534
	Subtotal Division 11				**$662,200**		
DIVISION 15 Mechanical							
24" RAS Piping							
MJ x Flgd 90 Elbow	3	EA	$1,600.00	18.361	$37.58	$2,290.01	$6,870
x 5'- 0" F x PE Wall Spool	3	EA	$1,099.20	8.768	$37.58	$1,428.70	$4,286
Disconnect Exist/Reconnect New Piping	3	EA	$250.00	32.000	$37.58	$1,452.56	$4,358
Misc Washdowns/Sprays Pipe/Ftgs/Valves	3	EA	$1,350.00	14.000	$37.58	$1,876.12	$5,628
	10% Allowance: Clips/Hangers/Straps/Supports/Misc Etc						$2,114
	Subtotal Division 15				**$23,256**		
DIVISION 16 Electrical							
Electrical Allowance	0.25%					$754,550	$1,886
	Subtotal Division 16				**$1,886**		
Tax on Materials	1	LS	$27,037.37			$27,037.37	$27,037
	Subtotal Tax on Materials				**$27,037**		
Subtotal This Facility							$802,385
Contractors Project Operational Costs			10%				$80,238
Allowance for Unidentified Items			20%				$176,525
Contractors Profit			8%				$84,732

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Origi[illegible]ate 15-Sep-98
Revised Date 15-Sep-98

Secondary Clarifiers 145'
Modifications

Description	Qty	Unit	Material Costs	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Estimated Facility Cost							$1,144,000

CH2MHI[illegible] - *Conceptual Design Cost Estimate*

Adams Field W[illegible]ter Treatment Plant
Little Rock Was[illegible]er Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Secondary Clarifier
New - 145'

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Structural Excavation	12,112	CY		0.044	$68.32	$3.01	$36,410
Gravel Fill Under Slab 6"	265	CY	$12.60	0.200	$35.49	$19.70	$5,221
Trench Excavation	88	CY		0.044	$68.32	$3.01	$265
Confined Native Backfill	2,552	CY		0.250	$35.49	$8.87	$22,646
Haul Excess Material Off Site for Disposal	9,648	CY		0.025	$102.37	$2.56	$24,692
	5% Allowance: Misc Materials & Items Required Etc						$4,462
	Subtotal Division 2				$93,696		
DIVISION 3 Concrete							
Stairway Landing Slab 6"	0.4	CY	$70.60	1.280	$20.20	$96.46	$43
Center Sludge Block/Pit	40.8	CY	$65.15	0.710	$20.20	$79.49	$3,240
Main Wall Footing Slab 18" Circular	173.5	CY	$65.15	0.710	$20.20	$79.49	$13,791
Main Slab 6" Circular/Conical	265.1	CY	$72.75	0.930	$20.20	$91.54	$24,264
Main Wall 12" Circular	243.4	CY	$118.95	9.360	$22.15	$326.27	$79,427
Launder Slab 12" Circular	61.3	CY	$104.34	4.013	$22.15	$193.21	$11,842
Launder Wall 12" Circular	71.2	CY	$174.39	18.190	$22.15	$577.30	$41,109
Main Slab Grout 2"	104.0	CY	$50.00	0.375	$20.20	$57.58	$5,985
Launder Slab Grout 4" Avg	14.6	CY	$50.00	0.375	$20.20	$57.58	$839
Concrete Encasement	43.3	CY	$55.00	1.150	$20.20	$78.23	$3,387
Forms	362.0	SF	$0.55	0.120	$36.25	$4.90	$1,774
Forms - 6"	552	LF	$0.15	0.060	$36.25	$2.33	$1,283
Forms - 18"	39	LF	$1.46	0.250	$36.25	$10.53	$410
Forms - 18" Circular	619	LF	$1.88	0.300	$36.25	$12.75	$7,891
6" Waterstop - Horizontal	1,560	LF	$2.87	0.060	$36.25	$5.05	$7,869
6" Waterstop - Vertical	111	LF	$2.87	0.080	$36.25	$5.77	$640
Reinforcement Steel	126,559	LB	$0.28	0.007	$46.44	$0.61	$76,578
Mechanical Placement	1,017.5	CY		0.075	$102.10	$7.66	$7,792
Finish - Slab	34,973	SF		0.020	$24.46	$0.49	$17,109
Finish - Wall	15,898	SF	$0.10	0.035	$24.46	$0.96	$15,200
	5% Allowance: Embedded Items/Cutting/Touch-Ups/Etc						$16,024
	Subtotal Division 3				$336,495		
DIVISION 5 Metals							
Aluminum Stairway 5 Riser w/HR BS & Land	1	EA	$1,393.50	14.450	$39.07	$1,958.06	$1,958
Aluminum Weir & Scum Baffle	456	LF		0.200	$39.07	$7.81	$3,560
Aluminum Grating 1-3/4"	8	SF	$18.05	0.035	$39.07	$19.42	$149
Aluminum Grating Support Angle	12	LF	$4.25	0.125	$39.07	$9.13	$106
	5% Allowance: Misc Nuts/Bolts/Connections/Etc						$289
	Subtotal Division 5				$6,061		
DIVISION 9 Finishes							
Painting/Coatings Allowance	2.5%					$712,546	$17,814
	Subtotal Division 9				$17,814		
DIVISION 11 Equipment							
Clarifier Mechanism w/Bridge/Sweep/Grating Column/Weirs & Baffles Etc. 145'	1	EA	$182,700.00	640.000	$43.01	$210,226.40	$210,226
	5% Allowance: Misc Attachment Materials & Items Etc						$10,511
	Subtotal Division 11				$220,700		
DIVISION 15 Mechanical							
48" ML Piping	81	LF	$132.00	0.831	$37.58	$163.24	$13,141
Flex Coupling w/Thrust Ties	2	EA	$2,358.00	10.800	$37.58	$2,763.86	$5,528
Fab'd 90 Elbow	1	EA	$1,980.00	27.300	$37.58	$3,005.93	$3,006
Flange	1	EA	$1,200.00	51.110	$37.58	$3,120.71	$3,121
24" RAS Piping	77	LF	$60.00	0.303	$37.58	$71.40	$5,462
Flex Coupling w/Thrust Ties	2	EA	$1,192.00	5.400	$37.58	$1,394.93	$2,790
6" DR Piping	77	LF	$7.85	0.064	$37.58	$10.26	$785
Flex Coupling w/Thrust Ties	2	EA	$153.00	1.500	$37.58	$209.37	$419
x 2'- 6" MJ x PE Wall Spool	1	EA	$136.80	1.680	$37.58	$199.93	$200
MJ Plug Valve w/Valve Box	1	EA	$288.00	5.882	$37.58	$509.05	$509

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Secondary Clarifier
New - 145'

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
42" SE Piping	8	LF	$115.50	0.674	$37.58	$140.82	$1,056
Flex Coupling w/Thrust Ties	2	EA	$2,049.00	9.450	$37.58	$2,404.13	$4,808
x 2'- 6" MJ x PE Wall Spool	1	EA	$1,766.40	31.099	$37.58	$2,935.10	$2,935
8" Scum GLDI Piping	10	LF	$48.35	0.048	$37.58	$50.15	$502
Flgd 90 Elbow	1	EA	$261.60	2.650	$37.58	$361.19	$361
x 2'- 0" F X MJ Wall Spool	1	EA	$294.40	1.917	$37.58	$366.44	$366
Misc Washdowns/Sprays Pipe/Ftgs/Valves	1	EA	$3,000.00	24.000	$37.58	$3,901.92	$3,902
	10% Allowance: Clips/Hangers/Straps/Supports/Misc Etc						$4,889
	Subtotal Division 15				$53,779		
DIVISION 16 Electrical							
Electrical Allowance	0.25%					$710,769	$1,777
	Subtotal Division 16				$1,777		
Tax on Materials	1	LS	$17,638.54			$17,638.54	$17,639
	Subtotal Tax on Materials				$17,639		
Subtotal This Facility							$747,998
Contractors Project Operational Costs			10%				$74,800
Allowance for Unidentified Items			20%				$164,560
Contractors Profit			8%				$78,989
Estimated Facility Cost							$1,066,000

CH2M *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
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Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

RAS/WAS Pump Station Modifications
& New Meter Vault

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Sawcut Exist Concrete Slab 12"	29	LF	$4.20	0.290	$40.17	$15.85	$454
Sawcut Exist Concrete Slab 5" w/Roofing	72	LF	$2.52	0.174	$40.17	$9.51	$685
Demo/Remove Existing Grating	72	SF		0.026	$39.07	$1.03	$74
Demo/Remove Concrete	17	CY		1.500	$47.74	$71.61	$1,217
Structural Excavation, Hand	8	CY		3.333	$24.60	$81.99	$680
Zone Material Backfill Around Piping	8	CY	$12.60	0.200	$35.49	$19.70	$163
Structural Excavation	595	CY		0.044	$68.32	$3.01	$1,789
Gravel Fill Under Slab	13	CY	$12.60	0.200	$35.49	$19.70	$250
Confined Native Backfill	340	CY		0.250	$35.49	$8.87	$3,019
Trench Excavation		CY		0.044	$68.32	$3.01	$0
Confined Native Backfill		CY		0.250	$35.49	$8.87	$0
Haul On Site Excess Excavated Material	255	CY		0.025	$65.68	$1.64	$419
Core exist 10" Wall for New 30" Pipe	2	EA	$112.09	14.523	$19.32	$392.67	$785
Remove Existing 14" RAS Piping							
Flgd 90 Elbow	4	EA		3.863	$37.58	$145.15	$581
Flgd Butterfly Valve	4	EA		7.826	$37.58	$294.11	$1,176
Flgd Check Valve	3	EA		13.847	$37.58	$520.35	$1,561
x 3'- 0" F x F Spool	3	EA		3.731	$37.58	$140.22	$421
x 5'- 6" F x PE Spool	4	EA		3.473	$37.58	$130.50	$522
Remove Exist RAS Pump w/Right Angle Drive	3	EA		81.600	$43.01	$3,509.62	$10,529
	5%	Allowance: Misc Materials & Items Required Etc					$1,216
		Subtotal Division 2			**$25,542**		
DIVISION 3 Concrete							
Meter Pit Slab 24"	50.8	CY	$64.16	0.460	$20.20	$73.45	$3,733
Meter Pit Wall 12"	48.3	CY	$107.56	5.580	$22.15	$231.16	$11,158
Meter Pit Support Beam 12"w x 18"d	1.9	CY	$126.42	12.590	$22.15	$405.29	$766
Meter Pit Elev Slab 12"	21.0	CY	$84.82	2.180	$22.15	$133.11	$2,794
Building Replacement Slab 5"	2.8	CY	$72.32	1.510	$22.15	$105.77	$295
Building Replacement Beam 12"w x 18"d	0.9	CY	$126.42	12.590	$22.15	$405.29	$360
Building Replacement Elev Slab 12"	7.8	CY	$84.82	2.180	$22.15	$133.11	$1,044
Slab Forms 24"	107	LF	$2.09	0.308	$36.25	$13.26	$1,423
6" Waterstop - Horizontal	95	LF	$2.87	0.060	$36.25	$5.05	$481
6" Waterstop - Vertical	54	LF	$2.87	0.080	$36.25	$5.77	$312
Reinforcment Steel	23,360	LB	$0.28	0.007	$46.44	$0.61	$14,135
Mechanical Placement	133.5	CY		0.075	$102.10	$7.66	$1,022
Finish - Slab	1,644	SF		0.020	$24.46	$0.49	$804
Finish - Wall	2,823	SF	$0.10	0.035	$24.46	$0.96	$2,699
	5%	Allowance: Embedded Items/Cutting/Touch-Ups Etc					$2,051
		Subtotal Division 3			**$43,075**		
DIVISION 5 Metals							
Aluminum Ships Ladder 4'	5	EA	$628.00	1.280	$39.07	$678.01	$3,390
Aluminum 3-Rail Handrail w/Toe Plate	14	LF	$30.50	0.359	$39.07	$44.53	$623
Aluminum Grating 1-3/4"	115	SF	$18.05	0.035	$39.07	$19.42	$2,227
Aluminum Grating Column 3"	7	LF	$4.18	0.068	$39.07	$6.85	$48
Aluminum Grating Support I Beam I 6 x 6.181	73	LF	$11.00	0.179	$39.07	$18.01	$1,321
Aluminum Ladder 14'	1	EA	$812.00	5.264	$39.07	$1,017.66	$1,018
Aluminum Access Hatch 4' x 4'	1	EA	$1,150.00	4.000	$39.07	$1,306.28	$1,306
	5%	Allowance: Misc Nuts/Bolts/Connections Etc					$497
		Subtotal Division 5			**$10,429**		
DIVISION 7 Thermal/Moisture Protect							
Replace Bldg Roofing w/Closures	144	SF	$3.50	0.100	$25.86	$6.09	$876
New Skylight w/Curbing & Flashing 5' x 5'	4	EA	$513.75	3.038	$25.86	$592.30	$2,369
	5%	Allowance: Edge/Ridge/Penetrations/Matl Etc					$162
		Subtotal Division 7			**$3,408**		
DIVISION 9 Finishes							
Coatings/Painting Allowance	1.5%					$713,244	$10,699

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

RAS/WAS Pump Station Modifications
& New Meter Vault

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
		Subtotal Division 9			**$10,699**		
DIVISION 10 Specialties							
Pipe Marking/Labels & Room Signs	1	LS	$100.00	4.000	$24.60	$198.40	$198
	5%	Allowance: Mounting Anchors/Nuts/Bolts/Connects Etc					$10
		Subtotal Division 10			**$208**		
DIVISION 11 Equipment							
New RAS Pump 50 Hp	4	EA	$65,400.00	72.000	$43.01	$68,496.72	$273,987
New RAS Pump VFD	4	EA	$10,000.00	32.000	$43.01	$11,376.32	$45,505
	5%	Allowance: Misc Connection Materials & Items Etc					$15,975
		Subtotal Division 11			**$335,467**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitter, Electromag 20"	1	EA	$16,500.00	18.000	$37.58	$17,176.44	$17,176
P 4 Pressure Gauge	4	EA	$120.00	1.500	$37.58	$176.37	$705
P 7 Pressure Switch	4	EA	$395.00	3.000	$37.58	$507.74	$2,031
P 9 Pressure Transmitter	4	EA	$1,150.00	4.000	$37.58	$1,300.32	$5,201
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$2,511
	Subtotal Division 13				**$27,626**		
DIVISION 15 Mechanical							
14" RAS DI Piping							
Flgd Butterfly Valve	4	EA	$810.00	10.435	$37.58	$1,202.15	$4,809
x 0'- 6" F x F Spool	4	EA	$512.80	4.325	$37.58	$675.33	$2,701
x 4'- 6" F x PE Spool	4	EA	$408.00	4.370	$37.58	$572.22	$2,289
20" RAS DI Piping							
x 14" Flgd 90 Elbow	4	EA	$901.25	12.663	$37.58	$1,377.13	$5,509
Flgd Butterfly Valve w/Elect Op	4	EA	$2,675.00	42.000	$37.58	$4,253.36	$17,013
Flgd Check Valve	4	EA	$15,000.00	40.000	$37.58	$16,503.20	$66,013
Flex Coupling w/Thrust Ties	4	EA	$1,022.00	4.500	$37.58	$1,191.11	$4,764
FCA Coupling w/Thrust Ties	4	EA	$1,058.00	5.850	$37.58	$1,277.84	$5,111
x 2'- 0" MJ x PE Spool	4	EA	$316.80	4.204	$37.58	$474.79	$1,899
x 2'- 0" F x PE Spool	4	EA	$485.60	6.726	$37.58	$738.36	$2,953
x 3'- 0" F x PE Spool	4	EA	$552.00	7.090	$37.58	$818.44	$3,274
x 3'- 0" F x PE Wall Spool	4	EA	$733.60	7.090	$37.58	$1,000.04	$4,000
x 4'- 0" F x F Spool	4	EA	$971.20	9.316	$37.58	$1,321.30	$5,285
30" RAS DI Piping					$37.58		
x 20" Flgd Reducer	8	EA	$3,100.00	27.540	$37.58	$4,134.95	$33,080
Flgd Butterfly Valve	4	EA	$4,800.00	42.000	$37.58	$6,378.36	$25,513
Flex Coupling w/Thrust Ties	4	EA	$1,440.00	6.750	$37.58	$1,693.67	$6,775
x 2'- 6" PE x PE Wall Spool	2	EA	$816.80	6.019	$37.58	$1,042.99	$2,086
x 3'- 0" MJ x PE Spool	4	EA	$811.20	6.185	$37.58	$1,043.63	$4,175
x 4'- 0" F x PE Wall Spool	4	EA	$2,113.60	10.428	$37.58	$2,505.48	$10,022
x 9'- 0" MJ x PE Spool	2	EA	$2,204.80	8.180	$37.58	$2,512.20	$5,024
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$21,230
		Subtotal Division 15			**$233,525**		
DIVISION 16 Electrical							
Electrical Allowance - Conduit/Wiring/Items	5%					$679,280	$33,964
		Subtotal Division 16			**$33,964**		
Tax on Materials	1	LS	$26,049.75			$26,049.75	$26,050
		Subtotal Tax on Materials			**$26,050**		
Subtotal This Facility							$749,992
Contractors Project Operational Costs			10%				$74,999
Allowance for Unidentified Items			20%				$164,998
Contractors Profit			8%				$79,199

CH2M - *Conceptual Design Cost Estimate*

Adams Field W ter Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

RAS/WAS Pump Station Modifications
& New Meter Vault

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Estimated Facility Cost							$1,069,000

CH2M - *Conceptual Design Cost Estimate*

Adams Field V ater Treatment Plant
Little Rock Wastewater Utility
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Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Gravity Thickeners & Sludge Piping Modifications

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Demo/Remove Exist PS Pumps/Pipe/Fittings	1	LS		72.000	$43.01	$3,096.72	$3,097
Core Exist 12" Wall for New 6" Pipe	1	EA	$29.38	3.202	$19.32	$91.24	$91
	5%	Allowance: Misc Materials & Items Required Etc					$159
		Subtotal Division 2			**$3,347**		
DIVISION 3 Concrete							
New Pump Pad 12"	0.7	CY	$65.23	0.700	$20.20	$79.37	$53
Slab Forms 12"	18	LF	$1.39	0.120	$36.25	$5.74	$103
Reinforcment Steel	117	LB	$0.28	0.007	$46.44	$0.61	$71
Mechanical Placement	0.7	CY		0.075	$102.10	$7.66	$5
Finish - Slab	18	SF		0.020	$24.46	$0.49	$9
	5%	Allowance: Embedded Items/Cutting/Touch-Ups Etc					$12
		Subtotal Division 3			**$253**		
DIVISION 9 Finishes							
Coatings/Painting Allowance	2.5%					$60,727	$1,518
		Subtotal Division 9			**$1,518**		
DIVISION 11 Equipment							
Thickener Sludge Pump	1	EA	$20,000.00	72.000	$43.01	$23,096.72	$23,097
Thickener Sludge Pump VFD	1	EA	$12,000.00	36.000	$43.01	$13,548.36	$13,548
	5%	Allowance: Misc Connection Materials & Items Etc					$1,832
		Subtotal Division 11			**$38,477**		
DIVISION 13 Special Construction							
P 4 Pressure Gauge	1	EA	$120.00	1.500	$37.58	$176.37	$176
P 7 Pressure Switch	1	EA	$395.00	3.000	$37.58	$507.74	$508
P 9 Pressure Transmitter	1	EA	$1,150.00	4.000	$37.58	$1,300.32	$1,300
P 15 Pressure Seal, Annular 6"	1	EA	$750.00	6.000	$37.58	$975.48	$975
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$296
	Subtotal Division 13				**$3,256**		
DIVISION 15 Mechanical							
Piping Tie-Ins & Connections	1	LS	$7,500.00	64.000	$37.58	$9,905.12	$9,905
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$991
		Subtotal Division 15			**$10,896**		
DIVISION 16 Electrical							
Electrical Allowance - Conduit/Wiring/Items	8%					$56,229	$4,498
		Subtotal Division 16			**$4,498**		
Tax on Materials	1	LS	$2,147.98			$2,147.98	$2,148
		Subtotal Tax on Materials			**$2,148**		
Subtotal This Facility							$64,393
Contractors Project Operational Costs			10%				$6,439
Allowance for Unidentified Items			20%				$14,167
Contractors Profit			8%				$6,800
Estimated Facility Cost							$92,000

CH2 - *Conceptual Design Cost Estimate*

Adams Field water Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

New Effluent Meter & Weir Vaults

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Structural Excavation	933	CY		0.044	$68.32	$3.01	$2,806
Gravel Fill Under Slab	11	CY	$12.60	0.200	$35.49	$19.70	$210
Confined Native Backfill	835	CY		0.250	$35.49	$8.87	$7,409
Haul On Site Excess Excavated Material	98	CY		0.025	$65.68	$1.64	$161
	5%	Allowance: Misc Materials & Items Required Etc					$529
			Subtotal Division 2		**$11,115**		
DIVISION 3 Concrete							
Weir Pit Slab 24"	12.5	CY	$64.16	0.460	$20.20	$73.45	$920
Weir Pit Wall 18"	24.3	CY	$92.90	4.220	$22.15	$186.37	$4,525
Weir Pit Wall 12"	9.3	CY	$107.56	5.580	$22.15	$231.16	$2,157
Meter Pip Slab 18"	24.0	CY	$64.52	0.460	$22.15	$74.71	$1,793
Meter Pit Wall 12"	34.4	CY	$107.56	5.580	$22.15	$231.16	$7,945
Meter Pit Elev Slab 12"	12.0	CY	$84.82	2.180	$22.15	$133.11	$1,597
Slab Forms 24"	52	LF	$2.09	0.308	$36.25	$13.26	$689
Slab Forms 18"	96	LF	$1.74	0.210	$36.25	$9.35	$898
6" Waterstop - Horizontal	300	LF	$2.87	0.060	$36.25	$5.05	$1,514
6" Waterstop - Vertical	110	LF	$2.87	0.080	$36.25	$5.77	$635
Reinforcment Steel	20,388	LB	$0.28	0.007	$46.44	$0.61	$12,336
Mechanical Placement	116.5	CY		0.075	$102.10	$7.66	$892
Finish - Slab	925	SF		0.020	$24.46	$0.49	$453
Finish - Wall	3,234	SF	$0.10	0.035	$24.46	$0.96	$3,092
	5%	Allowance: Embedded Items/Cutting/Touch-Ups Etc					$1,972
			Subtotal Division 3		**$41,417**		
DIVISION 5 Metals							
Stop Log Guide Channel	44	LF	$45.00	0.400	$39.07	$60.63	$2,668
Aluminum Grating 1-3/4"	69	SF	$18.05	0.035	$39.07	$19.42	$1,347
Aluminum Grating Suppoort Angle	33	LF	$4.25	0.125	$39.07	$9.13	$304
Aluminum Grating Support I Beam I 6 x 6.181	13	LF	$11.00	0.179	$39.07	$18.01	$234
Aluminum Ladder 17'	1	EA	$986.00	6.392	$39.07	$1,235.74	$1,236
Aluminum Ladder 18'	1	EA	$1,044.00	6.768	$39.07	$1,308.43	$1,308
Aluminum Access Hatch 4' x 4'	1	EA	$1,150.00	4.000	$39.07	$1,306.28	$1,306
	5%	Allowance: Misc Nuts/Bolts/Connections Etc					$420
			Subtotal Division 5		**$8,824**		
DIVISION 9 Finishes							
Coatings/Painting Allowance	1.5%					**$171,414**	$2,571
			Subtotal Division 9		**$2,571**		
DIVISION 10 Specialties							
Pipe Marking/Labels & Room Signs	1	LS	$100.00	4.000	$24.60	$198.40	$198
	5%	Allowance: Mounting Anchors/Nuts/Bolts/Connects Etc					$10
			Subtotal Division 10		**$208**		
DIVISION 13 Special Construction							
F 4 Flow Elem & Xmitter, Electromag 42"	1	EA	$35,000.00	64.000	$37.58	$37,405.12	$37,405
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$3,741
		Subtotal Division 13			**$41,146**		
DIVISION 15 Mechanical							
42" FE Stl Piping							
Flgd Butterfly Valve	2	EA	$8,500.00	64.000	$37.58	$10,905.12	$21,810
FCA Coupling w/Thrust Ties	1	EA	$1,058.00	5.850	$37.58	$1,277.84	$1,278
x 2'- 6" F x F Wall Spool	1	EA	$4,680.67	16.853	$37.58	$5,313.98	$5,314
x 4'- 0" F x PE Spool	1	EA	$2,935.33	12.514	$37.58	$3,405.61	$3,406
x 11'- 0" F x F Spool	1	EA	$6,898.27	17.238	$37.58	$7,546.07	$7,546
72" FE RCPP Piping	8	LF	$162.00	1.431	$37.58	$215.79	$1,726
x 42" Fab'd Reducer	2	EA	$5,400.00	42.000	$37.58	$6,978.36	$13,957

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

New Effluent Meter & Weir Vaults

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$5,504
			Subtotal Division 15		**$60,540**		
DIVISION 16 Electrical							
Electrical Allowance - Conduit/Wiring/Items	5%					$163,251	$8,163
			Subtotal Division 16		**$8,163**		
Tax on Materials	1	LS	$5,330.91			$5,330.91	$5,331
			Subtotal Tax on Materials		**$5,331**		
Subtotal This Facility							$179,316
Contractors Project Operational Costs			10%				$17,932
Allowance for Unidentified Items			20%				$39,449
Contractors Profit			8%				$18,936
Estimated Facility Cost							$256,000

CH2 - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Sitework

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
DIVISION 2 Sitework							
Piping Trench Clearinc	3	AC		12.000	$84.00	$1,008.00	$3,024
Sawcut Exist Asphalt Pavement	460	LF	$0.23	0.021	$20.29	$0.66	$302
Demo/Remove Exist Asphalt Pavemen	247	SY	$0.25	0.058	$47.74	$3.02	$746
Trench Excavatior	15,937	CY		0.044	$68.32	$3.01	$47,909
Pipe Bedding and Zone Materia	5,094	CY	$12.60	0.250	$35.49	$21.47	$109,385
Native Trench Backfil	7,850	CY		0.200	$35.49	$7.10	$55,719
Concrete Sidewalk 4" w/4" AB	200	SF		0.092	$35.49	$3.27	$655
Concrete Curb & Gutter 6" x 18'	200	LF	$0.75	0.083	$35.49	$3.71	$742
Asphalt Pavement w/Base (4"AC/8"UTBC)	2,225	SF	$1.20	0.004	$266.36	$2.26	$5,030
General Abandoned Structure Demo & Remov	1	LS	$1,500.00	120.000	$47.74	$7,228.80	$7,229
	5%	Allowance: Misc Materials & Items Etc					$11,537
		Subtotal Division 2			**$242,278**		
DIVISION 9 Finishes							
Painting/Coatings Allowanc	0.5%					$1,764,304	$8,822
		Subtotal Division 9			**$8,822**		
DIVISION 15 Mechanical							
3" Scum GLDI Piping	130	LF	$6.00	0.050	$57.32	$8.87	$1,153
MJ 45 Elbow	1	EA	$85.00	1.560	$57.32	$174.42	$174
12" PSD DI Piping	880	LF	$16.80	0.075	$57.32	$21.10	$18,567
MJ 90 Elbow	3	EA	$625.00	2.680	$57.32	$778.62	$2,336
MJ 45 Elbow	1	EA	$400.00	2.680	$57.32	$553.62	$554
30" RAS DI Piping	220	LF	$52.50	0.405	$57.32	$75.71	$16,657
x 24" MJ 90 Elbow	4	EA	$2,031.25	12.800	$57.32	$2,764.95	$11,060
MJ 45 Elbow	12	EA	$1,875.00	12.800	$57.32	$2,608.70	$31,304
x 3'- 6" F x PE Spool	4	EA	$2,113.60	10.428	$57.32	$2,711.33	$10,845
x 18'- 0" PE x PE Spool	4	EA	$2,204.80	8.180	$57.32	$2,673.68	$10,695
42" PI DI Piping	1,071	LF	$84.00	0.674	$57.32	$122.62	$131,325
MJ 90 Elbow	5	EA	$2,800.00	21.800	$57.32	$4,049.58	$20,248
MJ 45 Elbow	9	EA	$2,625.00	21.800	$57.32	$3,874.58	$34,871
42" SE DI Piping	265	LF	$84.00	0.674	$57.32	$122.62	$32,494
MJ 45 Elbow	4	EA	$2,625.00	21.800	$57.32	$3,874.58	$15,498
48" ML DI Piping	1,013	LF	$100.00	0.831	$57.32	$147.65	$149,567
MJ 45 Elbow	12	EA	$3,200.00	27.300	$57.32	$4,764.84	$57,178
48" PE DI Piping	235	LF	$100.00	0.831	$57.32	$147.65	$34,697
MJ 45 Elbow	2	EA	$3,200.00	27.300	$57.32	$4,764.84	$9,530
MJ Tee	2	EA	$4,400.00	54.600	$57.32	$7,529.67	$15,059
MJ Cap	1	EA	$2,200.00	27.300	$57.32	$3,764.84	$3,765
72" PE RCPP Piping	890	LF	$200.00	1.274	$57.32	$273.01	$242,980
Fabd 45 Elbow	5	EA	$8,640.00	41.500	$57.32	$11,018.78	$55,094
x 48" Fabd Wye	1	EA	$14,400.00	83.000	$57.32	$19,157.56	$19,158
Secondary Sludge Scum Pipe/Ftgs/Valves Mod	1	LS	$15,000.00	90.000	$57.32	$20,158.80	$20,159
Pipeline Detection Marking Tap	4,939	LF	$0.05	0.003	$57.32	$0.19	$955
	10%	Allowance: Clips/Hangers/Straps/Supports/Misc Etc					$94,592
		Subtotal Division 15			**$1,040,515**		
DIVISION 16 Electrical							
Primary Transformer w/Fuses and Accesssorie	1	LS	$100,000.00	360.000	$41.12	$114,803.20	$114,803
Primary Switchgear w/Accessorie	1	LS	$100,000.00	360.000	$41.12	$114,803.20	$114,803
Modify Eddi-Current Assembl	1	LS	$15,000.00	50.000	$41.12	$17,056.00	$17,056
Primary effluent PS Transformer w/Accessorie	2	EA	$25,000.00	90.000	$41.12	$28,700.80	$57,402
Administration Building Incoming Power Mods	1	LS	$15,000.00	50.000	$41.12	$17,056.00	$17,056
Electrical Allowance	10%					$1,603,913	$160,391
		Subtotal Division 16			**$481,511**		
Tax on Materials	1	LS	$53,374.36			$53,374.36	$53,374
		Subtotal Materials Tax			**$53,374**		
Subtotal This Facility							**$1,826,500**

CH2MHILL - *Conceptual Design Cost Estimate*

Adams Field Wastewater Treatment Plant
Little Rock Wastewater Utility
for the City of Little Rock, Arkansas
Prepared By: R Lawson/RDD
Project No: 147367.A0.CP

Original Date 15-Sep-98
Revised Date 15-Sep-98

Sitework

Description	Qty	Unit	Material Cost	Crew Hours	Labor/Equip Rate	Unit Cost	Total Cost
Contractors Project Operational Cost			10%				$182,650
Allowance for Unidentified Items			20%				$401,830
Contractors Profit			8%				$192,878
Estimated Facility Cost							$2,604,000

Preliminary Evaluation of the Fourche Creek WWTP

PREPARED FOR:	Little Rock Wastewater Utility
PREPARED BY:	Linda Ferguson, CG&S
COPIES:	Bob Blanz, CH2M HILL Glen Daigger, CH2M HILL Mike Guthrie, CH2M HILL Bob Lawson, CH2M HILL
DATE:	February 19, 1999

Task Objective

The Little Rock Wastewater Utility (LRWU) is planning to upgrade the Adams Field WWTP to rectify operation and maintenance limitations, improve treatment efficiency and increase the hydraulic capacity of the existing facility. Prior to starting the design effort on the proposed upgrades at Adams Field, LRWU has asked us to perform a preliminary evaluation of the Fourche Creek WWTP to determine if increasing the hydraulic capacity of this facility is a cost-effective method of reducing the hydraulic loading to the Adams Field facility.

The specific objectives of this task are:

- to perform a hydraulic throughput capacity evaluation of the Fourche Creek WWTP
- to provide an order of magnitude cost estimate of the upgrades required to increase the maximum hydraulic throughput capacity of the facility from 38 to 60 mgd (22-mgd increase)

This technical memorandum summarizes the results of the hydraulic evaluation and order-of-magnitude cost estimate to increase the hydraulic throughput capacity of the Fourche Creek facility.

Hydraulic Throughput Evaluation

WinHYDRO, a computer model that facilitates complex analysis of plant hydraulics, was used to evaluate the hydraulic characteristics of the Fourche Creek WWTP. Hydraulic and energy gradelines from the chlorine contact chamber overflow weir to the primary effluent pump station and from the primary effluent pump station to the plant headworks outfall were developed for the current peak (38 mgd) and the potential future peak (60 mgd) flow conditions. Hydraulic bottlenecks that limit the hydraulic throughput capacity of the existing facilities and flow distribution problems were identified and evaluated. The hydraulic throughput capacity of each unit process was determined.

Modeling Methodology

A hydraulic model of the existing facilities at the Fourche Creek WWTP was prepared using WinHYDRO, the CH2M HILL hydraulic modeling software package. It is a steady-state hydraulic modeling tool that performs a series of backwater calculations to determine the hydraulic grade line (HGL) and energy grade line (EGL) through the plant under different hydraulic loading conditions.

The model was constructed by entering the physical dimensions of each hydraulic element, starting at the receiving water elevation and moving upstream throughout the plant. The physical dimensions were obtained from the record drawings for the facility. A field survey was performed to confirm the elevations of key hydraulic control elements (e.g. weir elevations) and to establish a series of benchmarks at key locations through the facility.

The model was calibrated using the measured water surface levels at key locations under three flow conditions. Table 1 summarizes the flow rates and tanks in service during the three hydraulic surveys. The flow was measured using the existing influent, effluent, and RAS flow meters. The water surface levels were obtained by measuring down to the water surface level from the benchmarks established in the hydraulic survey.

The elevations of the hydraulic control structures were modified based on the survey results, and the hydraulic element minor loss coefficients were adjusted so that the water surface levels predicted by the model corresponded to the measured water surface levels. The calibrated model was then used to determine the hydraulic throughput capacity of each unit process.

TABLE 1
ADAMS FIELD WWTP EVALUATION – HYDRAULIC SURVEY

Date	Time	Flow (mgd)	RAS (mgd)	Basins in Service
January 12	13:00 – 14:30	Influent - 14 to 6 Effluent - 13 to 9	6.9	All
January 13	9:45 – 11:15	Influent - 22 to 4 Effluent - 13 to 9	3.3	1 primary clarifier 1 aeration basin 1 secondary clarifier
January 13	13:00 – 14:15	Influent - 22 to 1 Effluent - 16 to 8	6.9	All

Physical Structures Survey Results

Table 2 presents a summary of the survey results; the detailed level measurements are located in Appendix A. In general, the difference between the surveyed concrete elevations and the record drawings for the facility were less than +/- 0.10 feet. The small difference measured is likely the result of variation in concrete surface finish and slope on walkways and concrete floor slabs to provide surface drainage. Areas where the difference between the surveyed and record drawing elevations is greater than +/- 0.10 feet are discussed below.

TABLE 2
FOURCHE CREEK WWTP EVALUATION – SURVEY RESULTS

Unit Process	Measured Elevation (ft)	Drawing Elevation (ft)	Difference (ft)
Chlorine Contact Chamber			
Top of floor slab	251.48	251.50	– 0.02
Overflow weir	248.81	248.83	– 0.02
Secondary Clarifier			
Top of wall	252.89	253.00	– 0.11
Launder invert	249.02	249.04	– 0.02
Weir	250.70	250.50	+ 0.20
Aeration Basin			
Influent channel – south	252.94	253.00	– 0.06
Influent channel – north	252.93	253.00	– 0.07
Primary Effluent Pump Station			
Wet well	258.07	258.00	+ 0.07
Top of concrete approach channel	252.98	253.00	– 0.02
Top of concrete primary effluent channel	252.62	253.00	– 0.38
Primary Clarifier			
Top of concrete walkway	252.90	253.00	–0.10
Launder invert	250.19	249.16	+ 1.03
Weir	251.67	251.50	+ 0.17
Primary Clarifier Influent Channel			
Top of wall – downstream	253.02	253.00	+ 0.02
Top of wall – at roadway	257.22	257.21	+ 0.01
Parshal flume approach channel invert	252.31	252.27	+ 0.03
Detritor			
Top of grating channel	257.21	257.21	0.00
Screen Chamber	259.23	259.21	+ 0.02
Top of grating effluent channel	257.22	257.21	+ 0.01
Top of grating influent channel			

Secondary Clarifier Weir

The surveyed elevation of the secondary clarifier weir plate was 0.20 feet greater than the elevation presented in the record drawings. The difference between the surveyed and record drawing elevations varied between 0.18 and 0.22 feet, with an average difference of 0.20 feet. The surveyed weir elevations are based on the top-of-weir plate, whereas the record drawing elevations are based on the bottom of V-notch. The depth of V-notch is 3 inches, therefore the surveyed elevation for the bottom of the V-notch is 250.45 feet. The measured survey elevation was used in the calibrated model.

Primary Clarifier Effluent Channel

The surveyed top-of-grating elevation of the primary clarifier effluent channel was 0.38 feet lower than the elevation indicated on the record drawings. This channel was modified during the construction of the primary effluent pump station. The surveyed top of grating elevation was used to determine the maximum hydraulic throughput of the channel section.

Primary Clarifier Launder

The surveyed invert elevation of the primary clarifiers launders was 1.03 feet higher than the elevation indicated on the record drawings. The survey launder invert elevation of 250.19 was used in the calibrated model.

Primary Clarifier Weir

The surveyed elevation of the primary clarifier weir plate was 0.17 feet higher than the elevation indicated in the record drawings. The difference between the surveyed and record drawing elevations varied between 0.16 and 0.19 feet, with an average difference of 0.17 feet. The surveyed weir elevations are based on the top-of-weir plate, whereas the record drawing elevations are based on the bottom of V-notch. The depth of V-notch is 3 inches, therefore the surveyed elevation for the bottom of the V-notch is 251.42 feet. The measured survey elevation was used in the calibrated model.

Model Calibration

Figure 1 presents the influent and effluent flow measured during the three survey periods. The flow varied significantly during all three surveys. This is a result of the on-off operation of the College Sewage Pump Station (SPS).

During Survey 1 the flow measured by the influent flow meter varied from 6 to 14 mgd on a 9-minute cycle during the first 40 minutes of the survey. The flow measured by the effluent flow meter did not vary significantly and averaged approximately 10 mgd over the same time period.

During Survey 2 the flow measured by the influent flow meter varied from 10 to 22 mgd on a 12-minute cycle during the first 35 minutes of the survey. During the remainder of the survey, flow averaged 3 mgd except for a brief low of 4 mgd at 10:35 am and a brief high of 23 mgd at 10:45 am. The flow measured by the effluent flow meter did not vary significantly and averaged 12 mgd.

During Survey 3 the flow measured by the influent flow meter varied from 2 mgd to 23 mgd on an approximate 10-minute cycle. The flow measured by the effluent flow meter also varied, but the variations were less extreme and lagged the influent fluctuations by approximately 6 minutes.

The time difference between the peak flows measured by the influent and effluent meters attenuation of the peak flows measured by the effluent meters is associated with the hydraulic storage within the system. A significant portion of this will likely occur at the primary effluent pump station wet well. Therefore the flow measured by the effluent flow meter is more representative of the flow through the secondary treatment system, and the flow measured by the influent meter is more representative of the flow through preliminary and primary treatment. Table 3 presents a summary of the measured plant flow and flows used to calibrate the model for each survey period.

TABLE 3
FOURCHE CREEK WWTP EVALUATION – SUMMARY OF FLOWS USED FOR MODEL CALIBRATION

Location	Time	Measured Flow (mgd)	Calibration Flow (mgd)
Survey 1			
Chlorine contact chamber	13:10 – 13:20	9.6 – 13.5	9, 11, 13
Secondary clarifiers	13:20 – 13:45	8.9 – 10.6	9, 11, 13
Aeration basin	13:45 – 14:00	10.8 – 12.8	9, 11, 13
Primary clarifiers	14:00 – 14:15	13.2 – 14	13
Headworks	14:15 – 14:20	13.2 - 14	13
Survey 2			
Chlorine contact chamber	9:58 – 10:10	10.8 – 12.5	12
Secondary clarifiers	10:10 – 10:30	11.4 – 12.9	12
Aeration basin	10:30 – 10:45	10.8 – 12.3	12
Primary clarifiers	10:45 – 11:00	10.4 – 21.5	10, 13, 22
Headworks	11:00 – 11:10	11.6 – 13.0	10, 13, 22
Survey 3			
Chlorine contact chamber	13:05 – 13:15	9.3 – 12.2	8, 11, 15
Secondary clarifiers	13:15 – 13:30	8.7 – 10.3	8, 11, 15
Aeration basin	13:30 – 13:40	10.3 – 15.0	8, 11, 15
Primary clarifiers	13:40 – 13:55	1.8 – 21.1	2, 11, 22
Headworks	13:55 – 14:05	2.2 – 21.6	2, 11, 22

Figures 2 through 3 present a comparison of the measured water surface levels obtained during the survey to the water surface levels predicted by the calibrated model for the three surveys conducted. The detailed information used during calibration is presented in Appendix B. Table 4 summarizes the locations of the element sequence numbers used in these figures and in the tables in Appendix B.

In general, there was good agreement between the measured water surface levels and the water surface levels predicted by the model at the flow rates tested. However, the flow rate through the primary treatment system fluctuated significantly during Surveys 2 and 3. In both cases, the measured water surface level was between the minimum and maximum predicted water surface levels for the range of flows measured.

TABLE 4
FOURCHE CREEK WWTP HYDRAULIC EVALUATION – CALIBRATION SEQUENCE NUMBERS

Process	Seq. Number	Description
Chlorine Contact Chamber	1	Downstream end of the contact chamber collection channel
	2	Chlorine contact chamber overflow weir
	3	Water surface level over weir
	4	Upstream end of the chlorine contact chamber
	5	Chlorine contact chamber bypass manhole

	6	Access hatch for the channel at old secondary clarifiers
Secondary Clarifier	7	Secondary clarifier combined collection channel
	8	Secondary clarifier combined collection channel
	9	Collection channel for each clarifier - downstream
	10	Collection channel for each clarifier – upstream
	11	Clarifier launder - downstream
	12	Clarifier launder at midpoint
	13	Clarifier body upstream at center walkway
	14	Clarifier influent channel
Aeration Basin	15	Aeration basin influent channel
Primary Clarifier	16	Primary effluent pump station wet well
	17	Channel to primary effluent pump station - downstream
	18	Primary clarifier combined collection channel - downstream
	19	Primary clarifier combined collection channel – mid-length
	20	Primary clarifier combined collection channel - upstream
	21	Primary clarifier launder at the outfall
	22	Primary clarifier launder at the upstream
	23	Primary clarifier body at influent
	24	Clarifier influent channel
Headworks	25	Channel to primary clarifiers at bend
	26	Channel to primary clarifiers at road
	27	Channel to primary clarifiers upstream of the Parshal flume
	28	Channel to primary clarifiers upstream of the grit chamber
	29	Downstream of the screens
	30	Upstream of the screens

Capacity Evaluation

The calibrated model was used to estimate the hydraulic throughput capacity of the existing facilities at the Fourche Creek WWTP. The predicted water surface level for each unit process was developed based on the assumption that the downstream hydraulic bottlenecks have been resolved. Table 5 summarizes the assumptions used and the capacity analysis for each section of the facility.

TABLE 5
FOURCHE CREEK WWTP HYDRAULIC EVALUATION – SUMMARY OF HYDRAULIC THROUGHPUT CAPACITY

Flow Path	Capacity	Assumptions
Plant outfall	83 mgd	Starting point - the Arkansas River Arkansas River starting elevation – 244 feet Hydraulic exceedance – contact chamber overflow weir flooded
Chlorine contact chamber	50 mgd	Starting point – chlorine contact chamber weir (outfall not flooded) All (3) secondary clarifiers in service Hydraulic exceedance – clarifier effluent weir flooded
Secondary treatment	40 mgd	Starting point – secondary clarifier overflow weir All (3) secondary clarifiers in service All (3) aeration basins in service Return activated sludge flow at 6.9 mgd (current maximum) Hydraulic exceedance – primary effluent pump discharge Metered line between pump station and aeration basin significant hydraulic bottleneck

Primary effluent pump station	45 mgd	Starting point – primary effluent pump station wet well Capacity of pumps not included in evaluation All (2) primary clarifiers in service Hydraulic exceedance – primary clarifier weir flooded Primary clarifier launders significant hydraulic bottleneck
Primary treatment and headworks	55 mgd	Starting point – primary clarifier overflow weir All (2) primary clarifiers in service All (2) screens in service Hydraulic exceedance – overtopping the concrete wall of the channel upstream of the grit chamber Grit chamber significant hydraulic bottleneck

The following sections discuss the capacity evaluation for each unit process in more detail.

Plant Outfall

The hydraulic throughput capacity of the plant outfall is estimated to be 83 mgd with a water surface level in the Arkansas River of 244 ft (maximum water surface level indicated on drawings). The plant outfall model was not calibrated using measured river water surface levels. Therefore, the capacity estimate is based on standard friction coefficients and minor losses for the pipe material, age, and appurtenances in the outfall configuration.

Chlorine Contact Chamber

The hydraulic throughput capacity of the chlorine contact chamber and secondary clarifier collection channel is estimated to be 50 mgd. The hydraulic losses occurred in the full flow pipe between the secondary clarifiers and the chlorine contact chamber. The 72-inch pipe between the secondary clarifiers and the chlorine contact chamber would need to be upgraded (replaced with an 84-inch line or twinned) to accommodate the 60-mgd flow. At 60-mgd flow, the individual collection channels for the secondary clarifiers become a hydraulic bottleneck. Therefore, these collection channels would need to be replaced or additional secondary clarifiers provided.

Secondary Treatment

The hydraulic throughput capacity of the secondary clarifiers and aeration basin is estimated to be 40 mgd. At flow rates greater than 40 mgd, the water surface level in the chamber downstream of the primary effluent pumps exceeds the invert of the pump discharge. Most of the headlosses occur in the full flow pipe between the primary effluent pump station and the aeration basin.

The capacity of the secondary clarifier and aeration basin can be increased to 60 mgd if the hydraulic bottleneck of the full flow pipe (metered line) were reduced. There is a second metered line from the primary effluent pump station to the abandoned RBC facility that could be used to increase the hydraulic throughput capacity of the secondary treatment system. This would require rerouting the existing pipe to the aeration basin influent channel.

Primary Clarifier Collection Channel

The hydraulic throughput capacity of the primary clarifier collection channel is estimated to be 45 mgd. At flow rates greater than 45 mgd, the primary effluent weir is flooded. Most of the hydraulic losses occur in the primary clarifier effluent channel. This channel would need to be increased to 72 inches to accommodate the 60 mgd flow. At 60 mgd flow, the finger launders in the primary clarifier become a hydraulic bottleneck. Therefore the finger launders would need to be replaced or additional primary clarifiers provided.

Primary Clarifiers and Headworks

The hydraulic throughput capacity of the primary clarifiers and headworks is estimated to be 55 mgd. At flow rates greater than 55 mgd the water surface level in the channel upstream of the grit chamber is greater than the top-of-concrete level for the channel wall. Significant hydraulic losses occur at the grit chamber influent and effluent gates. At a flow rate of 60 mgd, the water surface level in the channel between the primary clarifier and roadway will also be overtopped. To accommodate a flow rate of 60 mgd, the channel between the screen chamber and primary clarifiers would need to be upgraded. This upgrade would include increasing the wall height of the channel between the primary clarifiers and the roadway, providing an additional grit chamber, and increasing the wall height of the channel between the grit chamber and the screen channel.

Order of Magnitude Cost Estimate

An order-of-magnitude cost estimate was prepared for the upgrades required to increase the maximum hydraulic treatment capacity of the Fourche Creek WWTP from 38 to 60 mgd. The order-of-magnitude cost estimate will be used to evaluate if upgrading the Fourche Creek facility is a cost-effective method of relieving the hydraulic loading to the Adams Field WWTP during wet-weather-flow conditions. The cost estimates are preliminary and should be used for comparison purposes only.

The upgrade includes work required in the collection system to transport the additional flow to the Fourche Creek facility and the work required at Fourche Creek to treat the additional flow. Table 6 summarizes required upgrades and estimated capital costs. The basis of design and capital cost worksheets are located in Appendix C.

Collection System Upgrades

The Fourche Creek collection system consists of a 42-inch force main from the Arch Street to the College Station Sewage Pump Station (SPS) and a 42-inch force main from College Station SPS to the Fourche Creek WWTP. The current peak hydraulic capacity of the two force mains and associated pumping stations is 38 mgd.

The work required to increase the peak hydraulic capacity of the collection system includes

- providing a new 30-inch force main to operate in parallel with the existing 42-inch force main
- providing three new pumps complete with VSD
- replacing the existing screens at the Arch Street SPS
- modifying the College Station SPS to pump contributory flow into the new pump station

The order-of-magnitude cost for performing this work is approximately $12,600,000.

Fourche Creek WWTP Upgrades

Preliminary treatment at the Fourche Creek WWTP consists of two mechanically cleaned bar racks and a centrifugal grit removal system. The existing bar screens are in poor condition and should be replaced in the near future. The work required to increase the hydraulic capacity of the preliminary treatment system includes:

- Provide three new mechanical screens
- Provide additional grit removal tank
- Provide grit washing system

The Fourche Creek WWTP has two primary treatment tanks equipped with traveling bridge sludge removal mechanisms. The sludge removal system requires a lot of maintenance to keep in service and should be replaced in the near future. An additional primary clarifier is required to increase the hydraulic capacity of the primary treatment system. One of the abandoned RBC secondary clarifiers could be brought back into service as a primary clarifier. The work required to upgrade the primary treatment system includes:

- Provide a diversion pipe to the RBC secondary clarifier
- Modify clarifiers to accommodate new sludge removal mechanisms
- Replace the traveling bridge sludge removal mechanism with chain and flight (three passes per tank)
- Upgrade existing primary sludge pump stations

The Fourche Creek WWTP has two Archimedes' screw primary effluent pumps with a rated capacity of 50 mgd each. A third primary effluent pump would be required to provide a firm capacity (one pump out of service) of 60 mgd for the facility. The primary effluent flow meter and associated piping is a significant hydraulic bottleneck. An additional meter would be required under high-flow conditions. The abandoned RBC flow meter and meter chamber could be brought into service. The work required to upgrade the primary effluent pump station includes:

- Provide a new primary effluent pump
- Modify the RBC flow meter piping

The secondary treatment system consists of three (3) four-pass step feed aeration basins followed by three (3) two-bay rectangular secondary clarifiers with a chain and flight and a central hopper sludge removal system. Two additional aeration basins and secondary clarifiers are required to increase the hydraulic capacity of the secondary treatment system to 60 mgd. The existing blowers and blower building are sufficient to meet the air requirements of the additional aeration basins. The work required to upgrade the secondary treatment system includes:

- Provide two new aeration basins and associated aeration equipment
- Provide two new secondary clarifiers and associated sludge removal mechanisms
- Extend pipe gallery to accommodate the new aeration basins and clarifiers
- Provide four additional RAS/WAS pumps

The order-of-magnitude cost for performing this work is approximately $23,400,000.

TABLE 6
FOURCHE CREEK WWTP – CAPITAL UPGRADES REQUIRED TO INCREASE CAPACITY TO 60 MGD

Process	Upgrades	Cost ($000)
Force main	30" force main L = 41,500'	$9,716
Arch Street SPS	3 new pumps VSD 1 screen	$2,922
Fourche Creek	3 screens 1 grit tank and washer modify existing clarifier structure replace primary clarifier mechanisms replace primary sludge pump station 1 primary effluent pump 2 aeration basins 2 secondary clarifiers misc. piping modifications and site work	$23,422
Total		$36,065

Figures

Figure 1a: Fourche Creek WWTP - Influent and Effluent Flow during Survey 1
January 12, 1999 - 13:00 to 14:30

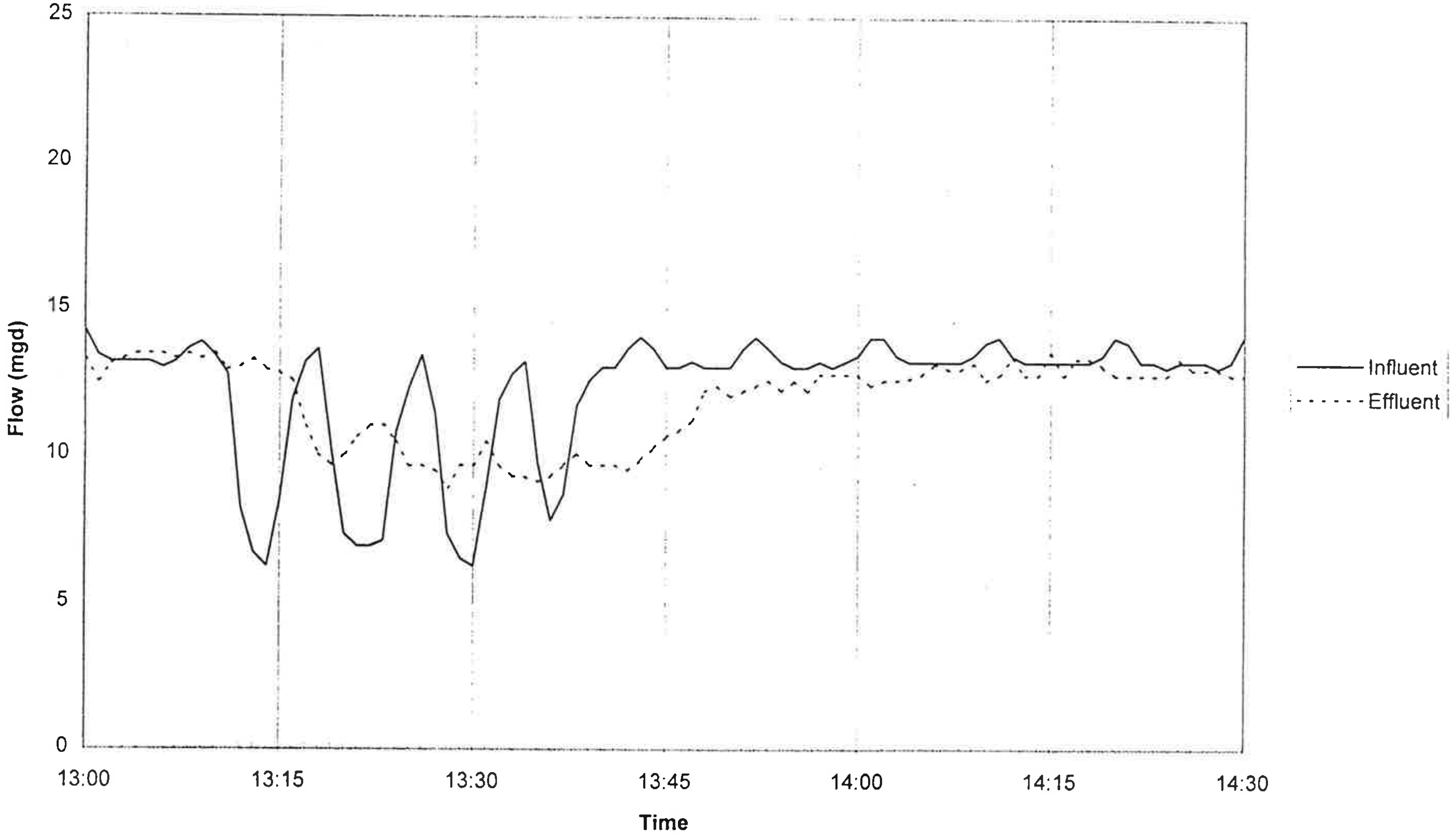

Figure 1b: Fourche Creek WWTP - Influent and Effluent Flow during Survey 2
January 13, 1999 - 9:45 to 11:15

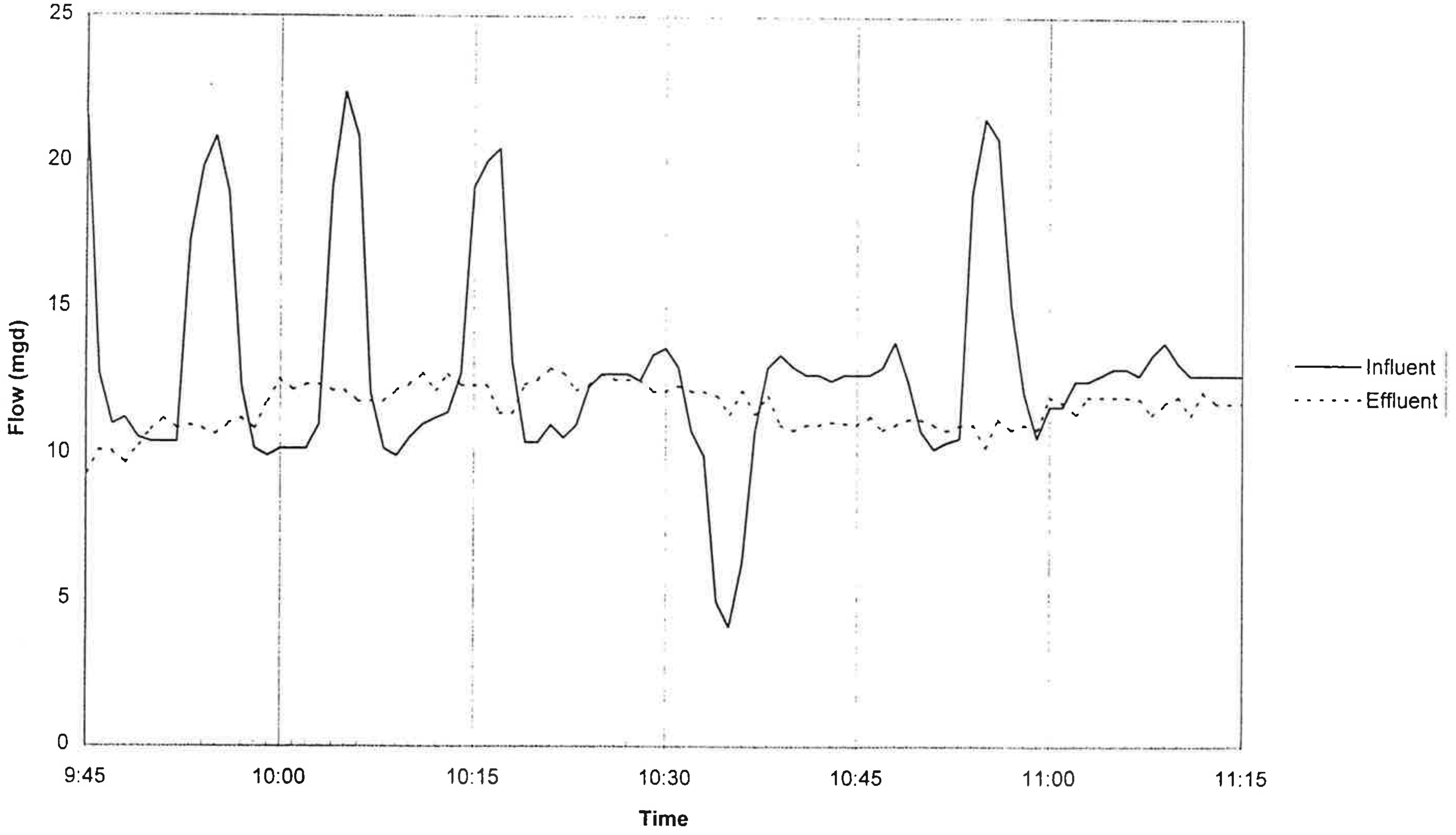

Figure 1c: Fourche Creek WWTP - Influent and Effluent Flow during Survey 3
January 13, 1999 - 13:00 to 14:15

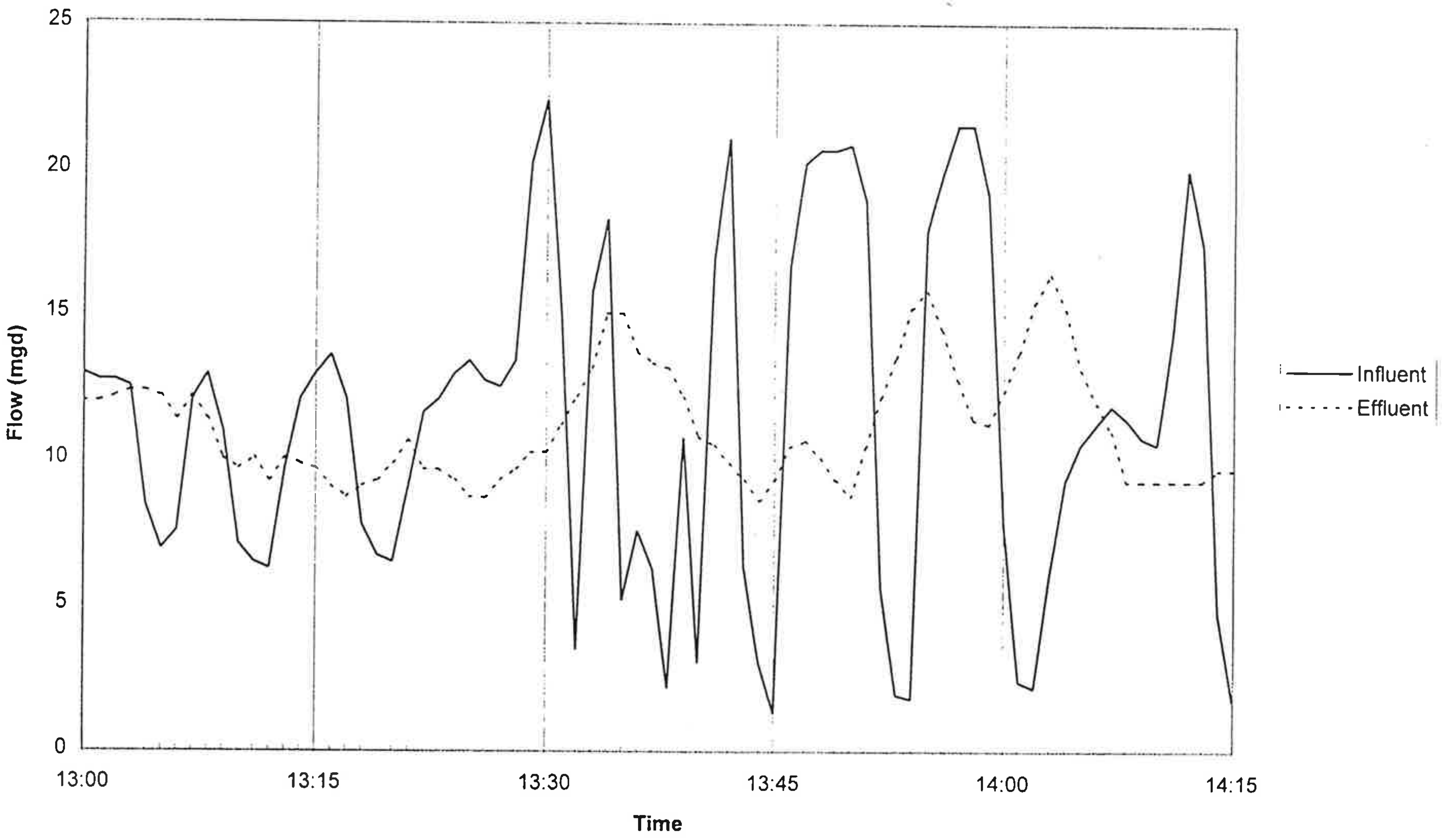

Figure 2a: Fourche Creek WWTP - Calibration of Secondary Treatment
Survey 1 - January 12, 1999 from 13:10 to 14:25

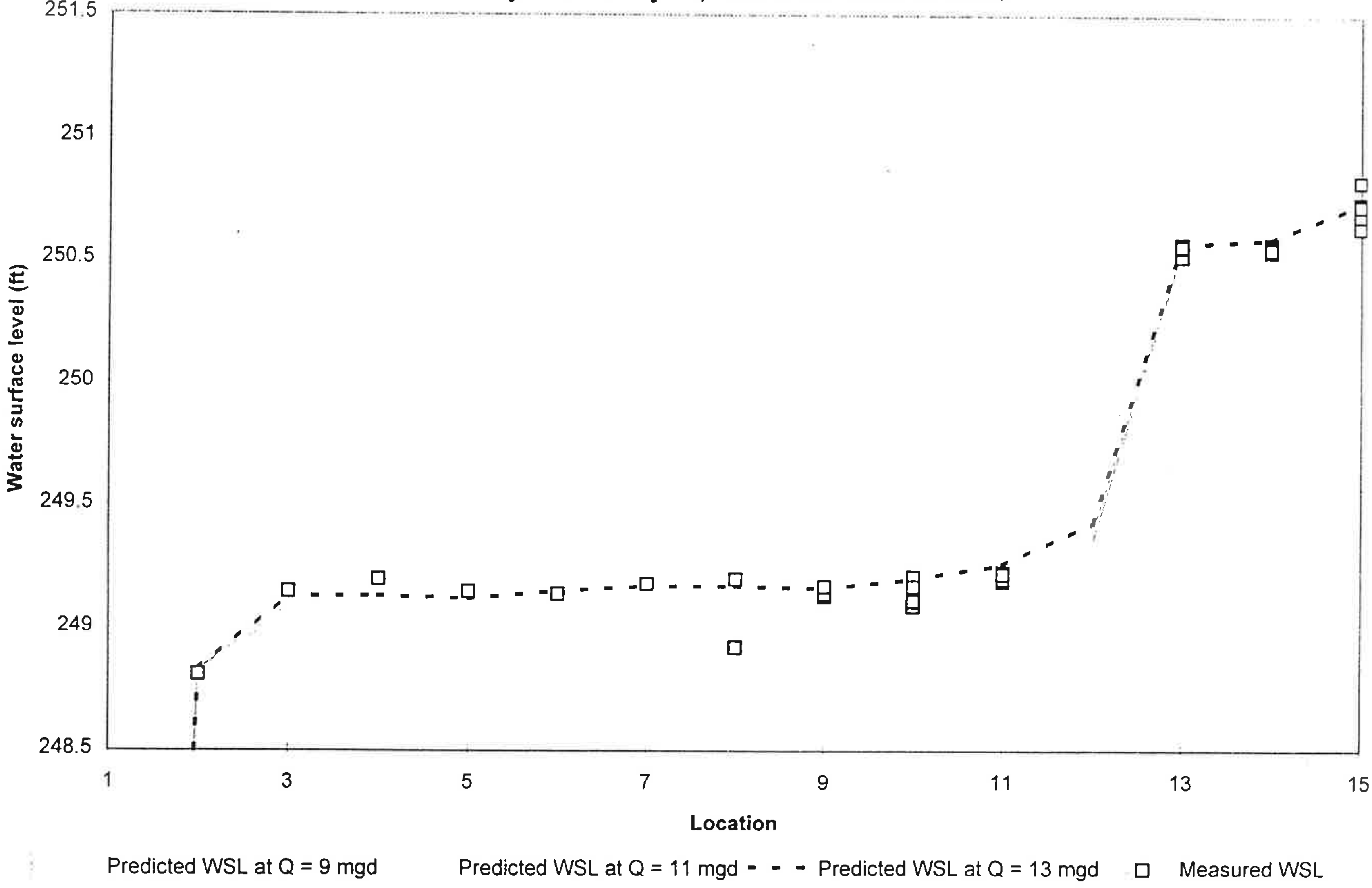

Chart - Survey 1 cal
Survey elevations.XLS

2/12/99
11:51 AM

Figure 2b: Fourche Creek WWTP Calibration of Secondary Treatment
Survey 2 - January 13, 1999 from 9:58 to 11:07

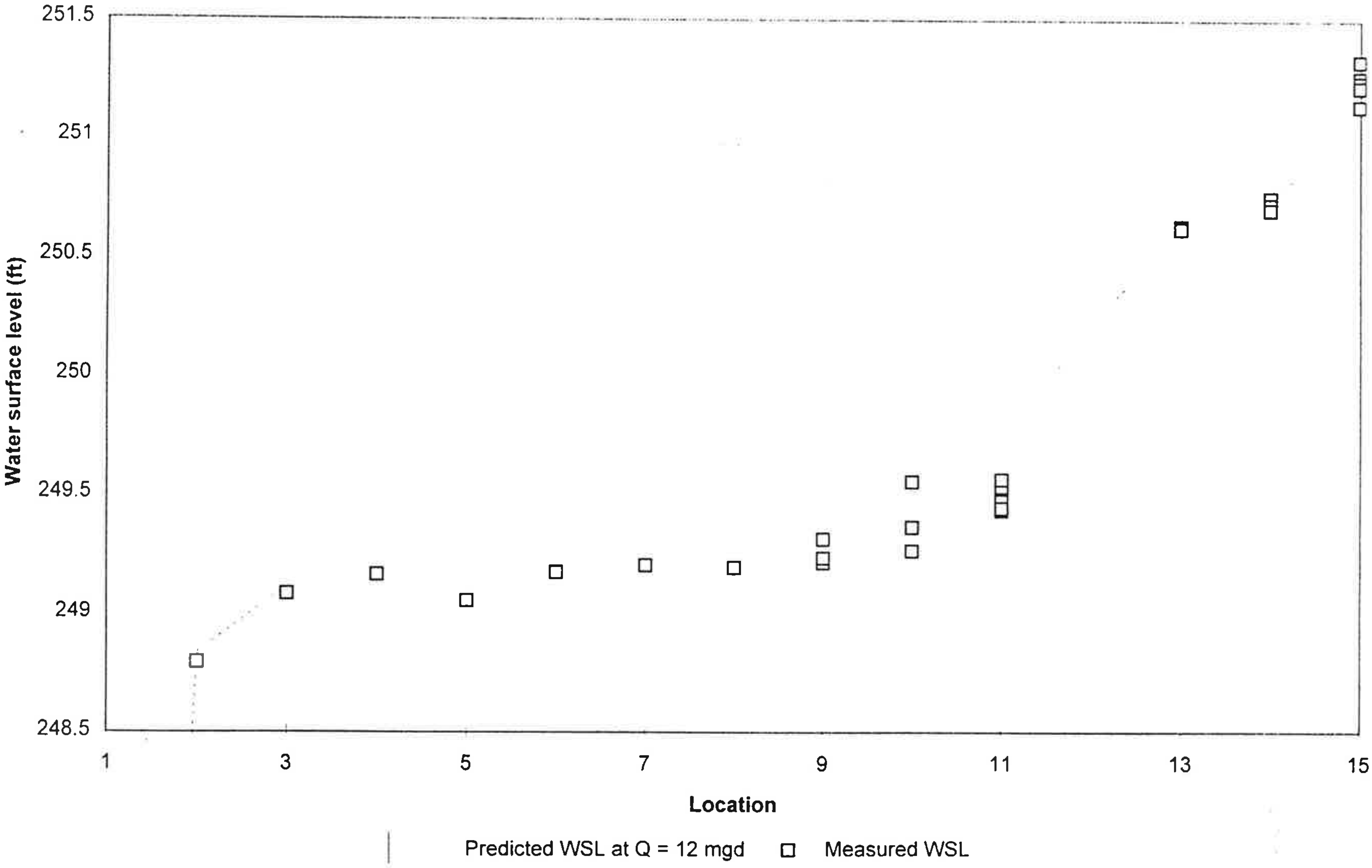

Chart - Survey 2 cal
Survey elevations.XLS

2/12/99
11:52 AM

Figure 2c: Fourche Creek WWTP - Calibration of Secondary Treatment
Survey 3 - January 13, 1999 from 13:08 to 14:06

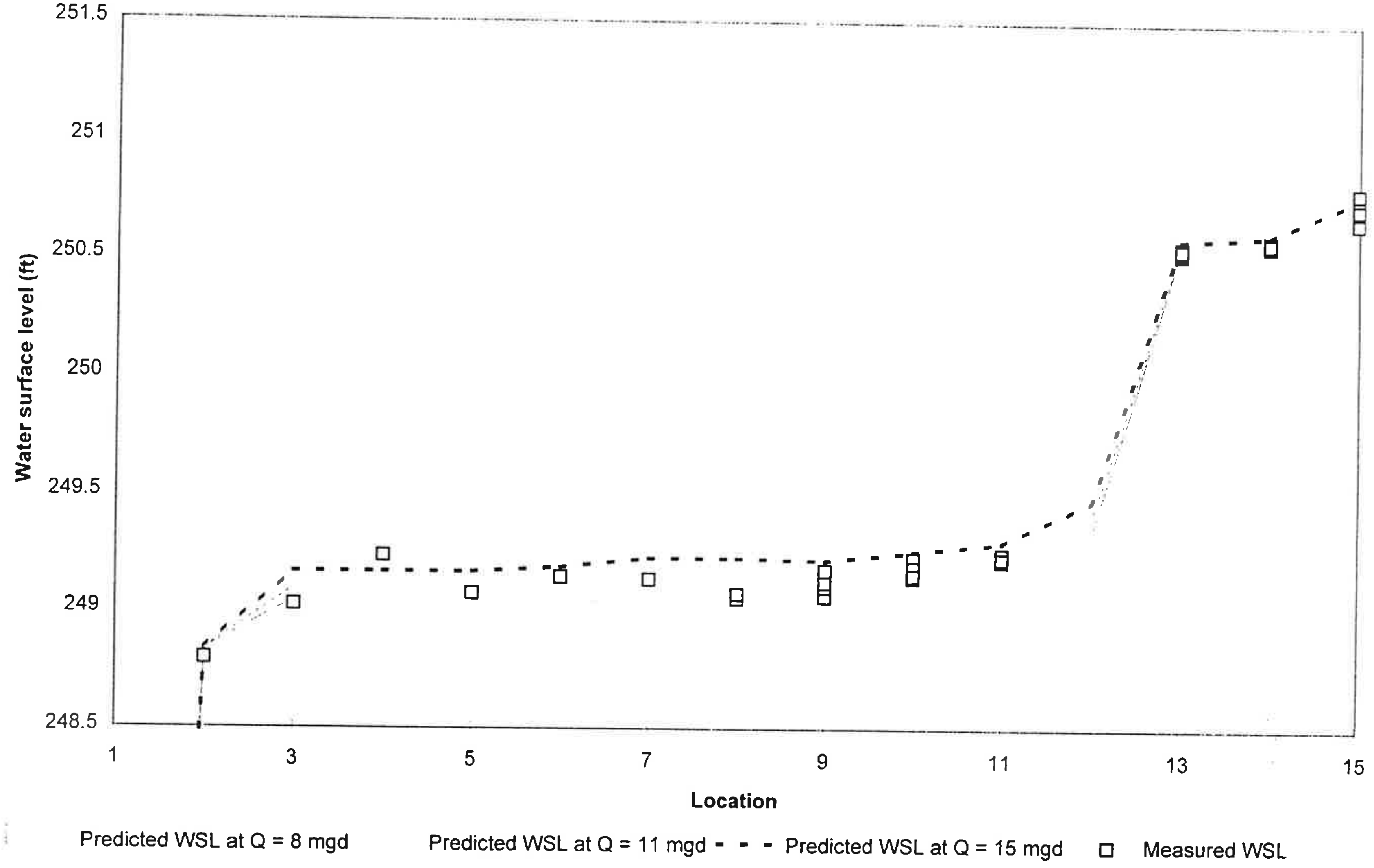

Chart - Survey 3 cal
Survey elevations.XLS

2/12/99
11:52 AM

Figure 3a: Fourche Creek WWTP - Calibration of Primary Treatment
Survey 1 - January 12, 1999 from 13:10 to 14:25

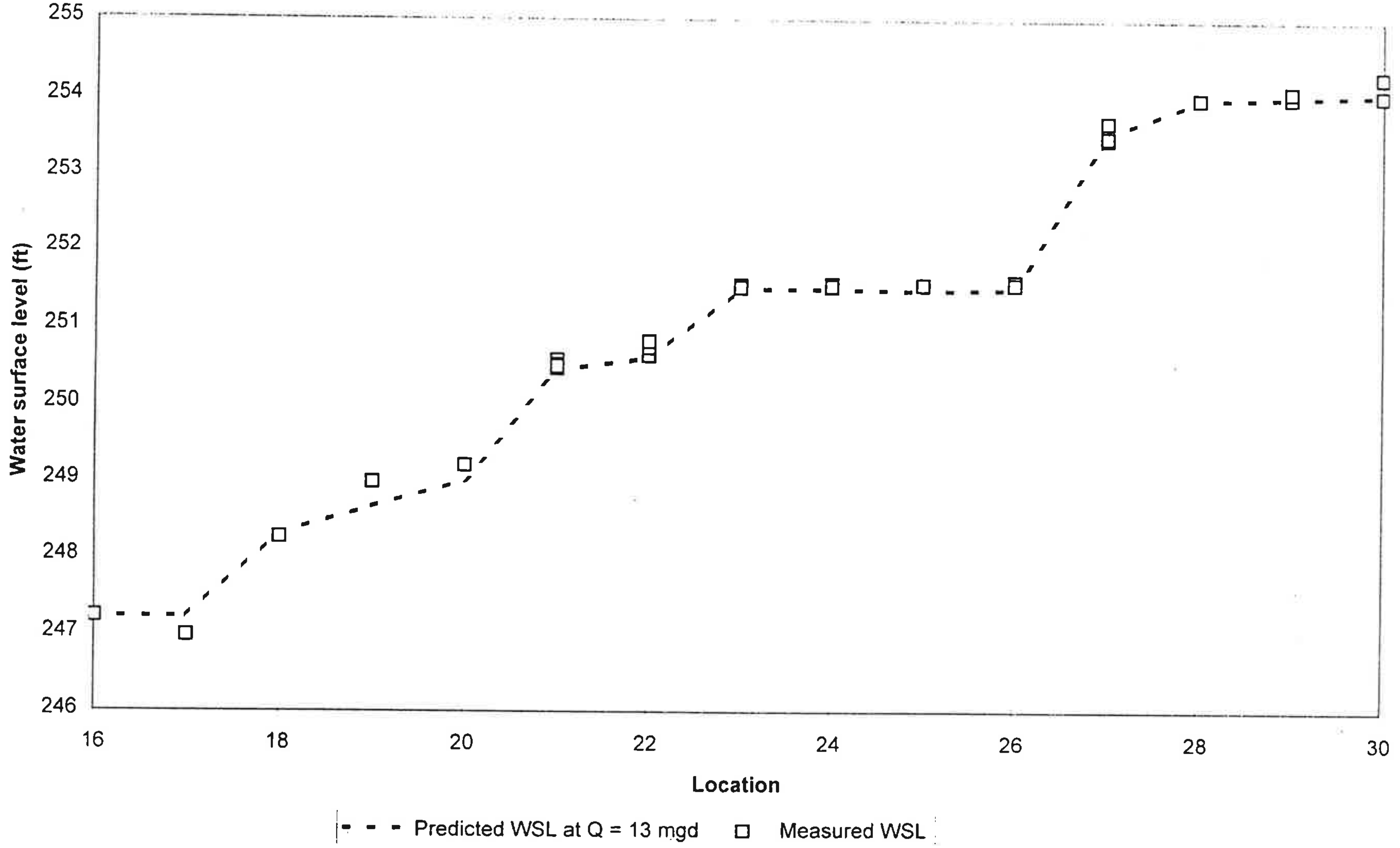

Chart - Survey 1 cal (2)
Survey elevations.XLS

2/12/99
2:58 PM

Figure 3b: Fourche Creek WWTP - Calibration of Primary Treatment
Survey 2 - January 13, 1999 from 9:58 to 11:07

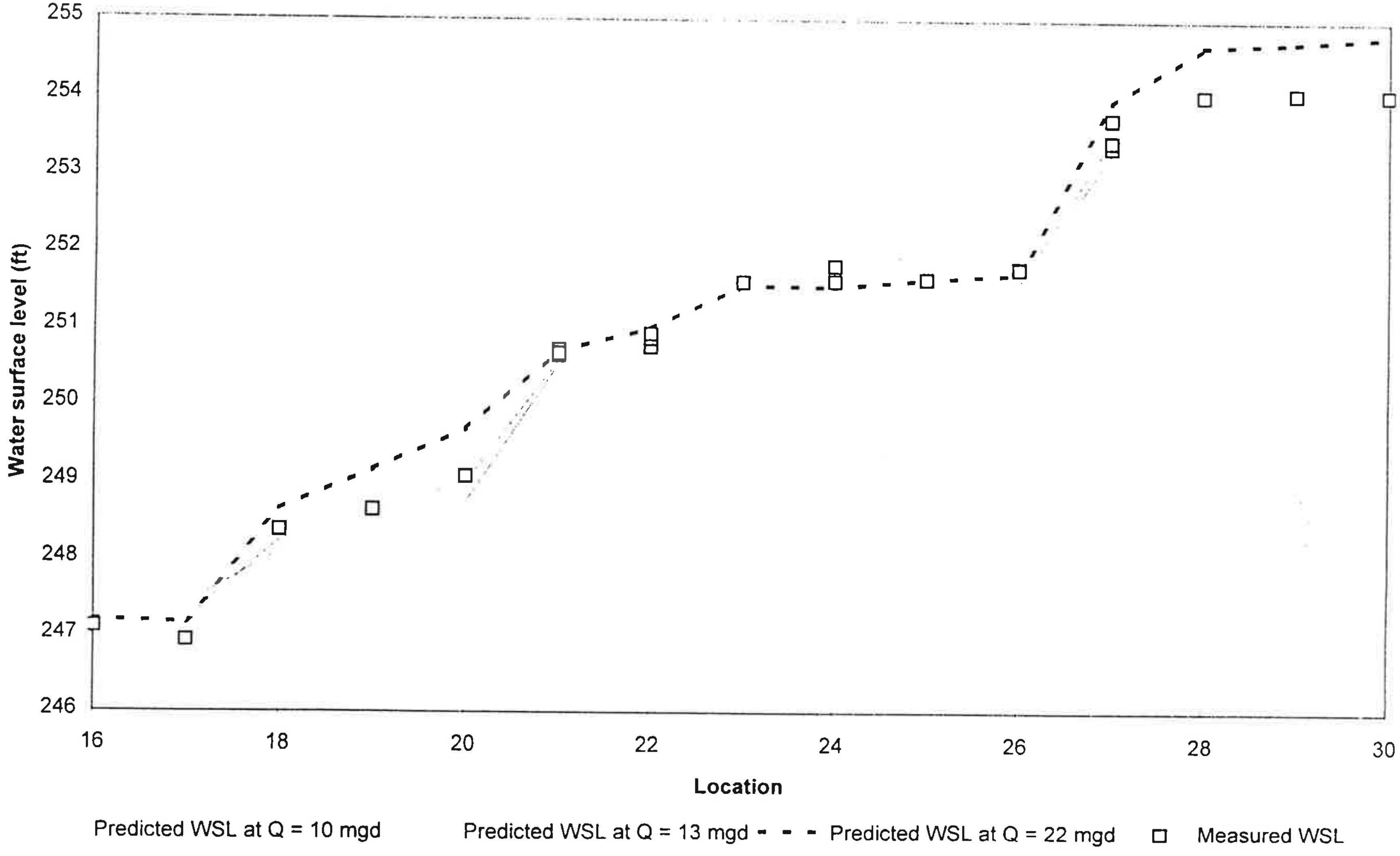

Chart - Survey 2 cal (2)
Survey elevations.XLS

2/12/99
3:02 PM

Figure 3c: Fourche Creek WWTP - Calibration of Primary Treatment
Survey 3 - January 13, 1999 from 13:08 to 14:06

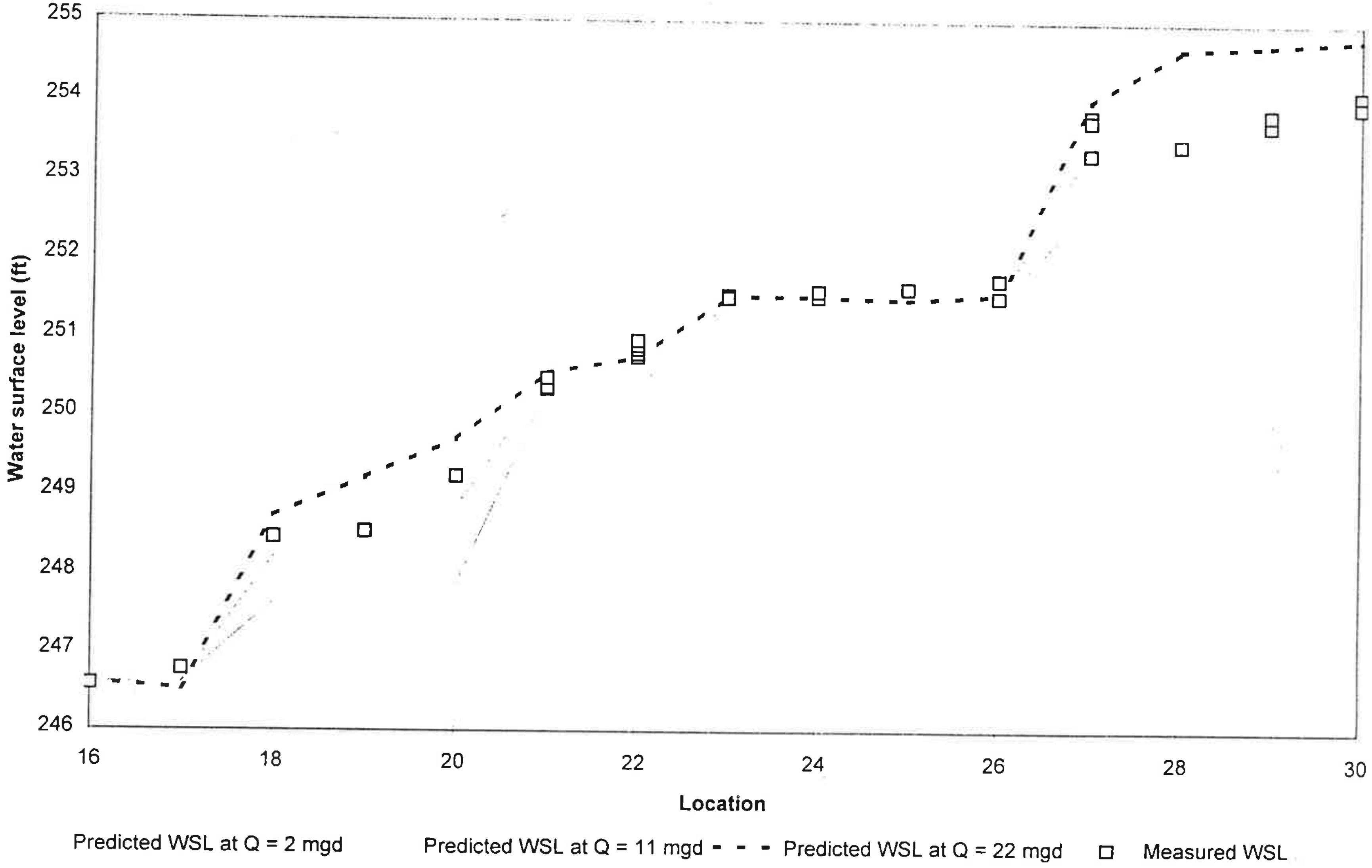

Chart - Survey 3 cal (2)
Survey elevations.XLS

2/12/99
3:05 PM

APPENDIX A

HYDRAULIC MODEL CALIBRATION

Fourche Creek WWTP
Hydraulic Model Calibration
Survey Locations

Location Number	Location	Measured Elevation	Design Elevation	Difference in Elevation
	OUTFALL			
1	Not used		252.75	
2	Not Used		234.82	
	CHLORINE BUILDING			
3	chlorine contact chamber outfall channel hatch (inside building)	251.473	251.5	-0.027
4	chlorine contact chamber weir elevation	248.81	248.83	-0.02
7	chlorine contact chamber inlet channel hatch (inside building)	251.458	251.5	-0.042
8	chlorine bypass manhole	254.986	255	-0.014
	OLD PLANT - SECONDARY CLARIFIERS			
9	makeup water pump chamber floor slab	251.843	251.85	-0.007
10	makeup water pump access hatch 1	252.168	252.18	-0.012
	NEW PLANT - SECONDARY CLARIFIERS			
107	Clarifier effluent channel Hatch A - TOC	252.968	253	-0.032
108	Clarifier effluent channel top of grating Hatch A	252.968	253	-0.032
110	Clarifier effluent channel top of grating Hatch C	252.908	253	-0.092
111	Clarifier effluent channel Hatch D - TOC	252.948	253	-0.052
112	Clarifier effluent channel top of grating Hatch D	252.948	253	-0.052
113	Clarifier collection channel 1 - TOC downstream	252.878	253	-0.122
115	Clarifier collection channel 1 - TOC upstream	252.898	253	-0.102
116	Clarifier collection channel 2 - TOC downstream	252.853	253	-0.147
118	Clarifier collection channel 2 - TOC upstream	252.888	253	-0.112
119	Clarifier collection channel 3 - TOC downstream	252.848	253	-0.152
121	Clarifier collection channel 3 - TOC upstream	252.868	253	-0.132
122	Clarifier collection channel 5 - TOC downstream	252.848	253	-0.152
124	Clarifier collection channel 5 - TOC upstream	252.883	253	-0.117
125	Clarifier collection channel 7 - TOC downstream	252.848	253	-0.152
127	Clarifier collection channel 7 - TOC upstream	252.868	253	-0.132
128	Clarifier 1 launder - TOC on walkway point A	252.888	253	-0.112
129	Clarifier 1 launder bottom at point A	249.018	249.04	-0.022
130	Clarifier 1 weir at point A	250.688	250.5	0.188
131	Clarifier 1 weir at point A	250.688	250.5	0.188
132	Clarifier 1 launder - TOC on walkway point B	252.878	253	-0.122

Location Number	Location	Measured Elevation	Design Elevation	Difference In Elevation
133	Clarifier 1 launder bottom at point B	249.048	249.04	0.008
134	Clarifier 1 weir at point B	250.718	250.5	0.218
135	Clarifier 1 weir at point B	250.713	250.5	0.213
136	Clarifier 1 launder - TOC on walkway point C	252.868	253	-0.132
137	Clarifier 1 launder bottom at point C	249.008	249.04	-0.032
138	Clarifier 1 weir at point C	250.698	250.5	0.198
139	Clarifier 1 weir at point C	250.698	250.5	0.198
140	Clarifier 1 launder - TOC on walkway point D	252.898	253	-0.102
141	Clarifier 1 launder bottom at point D	249.013	249.04	-0.027
142	Clarifier 1 weir at point D	250.703	250.5	0.203
143	Clarifier 1 weir at point D	250.708	250.5	0.208
144	Clarifier 1 launder - TOC on walkway point E	252.848	253	-0.152
145	Clarifier 1 launder bottom at point E	249.028	249.04	-0.012
146	Clarifier 1 weir at point E	250.698	250.5	0.198
147	Clarifier 1 weir at point E	250.703	250.5	0.203
148	Clarifier 1 launder - TOC on walkway point F	252.828	253	-0.172
149	Clarifier 1 launder bottom at point F	248.998	249.04	-0.042
150	Clarifier 1 weir at point F	250.713	250.5	0.213
151	Clarifier 1 weir at point F	250.708	250.5	0.208
152	Clarifier 1 center walkway channel 1	252.87	253	-0.13
153	Clarifier 1 center walkway channel 2	252.878	253	-0.122
154	Clarifier 2 center walkway channel 1	252.883	253	-0.117
155	Clarifier 2 center walkway channel 2	252.843	253	-0.157
156	Clarifier 3 center walkway channel 1	252.856	253	-0.144
157	Clarifier 3 center walkway channel 2	252.82	253	-0.18
77	Clarifier 1 influent channel west TOC	252.918	253	-0.082
78	Clarifier 1 influent channel east TOC	252.958	253	-0.042
80	Clarifier 3 influent channel west TOC	252.928	253	-0.072
81	Clarifier 3 influent channel east TOC	252.908	253	-0.092
	AERATION BASINS			
158	South influent channel downstream - TOC	252.958	253	-0.042
159	South influent channel corner - TOC	252.968	253	-0.032

Fourche Creek WWTP

Hydraulic Model Calibration

Survey Locations

Location Number	Location	Measured Elevation	Design Elevation	Difference In Elevation
160	South influent channel combined - TOC	252.908	253	-0.092
161	North influent channel downstream - TOC	252.958	253	-0.042
162	North influent channel corner - TOC	252.913	253	-0.087
163	North influent channel combined - TOC	252.928	253	-0.072
	PRIMARY EFFLUENT PUMP STATION			
164	Pump station influent wet well TOC	258.07	258	0.07
165	Pump station influent channel at wet well TOC	252.983	253	-0.017
166	Join with primary tank effluent channel	252.568	253	-0.432
	PRIMARY CLARIFIERS			
168	Clarifier effluent channel center	252.598	253	-0.402
169	Clarifier effluent channel west	252.633	253	-0.367
170	Clarifier 1 - finger launder downstream	250.208	249.16	1.048
171	Clarifier 1 - finger launder downstream	250.198	249.16	1.038
172	Clarifier 1 - finger launder downstream	250.186	249.16	1.026
173	Clarifier 1 - finger launder downstream	250.188	249.16	1.028
174	Clarifier 1 - finger launder downstream	250.18	249.16	1.02
175	Clarifier 1 - finger launder downstream TOC at walkway	252.918	253	-0.082
176	Clarifier 1 - finger launder downstream TOC at walkway	252.928	253	-0.072
177	Clarifier 1 - finger launder downstream TOC at walkway	252.918	253	-0.082
178	Clarifier 1 - finger launder downstream TOC at walkway	252.913	253	-0.087
179	Clarifier 1 - finger launder downstream TOC at walkway	252.918	253	-0.082
180	Clarifier 1 - finger launder upstream	250.188	249.16	1.028
181	Clarifier 1 - finger launder upstream	250.188	249.16	1.028
182	Clarifier 1 - finger launder upstream	250.188	249.16	1.028
183	Clarifier 1 - finger launder upstream	250.188	249.16	1.028
184	Clarifier 1 - finger launder upstream	250.188	249.16	1.028
185	Clarifier 1 - finger launder upstream TOC at walkway	252.908	253	-0.092
186	Clarifier 1 - finger launder upstream TOC at walkway	252.888	253	-0.112
187	Clarifier 1 - finger launder upstream TOC at walkway	252.878	253	-0.122
188	Clarifier 1 - finger launder upstream TOC at walkway	252.888	253	-0.112
189	Clarifier 1 - finger launder upstream TOC at walkway	252.908	253	-0.092
211	Clarifier 1 Weir elevation	251.688	251.5	0.188

Fourche Creek WWTP
Hydraulic Model Calibration
Survey Locations

Location Number	Location	Measured Elevation	Design Elevation	Difference in Elevation
212	Clarifier 1 Weir elevation	251.688	251.5	0.188
213	Clarifier 1 Weir elevation	251.683	251.5	0.183
214	Clarifier 1 Weir elevation	251.678	251.5	0.178
215	Clarifier 1 Weir elevation	251.678	251.5	0.178
216	Clarifier 1 Weir elevation	251.693	251.5	0.193
217	Clarifier 1 Weir elevation	251.688	251.5	0.188
218	Clarifier 1 Weir elevation	251.688	251.5	0.188
219	Clarifier 1 Weir elevation	251.678	251.5	0.178
220	Clarifier 1 Weir elevation	251.678	251.5	0.178
221	Clarifier 2 Weir elevation	251.671	251.5	0.171
222	Clarifier 2 Weir elevation	251.658	251.5	0.158
223	Clarifier 2 Weir elevation	251.658	251.5	0.158
224	Clarifier 2 Weir elevation	251.658	251.5	0.158
225	Clarifier 2 Weir elevation	251.666	251.5	0.166
226	Clarifier 2 Weir elevation	251.678	251.5	0.178
227	Clarifier 2 Weir elevation	251.669	251.5	0.169
228	Clarifier 2 Weir elevation	251.678	251.5	0.178
229	Clarifier 2 Weir elevation	251.668	251.5	0.168
230	Clarifier 2 Weir elevation	251.678	251.5	0.178
231	Clarifier 1 influent channel west TOC	252.986	253	-0.014
232	Clarifier 1 influent channel east TOC	252.978	253	-0.022
233	Clarifier 1 water surface level TOC	252.986	253	-0.014
234	Clarifier 2 influent channel west TOC	252.998	253	-0.002
235	Clarifier 2 influent channel east TOC	252.968	253	-0.032
236	Clarifier 2 water surface level TOC	252.958	253	-0.042
	GRIT TANKS AND SCREENING			
237	Combined primary influent channel at corner TOC	253.018	253	0.018
238	Combined primary influent channel at roadway east TOC	254.018	254	0.018
239	Combined primary inffluent channel at roadway west TOC	257.218	257.21	0.008
242	Parshal flume approach section - invert	252.313	252.27	0.043
243	Parshal flume middle of approach section - TOC	257.238	257.21	0.028
244	Parshal flume start of approach section - TOC	257.253	257.21	0.043

Fourche Creek WWTP

Hydraulic Model Calibration

Survey Locations

Location Number	Location	Measured Elevation	Design Elevation	Difference in Elevation
245	Grit chamber effluent	257.203	257.21	-0.007
246	Grit chamber influent	257.218	257.21	0.008
247	Screen chamber effluent channel east TOC	259.208	259.21	-0.002
248	Screen chamber effluent channel west TOC	259.238	259.21	0.028
249	Screen chamber influent channel east TOC	257.208	257.21	-0.002
250	Screen chamber influent channel west TOC	257.233	257.21	0.023

APPENDIX B

CALIBRATION RESULTS

Calibration Results
Survey 1 - all basins in service

	WSL Predicted by Model (ft)			Measured WSL (ft)	
Location	Q = 9 mgd	Q = 11 mgd	Q = 13 mgd	Point	Average
1 CCC outfall hatch	240.53	240.71	240.87	240.598	
2 CCC weir	248.83	248.83	248.83	248.81	
3 CCC weir - water level	249.06	249.09	249.13	249.15	
4 CCC inlet hatch	249.06	249.1	249.13	249.2	
5 CCC bypass manhole	249.07	249.1	249.12	249.15	
6 Old SC effluent channel	249.07	249.12	249.15	249.14	
7 SC effluent combined channel - dn	249.08	249.13	249.17	249.18	
8 SC effluent combined channel - mid	249.08	249.13	249.17	249.2	249.06
8	249.08	249.13	249.17	248.92	
9 SC collection channel - dn	249.08	249.12	249.16	249.13	249.15
9	249.08	249.12	249.16	249.14	
9	249.08	249.12	249.16	249.17	
10 SC collection channel - up	249.1	249.15	249.2	249.09	249.15
10	249.1	249.15	249.2	249.21	
10	249.1	249.15	249.2	249.16	
10	249.1	249.15	249.2	249.17	
10	249.1	249.15	249.2	249.11	
11 SC launder - dn	249.22	249.24	249.26	249.19	249.21
11	249.22	249.24	249.26	249.23	
11	249.22	249.24	249.26	249.22	
11	249.22	249.24	249.26	249.22	
11	249.22	249.24	249.26	249.2	
11	249.22	249.24	249.26	249.22	
12 SC launder - up	249.35	249.39	249.43		
13 SC body	250.55	250.56	250.57	250.57	250.55
13	250.55	250.56	250.57	250.53	
13	250.55	250.56	250.57	250.55	
13	250.55	250.56	250.57	250.55	
13	250.55	250.56	250.57	250.52	
13	250.55	250.56	250.57	250.56	
14 SC influent channel	250.57	250.58	250.59	250.57	250.56
14	250.57	250.58	250.59	250.56	
14	250.57	250.58	250.59	250.54	
14	250.57	250.58	250.59	250.55	
15 AB influent channel	250.7	250.72	250.74	250.67	250.72
15	250.7	250.72	250.74	250.68	
15	250.7	250.72	250.74	250.74	
15	250.7	250.72	250.74	250.73	
15	250.7	250.72	250.74	250.83	
15	250.7	250.72	250.74	250.64	

Calibration Results
Survey 1 - all basins in service

Location	WSL Predicted by Model (ft) Q = 13 mgd	Measured WSL (ft) Point	Average
16 Primary PS influent wet well	247.22	247.22	
17 Primary PS influent channel	247.21	246.98	
18 Primary clarifier effluent channel - dn	248.3	248.26	
19 Primary clarifier effluent channel - mid	248.645	248.98	
20 Primary clarifier effluent channel - up	248.99	249.2	
21 Primary clarifier launder - dn	250.45	250.58	250.51
21	250.45	250.52	
21	250.45	250.47	
21	250.45	250.47	
21	250.45	250.5	
22 Primary clarifier launder - up	250.6	250.66	250.70
22	250.6	250.64	
22	250.6	250.64	
22	250.6	250.74	
22	250.6	250.82	
23 Primary clarifier body	251.5	251.55	251.54
23	251.5	251.52	
24 Primary clarifier influent channel	251.5	251.53	251.55
24	251.5	251.57	
24	251.5	251.54	
24	251.5	251.54	
25 Combined clarifier influent channel	251.48	251.56	
26 Combined influent channel at road	251.5	251.6	251.58
26	251.5	251.56	
27 Parshal flume approach channel	253.53	253.47	253.56
27	253.53	253.5	
27	253.53	253.7	
28 Grit chamber influent	254	254.01	
29 Screens - dn	254.03	254.03	254.07
29	254.03	254.1	
30 Screens - up	254.07	254.06	254.18
30	254.07	254.3	

Calibration Results

Survey 2 - 1 Secondary Clarifier, 1 Aeration Basin, 1 Primary Clarifier in service

	WSL Predicted by Model (ft)	Measured WSL (ft)	
Location	Q = 12 mgd	Point	Average
1 CCC outfall hatch	240.79	240.81	
2 CCC weir	248.83	248.79	
3 CCC weir - water level	249.11	249.08	
4 CCC inlet hatch	249.11	249.16	
5 CCC bypass manhole	249.12	249.05	
6 Old SC effluent channel	249.13	249.17	
7 SC effluent combined channel - dn	249.15	249.2	
8 SC effluent combined channel - mid	249.15	249.19	
9 SC collection channel - dn	249.14	249.21	249.25
9	249.14	249.31	
9	249.14	249.23	
10 SC collection channel - up	249.35	249.26	249.39
10	249.35	249.55	
10	249.35	249.36	
11 SC launder - dn	249.72	249.46	249.48
11	249.72	249.43	
11	249.72	249.53	
11	249.72	249.56	
11	249.72	249.47	
11	249.72	249.44	
12 SC launder - up	250.22		
13 SC body	250.63	250.63	250.63
13	250.63	250.62	
14 SC influent channel	250.72	250.75	250.72
14	250.72	250.71	
14	250.72	250.72	
14	250.72	250.7	
15 AB influent channel	251.15	251.25	251.24
15	251.15	251.26	
15	251.15	251.24	
15	251.15	251.22	
15	251.15	251.33	
15	251.15	251.14	

Calibration Results

Survey 2 - 1 Secondary Clarifier, 1 Aeration Basin, 1 Primary Clarifier in service

	WSL Predicted by Model (ft)			Measured WSL (ft)	
Location	Q = 10 mgd	Q = 13 mgd	Q = 22 mgd	Point	Average
16 Primary PS influent wet well	247.4	247.2	247.2	247.11	
17 Primary PS influent channel	247.4	247.19	247.16	246.93	
18 Primary clarifier effluent channel - dn	248.1	248.25	248.64	248.38	
19 Primary clarifier effluent channel - mid	248.415	248.62	249.155	248.64	
20 Primary clarifier effluent channel - up	248.73	248.99	249.67	249.07	
21 Primary clarifier launder - dn	250.52	250.56	250.68	250.65	250.66
21	250.52	250.56	250.68	250.7	
21	250.52	250.56	250.68	250.63	
21	250.52	250.56	250.68	250.66	
21	250.52	250.56	250.68	250.65	
22 Primary clarifier launder - up	250.7	250.78	250.98	250.78	250.80
22	250.7	250.78	250.98	250.74	
22	250.7	250.78	250.98	250.74	
22	250.7	250.78	250.98	250.85	
22	250.7	250.78	250.98	250.91	
23 Primary clarifier body	251.51	251.52	251.54	251.59	251.70
24 Primary clarifier influent channel	251.51	251.57	251.52	251.8	251.70
24	251.51	251.57	251.52	251.6	
25 Combined clarifier influent channel	251.53	251.55	251.62	251.63	
26 Combined influent channel at road	251.54	251.57	251.69	251.77	251.77
26	251.54	251.57	251.69	251.76	
27 Parshal flume approach channel	253.28	253.48	253.95	253.36	253.50
27	253.28	253.48	253.95	253.43	
27	253.28	253.48	253.95	253.72	
28 Grit chamber influent	253.75	254	254.68	254.04	
29 Screens - dn	253.76	254.03	254.74	254.07	254.07
29	253.76	254.03	254.74	254.07	
30 Screens - up	253.8	254.07	254.82	254.06	254.15
30	253.8	254.07	254.82	254.23	

Calibration Results
Survey 3 - all basins in service

	WSL Predicted by Model (ft)			Measured WSL (ft)	
Location	Q = 8 mgd	Q = 11 mgd	Q = 15 mgd	Point	Average
1 CCC outfall hatch	239.43	240.71	241.02	240.64	
2 CCC weir	248.83	248.83	248.83	248.79	
3 CCC weir - water level	249.04	249.09	249.16	249.02	
4 CCC inlet hatch	249.04	249.1	249.16	249.23	
5 CCC bypass manhole	249.05	249.1	249.16	249.07	
6 Old SC effluent channel	249.05	249.12	249.18	249.14	
7 SC effluent combined channel - dn	249.06	249.13	249.22	249.13	
8 SC effluent combined channel - mid	249.06	249.13	249.22	249.05	249.06
8	249.06	249.13	249.22	249.07	
9 SC collection channel - dn	249.06	249.13	249.21	249.06	249.11
9	249.06	249.13	249.21	249.1	
9	249.06	249.13	249.21	249.12	
9	249.06	249.13	249.21	249.17	
10 SC collection channel - up	249.07	249.15	249.25	249.14	249.17
10	249.07	249.15	249.25	249.22	
10	249.07	249.15	249.25	249.18	
10	249.07	249.15	249.25	249.18	
10	249.07	249.15	249.25	249.15	
11 SC launder - dn	249.2	249.24	249.29	249.24	249.22
11	249.2	249.24	249.29	249.22	
11	249.2	249.24	249.29	249.21	
11	249.2	249.24	249.29	249.22	
11	249.2	249.24	249.29	249.21	
11	249.2	249.24	249.29	249.22	
12 SC launder - up	249.33	249.39	249.47		
13 SC body	250.55	250.56	250.58	250.53	250.54
13	250.55	250.56	250.58	250.52	
13	250.55	250.56	250.58	250.53	
13	250.55	250.56	250.58	250.55	
13	250.55	250.56	250.58	250.54	
13	250.55	250.56	250.58	250.54	
14 SC influent channel	250.56	250.58	250.6	250.58	250.57
14	250.56	250.58	250.6	250.56	
14	250.56	250.58	250.6	250.58	
14	250.56	250.58	250.6	250.57	
15 AB influent channel	250.69	250.72	250.77	250.67	250.72
15	250.69	250.72	250.77	250.72	
15	250.69	250.72	250.77	250.74	
15	250.69	250.72	250.77	250.72	
15	250.69	250.72	250.77	250.79	
15	250.69	250.72	250.77	250.66	

Calibration Results
Survey 3 - all basins in service

	WSL Predicted by Model (ft)			Measured WSL (ft)	
Location	Q = 2 mgd	Q = 11 mgd	Q = 22 mgd	Point	Average
16 Primary PS influent wet well	246.6	246.6	246.6	246.57	
17 Primary PS influent channel	246.6	246.58	246.51	246.77	
18 Primary clarifier effluent channel - dn	247.62	248.2	248.7	248.44	
19 Primary clarifier effluent channel - mid	247.73	248.51	249.185	248.51	
20 Primary clarifier effluent channel - up	247.84	248.82	249.67	249.21	
21 Primary clarifier launder - dn	250.29	250.43	250.53	250.44	250.39
21	250.29	250.43	250.53	250.37	
21	250.29	250.43	250.53	250.32	
21	250.29	250.43	250.53	250.34	
21	250.29	250.43	250.53	250.46	
22 Primary clarifier launder - up	250.35	250.56	250.73	250.74	250.84
22	250.35	250.56	250.73	250.78	
22	250.35	250.56	250.73	250.84	
22	250.35	250.56	250.73	250.89	
22	250.35	250.56	250.73	250.95	
23 Primary clarifier body	251.46	251.49	251.52	251.53	251.52
23	251.46	251.49	251.52	251.5	
24 Primary clarifier influent channel	251.46	251.49	251.51	251.55	251.54
24	251.46	251.49	251.51	251.52	
24	251.46	251.49	251.51	251.51	
24	251.46	251.49	251.51	251.58	
25 Combined clarifier influent channel	251.46	251.48	251.47	251.62	
26 Combined influent channel at road	251.46	251.5	251.54	251.73	251.62
26	251.46	251.5	251.49	251.51	
27 Parshal flume approach channel	252.67	253.41	254	253.82	253.63
27	252.67	253.41	254	253.75	
27	252.67	253.41	254	253.33	
28 Grit chamber influent	252.93	253.83	254.68	253.46	
29 Screens - dn	252.93	253.85	254.74	253.72	253.79
29	252.93	253.85	254.74	253.85	
30 Screens - up	252.94	253.89	254.82	254.09	254.03
30	252.94	253.89	254.82	253.96	

APPENDIX C

ORDER-OF-MAGNITUDE COST INFORMATION

FOURCHE CREEK WWTP
UPGRADES REQUIRED TO TREAT ADDITIONAL EXTRANEOUS FLOWS AT THE FACILITY

DESIGN CRITERIA

	Current Conditions		Expansion	
	Average	Max	Average	Max
Flow (mgd)	15	38	15	60
Forcemain	existing forcemain 42", additional 30" forcemain required			
dia (inch)	42	42	30	51.6
area (ft2)	9.62	9.62	4.91	14.52
velocity (ft/s)	2.41	6.11	4.73	6.39
length (ft)	41,500	41,500	41,500	41,500
Headworks - screens				
# of screens	2	2	2	3
width (ft)	10	10	10	15
Inlet channel	existing channel supplemented with 30" dia pipe to old secondary clarifiers			
width (ft)	5	5	5	
Primary clarifiers	old secondary clarifiers retrofitted to provide additional primary clarifier capacity			
# of clarifiers	2	2	2	3
width (ft)	60	60	60	60
length (ft)	200	200	200	200
SOR (gpd/ft2)	625	1583	625	1667
Aeration basin	additional aeration basin volume provided			
# of basins	3	3	3	5
RAS per basin (mgd)	2.3	2.3	2.3	2.3
volume (mg)	0.87	0.87	0.87	0.87
HRT (hours)	4.2	1.6	4.2	1.7
Secondary clarifiers	additional secondary clarifier volume provided			
# of clarifiers	3	3	3	5
width (ft)	40	40	40	40
length (ft)	186	186	186	186
SOR (gpd/ft2)	672	1703	672	1613
Chlorine Contact Chamber				
# of units	1	1	1	1
volume (ft3)	17,372	17,372	17,372	17,372
HRT	30	12	30	7
Outfall				
dia (in)	72	72	72	72
length (ft)	1085	1085	1085	1085
available volume (ft3)	30,662	30,662	30,662	30,662
additional HRT (min)	53	21	53	13

COST INFORMATION
FOURCHE CREEK UPGRADES

FORCEMAIN UPGRADE - to increase hydraulic cacpacity from Arch Street PS to Fourche Creek to 60

Item	Unit	Number	Unit Cost ($)	Install factor	Cost ($)
1 Forcemain					
30" forcemain	ft	41500	140	1	$ 5,810,000
2 Contingency	%	1	0.2		$ 1,162,000
Subtotal					$ 6,972,000
Contractors operation	%	1	0.1		$ 697,200
Contractors profit	%	1	0.08		$ 557,760
Estimated Cost					$ 8,226,960
Escalation	%	1	0.061		$ 501,845
Engineering	%	1	0.12		$ 987,235
Project Total					$ 9,716,040

Arch Street PS

COST INFORMATION
FOURCHE CREEK UPGRADES

ARCH STREET PUMP STATION UPGRADE - replace existing pumps and screens to increase capacity to 60 mgd

Item	Unit	Number	Unit Cost ($)	Install factor	Cost ($)	
2 Mechanical equipment						
Pumps	ea	3	150000	1.3	$ 585,000	
VFD	ea	3	170000	1.5	$ 765,000	
Screens	ea	1	120000	1.5	$ 180,000	
3 Electrical	allow	1	150000	1	$ 150,000	$ 1,680,000
4 Contingency	%	1	0.25		$ 420,000	
Subtotal					$ 2,100,000	
Contractors operation	%	1	0.1		$ 210,000	
Contractors profit	%	1	0.08		$ 168,000	
Estimated Cost					$ 2,478,000	
Escalation	%	1	0.061		$ 151,158	
Engineering	%	1	0.12		$ 297,360	
Project Total					$ 2,926,518	

Fourche Creek

COST INFORMATION
FOURCHE CREEK UPGRADES

WWTP UPGRADE - to increase peak hydraulic capacity to 60 mgd

Item	Unit	Number	Unit Cost ($)	Install factor	Cost ($)	
1 Headworks						
Screens	ea	3	150000	1.7	$ 765,000	
Washers	ea	3	60000	1.2	$ 216,000	
Grit removal	ea	1	300000	1.2	$ 360,000	$ 1,341,000
2 Primaries						
Pipe	ft	800	120	1.1	$ 105,600	
Mechanism	ea	9	70000	1.2	$ 756,000	
Sludge pump stations	ea	2	100000	1.5	$ 300,000	
Clarifier modifications (old final)	ea	1	100000	1.1	$ 110,000	
Clarifer modifications (existing)	ea	2	30000	1.1	$ 66,000	$ 1,337,600
3 Primary effluent pump station						
Pump	ea	1	500000	1.3	$ 650,000	
Piping modifications	allow	1	50000	1.3	$ 65,000	$ 715,000
4 Secondary Treatment						
Aeration basins	ea	2	650000	1.4	$ 1,820,000	
Aeration equipment	ea	2	450000	1.6	$ 1,440,000	
Gallery	ft2	2400	300	1.2	$ 864,000	
RAS/WAS pumps	ea	4	70000	1.6	$ 448,000	$ 4,572,000
Secondary clarifiers	ea	2	400000	1.3	$ 1,040,000	
Clarifier mechanisms	ea	8	70000	1.2	$ 672,000	$ 1,712,000
5 Site work	%	1	0.1		$ 967,760	
6 Contingency	%	1	0.35		$ 3,725,876	
Subtotal					$ 14,371,236	
Contractors operation	%	1	0.1		$ 1,437,124	
Allowance for unidentified items	%	1	0.2		$ 2,874,247	
Contractors profit	%	1	0.08		$ 1,149,699	
Estimated Cost					$ 19,832,306	
Escalation	%	1	0.061		$ 1,209,771	
Engineering	%	1	0.12		$ 2,379,877	
Project Total					$ 23,421,953	

ENGINEERING AND COST REPORT

for

LITTLE MAUMELLE RIVER SUBBASIN SEWERAGE STUDY

Prepared for

WATER / WASTEWATER ADVISORY COMMITTEE

On behalf of the

LITTLE ROCK WASTEWATER UTILITY

Little Rock Sanitary Sewer Committee

James R. Pender, Chair
Dale J. Wintroath, Vice Chair
Stuart S. Mackey, Secretary
Charles G. Goss, Member
Patrick D. Miller, Member

Utility Manager
Mr. Reggie Corbitt, P.E.

221 East Capitol
Little Rock, Arkansas 72202

FINAL DRAFT
Prepared by

TEC

Tanner Engineering Consultants

in Affiliation with

Carter Burgess

10809 Executive Center, Suite 204
Little Rock, Arkansas 72211-6021
www.c-b.com`

September 2001

ENGINEERING AND COST REPORT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

SECTION I

PROJECT IDENTIFICATION

1.1 PROJECT NAME:

Engineering and Cost Report for Little Maumelle River Subbasin Sewerage Study.

1.2 LOCATION:

The project area incorporates 51,475 acres within Pulaski County, of which fifteen percent is bound within the city limits of Little Rock. The Little Rock Wastewater Utility (Utility) has developed comprehensive wastewater basin maps of the sewer drainage basins. The area incorporates the following subbasins for the study area: 60010, 60100, 60200, 60301, 60302, 60400, 60500, 60600, 60700, 60800, and 60900. The subbasins will be referred to as the "Watershed". Exhibit 1 depicts the study area and individual subbasins.

1.3 TOTAL COST:

The total cost for the proposed improvements is $18,878,000.

1.4 CONSUMER CHARGE:

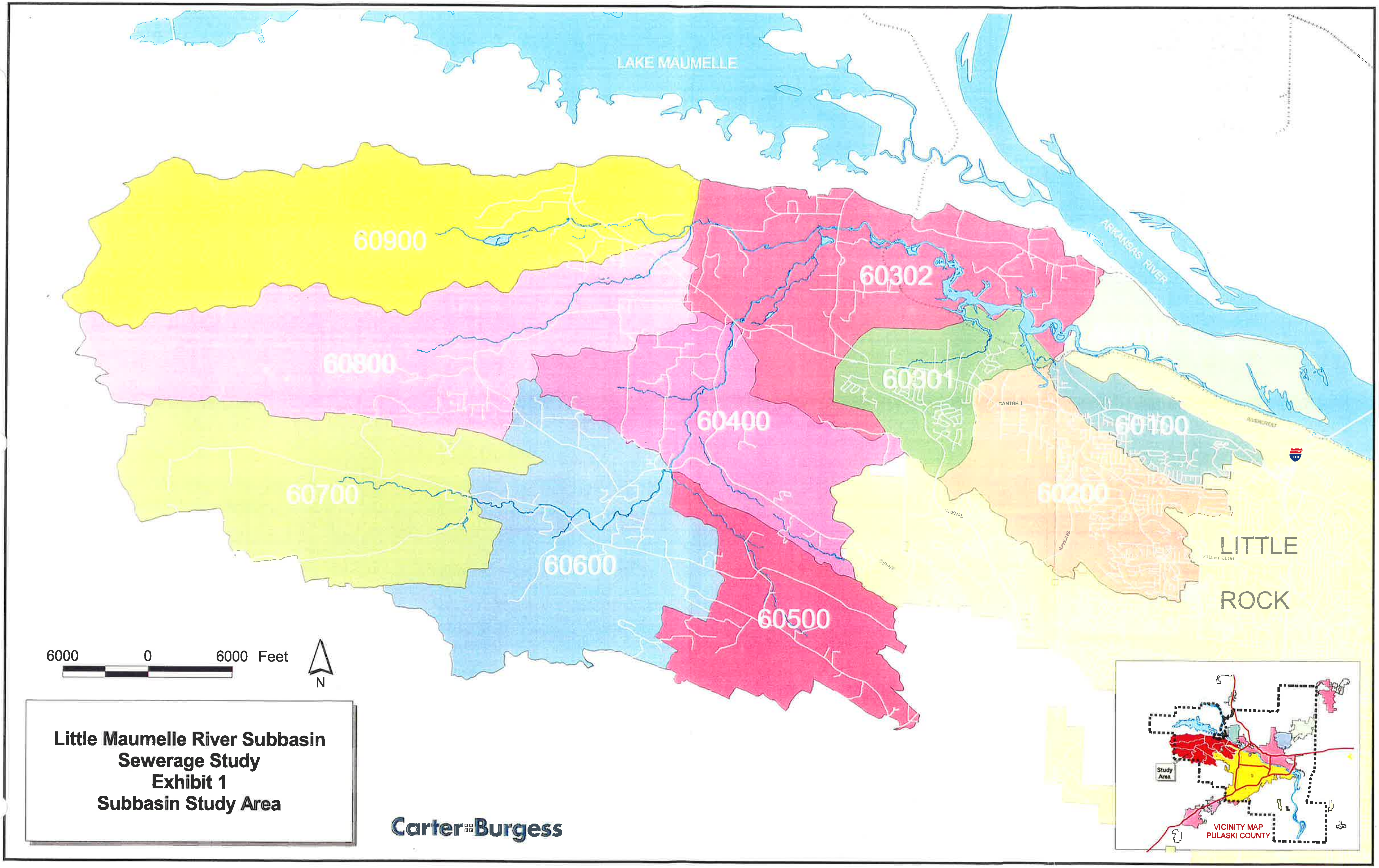
The consumer charge for the system will increase due to the project. The Utility's increased consumer charge will be calculated at a future date depending upon the funding source for the proposed project.

1.5 CONNECTION FEE:

Connection fees are not expected to change as a result of this project.

Propose
4.4 Gall Day

36 adams



Little Maumelle River Subbasin
Sewerage Study
Exhibit 1
Subbasin Study Area

Carter::Burgess

1.6 ANNUAL MEDIAN HOUSEHOLD INCOME:

The 1997 U.S. Census Bureau reported an annual median household income of $34,727 for Pulaski County.

1.7 AFFORDABILITY:

Based upon the available data, the proposed project is considered affordable to the customers.

SECTION II

BACKGROUND

2.1 EXISTING PROCESS:

Little Rock has two major treatment facilities: one at Adams Field and one at Fourche Creek. Both facilities discharge into the Arkansas River. The plants will not be affected by the proposed construction projects.

2.2 COMPONENTS:

Both plants are activated sludge treatment processes with chlorine disinfection. Waste solids from Adams Field are transferred to Fourche Creek where the combined solids from both plants are thickened and anaerobically digested. The Fourche Creek plant recovers methane for power generation.

2.3 LOCATION OF PLANTS:

The Fourche Creek Plant is located at 34 degrees, 41 minutes, 55 seconds North and 92 degrees, 8 minutes, 40 seconds West. Adams Field Plant is located at 34 degrees, 44 minutes, 34 seconds North and 92 degrees, 12 minutes, 45 seconds West.

2.4 PROBLEM:

Currently, the wastewater from the Watershed is transported to the Adam's Field Treatment Facility through a series of two pump stations and interceptors along the Arkansas River. The names of the pumps stations are the Little Maumelle Pump Station and the Cantrell Road Pump Station. The Little Maumelle Pump Station is within the study area and has an observed maximum pumping capacity of 3,450 gpm or 4.97 MGD; however, design curve capacity is 5,200 gpm or 7.28 MGD. This difference is unexplained, but may be due to a constriction, such as entrapped air, in the downstream force main.

The Little Maumelle Sewerage System has surcharged in the past because pumping capacity is insufficient to transport wet weather peaks during heavy rains. Peak influent flow reported by Byrd-Forbes Pitometer during March 15-16 2000 for a 1.70-inch rain event measured 7.1 MGD through the Watershed. The rain event was less than a 1-year frequency event. The pumping capacity could be increased but downstream sewers located adjacent to Murray Park lack capacity to convey additional flows.

To abate overflows near Murray Park the Utility must reduce Little Maumelle pumping rates when the Rebsamen interceptor is hydraulically overloaded. This practice causes the Watershed to surcharge and overflow more often than it would otherwise.

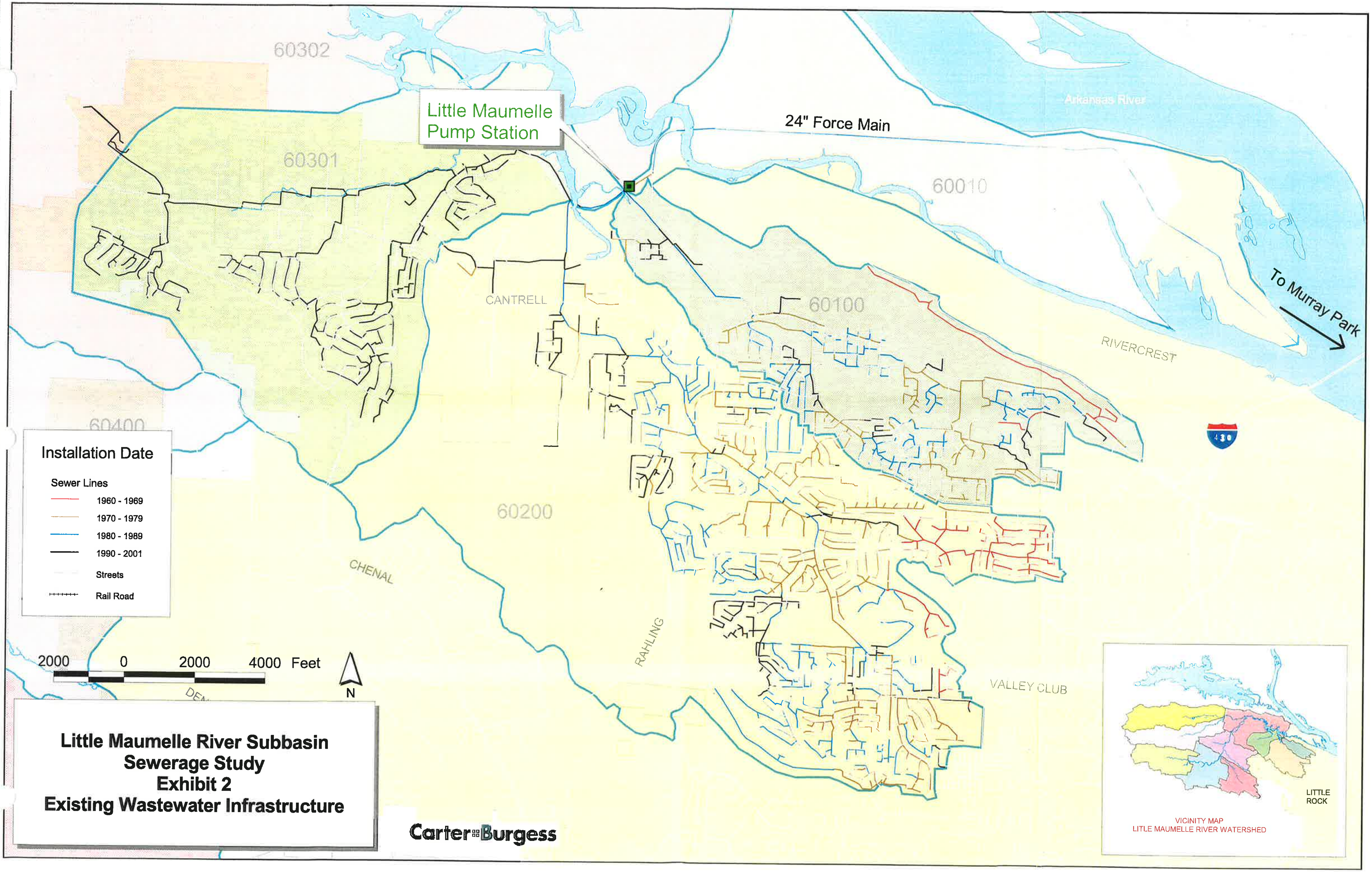
Therefore, there is an immediate need to address the wastewater flows for the Watershed.

2.5 EFFLUENT DATA:

Effluent data is not required for this study.

2.6 COLLECTION SYSTEM:

The existing collection system within the Watershed is primarily within five of the eleven subbasins. Exhibit 2 denotes a graphic presentation of the existing wastewater mains within the subbasins with an approximate installation date. Table 1 details the quantity and size of the existing infrastructure within the Watershed.



Little Maumelle River Subbasin
Sewerage Study
Exhibit 2
Existing Wastewater Infrastructure

Table 1: Existing Sanitary Sewer Pipe Infrastructure

Pipe Size	Sub-basin					
	60010 (ft.)	60100 (ft.)	60200 (ft.)	60301 (ft.)	60302 (ft.)	Total (ft.)
<8"	0	5,688	12,157	403	2,947	**21,195**
8"	0	98,442	274,140	70,397	2,769	**445,748**
10"	0	6,284	15,266	6,074	0	**27,624**
12"	0	332	4,832	1,898	0	**7,062**
14"	0	185	0	0	0	**185**
15"	0	4,986	640	4,941	0	**10,567**
18"	0	7,035	323	4,593	0	**11,951**
20"	0	0	3,965	0	0	**3,965**
21"	0	0	9,488	0	0	**9,488**
24"	24,124(1)	393	158	2,933	0	**27,608**
Total	**24,124**	**123,345**	**320,969**	**91,239**	**5,716**	**565,393**

(1) Force Main Interceptor from Little Maumelle River Pump Station

The Watershed contains one pump station facility within Subbasin 60010. The pump station, called Little Maumelle Pump Station, was constructed in 1987, and can be located in Exhibit 2. The station is comprised of four pumps constructed in parallel: two 150 horsepower pumps, two 20 horsepower pumps, and a wet well with an approximate capacity of 300,000 gallons. The maximum observed operating capacity of the pump station is approximately 3,450 gpm (4.97 Mgd).

2.7 INFILTRATION / INFLOW STUDY:

The Utility is currently under contract with Montgomery Watson to produce infiltration and inflow data for the Watershed. The results of the ongoing study will be available in late 2001. Byrd Forbes Pitometer completed a draft I/I study in September 2000 which included I/I data on sub-basins 60100, 60200, and 60301.

2.8 NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM PERMITS

A wastewater discharge permit for any new plant serving the study area will be dependent upon the site selected and the final discharge point. If treated wastewater is discharged to the Arkansas River, it is assumed that the discharge requirement for wastewater treatment facilities will comply with current permits set forth for the existing Adam's Field and Fourche Creek facilities. These plants have effluent permit limits of 30/30 mg/L BOD/TSS. Current NPDES permits are on file at ADEQ, and at the offices at LRWU.

If a new wastewater treatment plant is selected for implementation, a specific NPDES permit application will be filed with ADEQ for the proposed facilities.

2.9 DISCHARGE FLOWS

No discharge flow information is provided in this report because existing treatment plants are not included in these projects.

SECTION III

PROPOSED PROJECT

3.1 PURPOSE AND NEED:

Previous wastewater studies (Crist and Smith, 1969, Mehlburger, August 1974, Freese and Nichols, Inc. 1979) have expressed the need to construct a treatment facility near the mouth of the Little Maumelle River and divert wastewater flows from the Adam's Field treatment facility. A facility plan was submitted to the United States Environmental Protection Agency ("USEPA") in April 1977 as part of an application for a step one grant for the construction of a treatment plant for the Watershed. The facility plan was met with public opposition, and USEPA mandated an Environmental Impact Statement ("EIS") be prepared to address public concerns.

The conclusion of the EIS recommended no subsequent grants be awarded for the project, but failed to address alternatives for the environmental questions related to transporting and treating wastewater flows from the Watershed. In 1979, when it became evident that a permanent treatment facility would not be constructed, the Utility proceeded with the design and construction of three new pumping stations in the Watershed to increase wastewater flow conveyance capacity to the Adam's Field treatment facility.

A Sewer Service Study for Northwest Little Rock was compiled in April 1980 by the Little Rock Office of Comprehensive Planning (See Appendix A1). As a result, the city of Little Rock imposed a low-density single- family residential classification throughout the northwest area of Little Rock until the Utility installed the infrastructure to address anticipated wastewater flows. Based upon a wastewater study performed in November 1983, a new pump station (Little Maumelle Pump Station) was constructed near Pinnacle Valley Farms and a force main was extended to the Rebsamen Interceptor near the Murray Lock and Dam. In addition, the study highlighted improvements for the wastewater infrastructure at an approximate cost of six million dollars. This included improvements to the Hinson Road, Ison, and Walton Heights Interceptors. These improvements curtailed the immediate need for a treatment facility located near the mouth of the Little Maumelle River, and rerouted flows from the Watershed to the Rebsamen interceptor and Murray Park. Under normal operating conditions, in 1987, the Rebsamen interceptor had sufficient capacity to receive and transport the flow from the new pump station.

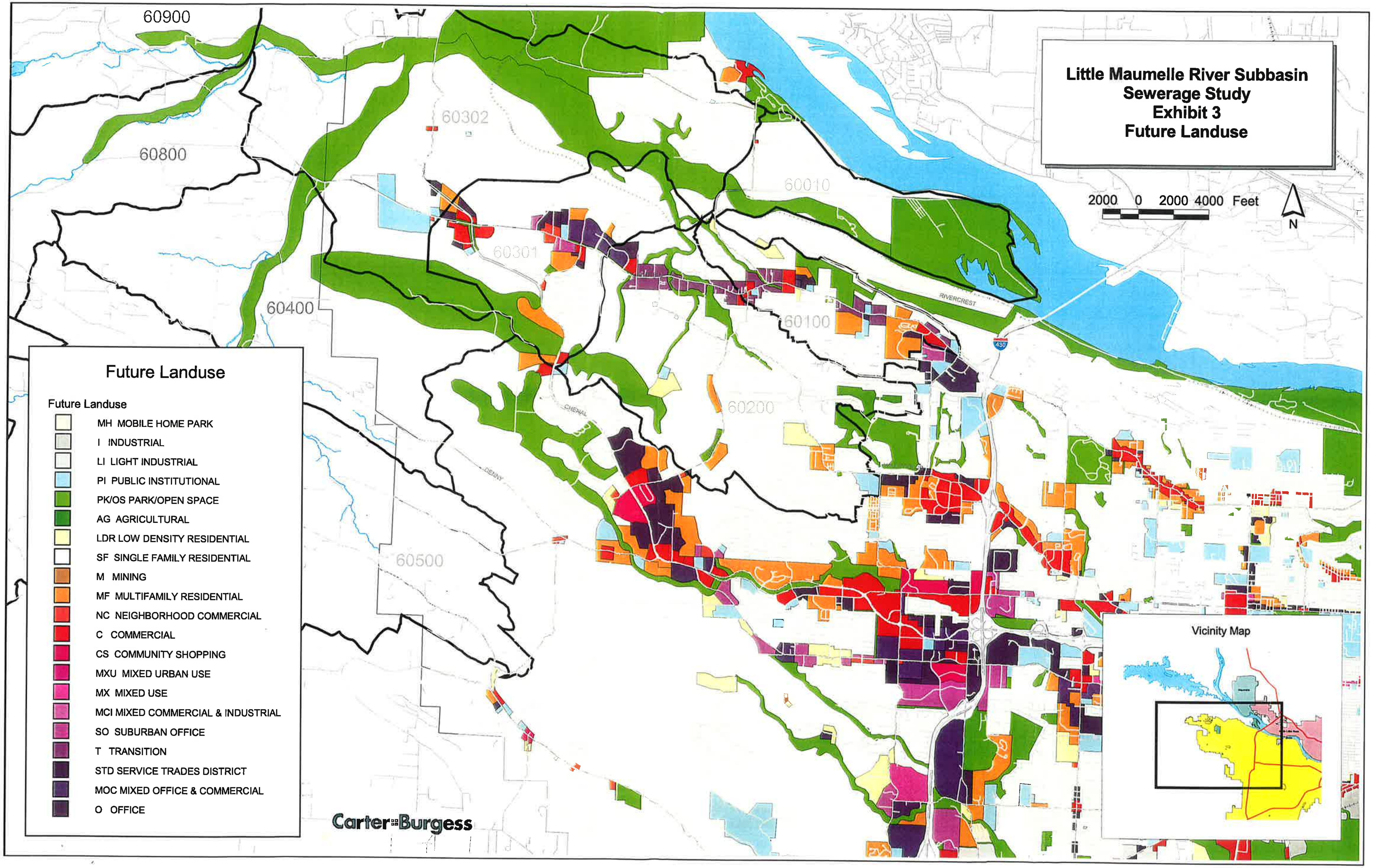
The Little Maumelle Pump Station was designed to serve 11,000 people in the year 2000. The 1983 study proposed pump improvements and the construction of a parallel river interceptor for the year 2000. The improvements would transport anticipated flows to the Adam's Field Treatment Facility. The study did not include anticipated costs for the parallel interceptor or the feasibility to construct a treatment facility for the Watershed to divert flows from Adam's Field.

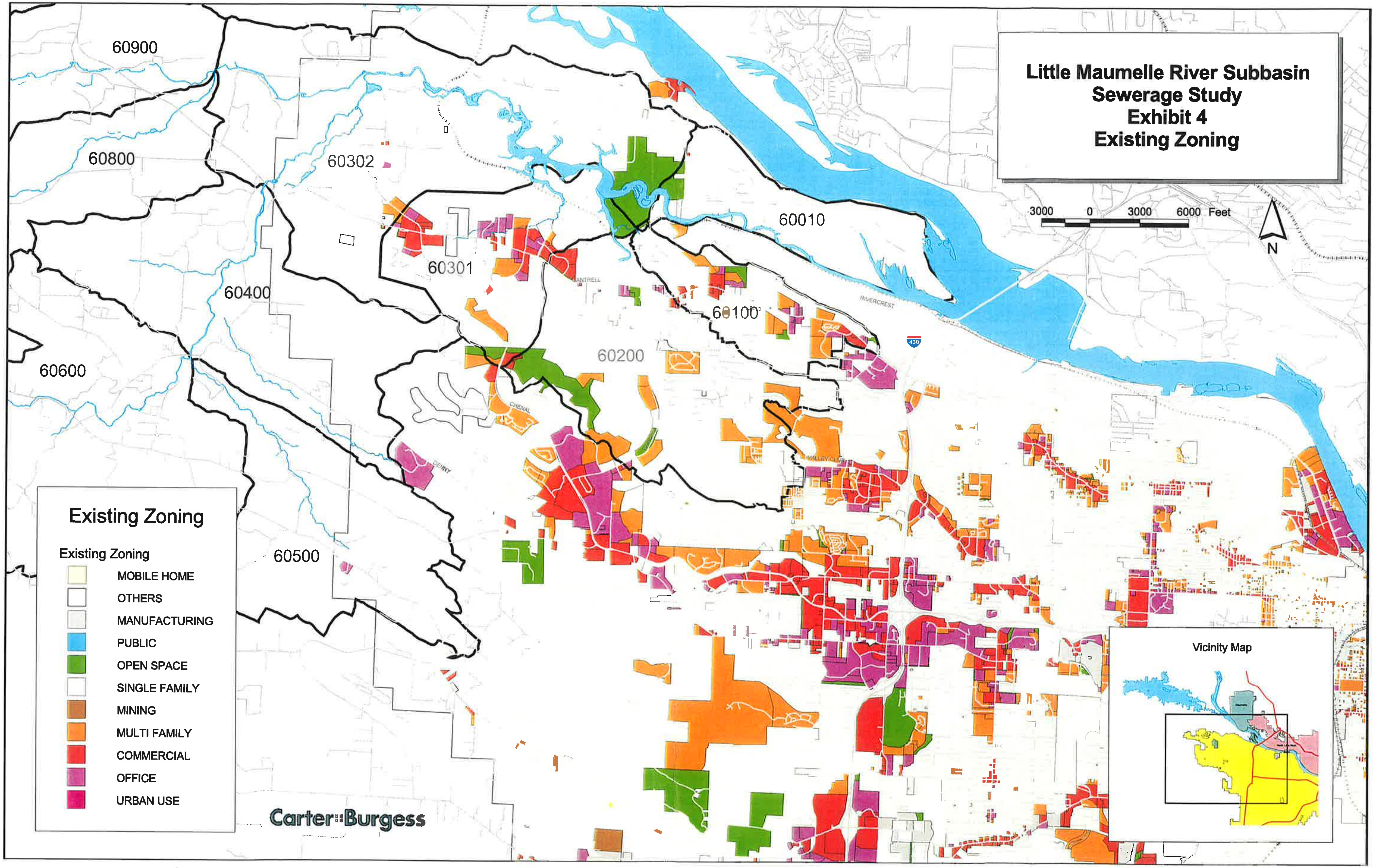
Overflows have been documented in the Rebsamen Interceptor near Murray Park. Even though this section of the system is not within the Little Maumelle River Watershed, the Rebsamen Interceptor receives and transports all wastewater from the study area. To abate overflows near the Murray Park Interceptor, the Little Maumelle Pump Station discharge rate is reduced when the Rebsamen Interceptor is hydraulically overloaded. Lowering the pump station discharge rate causes the Maumelle System to overflow during high wet weather flows.

3.2 FACILITY PLANNING AREA:

The Little Maumelle Subbasin is the facility planning area. Exhibit 3 and 4 denote planning boundaries and future land use. Table 2 below depicts land use application as reported by the Sewer Service Study reference in Appendix A2.

Little Maumelle River Subbasin Sewerage Study
Exhibit 3
Future Landuse





Little Maumelle River Subbasin Sewerage Study
Exhibit 4
Existing Zoning

Table 2: Development Pattern Projections

Sub-basin	Existing Development – Acres				Total Development - Acres		
	Total Area	**Not Developable**	**Existing Large lot**	**Non-residential**	**Large Lot**	**Urban**	**Urban + Non Residential**
60010	1,738	956	245	10	257	-	10
60100	1,312	79	-	262	197	774	1,036
60200	3,926	393	-	393	196	2,944	3,337
60301	2,235	335	-	335	220	1,345	1,680
60302	6,437	2,124	1030	966	2,575	772	1,738
60400	4,411	220	975	90	4,101	-	90
60500	3,632	218	734	182	3,232	-	182
60600	6,042	604	1,364	604	4,834	-	604
60700	6,014	902	456	300	4,812	-	300
60800	7,401	370	1,000	740	1,961	4,070	4,810
60900	8,325	416	277	1,250	1,029	5,430	6,680
Totals	**51,473**	**6,617**	**6,081**	**5,132**	**23,414**	**15,335**	**20,467**

Development patterns vary pending on land use. The Little Rock Wastewater Utility has not typically provided sewer service for large lot developments due to economics. For these tracts, the cost of installation versus number of sewer customers served is not cost effective. In addition, based upon past development trends, denser development on large acre tracks is unlikely according to the data supplied by Little Rock Planning and Development. Utilizing this same philosophy, it is unlikely that a wastewater collection system will be installed to support non-residential development without any projected urban development. As such, subbasins not projected for urban development will be removed for flow capacity analysis for this report, but are included in Appendix A3 as supplemental data. The subbasins not included for wastewater calculations are 60010, 60400, 60500, 60600, and 60700.

3.3 SELECTED ALTERNATIVES:

Based upon the existing and projected wastewater flows from the Watershed and documented overflows, two distinct alternatives are available for analysis. The first alternative is to upgrade the Little Maumelle Pump Station, construct a Flow Equalization Basin, upgrade the Cantrell Pump Station, and construct a new parallel interceptor along the existing interceptors to transport the existing and projected wastewater flow from the Watershed to the Adam's Field Treatment Facility.

The second alternative would be to construct a new treatment facility located near the mouth of the Little Maumelle River to treat and discharge the wastewater from the Watershed.

Constructing a new treatment facility near the mouth of the Little Maumelle River has been proposed as a feasible alternative previously. The "Comprehensive Sanitary Sewerage Plan for the Pulaski-Saline Metroplan Area", 1969, detailed the need for a sanitary treatment facility near the mouth of the Little Maumelle River. Subsequent reports, Mehlburger 1974, Freese and Nichols, 1979, stressed the necessary need for a separate treatment facility to treat wastewater discharge from the Watershed near the mouth of the Little Maumelle River.

Site selection was based upon available land area optimizing the function of existing infrastructure. The topography was analyzed for placement of a treatment facility for the Watershed. Upon investigation and reference to previous studies, the mouth of the Little Maumelle River is the most cost effective location to serve wastewater flows from the Watershed. In addition the existing Little Maumelle Pump Station could be utilized to pump influent to or effluent from the wastewater treatment facility pending final location and function of the site.

The Utility was consulted for possible site locations. Field visits were conducted and effected property owners identified. Possible site selections are shown in Exhibit 5. The city of Little Rock currently has ownership of Site 1. Site 2, Site 3, and Site 4 are owned by private individuals.

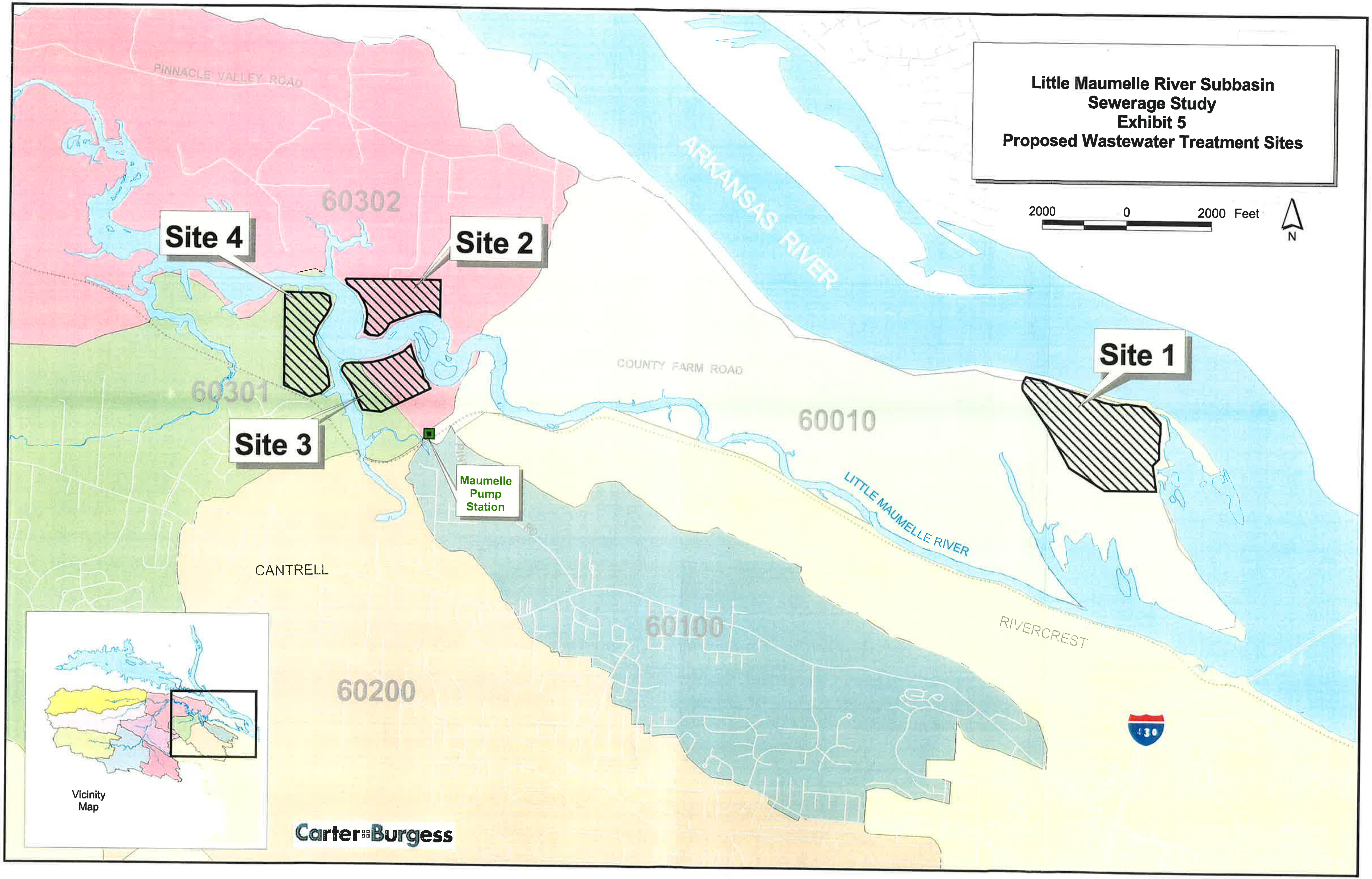
It is assumed that effluent from a plant on the Little Maumelle River would be conveyed to the Arkansas River for discharge, since a discharge into the Little Maumelle River would likely require more stringent permit limits. Whether providing a higher level of treatment is more expensive than effluent conveyance to the Arkansas River cannot be determined without more site specific permitting and cost evaluations, which would be addressed during subsequent detailed facility planning.

3.4 LAND OWNERSHIP:

The owners of the land located within the proposed improvements will be contacted regarding the proposed project needs at the appropriate time. The desirable method of acquisition is negotiation with the owners based upon the Federal Relocation and Acquisition Act.

3.5 PROPOSED COLLECTION SYSTEM:

There is not a collection system planned. Specific sites may require the construction of transmission lines to convey the wastewater from its current discharge point to new treatment facilities.



Little Maumelle River Subbasin
Sewerage Study
Exhibit 5
Proposed Wastewater Treatment Sites

3.6 COLLECTION SYSTEM REHABILITATION:

There is not a collection system rehabilitation planned.

3.7 DESIGN YEAR:

The design year for this project is 2025.

3.8 POPULATION:

The Utility tasked Little Rock Planning and Development to provide projections for households, non-residential demand, and residential development patterns for the Little Maumelle River Watershed. Past wastewater studies performed for the City (1969, 1974, 1979, and 1983) have taken this approach which has been generally adopted as a more accurate means of forecasting population growth and trends for the Pulaski county area. The Little Rock Planning and Development study is enclosed in Appendix A2.

Projected household data over the design period is presented in Table 3. To develop population data, 2.7 persons per household were utilized at each projected year. Populations can be seen in Table 4. Population for the year 2025 was developed from the projected high trend. Year 2000 projections were based upon the established 1990 data and residential permits from 1990 to 2000.

Table 3: Household Population Projection

Sub-basin	Household Population			Household Population 2025			Household Population
	1990 est.	90-99 Incr.	2010	Metroplan	Trend	High Trend	Projected Full Development
60010	65		88	102	105	105	260
60100	1250	468	2150	2363	2365	2365	2400
60200	2500	893	4065	4339	5000	5500	8900
60301	240	607	1450	789	2240	2840	4120
60302	190		790	1046	1490	1990	3200
60400	160		560	808	860	860	1370
60500	170		400	661	660	660	1080
60600	205		495	798	800	800	1610
60700	80		125	231	230	230	1605
60800	140		240	498	500	500	12800
60900	70		140	210	210	210	16650

Table 4: Population Projections

Sub-basin	Population (Capita)				Population Developed		
	2000	2010	2025	Projected Full	2000	2010	2025
60010	176	238	284	702	25%	34%	40%
60100	4,639	5,805	6,386	6,480	72%	90%	99%
60200	9,161	10,976	14,850	24,030	38%	46%	62%
60301	2,287	3,915	7,668	11,124	21%	35%	69%
60302	513	2,133	5,373	8,640	6%	25%	62%
60400	432	1,512	2,322	3,699	12%	41%	63%
60500	459	1,080	1,782	2,916	16%	37%	61%
60600	554	1,337	2,160	4,347	13%	31%	50%
60700	216	338	621	4,334	5%	8%	14%
60800	378	648	1,350	34,560	1%	2%	4%
60900	189	378	567	44,955	0%	1%	1%
Totals	**19,003**	**28,358**	**43,362**	**145,787**			

3.9 CAPACITY OF PROPOSED PROJECT:

One of the early challenges in wastewater transportation and treatment design is the development of wastewater flows based upon projected population data. Methods have been developed to predict anticipated wastewater flows with moderate success; however, predicting industry locations and land development trends is not an exact science.

The Little Rock Planning and Development study was evaluated to project wastewater flows in conjunction with I/I data obtained during the Byrd Forbes flow study conducted in the spring of 2000. Average daily flows were determined based upon population data; however, the peak hydraulic capacity of the facility is based upon measured field data which was projected to each respective design year and minimum design criteria established by the Utility. The criteria used to project the wet weather data for inflow and infiltration can be found in Appendix A4.

Since the Little Rock Planning and Development data is based upon household change, commercial use, and residential development patterns, the methodology was developed to estimate population trends that will be used for flow determination assuming a density of 2.7 people per household.

Based upon the available data the design flow parameters were developed for each subbasin at design years 2010, 2025, and fully developed. The parameters are summarized in Table 5. Please note that flows shown for year 2000, are estimated from data provided by Little Rock Planning and Development and not from documented wastewater flows.

Percent of the developed population in each respective subbasin was utilized to breakdown each design year. Household flow, commercial and office / institutional flows are only determined for subbasins that have projected urban development. This rationale, as discussed earlier, is based upon the unliklihood of wastewater improvements on large lot development. Comprehensive flows were developed for all subbasins and can be referenced in Appendix A3.

Table 5: Wastewater Design Parameters

Design Flow	**Parameters**
Average Daily Flow (ADF)	Household Flow + Commercial Flow + Office / Institutional Flow
Wet Weather Flow (WWF)	Measured Flow Projected by Byrd Forbes Study

Where:
Household Flow = 90 gallons per capita day (gpcd)
Commercial Flow = 15 gpcd
Office / Institutional = 15 gpcd

Table 6: Household Wastewater Flows

	Population (Capita)				**Flows (Mgd) - Average**			
Sub-basin	**2000**	**2010**	**2025**	**Projected Full**	**2000**	**2010**	**2025**	**Projected Full**
60100	4639	5805	6386	6480	0.42	0.52	0.57	0.65
60200	9161	10976	14850	24030	0.82	0.99	1.34	2.40
60301	2287	3915	7668	11124	0.21	0.35	0.69	1.11
60302	513	2133	5373	8640	0.05	0.19	0.48	0.86
60800	378	648	1350	34560	0.03	0.06	0.12	3.46
60900	189	378	567	44955	0.02	0.03	0.05	4.50
Totals	**17167**	**23855**	**36194**	**129789**	**1.54**	**2.15**	**3.26**	**12.98**

Table 7: Commercial Wastewater Flow

Sub-basin	2000 (Mgd)	2010 (Mgd)	2025 (Mgd)	Fully Developed (Mgd)
60100	0.05	0.07	0.07	0.08
60200	0.03	0.03	0.05	0.08
60301	0.02	0.04	0.07	0.11
60302	0.01	0.05	0.12	0.19
60800	0.00	0.01	0.01	0.29
60900	0.00	0.00	0.01	0.42
Totals	**0.12**	**0.19**	**0.33**	**1.15**

Table 8: Office / Institutional Wastewater Flow

Sub-basin	2000 (Mgd)	2010 (Mgd)	2025 (Mgd)	Fully Developed (Mgd)
60100	0.09	0.11	0.12	0.12
60200	0.10	0.12	0.17	0.27
60301	0.03	0.05	0.09	0.14
60302	0.04	0.17	0.42	0.67
60800	0.01	0.01	0.02	0.46
60900	0.00	0.01	0.01	0.67
Totals	**0.27**	**0.46**	**0.83**	**2.34**

Table 9: Wastewater Flow Projections

Sub-basin	Average Daily Flow (Mgd)				Peak Wet Weather Flow (Mgd)			
	2000	2010	2025	Fully Developed	2000	2010	2025	Fully Developed
60100	0.56	0.70	0.77	0.85	3.10	3.18	3.21	3.22
60200	0.96	1.15	1.55	2.75	8.64	8.64	8.64	8.64
60301	0.26	0.44	0.86	1.35	0.44	0.61	1.05	1.46
60302	0.10	0.40	1.02	1.72	0.13	0.39	0.98	1.40
60800	0.04	0.07	0.15	4.21	n/a	0.08	0.15	5.65
60900	0.02	0.04	0.06	5.59	n/a	0.05	0.05	7.84
Totals	**1.93**	**2.80**	**4.41**	**16.47**	**12.31**	**12.95**	**14.09**	**28.21**

Table 10 below depicts the existing capacity of the interceptors from the Little Maumelle Pump Station to Adam's Field. Exhibit 6 denotes the interceptor locations. The Utility is currently under contract with Montgomery Watson to determine current flow within the interceptors. Observed flows during five year frequency events through the interceptor are at or near capacity for the entire interceptor length.

Table 10: Existing Interceptor Capacity

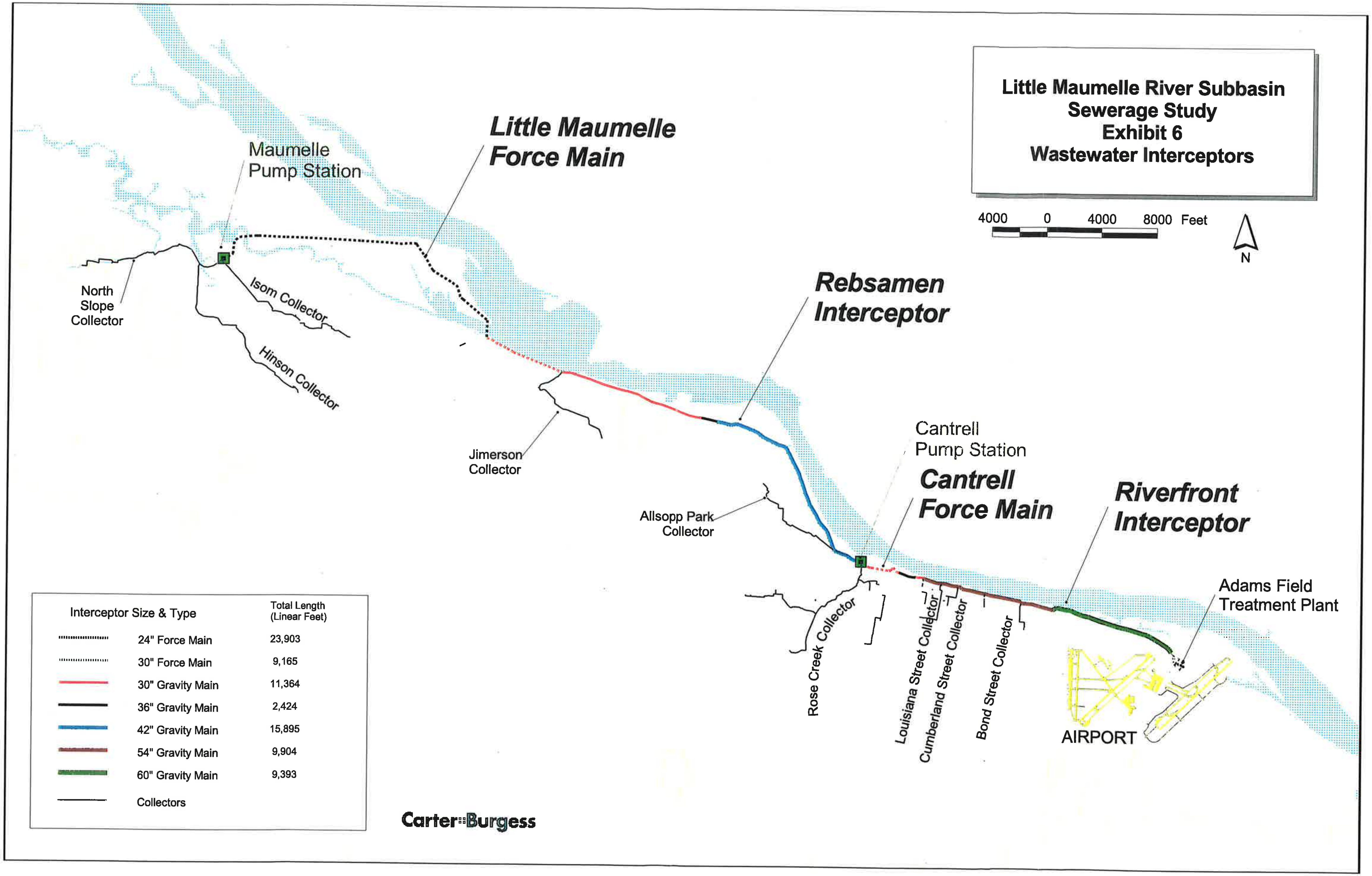
Interceptor Section	Pipe Diameter	Maximum Capacity (Mgd)
Little Maumelle Force Main(1)	24"	10.00
Rebsamen – Gravity(2)	30"	6.33
Cantrell – Force Main(1)	30"	15.82
Riverfront Louisiana St – Bond St.(2)	54"	19.57
Riverfront Bond St. – Adam's Field(2)	60"	23.95

(1)Based on Maximum Velocity of 5 fps
(2)Based on Minimum Velocity of 2 fp

3.10 SLUDGE TREATMENT AND DISPOSAL:

Sludge disposal is anticipated to be handled in the same manner which the Utility currently uses. The sludge will be stabilized and land applied on a remote site. The need for temporary storage facilities on the plant site for stabilized sludge will be determined during design.

Little Maumelle River Subbasin Sewerage Study
Exhibit 6
Wastewater Interceptors



Interceptor Size & Type		Total Length (Linear Feet)
┈	24" Force Main	23,903
┈	30" Force Main	9,165
🟥	30" Gravity Main	11,364
━	36" Gravity Main	2,424
🟦	42" Gravity Main	15,895
🟫	54" Gravity Main	9,904
🟩	60" Gravity Main	9,393
─	Collectors	

SECTION IV

ALTERNATIVES

4.1 ALTERNATIVES CONSIDERED:

Alternatives considered for this project include:

1. No action
2. Upgrade Pumping Facilities, Construct Flow Equalization Basin, and Construct Parallel Interceptor.
3. New Wastewater Treatment Facility

4.2 DESCRIPTION OF ALTERNATIVES:

1. No action.

This alternative would result in continued wastewater overflows within the Watershed and along the interceptor route. The Utility is being sued by the Sierra Club as a direct result of the overflows. In addition to increased opposition by the Sierra Club, wastewater overflows are generally not allowed by NPDES policy as enforced by ADEQ.

2. Upgrade Pumping Facilities, Construct Flow Equalization Basin, and Construct Parallel Interceptor

The Little Maumelle Pump Station and the Cantrell Pump Station would be upgraded to transport a minimum of average daily flows that are to be expected from the Watershed for the design year. To address infiltration and inflow during wet weather periods a flow equalization basin would be constructed near the existing Little Maumelle Pump Station. Wet weather flows would be diverted into the flow equalization basin. Wastewater stored in the flow equalization basin would be transported through the system during off-peak periods.

The existing interceptors do not have adequate capacity to transport the wastewater from the Watershed to Adam's Field, therefore; a 36- inch parallel interceptor is proposed to accommodate the flows from the Watershed. The parallel interceptor will require construction through downtown Little Rock along Highway 10 (Cantrell).

3. Wastewater Treatment Facility

The third alternative is to construct a new wastewater treatment plant (WWTP) on a site near the Little Maumelle Pump Station. Costs have been developed using an activated sludge treatment process with nitrification, recognizing that nitrification may not be required depending on the discharge location. The Utility currently utilizes similar treatment facility at its Fourche Treatment plant without nitrification, which has an excellent compliance record. Facilities for sludge stabilization would also be provided, although not perhaps initially, with final disposal or beneficial use of treatment residuals off-site.

In evaluating potential sites for a new WWTP, it is important to consider the maximum size plant that ultimately may be required with complete urbanization of the contributing area. As shown in Table 9, the study area is projected to generate 16.5 MGD in wastewater flow at full buildout. Including a buffer zone around the developed treatment facility, a minimum of 50 acres is recommended for a new plant. All of the sites being considered are approximately this size or larger. For comparison, the existing 36 MGD Adams Field WWTP is located on a 30 acre site, and the 15 MGD Fourche Creek WWTP is located on a 70 acre site.

Four sites have been selected as potential locations for the new facility. The sites are shown in Exhibit 5 and are discussed below. Each of these sites has certain costs that are related only to that particular site and will be considered to be above the cost of the basic treatment plant. These costs are separated in this study and can be used as one factor in making a final selection of the facility's site.

Site 1

The City of Little Rock owns this property. The location of this site takes advantage of the existing infrastructure by utilizing the Little Maumelle Pump Station and the Force Main along a county road to transport wastewater to the treatment facility. In addition, the existing force main could be utilized to discharge treated effluent downstream of Murray Lock and Dam. The site is situated within the 100-year floodplain, which would mandate the construction of levees along the perimeter of the property. This site is the most visible site from the Walton Heights area, which mounted enormous public opposition during presentation of the 201 Facility Plan in April 1977. Appropriate facility planning of the wastewater treatment facility will reduce odors and aesthetic modifications should overcome public opposition.

Site 2

This location would require acquisition of private property. The location would require at least one water crossing of the Little Maumelle River. An additional crossing may be necessary to discharge the effluent in the Arkansas River. The existing Little Maumelle Pump Station could be used as head-works into the facility, since the construction of a gravity system is unlikely due to the high possibility of aerial crossings being required at the Little Maumelle River. The construction of levees around the perimeter of the property will be necessary for flood control. This location is the most secluded site.

Site 3

The influent wastewater can flow by gravity to this site. The effluent could be easily pumped from the existing Little Maumelle Pump Station to the Arkansas River above or below the Murray Lock and Dam utilizing the existing Force Main. The wastewater treatment plant could be designed to offset wet weather flows by constructing flow equalization basins; therefore, the Little Maumelle Pump Station would not require an upgrade until effluent discharge rates neared maximum pump capacity. The location would require acquisition of private property. Land use of the property is recreational with a large horse farm, including multi-purpose buildings, barn, and soccer fields.

A portion of the site could be designed outside of the 100-year floodplain; thus not requiring levees around the entire site perimeter.

Site 4

Influent wastewater could gravity flow to the site. The effluent could then gravity flow to the Little Maumelle Pump Station, and then be pumped to the Arkansas River above or below the Murray Lock and Dam utilizing the existing Force Main. The wastewater treatment plant could be designed to offset high wet weather flows by constructing flow equalization basins. As with Site 3, flow equalization basins would be designed in conjunction with the limitations of the Little Maumelle Pump Station. The location would require acquisition of private property. The current land use is agricultural. The site is within the 100- year floodplain and would require levees around the site perimeter. This site would also be visible from residential development.

4.3 COST ANALYSIS OF EACH ALTERNATIVE:

1. No action.

No additional costs would be incurred if the "no action" alternative were selected.

2. Upgrade Pumping Facilities, Construct Flow Equalization Basin, and Construct Parallel Interceptor.

   Costs for Alternative 2 are presented in Table 11.

Table 11: New Interceptor and Pump Station Upgrade Cost

Item	Unit	Qty	Unit Cost	Amount
Upgrade Little Maumelle Pump Station	LS	1	$1,500,000	$1,500,000
Flow Equalization Basin (10 million gallon storage)	LS	1	$1,000,000	$1,000,000
Upgrade Cantrell Pump Station	LS	1	$3,000,000	$3,000,000
Parallel Interceptor – Force Main (Rural)	LF	23903	$52.00	$1,243,000
Parallel Interceptor – Force Main (Urban-Cantrell East)	LF	9165	$85.00	$779,000
Gravity Parallel Interceptor (Rural-Rebsamen-Cantrell)	LF	29421	$225,000	$6,620,000
Gravity Parallel Interceptor (Urban-Riverfront-Adams)	LF	20559	$325,000	$6,682,000
R-O-W Easement 30 ft Wide	LF	82048	$10.00	$820,000
Subtotal				$21,644,000
Engineering, Legal & Contingency	35% of Construction Cost			$7,575,000
Total Construction Cost				$29,219,000
Additional Operation and Maintenance Cost	Additional pumping, line maintenance, and treatment			$550,000

3. Wastewater Treatment Facility

   It is not the intent of this study to size any component of the treatment plant, but the general cost of a treatment plant has been developed in order to compare with the alternative of transporting the wastewater to the Adams Field Treatment Facility. Presented below is the basic design philosophy that is recommended for a new plant in the Little Maumelle River area.

Project Phasing

The proposed Little Maumelle River WWTP is projected to require a capacity of 4.4 MGD average daily flow in 2025. Since initial flows will be in the range of 2.0 – 3.0 MGD, it is recommended that the initial plant be constructed with a capacity of 4.0 MGD, with the provision for easily enlarging and/or upgrading the plant in the future. The plant site should also be master planned to enable further expansion to the ultimate projected capacity of 16.5 MGD.

Desired Operating Characteristics

The required 4.4 MGD plant in the Little Maumelle River watershed will be smaller and more remote compared to the City's larger, fully integrated Adams Field and Fourche Creek facilities. Therefore, certain operating characteristics should be incorporated consistent with the more remote location and availability of city staff resources to operate and maintain the plant. These characteristics are listed below.

- The plant should be simple to operate without requiring complex procedures or intensive on-site monitoring.
- The plant should be capable of running unattended. It would normally be unattended for two shifts per day, although it should be possible to leave it unattended for longer periods if desired, such as over a weekend.
- The plant should reliably achieve discharge permit limits over all anticipated flow and loading ranges.
- The plant should utilize conventional equipment that minimizes maintenance requirements. Equipment requiring frequent or complex maintenance should be avoided.

- The plant should incorporate the latest energy efficiency measures where feasible.
- The plant should have a low odor producing potential, and any odor generating processes or equipment should be equipped with appropriate odor control measures.
- The plant should be equipped with a Supervisory Control and Data Acquisition (SCADA) system as an extension of the City's existing SCADA system. This will allow remote monitoring and control of the entire plant from either the Adams Field or Fourche Creek facility.

Plant Design Philosophy

To be consistent with the desired operating characteristics, it is recommended that the plant be a fully aerobic process which will minimize odors and reduce operations complexity. For this reason primary clarifiers should not be used. These units would require handling raw primary sludge, a difficult material, and would increase the odor producing potential. While primary clarifiers are an efficient process common at large plants, they are not considered appropriate for small plants in the size range being considered; however, in master planning future phases, the option of adding primary clarifiers in the future should be incorporated into the site planning.

Attached growth processes, such as trickling filters, are a proven process and can be designed to achieve nitrification. However, in warm climates significant operations effort is required to control snails and filter flies, so this process is not considered appropriate for a new satellite treatment plant. Instead, activated sludge or one of its variants is recommended.

It is assumed at this point that some type of on-site sludge stabilization will be required. However, the most expedient means of sludge management, at least in the initial phases, would be to simply convey waste activated sludge to the Rebsamen interceptor via the Little Maumelle force main, and thence to the Adams Field WWTP for final treatment. Waste sludge from the proposed 4.0 MGD plant should average 100,000 gpd or less, and, with a solids concentration of less than 1%, it would be primarily water. While uncommon, this means of waste sludge management is being practiced in some places (e.g., San Antonio, Texas) without causing problems downstream.

For on-site stabilization, the provision of anaerobic digestion would require more operator attention and could produce fugitive odors. This process is capital intensive and complex, and is not recommended for plants under 10 MGD. Accordingly, aerobic digestion is assumed for costing purposes as the means of on-site sludge stabilization.

For peak flow management, a stormwater holding basin is proposed and is included in the cost estimate. A peak flow of 20 MGD was projected for the 2025 average daily flow of 4.4 MGD. It is assumed that a 10 MG storage basin would be provided which is the same size as calculated for the parallel line alternative.

Proposed Treatment Processes

Consistent with the above design philosophy and considering the proposed setting, a new Little Maumelle River satellite treatment plant should be a fully aerobic process with low odor producing potential. The following treatment process units are recommended:

- Refurbish existing Little Maumelle River pump station.
- Headworks with fine screening, screenings compaction and dewatering, grit removal, and grit washing.

- Conventional activated sludge system without primary clarifiers incorporating single stage nitrification (if required), fine bubble diffusers, and separate blower facility. Alternatively, an extended aeration oxidation ditch system could be used which would provide greater peak flow buffering and greater operational stability at slightly increased construction cost.
- Two secondary clarifiers incorporating modern clarifier optimization components.
- To avoid on-site storage of chlorine gas and need for a risk management plan, alternative disinfection should be used such as ultraviolet (UV) radiation or liquid sodium hypochlorite. The suitability of UV disinfection would require more detailed investigation to determine compatibility with projected peak flows and a 30/30 discharge permit limit.
- Aerobic digestion of waste sludge to achieve Class B stabilization standards suitable for land application (or an appropriate Class A process, such as heat drying, depending on the means of final disposal).
- Sludge thickening to enable use of a smaller and more efficient aerobic digester.
- Sludge dewatering and off-site transportation of sludge cake.
- Necessary support facilities such as a small operations/lab/ maintenance building, utilities, yard piping, flow distribution structures, plant water system, and flood control levee.
- Required off-site improvements to construct an entrance road to the selected site, and bring in electrical power and city water.
- Implementation of a SCADA system to allow remote monitoring and control of plant processes and conditions.

A representative cost estimate for a new 4.0 MGD WWTP on an undeveloped site incorporating the above processes is provided in Table 12

Table 12
Little Maumelle River WWTP
Construction Cost Opinion

Proposed Capacity: 4.0 MGD

Process	*Representative Cost*
Site Work	
Clearing and grubbing (6 acres)	$30,000
Service roads	$20,000
Finish grading	$35,000
Pump Station	$1,500,000
Headworks with Odor Control	$900,000
Aeration Basins	$2,000,000
Blower Facility	$300,000
Secondary Clarifiers (2 @ 85 ft dia.)	$600,000
UV Disinfection	$800,000
Solids Processing	
Sludge Pump Station	$100,000
Aerobic Digester	$500,000
Thickening & Dewatering Facility	$1,000,000
Sludge Hauling Truck	$80,000
Peak Flow Storage Basin	$1,000,000
Support Facilities	
Small Operations/Lab/Maintenance Bldg.	$200,000
Flow Distribution Box	$40,000
Yard Piping	$600,000
Plant Water System	$30,000
SCADA Instrumentation	$250,000
Electrical work	$1,500,000
Perimeter Levee	$500,000
Offsite Construction Allowances	
Entrance Road	$200,000
Water Line	$200,000
Power Line	$200,000
Subtotal	$12,585,000
Contractor Overhead & Profit, 15%	$1,888,000
Professional Services, 15%	$1,888,000
Contingencies, 20%	$2,517,000
Total Capital Cost	$18,878,000

Table 12 assumes that the Lake Maumelle Pump Station will be rehabilitated and used with the existing force main as the plant influent Pump Station. Also, the estimate does not include site acquisition costs, if required, or any additional costs for transporting effluent to a remote discharge point.

An estimate of annual O& M cost for the plant is provided in Table 13.

Table 13: 4.0 MGD WWTP Estimated O&M Costs

CATERGORY	ANNUAL O&M COST
Power	$200,000
Labor	70,000
Chemicals	50,000
Maintenance	50,000
Sludge Disposal	160,000
Laboratory	30,000
Regulatory/permitting	10,000
Miscellaneous	30,000
Total Annual Cost	$600,000

A summary of the cost for Alternatives 2 and 3 are presented in the table below. This summary uses a present worth factor for the operation and maintenance cost of 6-3/8 percent per year. The design period of 20 years is also used in the analysis. As can be seen, Alternative 3 is the most cost-effective. For this reason, Alternative 3, construction of a new wastewater treatment plant to serve the Little Maumelle River watershed, is selected for implementation.

Table 14: Cost Analysis Summary

OPTION	INITIAL COST	0 & M COST	0&M PRESENT WORTH	TOTAL PRESENT WORTH
Alternative Two	$29,219,000	$550,000	$6,118,000	$35,337,000
Alternative Three	$18,878,000	$600,000	$6,674,000	$25,552,000

4.4 ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES:

The beneficial effects of all the alternatives considered will ultimately result in improved water quality in nearby receiving streams. The Alternative of "No Action" would result in the water quality of the receiving streams to stay the same or possibly deteriorate with re-occurring sanitary sewer overflows.

No long term adverse primary or secondary environmental impacts would result from any of the alternatives. During the construction of the proposed lines, short-term adverse impacts will result from the actual construction process. However, provisions will be included in the construction of the project to minimize these impacts.

Some of the proposed improvements and sewer lines will be located in wetland areas and floodplains. These areas will be identified and the appropriate permit will be applied for. The sewer lines will be underground and will not impact the wetlands. The Utility has a nationwide permit to construct lines in these types of areas. A copy of this engineering report will be provided to the Corps of Engineers with a request to include this project under the nationwide permit.

Manholes in the wetlands will protrude above ground to keep water out of the sewer lines during high water. These manholes will not adversely affect the wetlands or the flood plain. Flood control levees will be constructed around the perimeter of the wastewater treatment facilities removing the hazard of flood inundation.

Long-term beneficial impacts also include capability to meet NPDES requirements enforced by ADEQ.

4.5 REASONS FOR ACCEPTING / REJECTING ALTERNATIVES:

Alternatives were evaluated based upon cost effectiveness, degree of operation/maintenance ease, and impacts on the environment. All the construction alternatives would provide the necessary sewer service and should have minimal impacts on the environment.

Alternative 3, construction of a new treatment facility, was selected because of cost effectiveness.

SECTION V

ENVIRONMENTAL SETTING

5.1 GEOLOGY:

Generally, bedrock in the proposed sewer line locations is very deep. None should be encountered in the construction of the project.

5.2 PHYSIOGRAPHY AND TOPOGRAPHY:

The topography of the Little Maumelle River Watershed is undulating. Gentle flat slopes are present in the agricultural areas of the Little Maumelle River, while steep slopes exceeding eight percent are present near the areas of Pinnacle Mountain. Of the eleven subbasins most exhibit relief beyond 300 feet, except for subbasin 60010. The majority of subbasin 60010 lies within the 100-year floodplain. As such, the wastewater flows from the Little Maumelle River Watershed converge through subbasin 60010.

Table 13 gives the average peak and low elevation, to the nearest ten-foot interval, for each subbasin within the Watershed. Tributaries within each subbasin are also shown.

Table 15: Topographic Range and Tributaries

Sub-basin	Highest Elevation	Lowest Elevation	Tributaries
60010	270	250	Little Maumelle River
60100	530	260	Little Maumelle River
60200	810	260	Little Maumelle River
60301	930	250	Little Maumelle River
60302	940	260	Little Maumelle River
60400	1050	290	Little Maumelle River
60500	680	320	Little Maumelle River Fletcher Creek
60600	810	320	Little Maumelle River Ferndale Creek
60700	740	410	Little Maumelle River Hog Creek
60800	760	290	Little Maumelle River Neal Creek Kennerley Creek
60900	860	280	Nowlin Creek

Note: Elevations are NGVD 1929 to the nearest 10 feet

5.3 SOILS:

The "Soil Survey of Pulaski County" indicates the majority of the soils in the Watershed are composed within the Carnasaw-Mountainburg association and the Sallisaw-Leadvale association. The low- lying area within Subbasin 60010 indicates soil within the Rilla-Keo, Perrry Norwood, and Bruno-Crevasse associations.

The Carnasaw-Mountainburg association is well drained, gently sloping to steep, moderately deep and shallow, loamy and stony soils on hills, mountains, and ridges. It is predominantly clayey material with bedrock depths of 40 inches or less in places. The soils exhibit low permeability, but are moderately deep over bedrock. Typically this soil can support sewage lagoons when the bedrock strata is beyond forty inches from the surface and where slopes do not exceed seven percent.

The Sallisaw-Leadvale association is well drained to moderately well drained, nearly level to gently sloping, and with deep, loamy soils in valleys. Shallow excavations can be made encountering coarse fragments. This soil does not adequately support septic tank absorption fields. Sewage lagoons will exhibit moderate permeability above twenty- seven inches in depth. High permeability is present beyond twenty- seven inches and when slopes exceed seven percent.

Rilla-Keo association is well drained, level to gently sloping, with deep, loamy soils on bottomlands. Perry-Norwood Association ranges from poorly drained to well drained, level, deep, clayey and loamy soils on bottomlands. Bruno-Crevasse Association is excessively drained, level to nearly level, deep, loamy and sandy soils on bottomlands. Suitability of septic tank absorption fields and sewage lagoons for these soil associations ranges from moderate to unfavorable.

5.4 CLIMATOLOGY:

The Little Rock planning area lies in a semi-humid region characterized by long summers, relatively short winters, and wide range of temperatures. Extremes in air temperatures may vary from winter lows near 0 degrees Fahrenheit, to summer highs above 100 degrees Fahrenheit. The growing season averages 244 days per year.

Average pan evaporation is about 54.9 inches for the planning area. Lake evaporation averages about 69 percent of the Class A pan evaporation. Precipitation is well distributed throughout the year with the driest periods occurring during the late summer and early fall. Mean annual precipitation in the area ranges from 48 to 52 inches per year.

5.5 HYDROLOGY:

Little Rock's municipal water comes from Lake Maumelle and Lake Winona. The proposed project will have no impact upon the water supplies.

5.6 RECEIVING STREAM:

The existing treatment facilities discharge into the Arkansas River. No increased flow will result as a result of the proposed project. At the USGS gauging station located at Murray Dam in Little Rock, the Arkansas River drainage area is 158,030 square miles.

The water quality of the Arkansas River varies within its watershed. The forested perimeter areas have the highest water quality with the quality declining as the water flows through pastures and cropland. The quality has shown improvement in the past 25 years due to the completion of the McClellan-Kerr Navigation System and the more stringent water pollution laws.

The maximum-recorded flow at the Broadway Bridge gauging station was 536,000 cfs in May of 1943, and the minimum flow was 14 cfs in October of 1978. The average recorded flow since 1927 is 40,270 cfs. Mean monthly averages from 1970-1984 varied from a low of 12,290 cfs in July to 70,300 cfs in October.

The 7Q10 flow for the 1970-84 period amounted to 684 cfs. Minimum instream flows have been proposed, based upon interstate compacts (IC), fish and wildlife (FW) and navigation (N) requirements. No additional flow to the receiving stream will occur as a result of the proposed project. The proposed minimum instream flows are as follows:

Table 16: Arkansas River Flow Requirements

NOV.-MAR	APR.-JUNE	JULY-OCT.
FLOW, REQM'T	FLOW, REQM'T.	FLOW, REQM'T
4,361cfs, FW	6,778 cfs, FW	3,000 cfs, N

5.7 BIOLOGICAL ELEMENTS:

There are no known threatened or endangered species in the project area. Although some of the project area is considered to be in wetlands, the project will not adversely impact the wetlands. Wildlife in this area consists of the normal species that inhabit Arkansas; rabbits, squirrels, deer, etc. The project will not hinder the wildlife once it is built.

5.8 CULTURAL ELEMENTS:

There are no known historical structures or landmarks in the project area. No archeological survey has been performed. The wastewater treatment facility located at Site 1 has been converted into park space by the City of Little Rock. Site 1 was utilized as the Pulaski county penal facility, which utilized agricultural practices.

5.9 NATIONAL NATURAL LANDMARKS:

There are no known national natural landmarks in the project area.

5.10 ENVIRONMENTAL SENSITIVE AREAS:

The project is located in an area containing marginal wetlands, and a Corps of Engineers' 404 permit determination must be made. A determination will be requested of the Corps.

There are no important farmlands, wild and scenic rivers, coastal zones, barrier islands, natural parks, national forests or refuges near the project location.

5.11 SOCIO-ECONOMIC:

The population projections presented within this study dictate growth for the Watershed through the design period. Without wastewater facilities in place for the projected growth, emergency ordinances could be enacted to restrict developments, stunting potential economic investment within the western city limits and Pulaski County.

Construction and operation of wastewater infrastructure will create and sustain employment. Increased maintenance and operational requirements for the proposed improvements will create long term employment for the design life of the infrastructure.

5.12 COMMUNITY NEEDS:

In addition to regulatory and legal issues involved with this project, the community needs an avenue to effectively transport and treat wastewater within the community. Continued overflows will result in an unsanitary community.

5.13 LAND USE:

Land use for the project area was provided on Exhibit 3.

SECTION VI

ENVIRONMENTAL IMPACTS

6.1 TRAFFIC DISRUPTION:

There will be some effects on traffic within project area since the project will be constructed near the residential areas and streets. These effects are considered minimal.

Alternative 2 will cause traffic disruption along Highway 10, which serves as a main arterial for traffic to downtown Little Rock.

6.2 EROSION AND SEDIMENTATION:

Erosion during the construction of the proposed project is not anticipated to be a problem. The contractor will be required to seed all areas he disturbs during construction. The watercourses should not experience any adverse siltation or sedimentation.

6.3 LOSS OF VEGETATION:

Vegetation will be removed in the areas where construction of the proposed project will occur. Stumps will be burned and/or buried on site. Any excess soil will be taken off site and disposed of in a satisfactory location.

6.4 NOISE:

The construction area is near residential and commercial areas and some construction related noise will be unavoidable. This noise will not have an adverse impact on any of these areas.

6.5 ODOR:

Minimal odors are expected from the construction of this project. Final design of the wastewater treatment facility will contain provisions to reduce or eliminate odors.

6.6 DUST CONTROL MEASURES:

The contractor will use water trucks to wet the soil and keep the dust from leaving the construction site. No dust control issues should be related to completed facilities and infrastructure.

6.7 BY-PASSING:

No bypassing will occur.

6.8 AESTHETIC VALUES:

The Utility is cognizant of the areas where the general population is concerned with aesthetics. The Utility will address the concerns during the final design phase.

6.9 LONG-TERM AND SECONDARY IMPACTS OF GROWTH:

The current infrastructure cannot accommodate wastewater flows from the Watershed. Overflows have been documented by the Utility, and the Utility is involved in a lawsuit with the Sierra Club regarding chronic sanitary sewer overflows within the project area.

Individual wastewater treatment facilities could be installed without monitoring in sparsely populated areas. The soils in the project area are not generally conducive to septic tank systems. Low permeable soils and individually operated package treatment system will degrade water quality, contaminate water wells, or impair clean water lakes.

SECTION VII

COORDINATION AND DOCUMENTATION

A copy of the Environmental Information Document will be sent to the following agencies for their input and/or comments:

Little Rock District, Corps of Engineers

Arkansas Game & Fish Commission

State Clearinghouse

Arkansas Department of Parks & Tourism

U.S. Fish & Wildlife Service

State Historic Preservation Officer

Arkansas State Board of Health

A notification of the availability of the Environmental Information Document will be sent to the following agencies for their comments:

The Honorable Tim Hutchinson
The Honorable Blanche Lincoln
The Honorable Vic Snyder
U.S Department of Agriculture, SCS
Council on Environmental Quality
U.S. EPA, Region VI
Central Arkansas Planning and Development District
State Archeologist
Arkansas Natural Heritage Commission
Arkansas Wildlife Federation
Arkansas State Geologist
Arkansas Soil & Water Conservation Commission
Arkansas Waterways Commission
Arkansas Highway & Transportation Department
Arkansas Forestry Commission
Arkansas Industrial Development Commission
Arkansas Department of Parks & Tourism
Arkansas Natural & Scenic River Commission
League of Women Voters
Arkansas Water Resources
Ozark Society and Sierra Club

SEWER
SERVICE
STUDY

NORTHWEST
LITTLE ROCK

SEWER SERVICE STUDY

NORTHWEST LITTLE ROCK

APRIL, 1980

Little Rock Office of Comprehensive Planning
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TABLE OF CONTENTS

1.0 AN INTRODUCTION TO THE ISSUES

Little Rock is confronted with an important policy issue, the resolution of which will go far toward determining the location and character of future suburban development. This issue arises within the context of identified sewer capacity limitations in northwest Little Rock coupled with significant pressures for new residential development in this area. It seems clear that in the near future, Little Rock will have to make a fundamental decision about how and under what circumstances future development will be allowed to proceed in northwest Little Rock.

Historically, Little Rock has responded to development trends extending sewer and water facilities and constructing needed street improvements on a demand basis as resources permit. Nowhere is this approach to growth more apparent than in northwest Little Rock which has been the community's preferred location for new residential and commercial development over the past twenty years.

As long as sewer facilities were extended within the watershed served by the Adams Field Treatment Plant, growth posed no overriding public utility problems for the community. In recent years, however, development has pushed into the watershed of the Little Maumelle River, thereby necessitating the construction of a costly system of lift stations and force mains to allow additional residential construction in northwest Little Rock to continue. Subsequently, Sewer Improvement District #222 was established by local property owners to extend sewer service to prospective subdivisions and the area was annexed to the City.

More recently, several zoning requests which, if granted, would absorb a significant proportion of the entire sewer capacity made available by the pumping facilities serving District #222, have been considered by the Planning Commission and Board of Directors. These requests surfaced the issue of how much additional development could occur in northwest Little Rock without overloading the sewer system. The Sanitary Sewer Committee has determined that existing and projected improvements can accommodate a total of 11,000 persons within the service area of these pumping stations. Developer expectations for growth in this area, however, are substantially higher.

This study has been undertaken by the Office of Comprehensive Planning at the request of the Board of Directors to ascertain how and under what conditions future land use approvals will be granted in this area. This is a complex and critical issue, one which raises numerous issues of public policy, including the following:

1.) Finanacial inability of the City to undertake major new sewer improvements beyond commitment to existing system and expansion to the southwest.

2.) Lack of federal aid program to assist the community in obtaining wastewater facilities for anticipated growth.

3.) Availability of significant sewer capacity to accommodate growth in the central and southwestern suburbs.

4.) Equity of investing in additional sewer capacity for the Northwest Sector while sufficient capacity to accommodate growth to the year 2000 is available in the West and Southwest Sectors.

5.) Willingness of the City to use sewer facilities as a determinant of future land use patterns, i.e. public utility extensions as a growth management tool.

6.) Absence of sewer service to the Pankey community.

7.) Overriding constraints to the provision of additional sewer service to northwest Little Rock in the absence of a new treatment plant.

8.) Problems associated with redirecting the primary thrust of suburban growth in Little Rock from the Northwest to the West and Southwest Sectors.

These and other policy questions are addressed in this report. Our objective is to set forth the facts and to clarify the issues to bring about an equitable solution of the problem. A number of alternative options are available, and it may be that a combination of several may be the appropriate course for the Little Rock Board of Directors and the Sanitary Sewer Committee to take. The Office of Comprehensive Planning, however, believes that the most reasonable approach for the City to take would be to utilize its land use control powers to establish development densities which would not overload the existing system, together with a careful assessment of the pros and cons of investing additional public funds for sewer expansion in this area.

2.0 GEOGRAPHICAL LOCATION

The service area of the pumping stations serving District #222 occupies approximately 2,400 acres in extreme northwest Little Rock. Study area boundaries are irregular, but encompass the Pebble Beach, Pleasant View, Pleasant Forest subdivisions and portions of Pleasant Valley and Walton Heights subdivisions, together with the Pankey area. The District is roughly bounded on the north by Southridge and Rivercrest Drives, on the east by Rodney Parham Road and on the south and west by the watershed boundary of Ison Creek and Taylor Loop Road. (See Figure 1)

The area is further subdivided in three (3) drainage areas as follows: Hinson Road - 394 acres, Taylor Loop - 1,278 acres, Highway 10 - 744 acres.

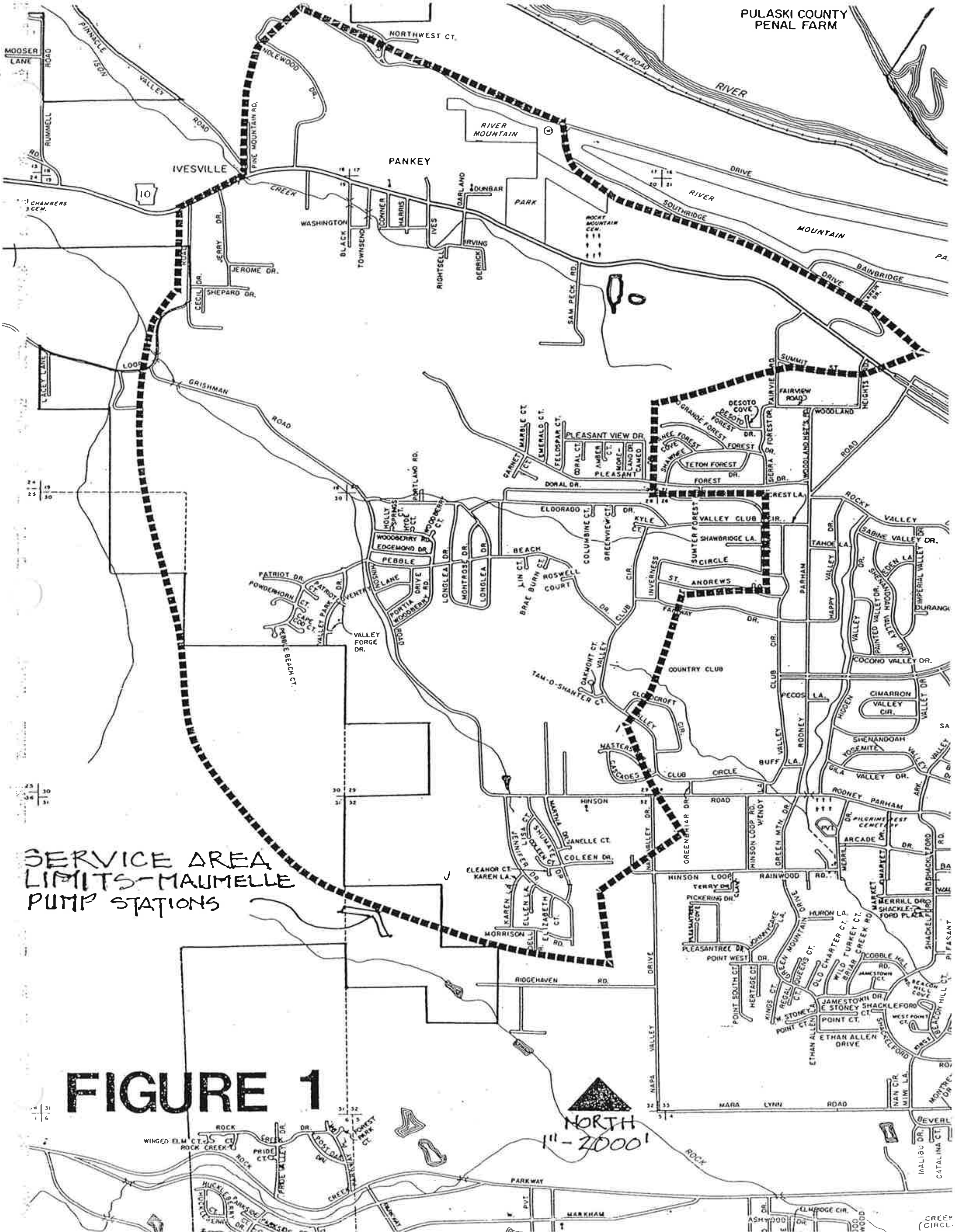


FIGURE 1

SERVICE AREA
LIMITS-MAUMELLE
PUMP STATIONS

3.0 LAND USE AND POPULATION

3.1 Land Use

This 3.8 square mile section of northwest Little Rock is developing as a predominantly single family residential environment with Pleasant Valley and its golf course perhaps best exemplifying the area's image as one of large and attractive homes in a landscaped suburban setting. Lot size in recently approved subdivisions range upwards from a minimum of 1/4 acre to 1/2 acres and more in Pleasant Valley and Longlea.

Development concepts in various stages of approval and construction will continue the established land use pattern except along the Highway 10 Corridor where multi-family, commercial, and office projects have been proposed. Existing multi-family and non-residential land uses in District #222 are scattered along the Highway 10 frontage, but do not constitute a significant land use except at Ivesville just west of Pankey.

As of March, 1980, only 40% of the District has been urbanized and more than two (2) square miles remain available for development. An estimated twenty-five (25) percent of this area, however, consists of public land, steep slopes, areas located above the highest elevation which can be served by the municipal water system, or otherwise restricted for urban use.

3.2 Population

The population of District #222 approximates 5,000 persons. ? with a sufficient number of improved, but still undeveloped single family lots (558) to increase that number to 6,800 persons. Residential densities amount to 6.5 persons per developed acre, a figure which will rise as the remaining improved lots are built on. When Pleasant Valley Golf Course, recreational facilities owned in common by subdivision residents and street rights-of-way are taken into account, the prevalent residential density within this portion of northwest Little Rock approximates two (2) single family homes per gross acre.

Future land use in the remaining 1,462 undeveloped acres of District #222 will be a factor of utility capacity, market forces, topographic constraints, and the Suburban Development Plan. At this time, developers, the Office of Comprehensive Planning, the Sanitary Sewer Committee, and the City Board of Directors are all in agreement that no major shift in prevailing land use patterns should occur. The primary issue in question (aside from the location of a commercial complex to serve everyday shopping needs of residents) is the density and configuration of future residential construction. Statistical material relating to existing land use assembled by the Office of Comprehensive Planning should be of considerable value in quantifying previous development patterns and identifying options and appropriate densities for future developments.

TABLE 1

RESIDENTIAL DEVELOPMENT AS OF 1980

SINGLE FAMILY LOTS		OTHER RESIDENTIAL LOTS(1)	TOTAL LOTS
Developed	1,515	14	1,529
Unbuilt	558	-	558
Total	2,073	14	2,087

(1) Mobile homes, duplexes, apartments

TABLE 2

ESTIMATED POPULATION

CURRENT(1)	ANTICIPATED(2)	ULTIMATE(3)
4,969	6,783	11,000

(1) Estimate of 3.25 persons per unit; source ULI - the Urban Land Institute ?

(2) Assumes construction of all vacant lots with improvements in place.

(3) Sanitary Sewer Committee policy limits

Source: Office of Comprehensive Planning Land Use Survey, March 1980.

TABLE 3

LAND USE 1980

LAND USE TYPE	ACRES	PERCENT
Single Family (1)	925	38.4
Multi Family (2)	2	.1
Public-Semi Public	9	.3
Office	0	.0
Commercial	9	.3
Industrial	9	.3
Undeveloped	1,462	60.6
Total	2,416	100.0

Source: Office of Comprehensive Planning

(1) Includes improved lots and part of Pleasant Valley Golf Course

(2) Includes duplexes and multi-family

4.0 EVALUATION OF SEWER SERVICE IN NORTHWEST LITTLE ROCK

4.1 Sewer Service

The present master plan for expansion of the Little Rock sewer system is the "Comprehensive Sanitary Sewage Plan for the Little Rock Metropolitan Area, 1969-1980" as published by Metroplan in 1969. In response to the 1973 Annexation Referendum which added approximately 55 square miles to the corporate limits of Little Rock, the Wastewater Utility staff began planning to provide urban level sewer service to this greatly enlarged city by implementing portions of this plan. Although the annexation and a subsequent similar referendum were both declared invalid by the Arkansas Supreme Court, the Utility has continued with plans for providing services to this area, much of which has voluntarily annexed to the City in recent years.

4.2 Proposed Maumelle Treatment Plant

Planning began simultaneously under two separate consultant contracts, one to serve the northwest part of the city and the other to serve the southwest part of the city. Both planning efforts quickly resulted in filing for Federal grant assistance and awarding of a USEPA Step I grant for each area. The preliminary steps in each area indicated a need for two new wastewater treatment plants for the city. One would be required at the mouth of the Valley of the Little Maumelle River to serve the growing northwest Little Rock area and the other would be located somewhere along the bank of Fourche Creek to serve the growing southwest Little Rock area. In 1974, property owners in the northwest Little Rock area formed Sewer Improvement District #222 which was intended to construct the sewage collection system tributary to the proposed Maumelle Treatment Plant. Previously, Sewer Improvement District #142 had been formed for similar purposes to construct the sewage collection system in southwest Little Rock for the new Fourche Plant. The planning for the Fourche Plant was delayed due to continuously changing water quality requirements affecting wastewater treatment discharging into Fourche Creek.

In 1976, the Utility purchased a site for the proposed Maumelle Plant and made public plans for construction of a small (1.25 MGD) secondary treatment plant which would serve the northwest Little Rock area including some existing homes presently on the sewer as well as provide growth capacity for existing suburban development on septic tanks and land planned for future residential development. The homes to be served by the new plant which were presently on the sewer were served by small sewage pumping stations which pumped wastewater over the ridge line into the Grassy Flat Creek sewage collection system which then flowed to the Adams Field Treatment Plant. The planning included this existing service in order to eliminate the small, inefficient pumping stations and remove this load from the Adams Field Plant which was operating at near maximum capacity.

A strong public reaction to the proposed Maumelle Plant arose from northwest area residents. These residents formed an action group called "Community Action for Maumelle Preservation" (CAMP) and lodged their protest with the United States Environmental Protection Agency who was funding the preliminary study and would be subsequently asked to grant construction aid for the proposed plant. EPA's response to the protest was to undertake preparation of an Environmental Impact Statement to answer the questions raised by CAMP and others. The conclusion of the EIS was that the project, as conceived, would not meet the regulations to allow use of EPA grant funds to construct a wastewater treatment plant due to a lack of demonstrated existing pollution problems. The EIS concluded by recommending that no subsequent grants be awarded for this project but failed to address the environmental questions which arose in the protest.

At the request of the Little Rock City Board of Directors, the Sewer Committee decided not to build the proposed plant on the site previously purchased for this purpose and sold the site back to the original owners, while declaring that a site for a proposed plant site acceptable to all concerned be sought. Due to the lack of Federal Grant assistance, the Utility turned its attention to the Fourche project. The preliminary study for the Fourche project was completed in 1978 which recommended construction of a new 15 MGD wastewater treatment plant on the bank of the Arkansas River in the vicinity of the Little Rock Port Industrial Park and that the wastewater from the existing and anticipated growth in Southwest Little Rock be piped to this plant for treatment and discharged directly to the Arkansas River. The conclusions of this preliminary study were approved by EPA and a subsequent grant for detailed design work was awarded in July, 1979. Present plans are for design to be completed in late summer, 1980, a construction grant awarded by September 30, 1980, and commencement of construction on this facility in early 1981.

4.3 Interim Improvements

At the same time as a "stop gap" to the delay in construction of the Maumelle Plant, the Utility proceeded with design and construction of a series of three new pumping stations in the Maumelle Valley. These pumping stations were intended to maximize the availability of wastewater handling capacity of the sewer system in the area without construction of a new wastewater treatment plant. These new stations were completed in 1979 at a cost of $600,000.00 all of which was from Utility construction funds without any Federal grant benefits. Utilization of the new stations is anticipated in the spring of 1980 on completion of a "scaled down" Sewer Improvement District 222 which was designed and is being constructed to utilize these pumping stations in a limited service area.

4.4 Planned Capital Wastewater Utility Projects

The present capital improvement plans of the Wastewater Utility are to construct the new Fourche Plant and its associated sewer lines at an estimated cost of 25 million dollars, 75 percent of which is U.S. EPA grants and 25 percent of which will be Wastewater

Utility funds, and also to enlarge the present Adams Field Plant at an estimated cost of 15 million dollars also benefiting from 75% EPA grants. Both of these projects are planned to be completed by 1985.

The local funds which will be required for these two projects are in excess of 10 million dollars. Present Wastewater Utility reserve funds are approximately 2 million dollars and the present sewer rates which were raised approximately 37% in December, 1979, will support a revenue bond issue of 4 to 5 million dollars. This means that a subsequent sewer rate increase of major proportions is necessary just to meet the balance of local funds required for these two projects. For this reason it is apparent that no subsequent multi-million project can be funded by the Wastewater Utility until at least after 1985.

The existing wastewater facilities in the Maumelle Valley portion of northwest Little Rock, although admittedly temporary and inadequate for the projected needs of the area, will likely be required to serve without supplement or replacement until the late 1980's.

5.0 SUBURBAN DEVELOPMENT PLAN

A fundamental assumption of the Suburban Development Plan is that no sewage treatment plant will be constructed within the Little Maumelle drainage basin prior to the Year 2000 and that future urbanization in northwest Little Rock will be restricted to what can be reasonably accommodated by the existing sewage system.

The Suburban Development Plan proposes a predominantly single family residential land use pattern for the northwest Little Rock area. Residential densities expected to range from as many as four (4) units per acre in conventional subdivisions to low density developments in rugged areas with one (1) home per two (2) or three (3) acres. In addition, the Plan envisions three (3) high intensity urban concentrations. The first of these is situated at the intersection of Highway 10 and Rodney Parham Road which is suggested as the location of a cluster of suburban offices, neighborhood commercial uses, and attached residential development. A second concentration is suggested at Ivesville in the vicinity of Highway 10, Taylor Loop Road intersection approximately two (2) miles west of Rodney Parham Road. This node would provide for expansion of existing highway commercial uses together with areas designated for attached residential development. Further, a small concentration of single family attached residences is suggested in the vicinity of the Hinson Road and Beckenham Drive. Pankey is to remain residential.

Urbanization in the Northwest Sector is expected to be limited to the approximately two (2) square miles of vacant land within the boundaries of the service area which have been provided with sewer service and remains available for development. This process will have run its course by the mid to late 1980's, at which time there will be 4,000 to 5,000 new residents in the area, development will extend as far west as Taylor Loop Road, and all available sewer capacity will have been exhausted.

At that point, the primary thrust of urban development is expected to shift to the West and Southwest Sectors. Several factors are set forth as justification for this rather dramatic redirection of Little Rock's anticipated pattern of development. These factors as outlined by the Suburban Plan are:

1.) "the rugged, mountainous terrain which parallel the Arkansas River Bottom on the north and the mountainous region extending from the Pleasant Valley area to the northwest."

2.) "the finite capacity of existing sewer facilities serving the area and limiting future urbanization to a point just beyond the future alignment of an Outerbelt West..."

3.) "the strong desire and tendency for quality development to extend westward from the Pleasant Valley area."

Topographic constraints are an important planning consideration in this area inasmuch as steep slopes preclude most nonresidential uses, increase development costs, and reduce structural densities. A more important development problem for northwest Little Rock, however, is utility capacity, inasmuch as only limited additional building can occur without a modern sewage treatment system.

Two (2) proposed "development policies" recommended for adoption as part of the Suburban Development Plan specifically address this question and further clarify the public issues at stake.

No. 9 Utility Infrastructure Investment

This policy envisions the need to "utilize public facility construction as a growth management tool by requiring investment in sewer...construction to be in conformance with the Suburban Development Plan". This is a fundamental principal of sound land use planning, and one which Little Rock is already implementing as it seeks to coordinate utility construction land use commitments, and extensions of City boundaries.

No. 16 Wastewater Treatment Plant Location

Little Rock is focusing all available federal and local sewer construction funds toward the construction of a new wastewater treatment plant to serve the Fourche Creek area. A primary consequence of this policy will be "to shift development from the Northwest toward the West and Southwest Sectors of the suburban development area. Serviced land available for development in the Northwest Sector is in limited supply..." As yet, the implication of the City's inability to provide utility services sufficient to accommodate future growth in Northwest at past levels is not well understood. Nevertheless, it seems essential that the Suburban Development Plan reflect this recent public action inasmuch as it will take as long as a decade to provide additional wastewater facilities to serve this area.

Both Team Four and the Office of Comprehensive Planning believe that further significant urban development to the northwest along Highway 10 is precluded in the absence of a fundamental shift in public policy and a major commitment of resources to fund and construct the Little Maumelle Sewage Treatment Plant or other additional wastewater facilities to serve the Maumelle Valley. In the event that such a commitment is made, the Suburban Development Plan would have to be amended in anticipation of renewed growth to the northwest.

6.0 CAPACITY AND DEVELOPMENT POTENTIAL

6.1 Residential Demand

The land use survey as outlined in Section 2 of this report identified an existing residential population of 4,969 persons. The survey also counted all vacant lots with improvements in place. These lots were counted, insomuch as approval has been granted by the City and residential construction could begin immediately. These lots were assumed to have a density of one (1) unit per lot equaling a population of 3.25 persons per unit.

Adding the potential population of the developed lots to the existing population of the area results in a total developed population of 6,783 persons. This total equals that portion of the 11,000 person capacity which has been already allocated.

6.2 Non-Residential Demand

Sewer demand for commercial and office uses must be based on the size of the use which is naturally related to the number of potential sewer users. The Wastewater Utility staff determined from its calculation that for each 1,000 square feet of office or commercial uses, the equivalent demand of 1.91 persons would be served. For a 2,000 square foot office use, there would be an equivalent of 3.82 persons being served, of which is roughly equivalent to the 3.25 persons that would be assumed for a 2,000 square foot residential unit.

The land use survey had revealed an approximate total of 600 square feet of office use and a total of 74,300 square feet of commercial uses. These two (2) classifications would then equate to a sewer demand equivalent to 143 persons. This 143 person total should then be added to the previously residential demand of 6,783 persons to set a grand total of a 6,926 person demand on the sewer service system.

6.3 Development Potentials

Table 4 gives a breakdown of the total additional persons who can be added to the Little Maumelle Sewer Service System and not exceed the capacity recommended by the Sanitary Sewer Committee. This total of 4,074 persons could be accommodated throughout the undeveloped 1096.5 acres at a single family density of 1.14 units/acre. The 1096.5 acres was a calculation arrived at by subtracting 25% of the land area out of the remaining undevelopable land of the valley. The wastewater staff determined that 25% of the area was undevelopable due to steep slopes and land at too high of an elevation to be served by municipal water.

The ultimate density figure of 1.14 units/acre mentioned previously, is merely an estimate. There could be as much as a 1/2 unit/acre deviation due to population estimates and land coverage estimates. A precise density figure could be determined if a detailed engineering analysis was performed.

Table 4 also shows population and development estimates using 3.0 persons per unit and 2.75 persons per unit. These estimates were included merely for comparisons. The staff feels that 3.25 persons per unit is a good estimate for a suburban area with many parents in the child rearing ages. However, since this is just an estimate it was felt that other estimates should be explored.

As the chart denotes, the unit per acre figure for remaining development still does not exceed 2 units per acre when you use even the lowest household size estimate of 2.75. The overall effect, then, of a lower household size is not that significant.

Table 5 illustrates the total number of new residential units which could be constructed and not exceed the 11,000 person capacity. The chart shows that 1,250 single family units can be constructed. Again, for comparison purposes, the 3.0 persons per unit and 2.75 persons per unit were used. The result was 1,579 remaining units and 1908 remaining units respectively.

TABLE 4

DEVELOPMENT CAPACITY
LITTLE MAUMELLE VALLEY

EXISTING POPULATION	REMAINING POPULATION CAPACITY(4)	UNDEVELOPED LAND (5)	DEVELOPMENT POTENTIAL
6,926(1)	4,074 Persons	1,462 Acres	1.14 Units/Acre(6)
6,261(2)	4,739 Persons	1,462 Acres	1.44 Units/Acre(7)
5,740(3)	5,260 Persons	1,462 Acres	1.74 Units/Acre(8)

(1) Total of all persons counted and an assumption of 3.25 persons per developed lot and nonresidential uses calculated as 1.91 persons per 1,000 sq. ft. of floor space.

(2) Total of all persons counted and an assumption of 3.0 persons per developed lot and nonresidential uses calculated as 1.91 persons per 1,000 sq. ft. of floor space.

(3) Total of all persons counted and an assumption of 2.75 persons per developed lot and nonresidential uses calculated as 1.91 persons per 1,000 sq. ft. of floor space.

(4) Existing population subtracted from the assumed 11,000 person capacity of the Valley.

(5) Land in which improvements have not been installed.

(6) Development potential assuming a density of 3.25 persons per unit and assuming that 25% of the land is undevelopable due to steep slopes and high elevations.

(7) Development potential assuming a density of 3.0 persons per unit and assuming that 25% of the land is undevelopable due to steep slopes and high elevations.

(8) Development potential assuming a density of 2.75 persons per unit and assuming that 25% of the land is undevelopable due to steep slopes and high elevations.

TABLE 5

REMAINING UNIT CAPACITY

ASSUMED PERSONS PER UNIT (EXISTING & PROJECTED)	POTENTIAL SINGLE FAMILY RESIDENTIAL UNITS
3.25	1,250
3.00	1,579
2.75	1,908

7.0 SANITARY SEWER COMMITTEE POLICY

The policy statement of the Sanitary Sewer Committee (see Appendix A) passed February 17, 1980, states that because of the financial commitments to the construction of the new Fourche Treatment Plant and modernization of the existing Adams Field Plant, there are no monies to construct a plant for the Little Maumelle Valley in the near future.

The policy statement further emphasizes that the existing pumping facilities in the Little Maumelle River Valley have a limited capacity which cannot be expanded due to equally limited capacity in the receiving sewers in the Fourche Creek Valley collection system. The capacity, then, for the Little Maumelle area, is estimated to be between 6,600 and 11,000 persons.

The policy statement then..."declares its policy to exercise what controls are necessary and proper and in the general public interest, to ensure that the capacity of the existing pumping stations is not exceeded before the properties they were constructed to serve have had the opportunity to connect to the sewer. The controls to be exercised are as follows:

1. No approval for sewer service will be given for properties outside the planned "gravity service" areas of these facilities. The boundaries of these service areas are depicted on the map attached to this policy statement.

2. The Committee hereby urges the Little Rock Planning Commission and the Little Rock Board of Directors to consider the population limits of these pumping facilities in their zoning recommendations and decisions, with the goal of not exceeding 11,000 persons or population equivalent in the service area of these facilities. The Committee recognizes the need for a land-use mixture, and does not insist on a uniform population density throughout the service area, providing that the total population does not exceed the maximum 11,000 person goal.

3. These controls will be effective until such time as a definite plan for additional or replacement facilities for sewer service in the Little Maumelle River Valley has been formulated, is acceptable to the citizens of the City and the appropriate State and Federal Pollution Control authorities, and a time schedule and financing plan exists to have the additional or replacement facilities in service before the existing facilities are overloaded.

8.0 SEWER SERVICE ALTERNATIVES

The City of Little Rock can coordinate sewer service extensions with land use control approvals in northwest Little Rock in one (1) of two (2) ways. The first way would be to work toward an engineering solution to this problem, committing the City to provide sufficient sewer capacity to allow continuation of historic growth patterns. This approach would involve constructing a new treatment plant and supplementing the existing system in various ways. It might also necessitate a temporary moratorium on development if available sewer capacity is exhausted before the system improvements can be brought on line. A second approach would be for the City to utilize its land use regulatory powers to limit growth to what can be reasonably accommodated by the existing sewer facilities. Then, when additional capacity is made available at a later date, further development could take place.

8.1 Engineering Options

Several engineering options are outlined below. A variety of technical solutions to the problem are possible, including developing a series of small package plants, and constructing a new sewage treatment facility. Any one of these proposals, however, would increase overall capacity in the Little Maumelle Valley sufficient to allow higher density development than would otherwise be possible. Before the City of Little Rock could undertake one or a combination of these approaches, however, an engineering study to identify potential project costs, system tradeoffs, and a timeframe for completing the necessary improvements will be needed.

Alternative #1 - Individual Treatment Facilities

The Rockefeller Foundation has prepared a report entitled "Alternative Wastewater Management Systems and their Applicability to Arkansas" which was published in December, 1979. This report addresses several types of individual wastewater treatment systems of which one or several could possibly be used in the Little Maumelle River Valley. Some of the systems which could be applicable are septic tanks, leaching trenches, aerobic treatment systems and several others that would have to meet with the Health Department's approval on a case by case basis.

This alternative would serve to limit development due to the fact that individual treatment systems generally require more land area than exists in a "typical" subdivision lot (75 feet X 150 feet).

Alternative #2 - "Package" Plants

Prefabricated "package" wastewater treatment plants capable of serving almost any number of homes are commercially available. Several are now in use in the Little Rock area significantly the Otter Creek Subdivision in Southwest Little Rock, and the Pleasant View Subdivision in Northwest Little Rock. The capital and operating costs of these facilities to achieve the permitted pollution reduction is much higher, on a unit basis, than for a regional plant, as it would be designed to serve an entire city or area.

The two (2) facilities mentioned above were constructed by the developers of the respective subdivisions, and the entire operating costs of each facility is paid by the development, although homes in the developments pay a standard city sewer charge. The package plants were approved by the Utility, State, and Federal authorities, as temporary treatment plants in advance of planned regional sewer systems. The Fourche Project will eliminate the need for the Otter Creek Plant, and the Maumelle Pump Stations will eliminate the need for the Pleasant View Plant.

In addition to the high initial and operation costs, the performance of "package" wastewater treatment plants is often poorer than desired. An additional condition imposed by State and Federal authorities on approval of these plants was that they be operated by Wastewater Utility Treatment Division licensed operators. In spite of this, neither facility has been able to achieve the pollution reduction limits set by their operating permits. The reasons for these failures are not clear, but appear to include the basic design of the facilities, and the amount of operator attention allowed by the budget in daily visits by an operator, whereas, the need appears to be for several hours attention each day by an operator, often assisted by a mechanic.

Alternative #3 - New Treatment Plant

This alternative was proposed in 1976 by the Little Rock Wastewater Utility. Considerable citizen opposition was encountered and as a result the Environmental Protection Agency prepared an Environmental Impact Statement (E.I.S.) for the Little Maumelle River Valley. This E.I.S. concluded that no pollution problem existed in this area, and therefore; the Environmental Protection Agency would not allocate funds for the construction of this facility.

A new study to plan enlargement of the existing Adams Field Wastewater Treatment Plant is now underway and includes the Little Maumelle River Valley. This study will again address the need of this area and the feasibility of a Maumelle Treatment Facility. The Adams Field Step I Facility Plan is scheduled to be completed by December, 1980.

Alternative #4 - One Major Pump Station to Adams Field Plant.

The 208 Areawide Plan proposes that a major pump station be constructed on the Little Maumelle River with the pump station discharging into the River Interceptor at Murry Lock and Dam. This major pump station and force main are currently not EPA grant eligible for the reason stated in Alternative #2 and are therefore, not being pursued at this time. Also, there are some serious questions about whether the proposed force main could be constructed along the Rock Island Railroad River Line, and if the River Interceptor can accept this additional hydraulic load. These questions will be answered in the Admas Field Step I Facility Plan.

Alternative #5 -Increase Capacity of the Highway 10 Taylor Loop Road, and Hinson Road Pump Stations

These pump stations operate in series with the Highway 10 station discharging to Taylor Loop and Taylor Loop discharging to Hinson Road. The Hinson Road Station then pumps the entire drainage area flow (see attached map) into the Grassy Flat Interceptors at Rodney Parham and Hinson Road.

The Hinson Road Pump Station has a design capacity of 2100 gallons per minute (gpm), but the Grassy Flat Interceptor is only designed to handle 1000 gpm flow from the Maumelle Valley. This indicates the Grassy Flat Interceptors will be overloaded when the current Hinson Road Station capacity is reached; therefore, the Hinson Road Station capacity cannot be increased in size.

Constructing another Grassy Flat Interceptor is also impractical due to the limited space that exists, operational problems in flow equalization in three parallel lines, and the large capital investment necessary.

COSTS per D.U. higher
This trend must continue
because

8.2 PLANNING OPTIONS

The City of Little Rock can utilize its municipal land use controls to prevent overloading the sewer system. This approach is gaining currency throughout the United States and probably could be defended under law, even though it would involve significant reductions in development density below what many property owners are presently anticipating.

A fundamental assumption explicit in this approach is that development which would exceed available sewer capacity in northwest Little Rock must be precluded until sufficient capacity is provided. It would be a mistake to allow development to proceed without restraint until an intolerable health hazard sufficient to necessitate remedial engineering improvements has been created. Information available to us suggests that the only way to generate sufficient funds to construct the needed improvements would be to increase sewer rates substantially.

Alternative #1 - Zoning in Conformance with the Suburban Development Plan

Strict adherence to the Suburban Development Plan would permit complete urbanization of the service area at low residential densities. The Plan proposes using the "R-1", "R-2", and "R-3" Single Family classifications in this area and restricting Single Family Attached and Multi-family development to three (3) high intensity urban concentrations. With sufficient capacity to accommodate approximately 1½ residential units per gross acre, the "R-1" Single Family District (which permits minimum 15,000 square foot lots) would be an appropriate zoning designation.

One effect of this approach would be to substantially preclude any form of multi-family or attached development in northwest Little Rock for the foreseeable future, even though the Plan envisions selection of multiple uses at appropriate locations even without formal designation. Office and commercial uses pose no particular problems. They generate service demand equivalent to that of single family residential development and could be accommodated at locations designated for such purposes in the Suburban Development Plan.

A primary advantage of this alternative would be to allow all property owners some development potential on their land. In addition, the City would be assured that it would not be confronted at some later date with the need to undertake additional sewer improvements to remedy system deficiencies in this area. Under this alternative, once the service area is fully built out, major development in northwest Little Rock would cease,

Alternative #2 - Unrestricted Development

This option would allow higher density development at selected locations on a first come first served basis. The principal land use consequence of this approach would be to increase development densities along Highway 10 and several other arterial and collector streets traversing this area. Once remaining capacity, (as determined by the Sanitary Sewer Committee) is exhausted, development would cease. At that time, a moratorium on further development would have to be imposed until such time as needed engineering improvements have been completed.

One argument in favor of this approach is that sufficient capacity remains to permit continued development at historical levels for several more years until the capacity limit is reached. By that time, according to this argument, the City will have been able to expand the capacity sufficient to permit further growth. An obvious weakness of this argument is that if the City is unable to complete necessary system improvements before capacity is exhausted, many property owners who have been taxed to construct the sewer system will be unable to make use of it by developing their property.

Alternative #3 - Shifting of Development Rights (SDR) ✓

This approach would involve dealing with each property owner on an individual basis, by assigning a total development capacity based upon the size of the land owned and district-wide capacity as determined by an objective assessment. The difference between this option and Alternative #1 is that this concept allows density shifts within individual ownerships. At a density of 1.5 units per gross acre, for example, the owner of 50 acres would be given a right to 75 sewer hookups which might then be used to cluster all the density in a single area or spread it evenly across the 50 acres at his option.

SDR offers some advantages in improving site planning by allowing cluster development on favorably situated portions of a property while retaining undevelopable areas as open space. Significant operational problems, however, would be associated with this approach inasmuch as it would be necessary for the City to undertake a detailed survey of land ownership patterns before putting this concept into operation.

9.0 CONCLUSION

The Sanitary Sewer Committee is asking the City Board of Directors to address the sewer capacity issue in the northwest. The Committee wants the Board to adopt a policy that will limit the population capacity in the Maumelle Valley to 11,000 persons. The Committee recognizes that they cannot set land use policy regarding the mixture of land use types or densities or even desire to do so. What they do realize, from an engineering standpoint, is that the system is now constructed to handle no more than 11,000 persons. The Committee, therefore, is asking the City Board of Directors to develop a policy which will guarantee that this capacity goal of 11,000 persons is not exceeded, until such time as supplemental or replacement wastewater facilities are constructed for the Little Maumelle drainage area.

The preceeding analysis suggests that there are no easy solutions to this problem. The practical constraints to expansion of sewer capacity in this area are very real. Even if a decision is made to construct a new sewage treatment plant at public expense and the monies are found, as much as a decade could pass before the new plant would become operational. This fact leads us to the conclusion that the public interest would be best served by imposing a low density single family residential classification throughout the service area. Appropriate commercial and office sites could also be designated. The alternatives to doing something of this sort, which would involve both a potential threat to public health and an increased tax burden on the property owners throughout the City, seem unacceptable.

APPENDIX A

LITTLE ROCK SANITARY SEWER COMMITTEE

POLICY STATEMENT

SERVICE LIMITATIONS IN THE LITTLE MAUMELLE RIVER VALLEY

A part of the extreme northwest part of the city of Little Rock, Arkansas lays in the valley of the Little Maumelle River. No community wastewater treatment facilities exist in this valley, although an attempt to provide such was made in 1976. At that time, the Committee made public plans to construct a regional wastewater treatment plant near the mouth of the Little Maumelle Valley. The United States Environmental Protection Agency conducted an Environmental Impact Statement on the proposed plant, and determined that the existing pollution problems did not justify a grant, therefore the plant was not built as proposed.

The existing public sewers in the valley are intercepted by pumping stations, and the wastewater pumped over the ridge into the sewage collection system in the Fourche Creek Valley. This Fourche Creek system flows to the Adams Field Wastewater Treatment Plant.

The existing pumping stations and force mains were constructed by the Committee in 1979 at a cost of approximately $600,000.00 in Wastewater Utility Funds when it became evident that the construction of the proposed plant would be delayed. These pumping stations are considered interim facilities, to provide service until larger, more permanent pumping and/or treatment facilities for the valley can be provided. The planning for the larger, more permanent facilities has been underway since 1974, and some recommendations may be available by the end of 1980.

It should be recognized by the citizens of Little Rock City officials. and other interested parties, that the size, scope, cost, timing and even feasibility of additional facilities in this Basin are unknown at this time and impossible to predict. Wastewater Utility Financing projections through 1985 do not contain any funds for Maumelle Valley, and without financing there will be no such facilities even if a project desired by the community and acceptable to area residents and pollution control authorities is identified.

The Wastewater Utility capital projects are financed exclusively from user charges and United States Environmental Protection Agency grants, and those resources are allocated to the maximum availability to the planned Fourche Creek Plant and Lines project, and the planned enlargement and modernization of the existing Adams Field Plant. Current estimates of the costs of these two projects, to be completed by 1985, are in excess of Forty Million Dollars. The Committee remain committed to providing permanent facilities in this area, as a priorit following the Fourche and Adams Field projects, subject to availabilit of funds.

It should also be recognized by the citizens of Little Rock, City officials, and other interested parties, that the existing pumping facilities in the Little Maumelle River Valley have a limited capacity, which cannot be expanded due to equally limited capacity in the receiving sewers in the Fourche Creek Valley collection system. The capacity of these pumping facilities has been estimated at between 6,600 persons and 11,000 persons, by various independent analyses by the committee's several consultants who have been involved in the design of the Facilities.

For these reasons, the Committee declares its policy to exercise what controls are necessary and proper and in the general public interest, to ensure that the capacity of the existing pumping stations is not exceeded before the properties they were constructed to serve have had the opportunity to connect to the sewer. The controls to be exercised are as follows:

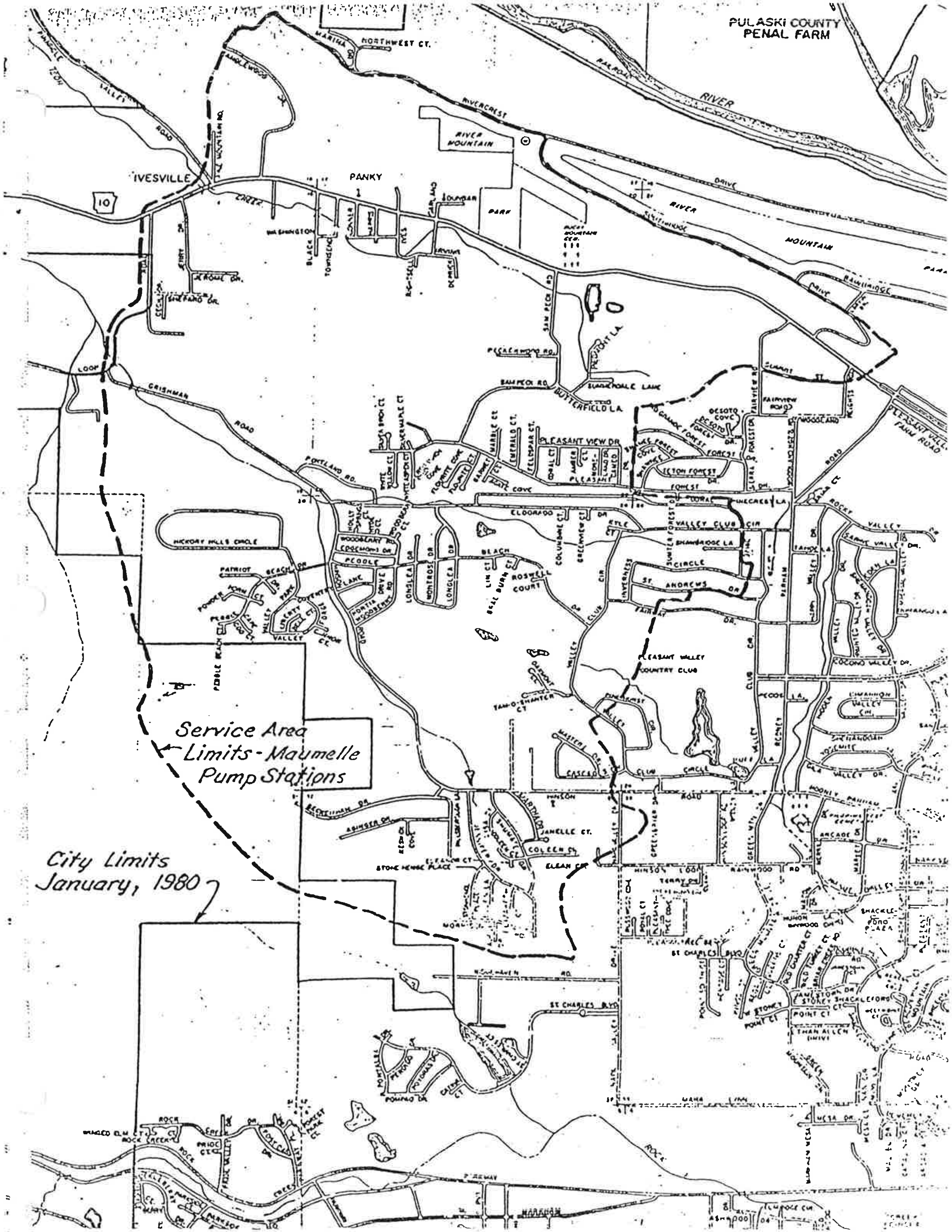
1. No approval for sewer service will be given for properties outside the planned "gravity service" areas of these facilities. The boundaries of these service areas are depicted on the map attached to this policy statement.

2. The Committee hereby urges the Little Rock Planning Commission and the Little Rock Board of Directors to consider the population limits of these pumping facilities in their zoning recommendations and decisions, with the goal of not exceeding 11,000 persons, or population equivalent in the service area of these facilities. The Committee recognizes the need for a land-use mixture, and does not insist on a uniform population density throughout the service area, provided that the total population does not exceed the maximum 11,000 person goal.

3. These controls will be effective until such time as a definite plan for additional or replacement facilities for Sewer Service in the Little Maumelle River Valley has been formulated, is acceptable to the citizens of the city and the appropriate State and Federal Pollution Control authorities, and a time schedule and financing plan exists to have the additional or replacement facilities in service before the existing facilities are overloaded.

Passed and Approved February 19, 1980

Woodson D. Walker, Secretary



Service Area Limits-Maumelle Pump Stations

City Limits January, 1980

APPENDIX B

Garver+Garve

Garver & Garver Incorporated
Engineers and Planners

Eleventh and Battery Streets
Little Rock, Arkansas 72202
501-376-3633

February 13, 1980

Little Rock Wastewater Utility
221 East Capitol
Little Rock, Arkansas 72202

Attention: Mr. Rick Barger, Engineer

Re: Maumelle Pump Stations
Service Area

Gentlemen:

As per your request, we submit this letter report stating our opinion of the service capabilities of the pump stations located in the Maumelle Drainage Basin and the gravity sewage collection system in the Grassy Flat Creek Basin to which these pump stations discharge.

The Maumelle service area is served by three pump stations. These pump stations and their service areas are identified on the exhibit attached to this report and are described as follows:

1) Highway 10 Pump Station	- Firm Capacity = 840 gpm @ 75' TDH - Gravity Service Area = 744 acres - Discharges to Taylor Loop Pump Station
2) Taylor Loop Pump Station	- Firm Capacity = 1500 gpm @ 128' THD - Gravity Service Area = 1278 acres - Discharges to Hinson Road Pump Station
3) Hinson Road Pump Station	- Firm Capacity = 2100 gpm @ 118' TDH - Gravity Service Area = 394 acres - Discharges to Grassy Flat Interceptor

The design criteria which was used to size these stations is as follows:

1) Net Area = Gross drainage area minus those areas that are:

   a) too steep,
   b) in creek flood plains,
   c) above the hydraulic gradient of the city water service, and
   d) golf course

2015 GPD/3.1 = 650

588 X 13 X 650 = 4.969 MGD

2) Development at 2.5 dwelling units per net acre

3) Full Development = 75% buildout

4) Peak Flow = 1000 gallons per day/dwelling unit

The net area was determined to be about 77% of the gross area. This would appear to be a reasonable estimate. The only possible defficiency we see in the service areas is that the service area of the Highway 10 Pump Station was limited to the area south of Highway 10. There are about 408 acres tributary to this station north of Highway 10.

The number of dwelling units per acre used for design seems somewhat light. If we were designing this system, we would probably propose to you that we use an "ultimate" development density of 13 people per gross acre, staged as would seem prudent considering development tendencies in the area. Assuming a per dwelling population of 3.1 persons, the design criteria used computes to a density of 7.75 people per net acre or about 6 people per gross acre.

Sizing of sewage collection facilities is based on maximum instantaneous flowrates. Maximum instantaneous flowrates are related to the water useage characteristics of the population served and the total number of people served. In Little Rock, we use an average sewage flow of 120 gallons per person per day which water consumption records indicate is a fairly safe design number. We also use an empirical formula presented in the Davis Handbook of Hydraulic Engineering which relates the peak flowrate to the average daily flowrate and also accounts for the observed fact that the greater the population served, the more diverse their activities, and the smaller the ratio of peak to average flow. This formula is

$$M = 5/p^{0.2}$$

Where M = multiplier of average flowrate
p = population in 1000's of people

Since no sewer lines are installed to be "bottle-tight", we customarily add a flat rate of 50 gpcd as an infiltration allowance. Using these figures and a population of 3.1 people per dwelling, the maximum instantaneous flowrate computes to be approximately 2,015 gpd per dwelling unit for population areas of less than 1000 people and 1329 gpd per dwelling unit for a service population of 10,000. The maximum flowrates used in sizing these pump stations was 1000 gallons per day per dwelling unit.

The force main from the Hinson Road Pump Station discharges to the Grassy Flat Interceptor sewer just south of Rodney Parham Road. These are 588 acres tributary to the Grassy Flat Interceptor above this point as shown on the attached exhibit. The Grassy Flat Interceptor was designed to serve an ultimate population of 13 people per gross acre. The reason for selection of an "ultimate development" criteria for this line was that this line paralleled an existing sewer in an area developed to the point that space to locate a third line would be almost nonexistent. A third parallel sewer would also have caused considerable maintenance problems associated with flow equalization in three lines and of course would be quite expensive in limited installation space.

During the design of this Grassy Flat Interceptor, the Utility opted to increase the size of the line to permit discharge of approximately 1000 gpm from the Maumelle basin. Attached is a copy of a letter from our office to the Utility concerning this matter which shows the line size at critical points and the "excess" capacity provided above Grassy Flat Creek design population flowrates. The Hinson Road Pump Station has a capacity of 2100 gpm.

In conclusion, using the design criteria outlined above we would compute the capacity of the existing Maumelle Basin pump stations to be as follows:

1)	Highway 10 Pump Station	- Capable of serving 2140 people
2)	Taylor Loop Pump Station	- Capable of serving a total of 4330 people located in its gravity service area and the service area of the Highway 10 Pump Station.
3)	Hinson Road Pump Station	- Capable of serving 6600 people in the entire service area.

We should reiterate that the Grassy Flat Interceptor cannot handle 2100 gpm additional flow at its design buildout of its gravity service area. There most surely is sufficient capacity at this time. How long that will exist is really beyond the scope of this report to determine.

We appreciate the opportunity to be of service to the Utility in this matter. We are available to discuss this report with you at your convenience.

Already handling ~ 950
800 gpm
from existing pumpage
therefore net is
2100 - 800 = 1300

Respectfully submitted,

GARVER & GARVER, INC.

Sanford M. Wilbourn

Sanford M. Wilbourn, P.E.
President

RP/SMW:ge

(12380)

LITTLE ROCK SANITARY SEWER COMMITTEE

POLICY STATEMENT

SERVICE LIMITATIONS IN THE LITTLE MAUMELLE RIVER VALLEY

A part of the extreme northwest part of the city of Little Rock, Arkansas lays in the valley of the Little Maumelle River. No community wastewater treatment facilities exist in this valley, although an attempt to provide such was made in 1976. At that time, the Committee made public plans to construct a regional wastewater treatment plant near the mouth of the Little Maumelle Valley. The United States Environmental Protection Agency conducted an Environmental Impact Statement on the proposed plant, and determined that the existing pollution problems did not justify a grant, therefore the plant was not built as proposed.

The existing public sewers in the valley are intercepted by pumping stations, and the wastewater pumped over the ridge into the sewage collection system in the Fourche Creek Valley. This Fourche Creek system flows to the Adams Field Wastewater Treatment Plant.

The existing pumping stations and force mains were constructed by the Committee in 1979 at a cost of approximately $600,000.00 in Wastewater Utility Funds when it became evident that the construction of the proposed plant would be delayed. These pumping stations are considered interim facilities, to provide service until larger, more permanent pumping and/or treatment facilities for the valley can be provided. The planning for the larger, more permanent facilities has been underway since 1974, and some recommendations may be available by the end of 1980.

It should be recognized by the citizens of Little Rock City officials and other interested parties, that the size, scope, cost, timing and even feasibility of additional facilities in this Basin are unknown at this time and impossible to predict. Wastewater Utility Financing projections through 1985 do not contain any funds for Maumelle Valley and without financing there will be no such facilities even if a project desired by the community and acceptable to area residents and pollution control authorities is identified.

The Wastewater Utility capital projects are financed exclusively from user charges and United States Environmental Protection Agency grants, and those resources are allocated to the maximum availability to the planned Fourche Creek Plant and Lines project, and the planned enlargement and modernization of the existing Adams Field Plant. Current estimates of the costs of these two projects, to be completed by 1985, are in excess of Forty Million Dollars. The Committee remain committed to providing permanent facilities in this area, as a priorit following the Fourche and Adams Field projects, subject to availabilit of funds.

It should also be recognized by the citizens of Little Rock, City officials, and other interested parties, that the existing pumping facilities in the Little Maumelle River Valley have a limited capacity, which cannot be expanded due to equally limited capacity in the receiving sewers in the Fourche Creek Valley collection system. The capacity of these pumping facilities has been estimated at between 6,600 persons and 11,000 persons, by various independent analyses by the committee's several consultants who have been involved in the design of the Facilities.

For these reasons, the Committee declares its policy to exercise what controls are necessary and proper and in the general public interest, to ensure that the capacity of the existing pumping stations is not exceeded before the properties they were constructe to serve have had the opportunity to connect to the sewer. The controls to be exercised are as follows:

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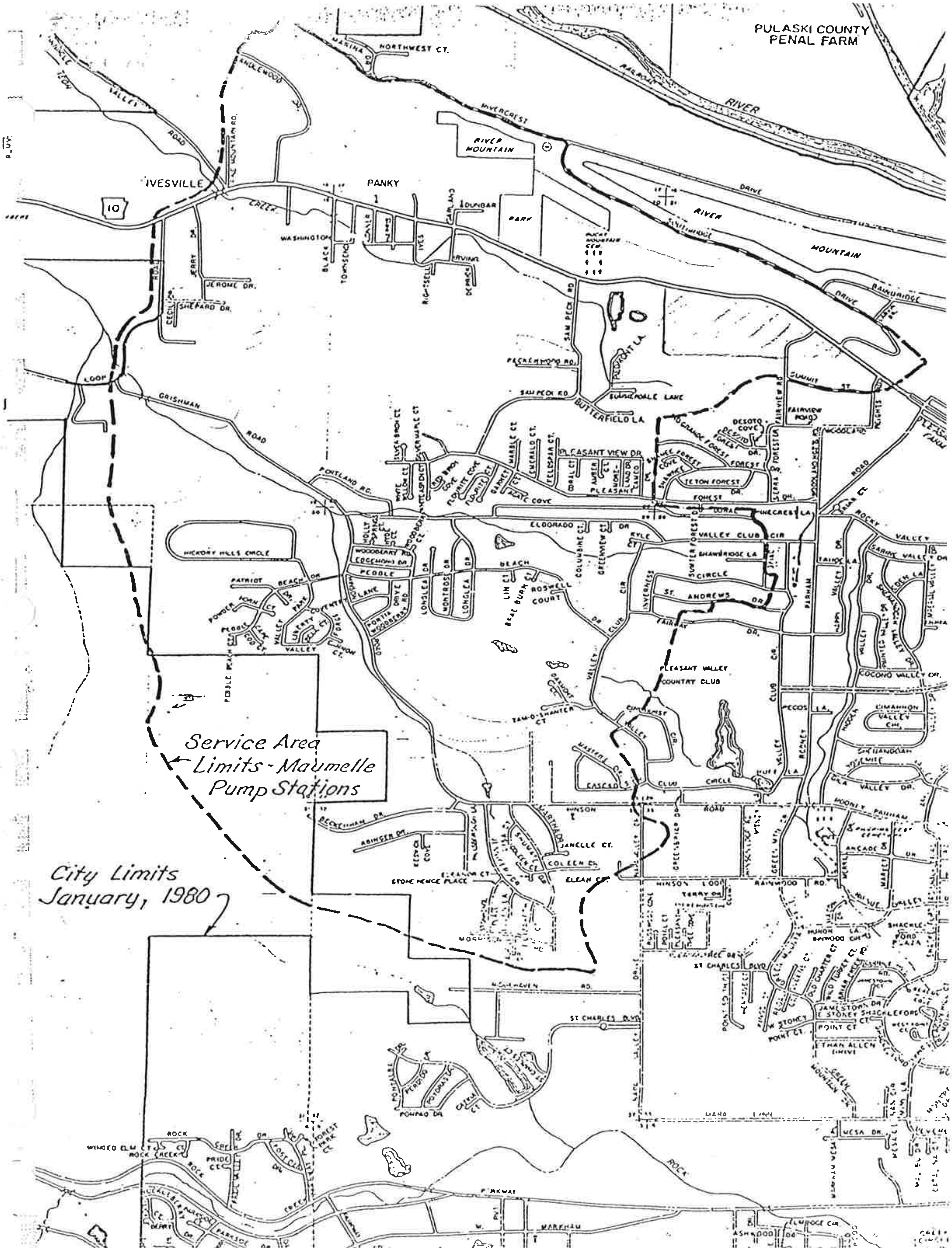
3. These controls will be effective until such time as a definite plan for additional or replacement facilities for Sewer Service in the Little Maumelle River Valley has been formulated, is acceptable to the citizens of the city and the appropriate State and Federal Pollution Control authorities, and a time schedule and financing plan exists to have the additional or replacement facilities in service before the existing facilities are overloaded.

Passed and Approved February 19, 1980

Woodson D. Walker, Secretary



Service Area Limits - Maumelle Pump Stations

City Limits January, 1980

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APPENDIX A2
LITTLE MAUMELLE BASIN STUDY

LITTLE MAUMELLE BASIN STUDY

Background and Data Sources

This report has been prepared for the Little Rock Wastewater Utility. The purpose of the report is to assist with the Utility's efforts to determine the demand for sewer service in the Little Maumelle basin. The basin is some 51,475 acres of which approximately 15 percent is within the Little Rock city limits. Approximately 9,210 acres of the basin are currently part of the Wastewater Utility service area.

In order to estimate future development within the basin, the City acquired existing parcel information from the Pulaski County Assessor. This information (in AutoCAD map units) was translated into state plane coordinates and fitted into the City GIS. City GIS data was used, more particularly – land use plan, zoning, roads, topography, and floodway/floodplain information. (Note: The Wastewater Utility provided the basin and sub-basin coverage for use in the study.)

Metroplan is the regional planning agency and was contacted for information and advice. Metroplan provided land use information from SPOT data; topography (steep slope), land use and floodplain information based on USGS data; and, projections of population and employment by sub-basin for the year 2025. This data provides the basis for the twenty-five year estimate.

Building permit data for the City and census tracts 42.05 & 42.06 (Chenal Parkway to the Maumelle River and Ferndale Cut-off Road to Hinson/Napa Valley Road) -- both number and value for the 1990s -- were used to trend future development in the area.

Methodology

Each sub-basin was reviewed independently. The total developable area was determined first by calculating the area of each sub-basin using GIS. Next the floodway/floodplain and steep slopes were determined, along with wetlands information provided by Metroplan. Finally, the amount of Park/Open Space was calculated from the City Land Use Plan. Based on all of this information, the amount of developable area was calculated.

The next step was to determine the amount of area already developed. This was done using Metroplan's numbers for existing land use and the County Assessor's parcel data. To determine the areas already developed, only those parcels less than 8 (eight) acres were used. It is assumed that this gives a good indication of the existing large tract (3 to 5 acre) subdivisions, which have become common in rural Pulaski and Saline counties. This development pattern is not likely to change to a denser pattern once developed.

Each sub-basin was then examined for likely density for the remaining area, that is 'urban density' (3 to 5 units per acre) or 'suburban/rural density' (3 to 5 acres per unit). (The current density of subdivisions in west Little Rock is from 3 to 4 units per acre.) This determination was made based on the existing development pattern; likelihood that the pattern would continue; and topography (developability) of the remaining area within the sub-basin.

The final step was to determine the amount of nonresidential development likely to occur on the remaining developable area. For those sub-basins within the City Land Use Plan area, that document was used to determine the amount of residential and nonresidential land to be developed. For those sub-basins beyond the City Land Use Plan, the existing development pattern and the existing road network were used to estimate the amount of future nonresidential development.

This work provided the projections for a fully developed basin. It should be noted that the projection assumes development trends will continue and sewer service can be made available to additional areas.

For the 2025 or twenty-five year projection, Metroplan population estimates are used with a 2.3 person per household assumption for 2025. The 1990 census indicates a 2.6 and 2.9 person-per-household for this area and 2.42 for the City of Little Rock. This provides the household numbers found in table 2.

Using the development pattern over the last 10 years for the City and west Little Rock, a crosscheck was developed of 250 single-family units per year and 600 multifamily units per decade. A review of permit activity over the last ten years shows only one year had less than 250 single family units permitted in census tracts 42.05 and 42.06 combined (NW Little Rock, north of Kanis and west of Bowman/Rodney Parham Roads). The average annual number of permitted single family homes was 292 for these two tracts. Over 850 multifamily units were added over the ten-year period. Based on these numbers, two trend lines (for the entire area within census tracts 42.05 & 42.06) were developed: 250 single family units per year and 600 multifamily units per decade; and 290 single family units per year and 800 multifamily units per decade. In table 2, these are referred to as 'Trend' and 'High Trend'.

For those sub-basins within Census Tracts 42.05 and 42.06 and likely to be in the City limits, the Metroplan projections by sub-basin were reviewed against building permit data. The number of permits outside the Little Maumelle basin but within census tracts 42.05 and 42.06 was determined. The City estimate for census tracts 42.05 and 42.06 (west Little Rock) was reduced for those areas outside the basin but within the tracts. This was done for the period from 1990 to now as well as for the 1990 to 2025 time period. The result was the trend line estimated another 2,700 to 2,800 households over the Metroplan estimate. (See table 2)

A review of building permit data for the last ten years was completed for three sub-basins – 60100, 60200 and 60301. Within these three basins approximately 1968 new units have been permitted since 1990. The estimates provided by Metroplan for the time period from 1990 to 2025 call for approximately 3,500 new units. The permit data indicates that, of the expected 3500 units over 56 percent were built in the first ten years (of a 35-year period). Using the Metroplan projections the sub-basins in question would be less than 50 percent developed in 2025. By distributing the majority of the trend projection 'overage' to sub-basins 60200, 60301 and 60302 the percent developed would range from 60 to 80 percent. Both the Metroplan and the trend estimates are provided for use. (See table 2)

Metroplan provided employment projections for 2025. The projections of employment were done at a metropolitan level. This number is then distributed to smaller geographic areas within the metropolitan area. Using existing zoning, land use plans and development trends, Metroplan staff assumes a certain percentage of the metropolitan employment will be captured in a sub-area. Projections of total development are based on acreage estimates for nonresidential use, other than open space (recreational). These projections are based on existing land use, zoning and plans where available. They are also based on the likelihood of additional non-residential use due to existing use and the road system. (See table 3)

In order to estimate occupancy/employment levels, the non-residential use area was divided into commercial and office/institutional use groups by sub-basin. The existing land use plan and zoning pattern were used to help calculate the ratio. To determine the amount of building per acre of land, a review of applications to the City was conducted. This review of site plan and planned development applications gave an average building area to site area. The resulting square footage numbers were given to the City of Little Rock's Plans Examination Administrator to generate demand. Numbers from a model building code were used to calculate the number of persons for plumbing loads. These loads were used to determine sewer needs in buildings.

TABLE 2
PROJECTION OF HOUSEHOLDS FOR THE LITTLE MAUMELLE BASIN

Sub-basin	1990 est.	Residential Permits 1990-1999	Household Change 1990 - 2010	Household Change 1990 to 2025 Metroplan*	Trend	High Trend	Projected Full Development
60010	65		23	37	40	40	260
60100	1250	468	900	1113	1115	1115	2400
60200	2500	893	1565	1839	2500	3000	8900
60301	240	607	1210	549	2000	2600	4120
60302	190		600	856	1300	1800	3200
60400	160		400	648	700	700	1370
60500	170		230	491	490	490	1080
60600	205		290	593	595	595	1610
60700	80		45	151	150	150	1605
60800	140		100	358	360	360	12800
60900	70		70	140	140	140	16650

*Note: Metroplan projection is based on a 2.8 or 2.6 person per household based on the 1990 census and 2.3 person per household assumed by City for 2025. Metroplan provided total population numbers not households.

Metroplan projection 1990 to 2025, 6775 households (based on 2.3 household size).

Trend 'projection' assumes 250 single-family units per year and 600 multifamily units per decade. (10850 households for census tracts 42.05 & 42.06 area, 3100 units are assumed for areas outside of basin).

High Trend 'projection' assumes 290 single-family units per year and 800 multifamily units per decade. (12950 households for census tracts 42.05 & 42.06 area, 3600 units are assumed for areas outside of basin)

TABLE 1
SUB-BASIN PROJECTED RESIDENTIAL DEVELOPMENT PATTERN
(IN ACRES)

Sub-basin	Total Area	Not developable	Existing Large lot	Non-residential	Total Development Large Lot	Total Development Urban
60900	8325	416	277	1250	1029	5430
60800	7401	370	1000	740	1961	4070
60700	6014	902	456	300	4812	
60600	6042	604	1364	604	4834	
60500	3632	218	734	182	3232	
60400	4411	220	975	90	4101	
60302	6437	2124	1030	966	2575	772
60301	2235	335	NA	335	220	1345
60200	3926	393	NA	393	196	2944
60100	1312	79	NA	262	197	774
60010	1738	956	245	10	257	

Residential is single and multifamily; non-residential is commercial, office, etc.; Not developable is steep slope, floodway, open space and park

Table 3
Projection of Non-residential Demand

	1990	2025	Development (acreage)			Number of persons for plumbing	
Sub-basin	(jobs)	(jobs added)	Total	Commercial	Off/Inst.	Commercial	Off/Inst.
60010	9	33	10	10	0	320	0
60100	523	1148	262	157	105	5050	8110
60200	320	1829	393	157	236	5050	18220
60301	17	1404	335	218	117	7010	9040
60302	68	431	966	386	580	12420	44790
60400	22	722	90	30	60	960	4630
60500	30	142	182	73	109	2350	41220
60600	26	135	604	423	181	13610	13980
60700	5	10	300	180	120	5790	9270
60800	8	56	1000	600	400	19300	30890
60900	5	3	1450	870	580	27990	44790

2025 Jobs added is provided by Metroplan based on Metropolitan projections distributed throughout the four county area

(Based on the land use assumptions sub-basins 60400 is over estimated for 2025. The major of the jobs added should go to sub-basin 60302 and adjacent areas outside of the basin. Sub-basin 60500 may also be high; however the jobs would likely be in adjacent sub-basins likely 60600.)

The Planning & Development Department does not take responsibility for the employment and persons for plumbing numbers which are provided.

Off/Inst. – Office/Institutional use

APPENDIX A3
SUPPLEMENTAL WASTEWATER DATA

APPENDIX A4
WET WEATHER FLOW PROJECTIONS

Maumelle Flows MGD - Current & Projected Average hourly flows

		2000 Base Diurnal	2010 Base Diurnal	2025 Base Diurnal
Sun	0:00	1.34	2.18	3.38
	1:00	1.28	2.09	3.24
	2:00	1.14	1.86	2.88
	3:00	1.12	1.82	2.82
	4:00	1.11	1.81	2.81
	5:00	1.24	2.01	3.12
	6:00	1.65	2.69	4.17
	7:00	2.31	3.76	5.83
	8:00	2.73	4.44	6.89
	9:00	2.64	4.29	6.65
	10:00	2.58	4.20	6.51
	11:00	2.39	3.89	6.03
	12:00	2.55	4.14	6.42
	13:00	2.52	4.10	6.37
	14:00	2.27	3.69	5.73
	15:00	2.20	3.57	5.55
	16:00	2.01	3.27	5.07
	17:00	2.35	3.82	5.94
	18:00	2.52	4.09	6.35
	19:00	2.66	4.33	6.72
	20:00	2.81	4.56	7.08
	21:00	2.67	4.34	6.73
	22:00	1.85	3.00	4.66
	23:00	1.52	2.48	3.85
Mon	0:00	1.28	2.40	3.72
	1:00	1.06	1.98	3.07
	2:00	1.00	1.87	2.91
	3:00	1.05	1.97	3.06
	4:00	1.03	1.93	2.99
	5:00	1.60	2.99	4.65
	6:00	3.16	5.92	9.19
	7:00	3.03	5.67	8.80
	8:00	2.16	4.03	6.26
	9:00	1.95	3.65	5.67
	10:00	1.88	3.51	5.46
	11:00	1.88	3.51	5.45
	12:00	1.88	3.51	5.45
	13:00	1.61	3.01	4.68
	14:00	1.50	2.81	4.37
	15:00	1.56	2.92	4.53
	16:00	1.66	3.10	4.81

	17:00	1.93	3.62	5.62
	18:00	2.00	3.75	5.82
	19:00	2.23	4.16	6.46
	20:00	2.41	4.52	7.01
	21:00	2.13	3.98	6.18
	22:00	1.74	3.25	5.04
	23:00	1.24	2.33	3.61
Tues	0:00	1.01	2.05	3.18
	1:00	0.90	1.83	2.83
	2:00	0.91	1.84	2.86
	3:00	0.86	1.74	2.70
	4:00	0.91	1.85	2.87
	5:00	1.36	2.76	4.29
	6:00	3.12	6.34	9.84
	7:00	2.81	5.71	8.86
	8:00	2.02	4.10	6.37
	9:00	1.99	4.05	6.29
	10:00	1.46	2.96	4.59
	11:00	1.47	2.99	4.64
	12:00	1.52	3.09	4.79
	13:00	1.43	2.90	4.51
	14:00	1.34	2.72	4.22
	15:00	1.26	2.57	3.98
	16:00	1.54	3.13	4.86
	17:00	1.77	3.59	5.57
	18:00	1.94	3.95	6.12
	19:00	2.06	4.18	6.49
	20:00	2.38	4.85	7.52
	21:00	2.49	5.06	7.85
	22:00	1.80	3.65	5.67
	23:00	1.23	2.50	3.89
Wed	0:00	1.01	2.10	3.27
	1:00	0.97	2.01	3.12
	2:00	0.88	1.83	2.84
	3:00	0.80	1.65	2.56
	4:00	0.90	1.86	2.88
	5:00	1.36	2.81	4.36
	6:00	2.79	5.79	8.99
	7:00	2.56	5.30	8.23
	8:00	2.25	4.66	7.24
	9:00	1.84	3.81	5.92
	10:00	1.61	3.33	5.17
	11:00	1.54	3.19	4.94
	12:00	1.47	3.04	4.73
	13:00	1.49	3.08	4.78
	14:00	1.34	2.78	4.31
	15:00	1.32	2.75	4.26
	16:00	1.48	3.06	4.76
	17:00	1.75	3.64	5.65

	18:00	1.84	3.82	5.93
	19:00	2.04	4.22	6.55
	20:00	2.24	4.65	7.22
	21:00	2.30	4.77	7.41
	22:00	1.77	3.67	5.70
	23:00	1.23	2.56	3.97
Thur	0:00	0.88	1.91	2.97
	1:00	0.78	1.69	2.63
	2:00	0.80	1.74	2.70
	3:00	0.80	1.75	2.71
	4:00	0.81	1.77	2.75
	5:00	1.40	3.06	4.74
	6:00	2.80	6.09	9.46
	7:00	2.45	5.34	8.29
	8:00	1.93	4.21	6.54
	9:00	1.77	3.85	5.98
	10:00	1.48	3.22	4.99
	11:00	1.46	3.17	4.92
	12:00	1.39	3.02	4.69
	13:00	1.43	3.11	4.83
	14:00	1.27	2.76	4.29
	15:00	1.34	2.92	4.53
	16:00	1.47	3.21	4.98
	17:00	1.76	3.84	5.96
	18:00	1.87	4.08	6.33
	19:00	1.87	4.07	6.31
	20:00	1.97	4.28	6.65
	21:00	2.16	4.71	7.31
	22:00	1.76	3.84	5.96
	23:00	1.27	2.77	4.30
Fri	0:00	1.03	2.21	3.43
	1:00	0.93	1.98	3.08
	2:00	0.81	1.73	2.69
	3:00	0.75	1.61	2.50
	4:00	0.79	1.70	2.64
	5:00	1.19	2.55	3.96
	6:00	2.31	4.95	7.69
	7:00	2.40	5.14	7.99
	8:00	2.25	4.82	7.48
	9:00	2.27	4.86	7.54
	10:00	2.00	4.29	6.66
	11:00	1.67	3.57	5.54
	12:00	1.68	3.60	5.59
	13:00	1.59	3.40	5.28
	14:00	1.56	3.33	5.17
	15:00	1.51	3.23	5.01
	16:00	1.67	3.58	5.55
	17:00	1.92	4.11	6.38
	18:00	1.76	3.76	5.84

	19:00	1.79	3.84	5.95
	20:00	1.85	3.95	6.13
	21:00	1.61	3.46	5.36
	22:00	1.22	2.61	4.06
	23:00	0.99	2.11	3.28
Sat	0:00	0.98	1.92	2.98
	1:00	0.83	1.63	2.53
	2:00	0.76	1.49	2.31
	3:00	0.77	1.50	2.33
	4:00	0.88	1.73	2.68
	5:00	1.21	2.37	3.67
	6:00	1.80	3.53	5.48
	7:00	2.60	5.10	7.92
	8:00	2.50	4.91	7.62
	9:00	2.43	4.77	7.40
	10:00	2.20	4.32	6.71
	11:00	2.09	4.11	6.37
	12:00	2.01	3.94	6.12
	13:00	2.01	3.95	6.12
	14:00	1.94	3.81	5.91
	15:00	1.86	3.65	5.66
	16:00	2.02	3.95	6.14
	17:00	1.96	3.84	5.97
	18:00	2.08	4.07	6.32
	19:00	2.06	4.04	6.28
	20:00	1.95	3.82	5.92
	21:00	1.72	3.37	5.23
	22:00	1.34	2.62	4.06
	23:00	1.00	1.96	3.04

Year 2000 Analysis of Twelve-hour One-Inch Rain Event

Calibrated in Against One-Inch Event Observed

Ison RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.592 X Total I/I Volume
Volume of Inflow = 0.408 X Total I/I Volume
Peak Infiltration = (Volume of Infiltration X 2 / 9.76)^0.5
Peak Inflow = (Volume of Inflow X 2 / 2.40)^0.5
Duration of infiltration in minutes = 9.76 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII =	1.22	MG
Volume of Infil =	0.72	MG
Volume of Inflow =	0.50	MG
Peak Infilitration =	385	gpm
Peak Inflow =	644	gpm
Duration infil =	3755	minutes
Duration inflow =	1546	minutes
Inflow Decline t =	1005	minutes
S Inflow Decline =	0.64	gpm/minute
S Infil Decline =	0.10	gpm/minute
Inflow /Infil transition	2053	minutes
S to Peak	1.43	gpm/minute

Hinson RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.701 X Total I/I Volume
Volume of Inflow = 0.299 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 /3.00)^0.5
Peak Inflow = (Volume of Inflow X 2 / .647)^0.5
Duration of infiltration in minutes = 3.00 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII =	3.35	MG
Volume of Infil =	2.35	MG
Volume of Inflow =	1.00	MG
Peak Infilitration =	1251	gpm
Peak Inflow =	1760	gpm
Duration infil =	3754	minutes

Duration inflow = 1138 minutes
Inflow Decline t = 854 minutes
S Inflow Decline = 2.06 gpm/minute
S Infil Decline = 0.33 gpm/minute
Inflow /Infil transition 1878 minutes
S to Peak = 4.18 gpm/minute

North Slope RDII Response

Designed to Mirror Hinson & Ison Response Shapes

Projected Peak RDII Flow = 120 gpm
S to Peak Slope = 0.17 gpm/minute
Inflow Decline Flow = 0.08 gpm/minute
S Inflil Decline Slope = 0.010 gpm/minute

Year 2000 Analysis of Twelve-hour 5-Year Frequency Rain Event

Ison RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.592 X Total I/I Volume
Volume of Inflow = 0.408 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 / 9.76)^0.5
Peak Inflow = (Volume of Inflow X 2 / 2.40)^0.5
Duration of infiltration in minutes = 9.76 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII = 5.74 MG

Volume of Infil = 3.40 MG
Volume of Inflow = 2.34 MG
Peak Infilitration = 834 gpm
Peak Inflow = 1397 gpm
Duration infil = 8144 minutes
Duration inflow = 1847 minutes
Inflow Decline t = 1127 minutes
S Inflow Decline = 1.24 gpm/minute
S Infil Decline = 0.10 gpm/minute
Inflow /Infil transition 2116 minutes

S to Peak 3.10 gpm/minute

Hinson RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.701 X Total I/I Volume
Volume of Inflow = 0.299 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 /3.00)^0.5
Peak Inflow = (Volume of Inflow X 2 / .647)^0.5
Duration of infiltration in minutes = 3.00 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII = 15.06 MG

Volume of Infil = 10.56 MG
Volume of Inflow = 4.50 MG
Peak Infilitration = 2653 gpm
Peak Inflow = 3731 gpm
Duration infil = 7959 minutes
Duration inflow = 1822 minutes
Inflow Decline t = 1102 minutes
S Inflow Decline = 3.38 gpm/minute
S Infil Decline = 0.33 gpm/minute
Inflow /Infil transition 2122 minutes
S to Peak = 8.87 gpm/minute

North Slope RDII Response

Designed to Mirror Hinson & Ison Response Shapes

Projected Peak RDII Flow = 396 gpm
S to Peak Slope = 0.55 gpm/minute
Inflow Decline Flow = 0.28 gpm/minute
S Inflil Decline Slope = 0.010 gpm/minute

	Timer in Minutes	Project RDII Flows in gpm				Total RDII in MGD
		Ison	Hinson	North Slope		
	0	0	0	0		0
	60	86	251	10		0.50
	120	172	502	20		1.00
	180	257	752	30		1.50
	240	343	1003	40		2.00
	300	429	1254	50		2.50
	360	515	1505	60		3.00
	420	601	1756	70		3.50
	480	686	2006	80		4.00
	540	772	2257	90		4.50
	600	858	2508	100		5.00
	660	944	2759	110		5.50
Peak	720	1030	3010	120		6.00
	780	992	2886	115		5.76
	840	953	2763	110		5.52
	900	915	2639	106		5.28
	960	876	2516	101		5.03
	1020	838	2392	96		4.79
	1080	800	2268	91		4.55
	1140	761	2145	86		4.31
	1200	723	2021	82		4.07
	1260	684	1898	77		3.83
	1320	646	1774	72		3.59
	1380	608	1650	67		3.35
	1440	569	1527	62		3.11
	1500	531	1403	58		2.87
	1560	492	1280	53		2.63
	1620	454	1156	48		2.39
	1680	416	1032	43		2.15
	1740	377	909	38		1.91
	1800	339	785	34		1.67
	1860	300	662	29	Inflow to	1.43
	1920	262	605	24	Infiltration	1.28
	1980	224	585	20	Transition	1.19
	2040	185	566	19	Period	1.11
	2100	166	546	18		1.05
	2160	160	526	18		1.01
	2220	154	506	17		0.98
	2280	148	486	16		0.94
	2340	142	467	16		0.90
	2400	136	447	15		0.86
	2460	130	427	14		0.82
	2520	124	407	14		0.78

2580	118	387	13	0.75
2640	112	368	12	0.71
2700	106	348	12	0.67
2760	100	328	11	0.63
2820	94	308	10	0.59
2880	88	288	10	0.56
2940	82	269	9	0.52
3000	76	249	8	0.48
3060	70	229	8	0.44
3120	64	209	7	0.40
3180	58	189	6	0.37
3240	52	170	6	0.33
3300	46	150	5	0.29
3360	40	130	4	0.25
3420	34	110	4	0.21
3480	28	90	3	0.17
3540	22	71	2	0.14
3600	16	51	2	0.10
3660	10	31	1	0.06
3720	4	11	0	0.02
3755	0	0	0	0.00

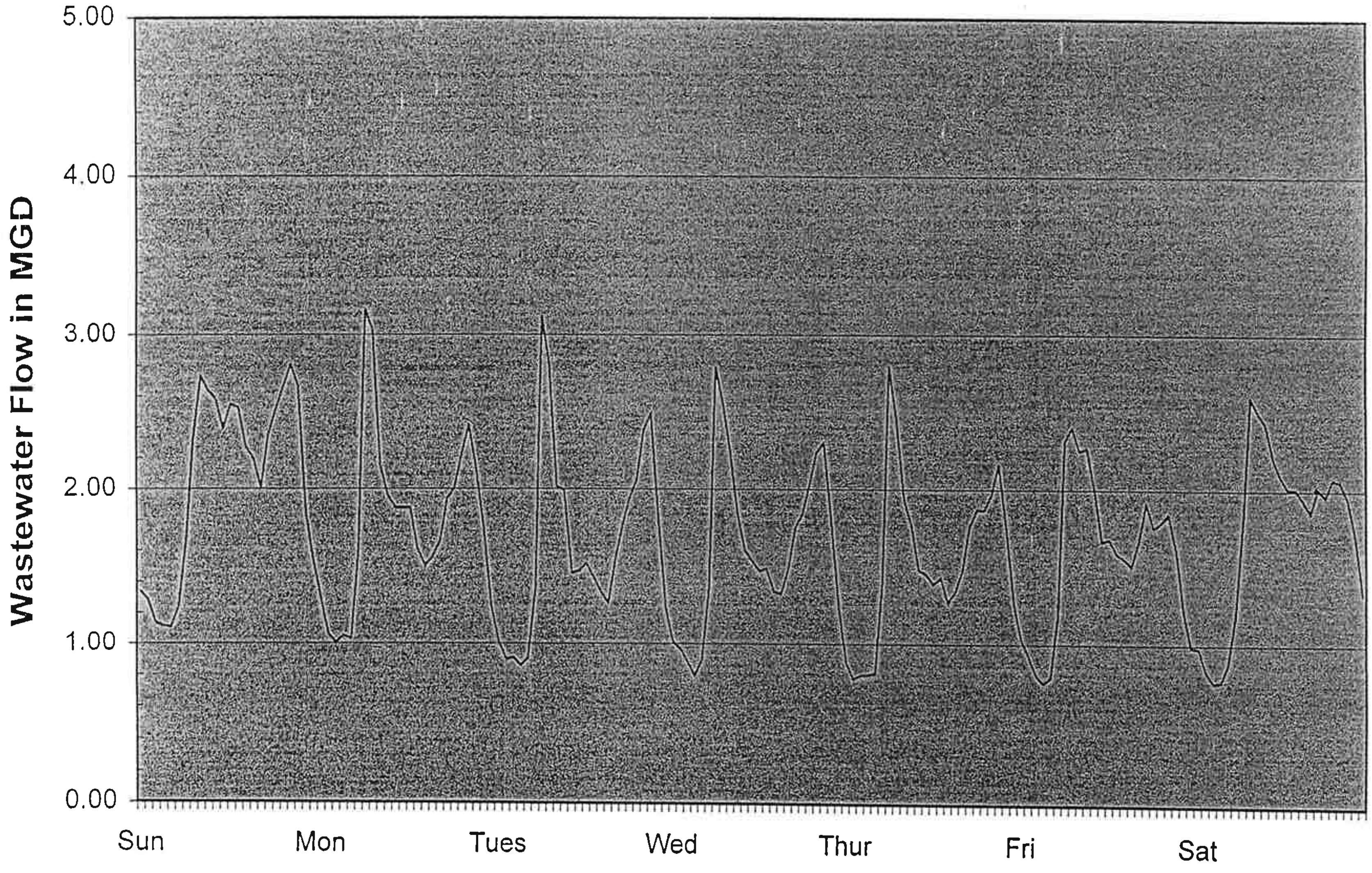
	Timer in Minutes	Project RDII Flows in gpm				Total RDII in MGD
		Ison	Hinson	North Slope		
	0	0	0	0		0
	60	186	532	33		1.08
	120	372	1064	66		2.17
	180	558	1597	99		3.25
	240	744	2129	132		4.33
	300	930	2661	165		5.41
	360	1116	3193	198		6.50
	420	1302	3725	231		7.58
	480	1488	4258	264		8.66
	540	1674	4790	297		9.75
	600	1860	5322	330		10.83
	660	2046	5854	363		11.91
Peak	720	2231	6384	396		12.99
	780	2157	6181	379		12.57
	840	2082	5978	362		12.14
	900	2008	5776	346		11.72
	960	1933	5573	329		11.29
	1020	1859	5370	312		10.87
	1080	1785	5167	295		10.45
	1140	1710	4964	278		10.02
	1200	1636	4762	262		9.60

1260	1561	4559	245		9.18
1320	1487	4356	228		8.75
1380	1413	4153	211		8.33
1440	1338	3950	194		7.90
1500	1264	3748	178		7.48
1560	1189	3545	161		7.06
1620	1115	3342	144		6.63
1680	1041	3139	127		6.21
1740	966	2936	110		5.78
1800	892	2734	94		5.36
1860	817	2531	77		4.94
1920	743	2328	60		4.51
1980	669	2125	43		4.09
2040	610	1953	40	Inflow to	3.75
2100	604	1933	39	Infiltration	3.71
2160	598	1914	38	Transition	3.68
2220	592	1894	38	Period	3.64
2280	586	1874	37		3.60
2340	580	1854	37		3.56
2400	574	1834	36		3.52
2460	568	1815	35		3.49
2520	562	1795	35		3.45
2580	556	1775	34		3.41
2640	550	1755	34		3.37
2700	544	1735	33		3.33
2760	538	1716	32		3.30
2820	532	1696	32		3.26
2880	526	1676	31		3.22
2940	520	1656	31		3.18
3000	514	1636	30		3.14
3060	508	1617	29		3.11
3120	502	1597	29		3.07
3180	496	1577	28		3.03
3240	490	1557	28		2.99
3300	484	1537	27		2.95
3360	478	1518	26		2.92
3420	472	1498	26		2.88
3480	466	1478	25		2.84
3540	460	1458	25		2.80
3600	454	1438	24		2.76
3660	448	1419	23		2.73
3720	442	1399	23		2.69
3780	436	1379	22		2.65
3840	430	1359	22		2.61
3900	424	1339	21		2.57
3960	418	1320	20		2.53
4020	412	1300	20		2.50
4080	406	1280	19		2.46
4140	400	1260	19		2.42

4200	394	1240	18	2.38
4260	388	1221	17	2.34
4320	382	1201	17	2.31
4380	376	1181	16	2.27
4440	370	1161	16	2.23
4500	364	1141	15	2.19
4560	358	1122	14	2.15
4620	352	1102	14	2.12
4680	346	1082	13	2.08
4740	340	1062	13	2.04
4800	334	1042	12	2.00
4860	328	1023	11	1.96
4920	322	1003	11	1.93
4980	316	983	10	1.89
5040	310	963	10	1.85
5100	304	943	9	1.81
5160	298	924	8	1.77
5220	292	904	8	1.74
5280	286	884	7	1.70
5340	280	864	7	1.66
5400	274	844	6	1.62
5460	268	825	5	1.58
5520	262	805	5	1.55
5580	256	785	4	1.51
5640	250	765	4	1.47
5700	244	745	3	1.43
5760	238	726	2	1.39
5820	232	706	2	1.36
5880	226	686	1	1.32
5940	220	666	1	1.28
6000	214	646	0	1.24
6060	208	627		1.20
6120	202	607		1.17
6180	196	587		1.13
6240	190	567		1.09
6300	184	547		1.06
6360	178	528		1.02
6420	172	508		0.98
6480	166	488		0.94
6540	160	468		0.91
6600	154	448		0.87
6660	148	429		0.83
6720	142	409		0.79
6780	136	389		0.76
6840	130	369		0.72
6900	124	349		0.68
6960	118	330		0.65
7020	112	310		0.61
7080	106	290		0.57

7140	100	270	0.53
7200	94	250	0.50
7260	88	231	0.46
7320	82	211	0.42
7380	76	191	0.39
7440	70	171	0.35
7500	64	151	0.31
7560	58	132	0.27
7620	52	112	0.24
7680	46	92	0.20
7740	40	72	0.16
7800	34	52	0.13
7860	28	33	0.09
7920	22	13	0.05
7980	16		0.02
8040	10		0.01
8100	4		0.01

Maumelle 2000 Dry Weather Diurnal Flow



Year 2010 - Projected Maumelle Response to a 12-hour 5-Year Frequency Rain Event

Ison RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.592 X Total I/I Volume
Volume of Inflow = 0.408 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 / 9.76)^0.5
Peak Inflow = (Volume of Inflow X 2 / 2.40)^0.5
Duration of infiltration in minutes = 9.76 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII =	6.02	MG
Volume of Infil =	3.56	MG
Volume of Inflow =	2.46	MG
Peak Infilitration =	855	gpm
Peak Inflow =	1431	gpm
Duration infil =	8341	minutes
Duration inflow =	1847	minutes
Inflow Decline t =	1127	minutes
S Inflow Decline =	1.27	gpm/minute
S Infil Decline =	0.10	gpm/minute
Inflow /Infil transition	2116	minutes
S to Peak	3.17	gpm/minute

Peak

Hinson RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.701 X Total I/I Volume
Volume of Inflow = 0.299 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 /3.00)^0.5
Peak Inflow = (Volume of Inflow X 2 / .647)^0.5
Duration of infiltration in minutes = 3.00 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII = 15.46 MG

Volume of Infil = 10.84 MG
Volume of Inflow = 4.62 MG
Peak Infilitration = 2688 gpm
Peak Inflow = 3780 gpm
Duration infil = 8064 minutes
Duration inflow = 1822 minutes
Inflow Decline t = 1102 minutes
S Inflow Decline = 3.43 gpm/minute
S Infil Decline = 0.33 gpm/minute
Inflow /Infil transition 2122 minutes
S to Peak = 8.98 gpm/minute

North Slope RDII Response

Designed to Mirror Hinson & Ison Response Shapes

Projected Peak RDII Flow = 786 gpm
S to Peak Slope = 1.09 gpm/minute
Inflow Decline Flow = 0.55 gpm/minute
S Inflil Decline Slope = 0.010 gpm/minute

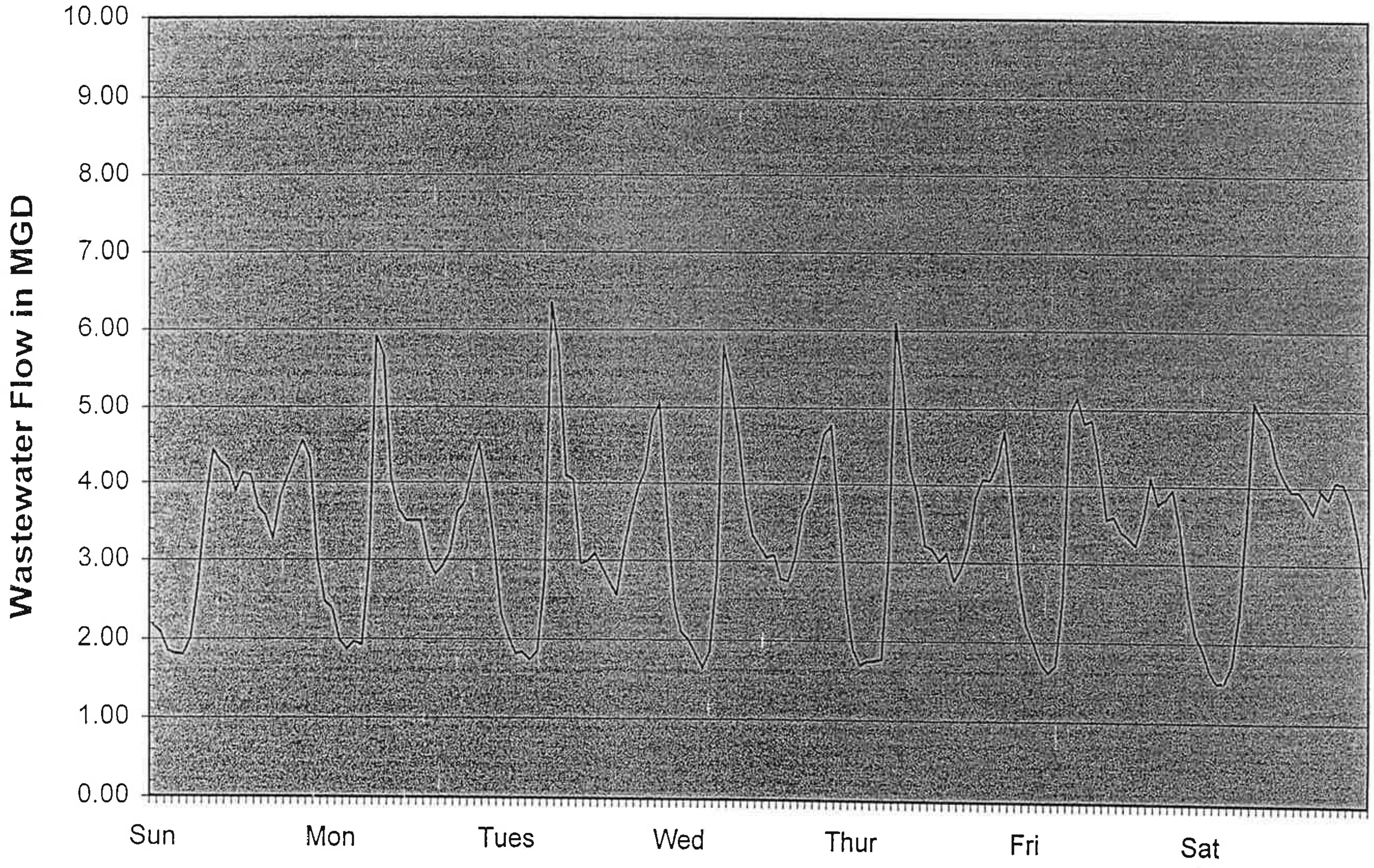
Timer in Minutes	Project RDII Flows in gpm				Total RDII in MGD
	Ison	Hinson	Other		
0	0	0	0		0
60	190	539	66		1.15
120	380	1078	131		2.29
180	571	1616	197		3.44
240	761	2155	262		4.58
300	951	2694	328		5.73
360	1141	3233	393		6.87
420	1331	3772	459		8.02
480	1522	4310	524		9.16
540	1712	4849	590		10.31
600	1902	5388	655		11.45
660	2092	5927	721		12.60
720	2286	6468	786		13.75
780	2210	6262	721		13.25
840	2137	6062	362		12.34
900	2063	5860	346		11.92
960	1988	5657	329		11.49
1020	1914	5454	312		11.07
1080	1840	5251	295		10.65
1140	1765	5048	278		10.22
1200	1691	4846	262		9.80
1260	1616	4643	245		9.38
1320	1542	4440	228		8.95
1380	1468	4237	211		8.53
1440	1393	4034	194		8.10
1500	1319	3832	178		7.68
1560	1244	3629	161		7.26
1620	1170	3426	144		6.83
1680	1096	3223	127		6.41
1740	1021	3020	110		5.99
1800	947	2818	94		5.56
1860	872	2615	77		5.14
1920	798	2412	60		4.71
1980	724	2209	43		4.29
2040	649	2006	42	Inflow to	3.89

2100	624	1968	41	Infiltration	3.80
2160	618	1948	40	Transition	3.76
2220	612	1929	40	Period	3.72
2280	606	1909	39		3.68
2340	600	1889	39		3.64
2400	594	1869	38		3.61
2460	588	1849	37		3.57
2520	582	1830	37		3.53
2580	576	1810	36		3.49
2640	570	1790	36		3.45
2700	564	1770	35		3.42
2760	558	1750	34		3.38
2820	552	1731	34		3.34
2880	546	1711	33		3.30
2940	540	1691	33		3.26
3000	534	1671	32		3.23
3060	528	1651	31		3.19
3120	522	1632	31		3.15
3180	516	1612	30		3.11
3240	510	1592	30		3.07
3300	504	1572	29		3.03
3360	498	1552	28		3.00
3420	492	1533	28		2.96
3480	486	1513	27		2.92
3540	480	1493	27		2.88
3600	474	1473	26		2.84
3660	468	1453	25		2.81
3720	462	1434	25		2.77
3780	456	1414	24		2.73
3840	450	1394	24		2.69
3900	444	1374	23		2.65
3960	438	1354	22		2.62
4020	432	1335	22		2.58
4080	426	1315	21		2.54
4140	420	1295	21		2.50
4200	414	1275	20		2.46
4260	408	1255	19		2.43
4320	402	1236	19		2.39
4380	396	1216	18		2.35
4440	390	1196	18		2.31
4500	384	1176	17		2.27
4560	378	1156	16		2.24
4620	372	1137	16		2.20
4680	366	1117	15		2.16
4740	360	1097	15		2.12
4800	354	1077	14		2.08
4860	348	1057	13		2.05
4920	342	1038	13		2.01
4980	336	1018	12		1.97

5040	330	998	12	1.93
5100	324	978	11	1.89
5160	318	958	10	1.85
5220	312	939	10	1.82
5280	306	919	9	1.78
5340	300	899	9	1.74
5400	294	879	8	1.70
5460	288	859	7	1.66
5520	282	840	7	1.63
5580	276	820	6	1.59
5640	270	800	6	1.55
5700	264	780	5	1.51
5760	258	760	4	1.47
5820	252	741	4	1.44
5880	246	721	3	1.40
5940	240	701	3	1.36
6000	234	681	2	1.32
6060	228	661	1	1.28
6120	222	642	1	1.25
6180	216	622	0	1.21
6240	210	602	0	1.17
6300	204	582		1.13
6360	198	562		1.10
6420	192	543		1.06
6480	186	523		1.02
6540	180	503		0.98
6600	174	483		0.95
6660	168	463		0.91
6720	162	444		0.87
6780	156	424		0.84
6840	150	404		0.80
6900	144	384		0.76
6960	138	364		0.72
7020	132	345		0.69
7080	126	325		0.65
7140	120	305		0.61
7200	114	285		0.58
7260	108	265		0.54
7320	102	246		0.50
7380	96	226		0.46
7440	90	206		0.43
7500	84	186		0.39
7560	78	166		0.35
7620	72	147		0.32
7680	66	127		0.28
7740	60	107		0.24
7800	54	87		0.20
7860	48	67		0.17
7920	42	48		0.13

7980	36	28	0.09
8040	30	8	0.05
8100	24		0.03
8160	18		0.03
8220	12		0.02
8280	6		0.01
8340	0		0.00

Maumelle 2010 Dry Weather Diurnal Flow

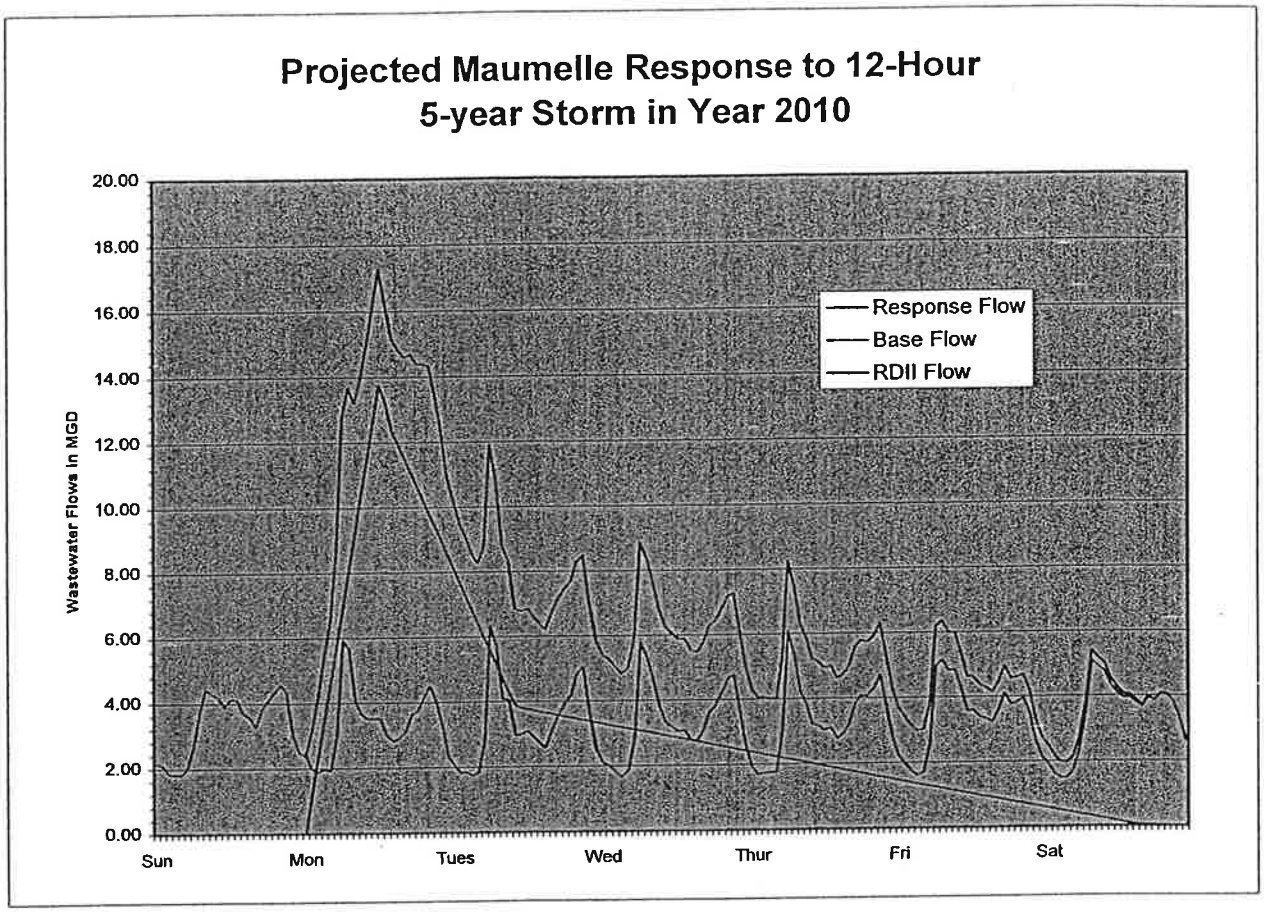


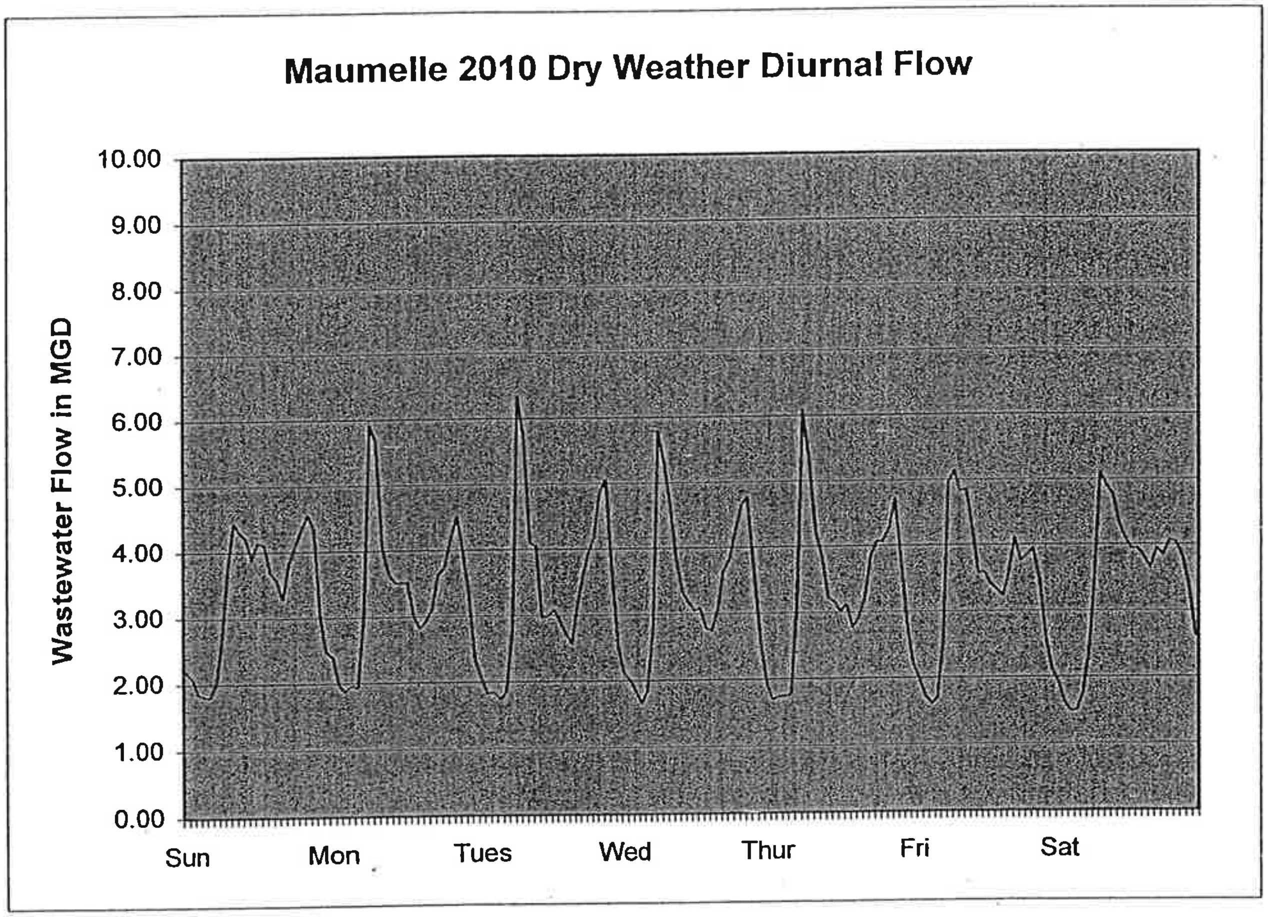
Projected Maumelle Hydrograph - Year 2010 - Twelve Hour 5-Year Frquency Event

		Base Q	RDII	Hydrograph
Sun	0:00	2.18		2.18
	1:00	2.09		2.09
	2:00	1.86		1.86
	3:00	1.82		1.82
	4:00	1.81		1.81
	5:00	2.01		2.01
	6:00	2.69		2.69
	7:00	3.76		3.76
	8:00	4.44		4.44
	9:00	4.29		4.29
	10:00	4.20		4.20
	11:00	3.89		3.89
	12:00	4.14		4.14
	13:00	4.10		4.10
	14:00	3.69		3.69
	15:00	3.57		3.57
	16:00	3.27		3.27
	17:00	3.82		3.82
	18:00	4.09		4.09
	19:00	4.33		4.33
	20:00	4.56		4.56
	21:00	4.34		4.34
	22:00	3.00		3.00
	23:00	2.48		2.48
Mon	0:00	2.40	0.00	2.40
	1:00	1.98	1.15	3.13
	2:00	1.87	2.29	4.17
	3:00	1.97	3.44	5.41
	4:00	1.93	4.58	6.51
	5:00	2.99	5.73	8.72
	6:00	5.92	6.87	12.79
	7:00	5.67	8.02	13.68
	8:00	4.03	9.16	13.20
	9:00	3.65	10.31	13.96
	10:00	3.51	11.45	14.97
	11:00	3.51	12.60	16.11
	12:00	3.51	13.75	17.27
	13:00	3.01	13.25	16.26
	14:00	2.81	12.34	15.16
	15:00	2.92	11.92	14.84
	16:00	3.10	11.49	14.60
	17:00	3.62	11.07	14.69
	18:00	3.75	10.65	14.40
	19:00	4.16	10.22	14.39
	20:00	4.52	9.80	14.32
	21:00	3.98	9.38	13.36
	22:00	3.25	8.95	12.20
	23:00	2.33	8.53	10.85
Tues	0:00	2.05	8.10	10.15
	1:00	1.83	7.68	9.51
	2:00	1.84	7.26	9.10
	3:00	1.74	6.83	8.57
	4:00	1.85	6.41	8.26
	5:00	2.76	5.99	8.75

	6:00	6.34	5.56	11.90
	7:00	5.71	5.14	10.85
	8:00	4.10	4.71	8.82
	9:00	4.05	4.29	8.34
	10:00	2.96	3.89	6.85
	11:00	2.99	3.80	6.78
	12:00	3.09	3.76	6.85
	13:00	2.90	3.72	6.62
	14:00	2.72	3.68	6.40
	15:00	2.57	3.64	6.21
	16:00	3.13	3.61	6.74
	17:00	3.59	3.57	7.16
	18:00	3.95	3.53	7.48
	19:00	4.18	3.49	7.67
	20:00	4.85	3.45	8.30
	21:00	5.06	3.42	8.47
	22:00	3.65	3.38	7.03
	23:00	2.50	3.34	5.84
Wed	0:00	2.10	3.30	5.41
	1:00	2.01	3.26	5.27
	2:00	1.83	3.23	5.06
	3:00	1.65	3.19	4.84
	4:00	1.86	3.15	5.01
	5:00	2.81	3.11	5.92
	6:00	5.79	3.07	8.86
	7:00	5.30	3.03	8.34
	8:00	4.66	3.00	7.66
	9:00	3.81	2.96	6.77
	10:00	3.33	2.92	6.25
	11:00	3.19	2.88	6.07
	12:00	3.04	2.84	5.89
	13:00	3.08	2.81	5.89
	14:00	2.78	2.77	5.55
	15:00	2.75	2.73	5.48
	16:00	3.06	2.69	5.76
	17:00	3.64	2.65	6.29
	18:00	3.82	2.62	6.44
	19:00	4.22	2.58	6.80
	20:00	4.65	2.54	7.19
	21:00	4.77	2.50	7.27
	22:00	3.67	2.46	6.14
	23:00	2.56	2.43	4.99
Thur	0:00	1.91	2.39	4.30
	1:00	1.69	2.35	4.04
	2:00	1.74	2.31	4.05
	3:00	1.75	2.27	4.02
	4:00	1.77	2.24	4.01
	5:00	3.06	2.20	5.25
	6:00	6.09	2.16	8.25
	7:00	5.34	2.12	7.46
	8:00	4.21	2.08	6.29
	9:00	3.85	2.05	5.90
	10:00	3.22	2.01	5.22
	11:00	3.17	1.97	5.14
	12:00	3.02	1.93	4.95
	13:00	3.11	1.89	5.00
	14:00	2.76	1.85	4.62
	15:00	2.92	1.82	4.73
	16:00	3.21	1.78	4.98
	17:00	3.84	1.74	5.58

	18:00	4.08	1.70	5.78
	19:00	4.07	1.66	5.73
	20:00	4.28	1.63	5.91
	21:00	4.71	1.59	6.30
	22:00	3.84	1.55	5.39
	23:00	2.77	1.51	4.28
Fri	0:00	2.21	1.47	3.68
	1:00	1.98	1.44	3.42
	2:00	1.73	1.40	3.13
	3:00	1.61	1.36	2.97
	4:00	1.70	1.32	3.02
	5:00	2.55	1.28	3.83
	6:00	4.95	1.25	6.20
	7:00	5.14	1.21	6.35
	8:00	4.82	1.17	5.99
	9:00	4.86	1.13	5.99
	10:00	4.29	1.10	5.39
	11:00	3.57	1.06	4.63
	12:00	3.60	1.02	4.62
	13:00	3.40	0.98	4.39
	14:00	3.33	0.95	4.28
	15:00	3.23	0.91	4.14
	16:00	3.58	0.87	4.45
	17:00	4.11	0.84	4.95
	18:00	3.76	0.80	4.56
	19:00	3.84	0.76	4.60
	20:00	3.95	0.72	4.68
	21:00	3.46	0.69	4.14
	22:00	2.61	0.65	3.26
	23:00	2.11	0.61	2.72
Sat	0:00	1.92	0.58	2.50
	1:00	1.63	0.54	2.17
	2:00	1.49	0.50	1.99
	3:00	1.50	0.46	1.97
	4:00	1.73	0.43	2.15
	5:00	2.37	0.39	2.76
	6:00	3.53	0.35	3.89
	7:00	5.10	0.32	5.42
	8:00	4.91	0.28	5.19
	9:00	4.77	0.24	5.01
	10:00	4.32	0.20	4.53
	11:00	4.11	0.17	4.27
	12:00	3.94	0.13	4.07
	13:00	3.95	0.09	4.04
	14:00	3.81	0.05	3.87
	15:00	3.65	0.03	3.68
	16:00	3.95	0.03	3.98
	17:00	3.84	0.02	3.86
	18:00	4.07	0.01	4.08
	19:00	4.04	0.00	4.04
	20:00	3.82		3.82
	21:00	3.37		3.37
	22:00	2.62		2.62

Projected Maumelle Response to 12-Hour
5-year Storm in Year 2010
Wastewater Flows in MGD
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sun
Mon
Tues
Wed
Thur
Fri
Sat
Response Flow
Base Flow
RDII Flow


Maumelle 2010 Dry Weather Diurnal Flow
Wastewater Flow in MGD
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Sun
Mon
Tues
Wed
Thur
Fri
Sat

Year 2025 - Projected Maumelle Response to a 12-hour 5-Year Frequency Rain Event

Ison RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.592 X Total I/I Volume
Volume of Inflow = 0.408 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 / 9.76)^0.5
Peak Inflow = (Volume of Inflow X 2 / 2.40)^0.5
Duration of infiltration in minutes = 9.76 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII = 6.16 MG

Volume of Infil = 3.65 MG
Volume of Inflow = 2.51 MG
Peak Infilitration = 864 gpm
Peak Inflow = 1447 gpm
Duration infil = 8437 minutes
Duration inflow = 1847 minutes
Inflow Decline t = 1127 minutes
S Inflow Decline = 1.28 gpm/minute
S Infil Decline = 0.10 gpm/minute
Inflow /Infil transition 2116 minutes
S to Peak 3.21 gpm/minute

Peak

Hinson RDII Response Curves for 12 Hour Event

Volume of Infiltration = 0.701 X Total I/I Volume
Volume of Inflow = 0.299 X Total I/I Volume
Peak Infilitration = (Volume of Infiltration X 2 /3.00)^0.5
Peak Inflow = (Volume of Inflow X 2 / .647)^0.5
Duration of infiltration in minutes = 3.00 X Peak Infiltration Flowrate in gpm
Duration of inflow minutes based upon shape of inflow triangle

Total Volume RDII = 16.27 MG

Volume of Infil = 11.41 MG
Volume of Inflow = 4.86 MG
Peak Infilitration = 2757 gpm
Peak Inflow = 3878 gpm
Duration infil = 8272 minutes

Duration inflow =	1822	minutes
Inflow Decline t =	1102	minutes
S Inflow Decline =	3.52	gpm/minute
S Infil Decline =	0.33	gpm/minute
Inflow /Infil transition	2122	minutes
S to Peak =	9.22	gpm/minute

North Slope RDII Response

Designed to Mirror Hinson & Ison Response Shapes

Projected Peak RDII	Flow =	1552	gpm
S to Peak	Slope =	2.16	gpm/minute
Inflow Decline	Flow =	1.08	gpm/minute
S Inflil Decline	Slope =	0.010	gpm/minute

Timer in Minutes	Project RDII Flows in gpm				Total RDII in MGD
	Ison	Hinson	Other		
0	0	0	0		0
60	193	553	129		1.26
120	385	1106	259		2.52
180	578	1660	388		3.78
240	770	2213	517		5.05
300	963	2766	647		6.31
360	1156	3319	776		7.57
420	1348	3872	905		8.83
480	1541	4426	1035		10.09
540	1733	4979	1164		11.35
600	1926	5532	1293		12.62
660	2119	6085	1423		13.88
720	2311	6635	1552		15.13
780	2234	6424	1487		14.62
840	2157	6213	1422		14.12
900	2081	6001	1358		13.61
960	2004	5790	1293		13.10
1020	1927	5579	1228		12.59
1080	1850	5368	1163		12.08
1140	1773	5157	1098		11.57
1200	1697	4945	1034		11.06
1260	1620	4734	969		10.56
1320	1543	4523	904		10.05
1380	1466	4312	839		9.54
1440	1389	4101	774		9.03
1500	1313	3889	710		8.52
1560	1236	3678	645		8.01
1620	1159	3467	580		7.50
1680	1082	3256	515		7.00
1740	1005	3045	450		6.49
1800	929	2833	386		5.98
1860	852	2622	321		5.47
1920	775	2411	256		4.96
1980	698	2200	191		4.45
2040	640	2057	126	Inflow to	4.07
2100	634	2037	62	Infiltration	3.94
2160	628	2017	42	Transition	3.87
2220	622	1997	42	Period	3.84
2280	616	1977	41		3.80
2340	610	1958	41		3.76
2400	604	1938	40		3.72
2460	598	1918	39		3.68
2520	592	1898	39		3.65

2580	586	1878	38	3.61
2640	580	1859	38	3.57
2700	574	1839	37	3.53
2760	568	1819	36	3.49
2820	562	1799	36	3.45
2880	556	1779	35	3.42
2940	550	1760	35	3.38
3000	544	1740	34	3.34
3060	538	1720	33	3.30
3120	532	1700	33	3.26
3180	526	1680	32	3.23
3240	520	1661	32	3.19
3300	514	1641	31	3.15
3360	508	1621	30	3.11
3420	502	1601	30	3.07
3480	496	1581	29	3.04
3540	490	1562	29	3.00
3600	484	1542	28	2.96
3660	478	1522	27	2.92
3720	472	1502	27	2.88
3780	466	1482	26	2.85
3840	460	1463	26	2.81
3900	454	1443	25	2.77
3960	448	1423	24	2.73
4020	442	1403	24	2.69
4080	436	1383	23	2.66
4140	430	1364	23	2.62
4200	424	1344	22	2.58
4260	418	1324	21	2.54
4320	412	1304	21	2.50
4380	406	1284	20	2.47
4440	400	1265	20	2.43
4500	394	1245	19	2.39
4560	388	1225	18	2.35
4620	382	1205	18	2.31
4680	376	1185	17	2.28
4740	370	1166	17	2.24
4800	364	1146	16	2.20
4860	358	1126	15	2.16
4920	352	1106	15	2.12
4980	346	1086	14	2.08
5040	340	1067	14	2.05
5100	334	1047	13	2.01
5160	328	1027	12	1.97
5220	322	1007	12	1.93
5280	316	987	11	1.89
5340	310	968	11	1.86
5400	304	948	10	1.82

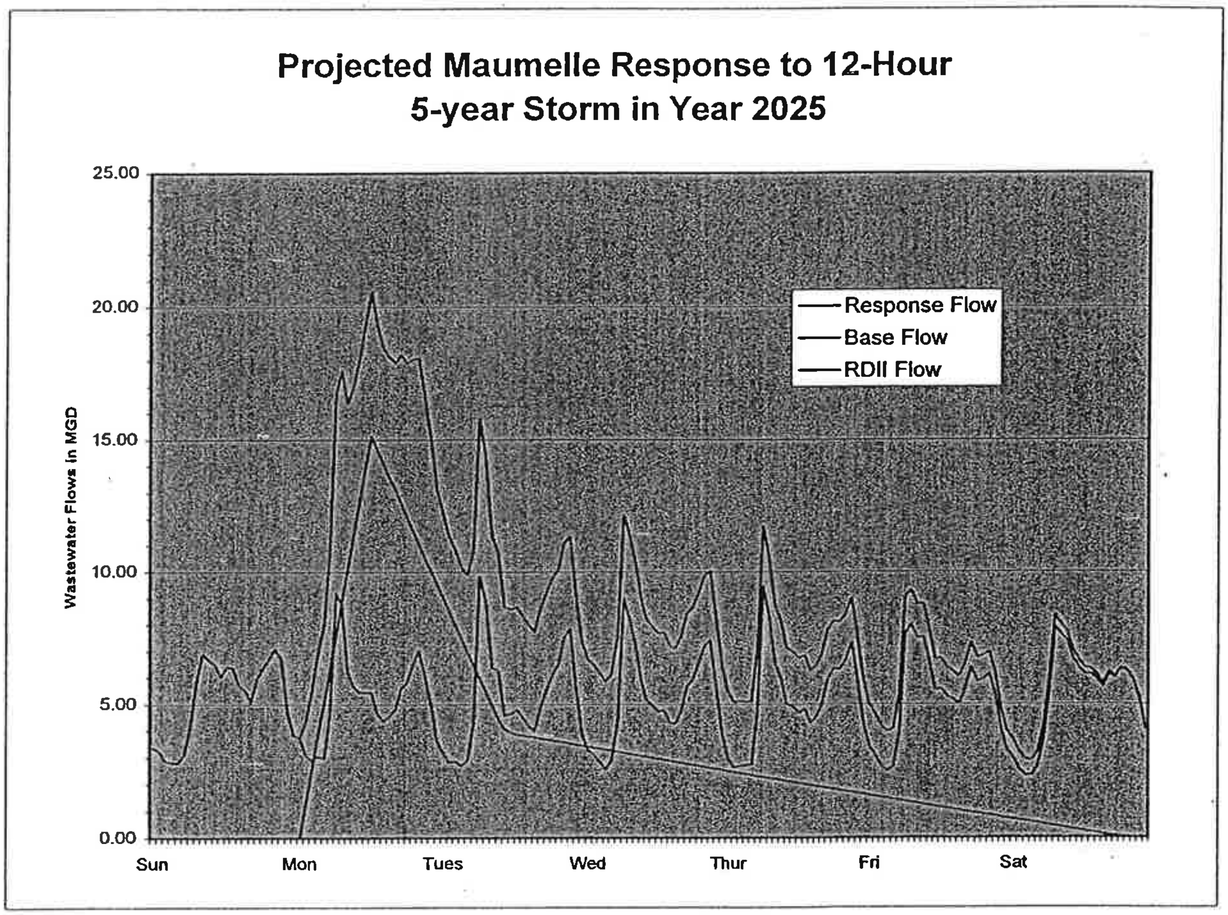
5460	298	928	9	1.78
5520	292	908	9	1.74
5580	286	888	8	1.70
5640	280	869	8	1.67
5700	274	849	7	1.63
5760	268	829	6	1.59
5820	262	809	6	1.55
5880	256	789	5	1.51
5940	250	770	5	1.48
6000	244	750	4	1.44
6060	238	730	3	1.40
6120	232	710	3	1.36
6180	226	690	2	1.32
6240	220	671	2	1.29
6300	214	651	1	1.25
6360	208	631	0	1.21
6420	202	611	0	1.17
6480	196	591		1.13
6540	190	572		1.10
6600	184	552		1.06
6660	178	532		1.02
6720	172	512		0.99
6780	166	492		0.95
6840	160	473		0.91
6900	154	453		0.87
6960	148	433		0.84
7020	142	413		0.80
7080	136	393		0.76
7140	130	374		0.73
7200	124	354		0.69
7260	118	334		0.65
7320	112	314		0.61
7380	106	294		0.58
7440	100	275		0.54
7500	94	255		0.50
7560	88	235		0.47
7620	82	215		0.43
7680	76	195		0.39
7740	70	176		0.35
7800	64	156		0.32
7860	58	136		0.28
7920	52	116		0.24
7980	46	96		0.20
8040	40	77		0.17
8100	34	57		0.13
8160	28	37		0.09
8220	22	17		0.06
8280	16			0.02
8340	10			0.01
8400	4			0.01

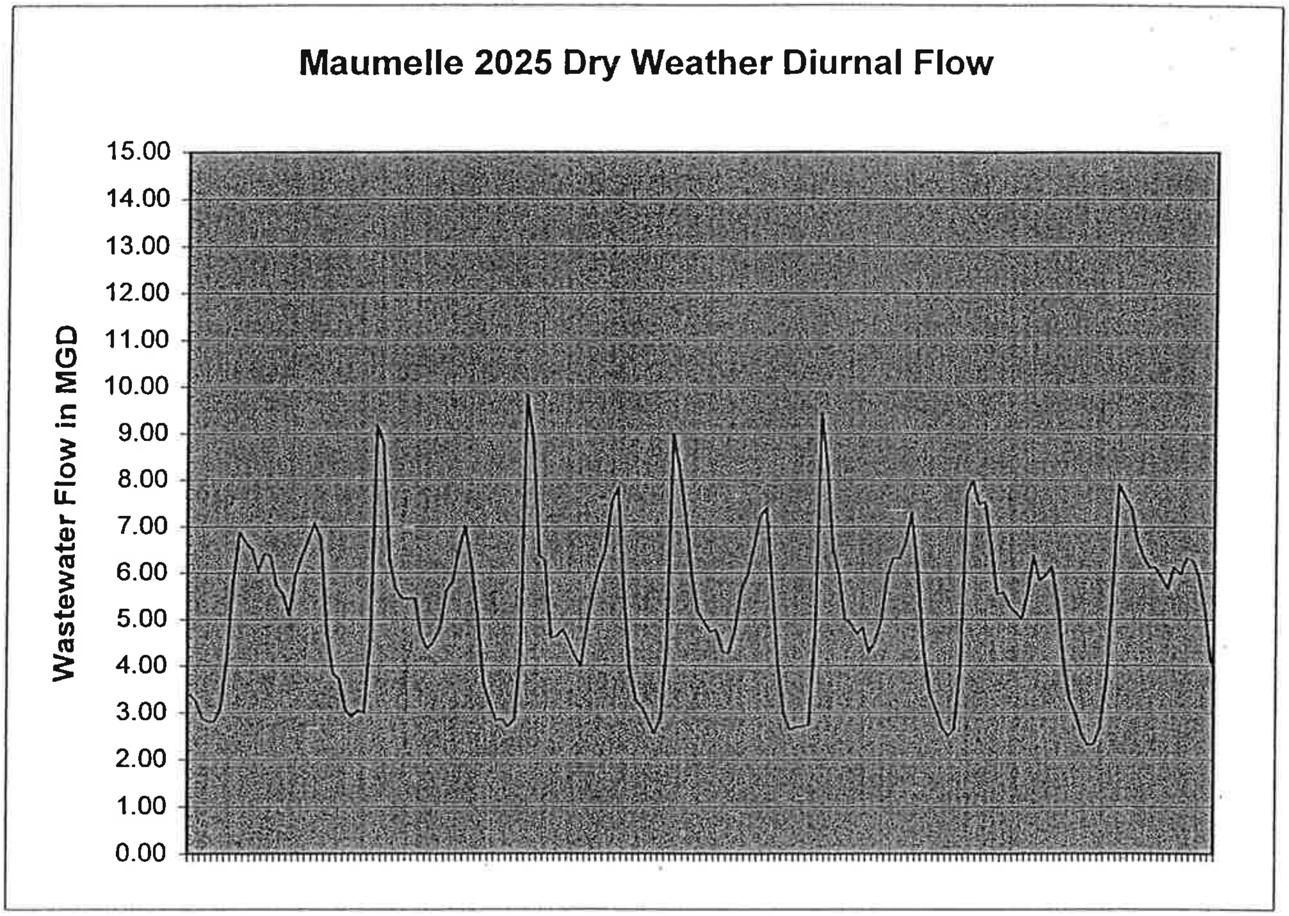
Projected Maumelle Hydrograph - Year 2025 - Twelve Hour 5-Year Frquency Event

		Base Q	RDII	Hydrograph
Sun	0:00	3.38		3.38
	1:00	3.24		3.24
	2:00	2.88		2.88
	3:00	2.82		2.82
	4:00	2.81		2.81
	5:00	3.12		3.12
	6:00	4.17		4.17
	7:00	5.83		5.83
	8:00	6.89		6.89
	9:00	6.65		6.65
	10:00	6.51		6.51
	11:00	6.03		6.03
	12:00	6.42		6.42
	13:00	6.37		6.37
	14:00	5.73		5.73
	15:00	5.55		5.55
	16:00	5.07		5.07
	17:00	5.94		5.94
	18:00	6.35		6.35
	19:00	6.72		6.72
	20:00	7.08		7.08
	21:00	6.73		6.73
	22:00	4.66		4.66
	23:00	3.85		3.85
Mon	0:00	3.72	0.00	3.72
	1:00	3.07	1.26	4.34
	2:00	2.91	2.52	5.43
	3:00	3.06	3.78	6.84
	4:00	2.99	5.05	8.04
	5:00	4.65	6.31	10.95
	6:00	9.19	7.57	16.76
	7:00	8.80	8.83	17.63
	8:00	6.26	10.09	16.35
	9:00	5.67	11.35	17.03
	10:00	5.46	12.62	18.07
	11:00	5.45	13.88	19.33
	12:00	5.45	15.13	20.59
	13:00	4.68	14.62	19.30
	14:00	4.37	14.12	18.48
	15:00	4.53	13.61	18.14
	16:00	4.81	13.10	17.91
	17:00	5.62	12.59	18.21
	18:00	5.82	12.08	17.90
	19:00	6.46	11.57	18.04
	20:00	7.01	11.06	18.07
	21:00	6.18	10.56	16.73
	22:00	5.04	10.05	15.09
	23:00	3.61	9.54	13.15
Tues	0:00	3.18	9.03	12.21
	1:00	2.83	8.52	11.36
	2:00	2.86	8.01	10.88
	3:00	2.70	7.50	10.20
	4:00	2.87	7.00	9.87

	5:00	4.29	6.49	10.78
	6:00	9.84	5.98	15.82
	7:00	8.86	5.47	14.33
	8:00	6.37	4.96	11.33
	9:00	6.29	4.45	10.74
	10:00	4.59	4.07	8.66
	11:00	4.64	3.94	8.58
	12:00	4.79	3.87	8.67
	13:00	4.51	3.84	8.34
	14:00	4.22	3.80	8.02
	15:00	3.98	3.76	7.74
	16:00	4.86	3.72	8.58
	17:00	5.57	3.68	9.26
	18:00	6.12	3.65	9.77
	19:00	6.49	3.61	10.10
	20:00	7.52	3.57	11.09
	21:00	7.85	3.53	11.38
	22:00	5.67	3.49	9.16
	23:00	3.89	3.45	7.34
Wed	0:00	3.27	3.42	6.68
	1:00	3.12	3.38	6.49
	2:00	2.84	3.34	6.18
	3:00	2.56	3.30	5.86
	4:00	2.88	3.26	6.15
	5:00	4.36	3.23	7.59
	6:00	8.99	3.19	12.18
	7:00	8.23	3.15	11.38
	8:00	7.24	3.11	10.35
	9:00	5.92	3.07	8.99
	10:00	5.17	3.04	8.21
	11:00	4.94	3.00	7.94
	12:00	4.73	2.96	7.69
	13:00	4.78	2.92	7.71
	14:00	4.31	2.88	7.19
	15:00	4.26	2.85	7.11
	16:00	4.76	2.81	7.56
	17:00	5.65	2.77	8.42
	18:00	5.93	2.73	8.66
	19:00	6.55	2.69	9.25
	20:00	7.22	2.66	9.87
	21:00	7.41	2.62	10.03
	22:00	5.70	2.58	8.28
	23:00	3.97	2.54	6.52
Thur	0:00	2.97	2.50	5.48
	1:00	2.63	2.47	5.09
	2:00	2.70	2.43	5.13
	3:00	2.71	2.39	5.10
	4:00	2.75	2.35	5.10
	5:00	4.74	2.31	7.06
	6:00	9.46	2.28	11.73
	7:00	8.29	2.24	10.53
	8:00	6.54	2.20	8.74
	9:00	5.98	2.16	8.14
	10:00	4.99	2.12	7.12
	11:00	4.92	2.08	7.00
	12:00	4.69	2.05	6.73
	13:00	4.83	2.01	6.84
	14:00	4.29	1.97	6.26
	15:00	4.53	1.93	6.46

	16:00	4.98	1.89	6.87
	17:00	5.96	1.86	7.81
	18:00	6.33	1.82	8.15
	19:00	6.31	1.78	8.09
	20:00	6.65	1.74	8.39
	21:00	7.31	1.70	9.02
	22:00	5.96	1.67	7.63
	23:00	4.30	1.63	5.92
Fri	0:00	3.43	1.59	5.02
	1:00	3.08	1.55	4.63
	2:00	2.69	1.51	4.20
	3:00	2.50	1.48	3.98
	4:00	2.64	1.44	4.08
	5:00	3.96	1.40	5.36
	6:00	7.69	1.36	9.05
	7:00	7.99	1.32	9.31
	8:00	7.48	1.29	8.77
	9:00	7.54	1.25	8.79
	10:00	6.66	1.21	7.87
	11:00	5.54	1.17	6.71
	12:00	5.59	1.13	6.72
	13:00	5.28	1.10	6.38
	14:00	5.17	1.06	6.23
	15:00	5.01	1.02	6.03
	16:00	5.55	0.99	6.54
	17:00	6.38	0.95	7.33
	18:00	5.84	0.91	6.75
	19:00	5.95	0.87	6.83
	20:00	6.13	0.84	6.97
	21:00	5.36	0.80	6.16
	22:00	4.06	0.76	4.82
	23:00	3.28	0.73	4.00
Sat	0:00	2.98	0.69	3.67
	1:00	2.53	0.65	3.18
	2:00	2.31	0.61	2.93
	3:00	2.33	0.58	2.91
	4:00	2.68	0.54	3.22
	5:00	3.67	0.50	4.18
	6:00	5.48	0.47	5.95
	7:00	7.92	0.43	8.35
	8:00	7.62	0.39	8.01
	9:00	7.40	0.35	7.75
	10:00	6.71	0.32	7.03
	11:00	6.37	0.28	6.65
	12:00	6.12	0.24	6.36
	13:00	6.12	0.20	6.33
	14:00	5.91	0.17	6.08
	15:00	5.66	0.13	5.79
	16:00	6.14	0.09	6.23
	17:00	5.97	0.06	6.02
	18:00	6.32	0.02	6.34
	19:00	6.28	0.01	6.29
	20:00	5.92	0.01	5.93
	21:00	5.23		5.23
	22:00	4.06		4.06


Projected Maumelle Response to 12-Hour
5-year Storm in Year 2025
Response Flow
Base Flow
RDII Flow
Wastewater Flows in MGD
25.00
20.00
15.00
10.00
5.00
0.00
Sun
Mon
Tues
Wed
Thur
Fri
Sat


Maumelle 2025 Dry Weather Diurnal Flow
Wastewater Flow in MGD
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00

MEMORANDUM

MONTGOMERY WATSON

LITTLE ROCK WASTEWATER UTILITY
COLLECTION SYSTEM FACILITIES PLAN

TECHNICAL MEMORANDUM - DATA INVENTORY / VALIDATION

SUBJECT: Data Inventory / Validation **DATE:** September 19, 2000

PREPARED BY: Andy Baldwin **MW FILE:**

This Technical Memorandum (TM) describes the data inventory and validation phase of the hydraulic modeling task for the Little Rock Wastewater Utility (LRWU) Collection System Facilities Plan. The model will be used to analyze the capacity requirements of the existing trunk sewer system and to verify that proposed trunk facilities will provide adequate capacity for future flows. The model database will be provided to LRWU so that LRWU staff can perform future updates and analyses of area-specific projects.

DATA SOURCES AND USE IN MODEL DEVELOPMENT

The basic sources of data for the LRWU model are data and graphic files maintained by various departments of LRWU. These include ArcView GIS files of pipes, manholes, and flow meter basins; GIS file of buildings; pump station data; land use mapping; industrial flow and billing data; and rainfall and flow monitoring data. This TM describes how the manhole and pipe data sources were validated for the six basins in the Little Rock study area.

MODEL BASINS

The data validation was conducted for the six separate model area basins as defined in Table 1. The initial manhole and pipe data received from LRWU was divided into the six areas to assist the data management and validation process. The data was converted into a node and link format suitable for using with ArcADE, the GIS data management software toolkit used for model construction and calibration.

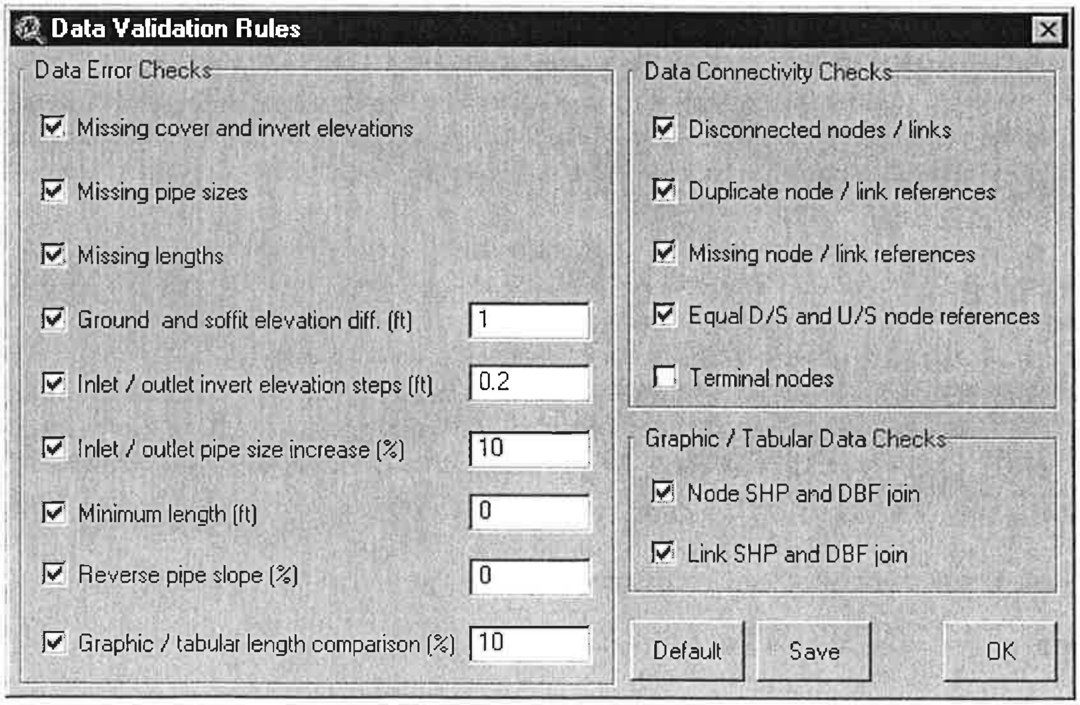
Table 1: Basin and Model Area Designations

Area Basin ID	Description
100	Riverfront (8502 acres)
200	North 60 (9213 acres)
300	South 60 (23698 acres)
400	Fourche (31562 acres)
500	District 142 (24980 acres)
600	Maumelle (9211 acres)

ARCADE DATA VALIDATION PROCESS

The ArcADE GIS data management toolkit contains a number of utilities for processing and validating sewer asset data. The toolkit contains a validation routine that queries and identifies data anomalies such as missing pipe inverts, negative slopes etc. The data validation rules applied during the first validation phase are displayed in Figure 1. The validation results are tabulated and joined to the node and link themes to display the validation problems. In addition, ArcADE displays profiles showing ground, pipe inverts and manhole locations. The profiles are used to visually identify pipe slope errors and invert steps. An example profile is displayed in Figure 2.

Figure 1: Data Validation Rules



Data Error Checks

- ☑ Missing cover and invert elevations
- ☑ Missing pipe sizes
- ☑ Missing lengths
- ☑ Ground and soffit elevation diff. (ft) 1
- ☑ Inlet / outlet invert elevation steps (ft) 0.2
- ☑ Inlet / outlet pipe size increase (%) 10
- ☑ Minimum length (ft) 0
- ☑ Reverse pipe slope (%) 0
- ☑ Graphic / tabular length comparison (%) 10

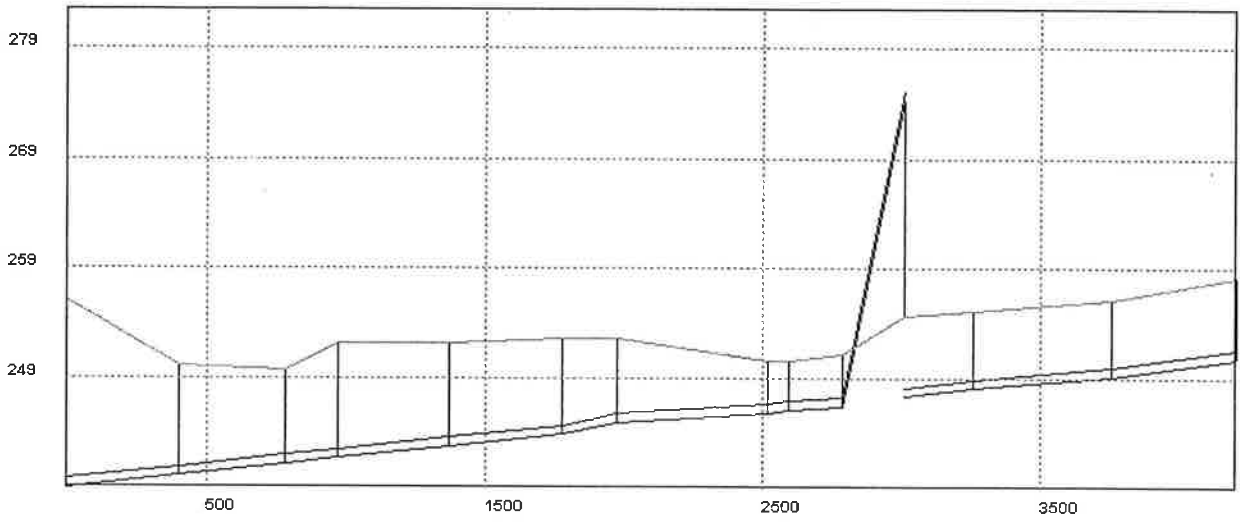
Data Connectivity Checks

- ☑ Disconnected nodes / links
- ☑ Duplicate node / link references
- ☑ Missing node / link references
- ☑ Equal D/S and U/S node references
- ☐ Terminal nodes

Graphic / Tabular Data Checks

- ☑ Node SHP and DBF join
- ☑ Link SHP and DBF join

Figure 2: Example Profile View



DATA VALIDATION RESULTS

Montgomery Watson conducted extensive review and data validation of the original pipe and manhole GIS and data files provided by the LRWU. This validation process identified a number of problems with the data with respect to its use for model building. Note that such "problems" are not necessarily errors or mistakes, but in many cases are simply limitations of the data or graphical format that result in problems for modeling. Example problems included disconnect between graphical and tabular data; pipes disconnected from the system; pipes with reversed upstream/downstream nodes; duplicate manhole numbers; plugged or abandoned pipes; missing data (e.g., diameters, rim or invert elevations); flow diversions; and incorrect "matching" invert elevations for different diameter pipes. Montgomery Watson, assisted by LRWU staff, corrected many of the data problems and developed missing information through the use of site surveys and examination of record drawings. However, most of these corrections and additions were limited to the modeled trunk sewers (primarily 10-inch diameter and larger). Montgomery Watson has provided the LRWU with a detailed listing of all such problems found and corrections made to the model database.

DATA VALIDATION SUMMARY

The following pages summarize the validation results for the six sewer basin areas. The tables show the number of errors identified during the initial data validation of the sewer data for the 10-inch and larger network. The North 60 and Fourche basins have been merged into one model basin.

M E M O R A N D U M

MONTGOMERY WATSON

LITTLE ROCK WASTEWATER UTILITY
COLLECTION SYSTEM FACILITIES PLAN

TECHNICAL MEMORANDUM - FLOW MONITORING

SUBJECT: Flow Monitoring **DATE:** June 05, 2001

PREPARED BY: Andy Baldwin **MW FILE:**

This Technical Memorandum (TM) describes the flow and rain data used for the hydraulic model calibration task for the Little Rock Wastewater Utility (LRWU) Collection System Facilities Plan. The model will be used to analyze the capacity requirements of the existing trunk sewer system and to verify that proposed trunk facilities will provide adequate capacity for future flows. The model database will be provided to LRWU so that LRWU staff can perform future updates and analyses of area-specific projects.

1. INTRODUCTION

Rainfall and flow monitoring data are used for calibration of the hydraulic model. ArcADE can import these types of data from various formats, including Sigma flow meter data files.

Rainfall data are used to generate event rainfall files (RED files) for HydroWorks. Radar rainfall data was obtained from NEXRAIN Corporation and imported into ArcADE, then converted into HydroWorks for selected wet-weather events.

After the model is run for a specific rainfall event, the resulting model simulated flow hydrographs at flow meter locations are compared to actual flow monitoring data. The flow monitoring data for the period January through April 1999 and January and February 2000 were used for model calibration. The calibration process and results are discussed later in this TM.

2. FLOW METER DATA

The flow meter data was obtained from a temporary flow monitoring contract conducted by Pitometer, Byrd / Forbes (PBF). The goals of the contract were to provide LRWU with dry and wet weather sewer flows for model calibration, measure I/I quantities upstream of each flow meter site, measure pump output of four LRWU pump stations, and monitor groundwater levels at eight locations in the collection system.

PBF installed 63 gravity flow meters, 4 force main flow meters, 8 groundwater gauges, 5 sewer gas meters and 8 rain gauges throughout the study area. A summary of the flow meters including meter locations, model references, and location descriptions is shown in Table 2.1.

Table 2.1 Flow Meter Locations

Meter_Name	Meter_Id	Node_Ref	Link_Ref	Comment
site015	015	-2E010	-2E009.1	Pleasant Valley, 31802 Split
site014	014	-2E037	-2E036.1	Pleasant Valley, 31802 Split
site059	059	2B002	2B006.1	Jimerson Creek West
site058	058	2C112	2C113.1	Jimerson Creek East
site003	003	0F146	0E171.1	Echo Valley, move monitor to 0F146
site057	057	6C006	6C007.1	Longfellow/Palisades
site006	006	1F056	1F055.1	Foreman Lake
site126	126	8E099	8E091.1	Country Club Hollow
site125	125	8E013	7E016.1	Allsopp Park North
site034	034	5H008	5H004.1	Upper Coleman
site055	055	9F024	9F058.1	Allsopp Park South
site001	001	0F003	0F002.1	Walnut Valley, 31801 Split
site002	002	0F013	0F012.1	Walnut Valley, 31801 Split
site005	005	1G119	1G120.1	Rock Creek East/Baptist Hospital
site004	004	1G075	1G076.1	Natural Resource Complex
site112	112	10G066	10G065.1	Rose Creek
site032	032	6L008	6L009.1	Middle & Lower Coleman
site031	031	6K022	6K020.1	District No.119, moved upstream
site029	029	9I064	9I065.1	Barton North
site009	009	2J066	2J067.1	District No.137
site122	122	16K009	16K010.1	North 60 Summation
site123	123	16K005	16K006.1	South 60 Summation
site063	063	13I049	13I050.1	Quapaw North
site019	019	15K019	15K020.1	Garden Homes
site021	021	14K005	14K004.1	Quapaw South
site010	010	2K143	2K144.1	Barrow Addition/South Boyle Park
site100	100	7K092	7K093.1	District 84 new interceptor
site026	026	11L049	11L050.1	Swaggerty parallel
site025	025	11L023	11L024.1	Swaggerty
site028	028	9K034	9K035.1	Barton South
site023	023	12K019	12K020.1	Washington Elementary/Ives Court
site105B	05B	4N014	4N013.1	dual probe, 24" and 42", Brodie Creek Interc.
site018	018	2O003	2O004.1	Reinstate at BFA request, Brodie Creek East
site104B	04B	2O026	2O024.1	24" Brodie Creek Interconnection
site106	106	11L092	11L091.1	Interstate Park Interconnect/LR02
site105	105	4N014	4N089.1	dual probe, 24" and 42", Brodie Creek Interc.
site062	062	14L003	14L004.1	Granite Mountain
site012	012	3M005	3M006.1	Western Hills

site036	036	5M009	5M036.1	Mabelvale Pike
site037	037	7O012	7O013.1	65th Industrial/Wakefield
site107	107	8Q015	8R006.1	Old 201 Outfall
site124	124	8R051	8R052.1	36" Line upstream of Jamison Road PS
site109	109	6T057	6T058.1	Reck Road
site101	101	-8G006	-8G009.1	Rock Creek West/Chennal Parkway
site102	102	-1L003	-1L004.1	Brodie Creek West/Sandpiper
site035	035	5M008	5N001.1	Meadowcliff
site103	103	2O008	2O009.1	District 142 summation
site044	044	2Q004	2Q005.1	Cloverdale
site043	043	2R053	2R009.1	Chicot
site118	118	0Q007	0Q008.1	Mabelvale
site108	108	6T059	6T060.1	District No.201- McClelland High
site110	110	4U014	4U015.1	SID 214/SID 145, 40503 Split
site111	111	4V001	4V002.1	Geyer Springs, 40503 Split
site050	050	17H004	17H003.1	Riverfront Int(Broadway to AFTP)/LR01
site116	116	-10-B007	-10-B008.1	Pinnacle (North Slope)
site113	113	-7-A006	-7-A005.1	Ison
site114	114	-8-A002	-8-A001.1	Hinson Summation
site115	115	-5D008	-5D009.1	Hinson Intra
site120	120	-4T002	-4T013.1	Callahan Creek
site119	119	-3R004	-3R034.1	Haw Creek
site117	117	-4U003	-4U004.1	Combination of Alexander and Vimy Ridge
site007	007	2G044	2G045.1	Leawood
site008	008	3H011	3H083.1	Hall High

The flow data was imported into ArcADE by converting the Sigma CSV data into DBF format for each flow meter. The flow meter DBF files, stored in the 'Flows/DBF' folder in the working directory, contain flows (mgd), velocities (ft/s) and depths (ft) recorded at 15 minute intervals. The flow data DBF files are named using 3 character meter ID's defined in the flow meter theme (SHP file). These files are automatically accessed via the ArcADE tools including the hydrograph viewing tool, flow analyzer, and the diurnal profile analyzer.

The flow data was evaluated for missing data or data anomalies such as very low velocity readings caused by 'sensor ragging'. In addition, the data was evaluated for accuracy and consistency by comparing average, minimum and maximum flows for each meter with upstream and downstream meters. For example, flow meters with an average flow less than nearby upstream meters would indicate a data error warranting further investigation. Furthermore, differences between pipe sizes from the flow survey report and pipe sizes in the database were checked to identify errors with flow meter locations. For example, flow meter 108 in the Fourche basin does not correlate with the downstream meters 107 and 124, plus the pipe size recorded during the flow meter installation does not match the corresponding pipe in the database. Following further investigation, the manhole ID for flow meter 108 was changed from 6T059 to 6T006.

The flow monitoring period extended from March 15th 2000 to April 28th 2000 and captured 5 rain events ranging from 0.50 to 3.09 inches per event. Figures 2.1 and 2.2 display flow and rain data from one of the flow meters and radar cells respectively for the total survey period.

Figure 2.1 Example Flow Hydrograph (MGD) from 03/15/2000 to 04/28/2000

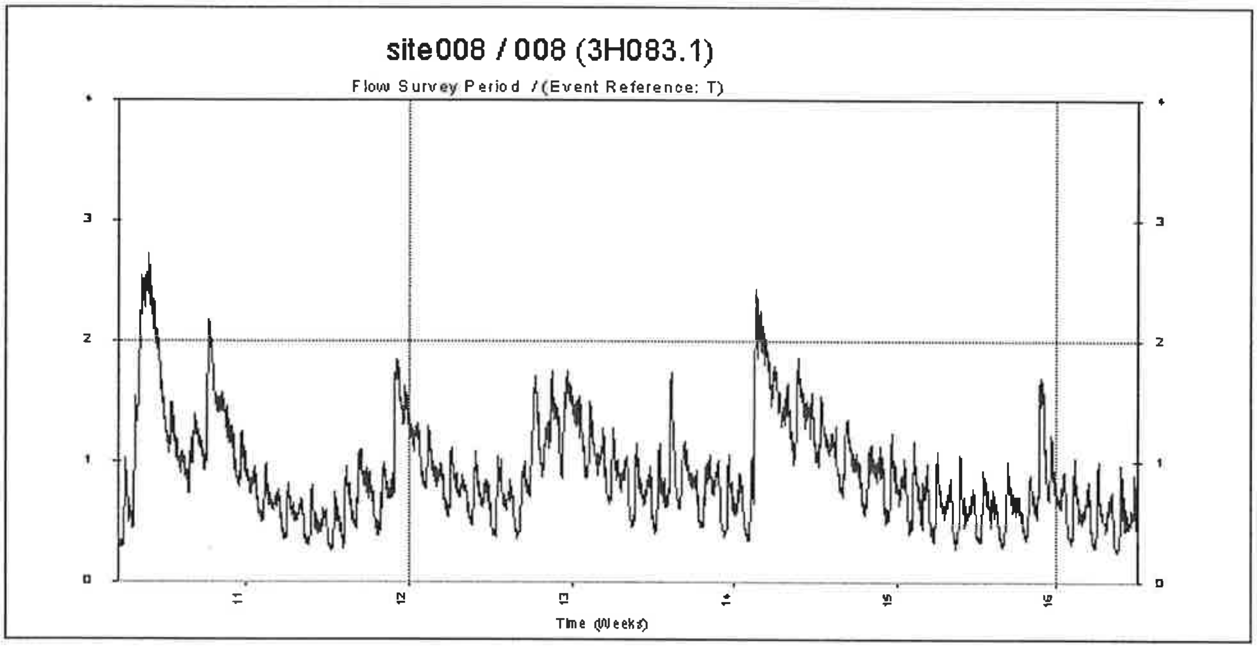
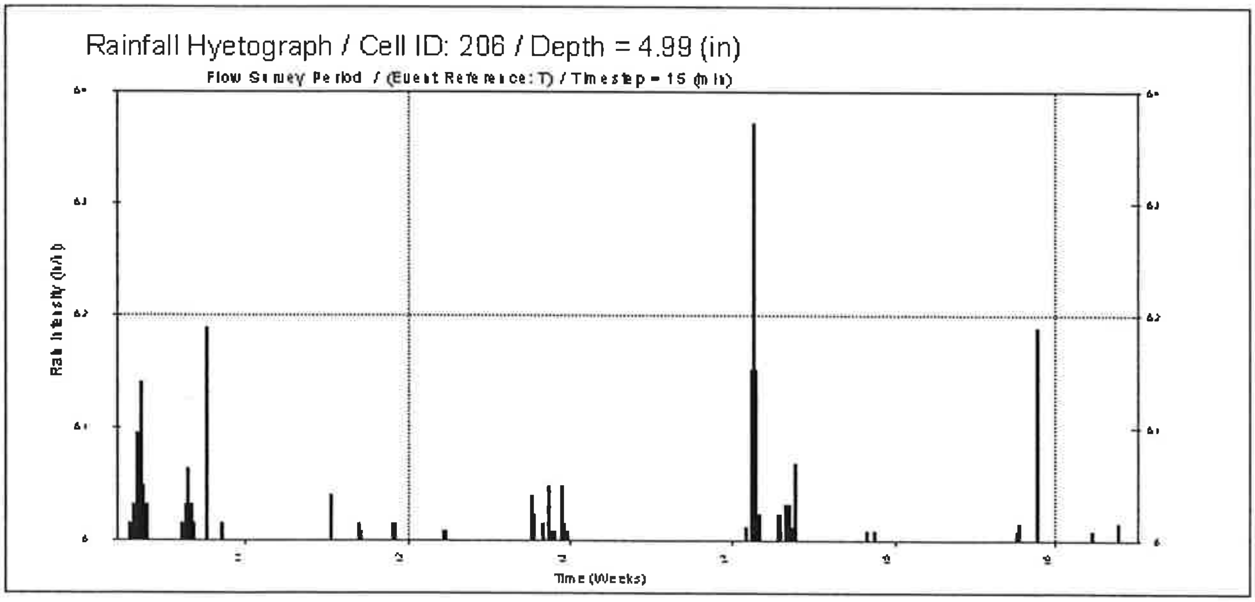


Figure 2.2 Example Rainfall Data (in/hr) from 03/15/2000 to 04/28/2000



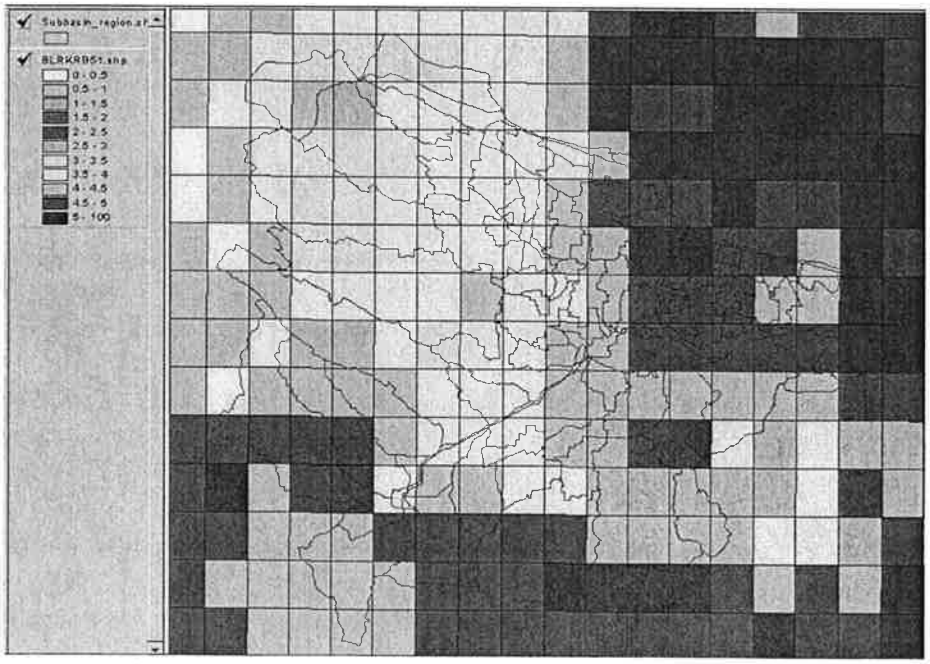
3. RAINFALL DATA

The rainfall data used for the project is gauge-adjusted radar-rainfall data provided by NEXRAIN Corporation. Radar rainfall data provides an accurate estimation of the spatial distribution of rainfall which is critical to model calibration. In the past, hydraulic models have been calibrated using rainfall data collected from rain gauge networks providing accurate rain measurements at discrete points, but with poor estimates falling between gauges. On the other hand, radar's strength is its ability to see between the gauges, but lacks the consistency in estimating rainfall at a specific point.

Gauge-adjusted radar rain data is the combination of rain data from a gauge network and rain data derived from radar which takes advantage of the strengths of each measurement system while minimizing their respective weaknesses. Essentially, a radar image is used as an areal template for the spatial distribution of rainfall. The rain gauge data are used to scale the areal template. The net result is a gauge-adjusted radar rainfall data set that combines the spatial distribution characteristics of the radar image with the scaling information from the gauges. NEXRAIN uses 15-minute radar-rainfall estimates obtained from WSI Corporation, a nationally recognized supplier of weather data. The adjusted radar rainfall data grid is formed of 396 grid cells measuring 2 km x 2 km. The grid covers an area bounded on the west by –92.533° longitude, on the east by –92.131° longitude, on the north by 34.883° latitude and on the south by 34.577° latitude.

The radar data was converted into ArcADE rain data DBF files, and a graphic theme of the grid cells. The data is used to develop HydroWorks rain data (RED) files for selected wet-weather events, and evaluate the spatial variation over the Little Rock study area. Figure 3.1 shows the spatial variation of total rainfall during the flow monitoring period.

Figure 3.1 Total Rain Depths (in) from 03/15/2000 to 04/28/2000



4. ANTECEDENT RAINFALL

Antecedent rainfall effects the inflow and infiltration (RDI/I) by increasing ground and surface wetness, and reducing the 'soil moisture' capacity. As a result, surface runoff and GWI increases when the catchment wetness increases due to preceding rainfall. The antecedent rainfall is assessed by calculating the 5-day Antecedent Rainfall Precipitation Index (API5) for the complete flow monitoring period. The results, shown in Figure 4.1, are used to identify dry and wet-weather events used for model calibration. Ideally, events are selected where the preceding ground condition is relatively 'dry' and at least not saturated from previous rainfall (ie; minimum or ideally zero API5). The equation used to calculate API5 is as follows:

$$API_5 \quad = \quad \Sigma_{n = 1,5} \; [P_{-n} \, C^{n-0.5}]$$

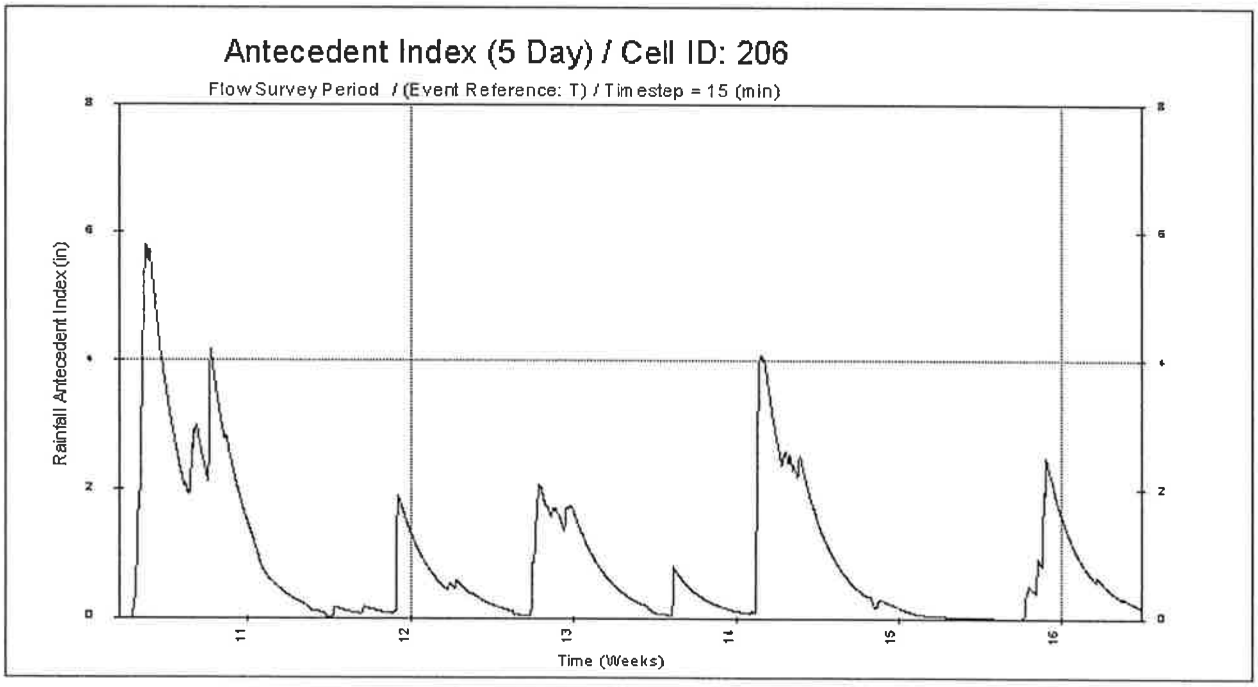
where;

P = *daily rainfall depth*

C = *decay coefficient (= 0.7)*

The decay coefficient (C) is related to the soil type and effects the magnitude of antecedent rainfall. For example, light sandy soils provide greater drainage which in turn lowers the impact of antecedent rainfall, eventually reducing runoff. A decay coefficient of 0.7 was used for this analysis.

Figure 3.1 Total Rain Depths (in) from 03/15/2000 to 04/28/2000



5. EVENT ANALYSIS

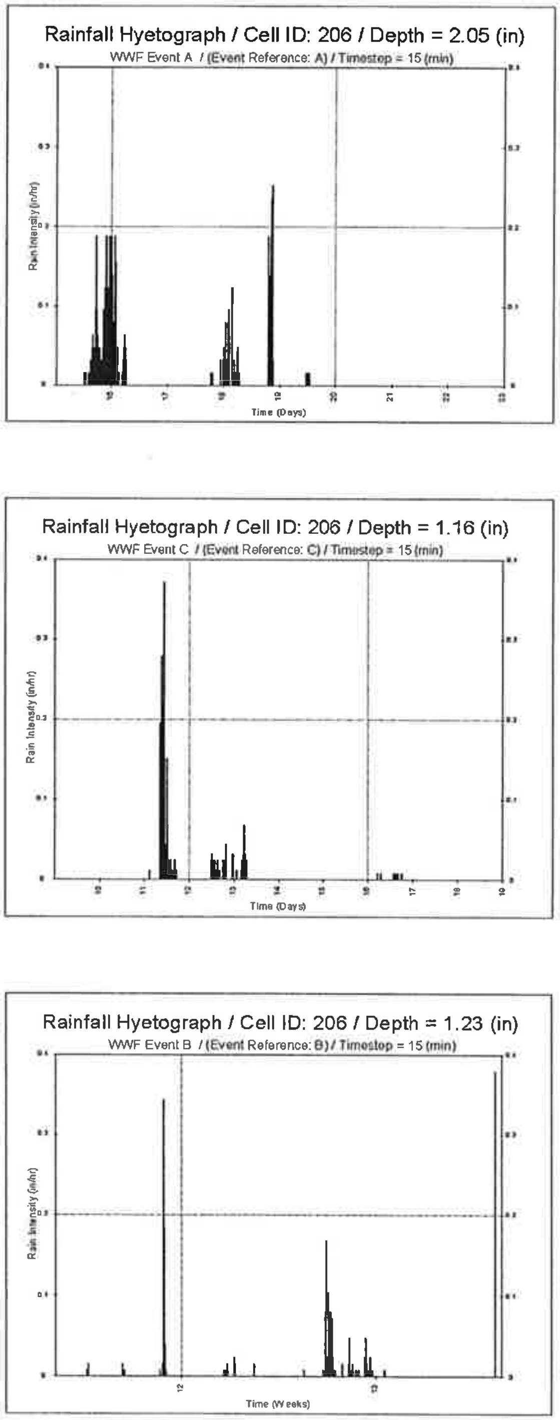
The flow and rain data were used to identify dry and wet weather events for model calibration. Dry weather events include weekday and weekend periods to account for different diurnal patterns resulting from changes in residential and employment behavior. Ideally, dry periods following preceding rainfall should be avoided as this results in high ground water flows. However, satisfying this condition is not always possible during the wet-weather season.

The wet-weather events were selected based on the peak intensity, total depth and storm duration. Table 5.1 lists the dry and wet weather events. In addition, Figure 5.1 displays the 3 wet-weather event rainfall hyetographs showing the variation of intensity and depth.

Table 5.1 Dry and Weather Event Summary

TITLE	REF	DURATION (hrs)	START DATE	START TIME	START DAY	END DATE	END TIME	END DAY
DWF Event X (Weekday)	X	48	04/26/2000	00:00	Wednesday	04/28/2000	00:00	Friday
DWF Event Y (Weekday)	Y	48	04/19/2000	00:00	Wednesday	04/21/2000	00:00	Friday
DWF Event Z (Weekend)	Z	48	04/29/2000	00:00	Saturday	05/01/2000	00:00	Monday
WWF Event A	A	192	03/15/2000	00:00	Wednesday	03/23/2000	00:00	Thursday
WWF Event B	B	383	03/23/2000	00:00	Thursday	04/08/2000	00:00	Saturday
WWF Event C	C	240	04/09/2000	00:00	Sunday	04/19/2000	00:00	Wednesday
Flow Survey Period	T	1055	03/15/2000	00:00	Wednesday	04/28/2000	00:00	Friday

Figure 5.1 Wet Weather Event Hyetographs



MEMORANDUM

MONTGOMERY WATSON

LITTLE ROCK WASTEWATER UTILITY
COLLECTION SYSTEM FACILITIES PLAN

TECHNICAL MEMORANDUM - MODEL BUILDING

SUBJECT: Model Building **DATE:** July 18, 2001

PREPARED BY: Andy Baldwin **MW FILE:**

This Technical Memorandum (TM) describes the model building phase of the hydraulic modeling task for the Little Rock Wastewater Utility (LRWU) Collection System Facilities Plan. The model will be used to analyze the capacity requirements of the existing trunk sewer system and to verify that proposed trunk facilities will provide adequate capacity for future flows. The model database will be provided to LRWU so that LRWU staff can perform future updates and analyses of area-specific projects.

1. NETWORK DEFINITION

Network definition is the process of identifying nodes and links to be included in the hydraulic model data. The process often referred to as 'simplification' involves selecting critical nodes and links based on size, length, contributing area, type of sewer etc. The user can select the criteria for defining a model network using the Rules dialog accessed from the Trace Manager. The network definition process creates two output files: Node List and a Link List. These files contain a list of nodes and links required for the model network and are used in the Data Extraction process to create the model data files.

The network definition process is conducted using the Trace Manager which provides the engine to select part or all of the master network and apply the model simplification rules. The network definition process involves defining criteria, or “rules”, for delineating the portion of the sewer system to be modeled. For the LRWU Master Plan, the criteria for defining the modeled system was based on pipe diameter greater than 10 inches. The ArcADE process of “network definition” consists of tracing upstream through the entire sewer system starting from each “outfall” node (discharge point to the interceptor system), and then “pruning” the network working downstream from each upstream terminal node until the first pipe larger than 10 inches in diameter is reached. All pipes downstream of those points (including any 10-inch and smaller pipes located downstream of 12-inch or larger pipes) are included in the model.

2. NETWORK EXTRACTION

Network Extraction is the process of selecting a sub-set of node / link data from the master data files and creating a new set of attribute (DBF) and theme (SHP) files. The process, which is conducted using the Data Extraction Manager, is primarily for creating model attribute (DBF) files based on the node and link list files generated from the network definition process. The format of the output files generated from the Data Extraction Manager is exactly the same as the format of the standard ArcADE attribute files.

In addition to creating model files, the Data Extraction Manager can create a sub-set of the graphic (SHP) and attribute (DBF) files from a user defined selection of the master data set. For example, the user may want to create a brand new set of node, link and sewer basin (SHP and DBF) files from a selected part of the network to reduce the time spent processing large data files.

Model attribute data comprises of node, link and sewer basin (DBF) files that store a simplified set of nodes and links resulting from the model definition process. Although the data tables follow exactly the same format as the master ArcADE attribute data, the content is different. For example, the data will include sewer basins that have been merged and nodes that have been removed due to model simplification. Also, the node file includes converted coordinates required for HydroWorks.

3. POPULATION DATA CONVERSION

The population data is used to estimate the dry weather flows generated from residential and employment populations. The population estimates were derived from on the 'Building Theme' which provided a spatial distribution of all buildings including residential, commercial and industrial buildings. The populations were expressed as equivalent residential units (ERU) per building. For example, a typical single family home was equal to 1 ERU, where as commercial buildings were assigned multiple ERU values.

The ArcView building theme (buildings2.shp) contained a field defining the building code ("Structure_") which allowed the consultant to identify the building type and estimate the ERU based on the building area. However, approximately 60% of the buildings had missing building codes, hence an alternative method of identifying the building type was implemented. The approach compared the building area (ie; 'footprint') with average building footprints for single family, multiple family, commercial and industrial buildings. Building footprints less than 500ft^2 were eliminated from the process to avoid including garages, storage sheds etc. The average building footprints were derived from buildings with known types. Table 3.1 below lists the building types with average building footprint areas.

Table 3.1 Average Building Footprint Areas

Description	Structure Code	Minimum Area (ft^2)	Maximum Area (ft^2)
Mobile Homes	410	500	1000
Single Family	411	1000	3000
Multi Family	414	3000	12000
Commercial	580	12000	50000
Industrial	650	50000	

4. SEWER BASIN PROCESSING

The Sewer Basin Manager processes all the model inflows including dry weather, wet weather, and industrial discharges and exports the inflow data to a 'sewer basin' (DBF) file. The sewer basin file is then loaded into the model export routine. The sewer basin file can either include one record for each sewer basin polygon ('Basin' file), or one record representing a series of consolidated sewer basin polygons ('Model' file).

The Sewer Basin Manager uses the sewer basin polygons to distribute populations, land-use data, rain basins, ground-water infiltration, wet-weather infiltration, industrial discharges and pipe condition rankings. The input data sources can be 'continuously' added to the input sewer basin file, creating an updated sewer basin file.

4.1 Population Distribution

Population data is used to calculate dry weather flows for residential and employment areas. The dry weather flow is calculated in the model by multiplying the population by a per capita flow rate (eg; 75 g/day/head). The Sewer Basin Manager is used to derive an 'equivalent' population per sewer basin from the residential and employment populations. The following formula is used to calculate the equivalent population:

$$Population\ (equiv) = Res\ Pop + [\ Emp\ Pop \times (Emp\ PCF\ /\ Res\ PCF)]$$

where; *Res Pop* = Residential Population
Emp Pop = Employment Population
Res PCF = Residential Per Capita Flow (eg; 75 g/day/head)
Emp PCF = Employment Per Capita Flow (eg; 25 g/day/head)

The population data consists of one polygon theme (SHP file) representing different 'population zones', joined to an attribute (DBF) file containing residential and employment populations. A different population attribute (DBF) file is used for each year, eg; existing, 2010, build-out etc. The residential and employment populations are distributed by the following method.

1) For each population polygon, calculate the population density (pop/acre)
2) Overlay the population polygons 'on top' of the sewer basin polygons
3) For each sewer basin, identify the population polygon 'fragments'
4) For each fragment, calculate the total population (= fragment area x density)
5) For each sewer basin, sum the fragment populations for residential and employment populations
6) For each sewer basin, calculate the 'Equivalent' population and enter in the 'Population' field in the sewer basin (DBF) file
7) For each sewer basin, assign a DWF index based on the following split between residential and employment populations

DWF Index	Residential %	Employment %
1	100 - 90	10 - 0
2	90 - 70	30 - 10
3	70 - 50	50 - 30
4	50 - 30	70 - 50
5	30 - 10	90 - 70
6	10 - 0	100 - 90

4.2 Land Use Data Distribution

Land-use data consists of a polygon theme containing land-use types such as residential, commercial, transport, vacant areas etc. The land-use data is used to identify 'developed' and 'un-developed' land areas. Developed land includes all areas that are paved and drained for residential, commercial, and industrial purposes. Un-developed land includes agriculture, vacant land, and parks. For modeling purposes, the developed land is assumed to contribute towards ground water and wet-weather infiltration flows. The following table lists the land-use types used in ArcADE.

Land-Use	Developed
1 Rural Homes (Low Density)	Y
2 Single Family (Medium Density)	Y
3 Multi Family (High Density)	Y
4 Mobile Homes	Y
5 Hotels / Dorms	Y
6 Industrial	Y
7 Transport	Y
8 Commercial	Y
9 Office	Y
10 Services	Y
11 Military	Y
12 Recreational	N
13 Agriculture	N
14 Vacant	N
15 Construction	N

4.3 Rain Basin Allocation

Rain basins are used to spatially distribute rainfall data and are created using methods such as Theissons Polygons or based on radar cells. The rain basin theme contains cell ID's which provide the link to rainfall data contained in separate DBF files.

As the rain basin theme can contain many polygons (especially for radar cells), temporary rain indexes are assigned to each rain basin and then later copied to the sewer basin table during the 'default' processing. Note, HydroWorks limits the number of rain indexes, hence the need to create temporary indexes. These indexes are also used in the rainfall event data (RED) file and cross-referenced with the cell ID's (using the rain basin theme) to export the rain data to HydroWorks. The following summarizes the rain basin allocation method:

1. Overlay the rain basin polygons 'on top' of the sewer basin polygons
2. Select rain basins intersecting the sewer basins
3. For each sewer basin, identify the rain basin polygon that contains the centroid of the sewer basin
4. Starting at '1', create a rain index (sequentially) for each selected rain basin
5. Write the rain index in the 'Rain_index' field in the rain basin theme and in the 'Rg_ref' field in the sewer basin theme

4.4 Pipe Condition Allocation

Pipe condition plays an important role in allocating dry and wet weather infiltration flows. For example, a fractured pipe increases the potential for I/I than a pipe in good structural condition. The process firstly uses the Sewer Basin Manager to derive average pipe conditions for each sewer basin. Then in the Dry and Wet Weather Flow Analyzers, the GWI and percentage effective areas are derived using the 'ranked' contributing area. These values are then fed back into the Sewer Basin Manager to distribute the dry and wet weather inflows.

M E M O R A N D U M

MONTGOMERY WATSON

LITTLE ROCK WASTEWATER UTILITY COLLECTION SYSTEM FACILITIES PLAN

TECHNICAL MEMORANDUM - MODEL INFLOWS

SUBJECT: Model Inflows **DATE:** September 30, 2001

PREPARED BY: Andy Baldwin **MW FILE:**

This Technical Memorandum (TM) describes the development of the model inflows for the hydraulic modeling task for the Little Rock Wastewater Utility (LRWU) Collection System Facilities Plan. The model will be used to analyze the capacity requirements of the existing trunk sewer system and to verify that proposed trunk facilities will provide adequate capacity for future flows. The model database will be provided to LRWU so that LRWU staff can perform future updates and analyses of area-specific projects.

The hydraulic sewer model requires dry weather and wet-weather inflows to assess the hydraulic impact of the existing sewer system. The following describes the methodology and data used to model both dry and wet weather flows.

1. DRY WEATHER MODEL INFLOWS

Dry weather sewer flows are generated from residential populations, commercial and industrial flows, ground water infiltration and rainfall related infiltration. The dominating population based flows were derived from the building and land-use data provided by LRWU with the ground water and rainfall flows derived from the flow meter data.

1.1 Residential and Employment Wastewater Flows

The population data is used to estimate the dry weather flows generated from residential and employment based populations (ie; commercial and industrial). The population estimates were derived from the 'Building Theme' which provided a spatial distribution of all buildings including residential, commercial and industrial buildings. The populations were expressed as equivalent residential units (ERU) per building. For example, a typical single family home was equal to 1 ERU, where as commercial buildings were assigned multiple ERU values.

The ArcView building theme (buildings2.shp) contained a field defining the building code ("Structure_") which allowed the consultant to identify the building type and estimate the ERU based on the building area. However, approximately 60% of the buildings had missing building codes, hence an alternative method of identifying the building type was implemented. The approach compared the building area (ie; 'footprint') with average building footprints for single family, multiple family, commercial and industrial buildings. Building footprints less than $500ft^2$ were eliminated from the process to avoid including garages, storage sheds etc. The average building footprints were derived from buildings with known types. **Table 1.1** below lists the building types with average building footprint areas.

Table 1.1 Average Building Footprint Areas

Description	Structure Code	Minimum Area (ft^2)	Maximum Area (ft^2)
Mobile Homes	410	500	1000
Single Family	411	1000	3000
Multi Family	414	3000	12000
Commercial	580	12000	50000
Industrial	650	50000	No limit

Population data was used to calculate dry weather flows for residential and employment areas. The dry weather flow is calculated in the model by multiplying the population by a per capita flow rate (eg; 75 g/day/head for residential and 25 g/day/head for employment). The HydroWorks model only accepts one population per sewer basin, therefore it was necessary to derive an 'equivalent' population from the residential and employment populations. The following formula was used to calculate the equivalent population:

Population (equiv) = *Res Pop + [Emp Pop x (Emp PCF / Res PCF)]*

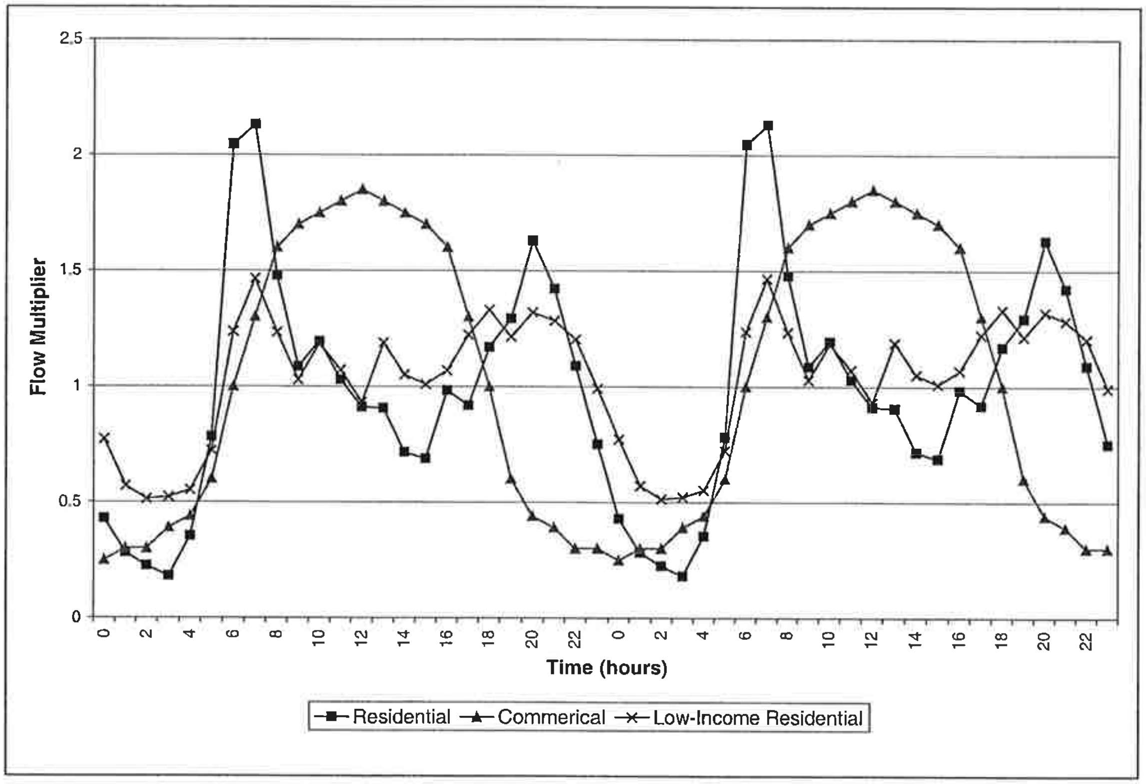
where; *Res Pop* = Residential Population
Emp Pop = Employment Population
Res PCF = Residential Per Capita Flow (eg; 75 g/day/head)
Emp PCF = Employment Per Capita Flow (eg; 25 g/day/head)

The Sewer Basin Manager tool within the ArcADE suite, was used to allocate the populations to each sewer basin. This was achieved by overlaying the population theme (ie; converted from the building theme), on top of the sewer basin polygons and spatially distributing the population data.

1.2 Wastewater Diurnal Profiles

Diurnal profiles for residential and employment wastewater flows are used to model the daily dry weather flow variation. The profiles were generated from observed flow meter data to create a true representation of time-varying dry weather flows in the Little Rock sewer basin. Flow meters located in the upstream portions of the network were selected to provide a typical residential profile, and a low-income residential profile. The flow data was averaged and normalized to create flow multipliers for 24 hour weekday and weekend periods. The employment diurnal profile was created from a standard commercial diurnal curve. This standard curve was adjusted during initial calibration based on model results to make it specific to the LRWU system. **Figure 1.1** displays the diurnal curves used for this project. The diurnal profiles are stored in the HydroWorks wastewater generator (.WWG) file, and in a corresponding ArcADE data file.

Figure 1.1 Wastewater Diurnal Profiles



1.3 Groundwater Infiltration / Inflow

Groundwater infiltration (GWI) and inflow enters the sewer system via pipe joints, manholes, and pipe cracks, and is typically observed as a constant inflow. The GWI flow varies seasonally, and depending on the soil and ground conditions, the flow will fluctuate according to local rainfall patterns. The flow monitoring data collected for this study shows significantly high GWI throughout the sewer network, and is wide spread throughout the basin.

The GWI flows were derived from the flow monitoring data by extracting the calculated population-based dry weather flow (base DWF) from the observed minimum dry weather flows. Minimum flows typically occur during the nighttime or early morning hours when base wastewater flows are at a low. Subtracting an estimate of minimum base DWF from the minimum measured flow yields the estimated GWI for each monitored area. The minimum base DWF is typically assumed to be about 15 to 20 percent of average base DWF. The resulting GWI is expressed on a unit basis (g/day/acre) by dividing by the sewered acreage of the monitored area.

The GWI flows were distributed throughout the model network using ArcADE by allocating observed GWI rates to the sewer basins. The model was checked by comparing the dry weather flows with the flow monitoring data, to ensure the correct GWI distribution was applied to the model.

2. WET WEATHER MODEL INFLOWS

Wet weather inflows are generated from rainfall dependent inflow and infiltration (I/I) entering the sewer system via cracks, joints, manholes and other 'leaky' defects in the sewer system. Soil conditions, groundwater levels, and the capacity of the storm system effect the quantity and timing of wet weather inflow. The following describes the processes and approach for modeling the wet weather inflows.

2.1 Hydrological Observations

The Little Rock sewer basin exhibits a significant wet-weather flow response observed in the flow meter data collected during the monitoring period. The flow meter data was reviewed to identify the hydrological processes that transform the rainfall to wet-weather inflows, and develop the wet-weather modeling approach. The flow meter data revealed the following observations:

- Delayed infiltration
- Increased infiltration during rainfall event
- Decreasing infiltration after rainfall event
- Rapid flow response is delayed following the initial rainfall
- Groundwater infiltration (GWI) increases during a succession of rainfall events
- Low rapid response flows indicating few direct connections
- Large wet-weather flow variation between flow meters

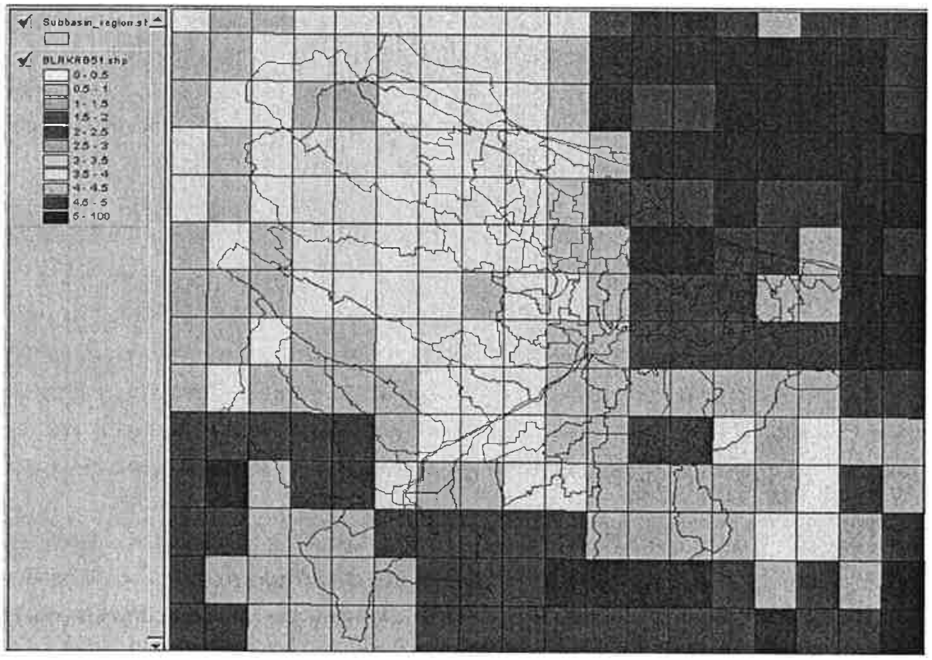
Following the review and identification of hydrological processes, the consultant developed an approach for modeling the rainfall, runoff and routing processes. Firstly the rainfall describes the intensity and duration of rainfall falling onto the sewer basin during and preceding the event period. The spatial variation of rainfall is significant when relating the rainfall to the wet-weather inflow. Secondly, the runoff process converts the rainfall depth to an inflow volume. This process uses an 'effective area' to represent the flow mechanisms such as groundwater seepage, storm water connections, and flow through laterals. Finally, flow routing describes the translation and attenuation of inflow caused by overland routing, seepage through ground, and slow leakage via cracks.

2.2 Modeling Rainfall

Calibrating the hydrological runoff process requires accurate rainfall and sewer flow volumes to determine the 'effective areas'. Rainfall varies spatially as the storm cells travel over the basin. Topography, land elevations, and localized climatic conditions give rise to significant differences in rainfall volumes during storm periods which need to be accounted for during wet-weather calibration.

The rainfall data used for the project is gauge-adjusted radar-rainfall data provided by NEXRAIN Corporation. The radar rainfall data, comprising of 396 grid cells measuring 2 km x 2 km, provides an accurate estimation of the spatial distribution of rainfall which is critical to model calibration. The radar data was converted into ArcADE rain data DBF files, and a graphic theme of the grid cells. The data is used to develop HydroWorks rain data (RED) files for selected wet-weather events, and evaluate the spatial variation over the Little Rock study area. **Figure 2.1** shows the spatial variation of total rainfall during the flow monitoring period.

Figure 2.1 Total Rain Depths (in) from 03/15/2000 to 04/28/2000



Initial rainfall losses occur when dry ground conditions soak up the first part of the rainfall hence reducing sewer inflows. During the calibration period (March / April 2000) significant preceding rainfall ensured wet ground conditions, hence minimizing initial rainfall losses. For the purpose of model calibration, no initial rainfall losses were modeled for the calibration events (ie; Event A and C).

2.3 Modeling Runoff (I/I)

HydroWorks generates wet weather flows by applying runoff parameters to a rainfall hyetograph to generate hydrographs representing the rainfall-induced I/I entering the collection system for a specified rainfall event. Although the runoff parameters in HydroWorks are intended to compute storm water runoff (surface drainage), they can be used effectively to simulate I/I flows by calibrating the parameters to actual metered sewer flows during storm events. Runoff (or I/I) is computed as a percentage of the rainfall falling on the contributing area of a sewershed for each of three components, representing fast, medium, and slow flow responses, respectively. The procedure for calculating and distributing runoff (I/I) is described in the following steps.

1. For each flow meter, compute the wet weather flow component from the storm event hydrograph. This is calculated by extracting the model dry weather volume from the observed storm event hydrograph.

2. Calculate the *effective area* by dividing the wet weather volume by the total rainfall depth for each flow meter. The effective area is used to convert the rainfall depth into a I/I volume.

3. Wet weather flow enters the sewer system from a variety of sources including paved areas, storm systems, and groundwater. These sources effect the speed and timing of the runoff entering the system. For example, wet weather I/I from direct (paved) connections exhibits a *fast* response, where groundwater I/I exhibits a *slow* response. Wet weather flows are modeled by simulating the fast, medium and slow components, which are superimposed to create a single wet weather inflow for each sewer basin. For this study, these components are used as follows:

   a) *Fast* areas model rapid / immediate flow response (eg; direct connections)
   b) *Medium* areas model a delayed flow response with an increasing I/I during the rain event
   c) *Slow* areas model the increase and decrease of GWI resulting from preceding rainfall

4. The wet weather runoff components (fast, medium and slow) are modeled using two HydroWorks modeling methods; 1) *Fixed* runoff, and 2) *Variable* runoff. The Fixed runoff method simply applies a percentage runoff factor to derive the proportion of runoff entering the sewer system. This method is used to model the *fast* and *slow* runoff components. The Variable runoff method, used for *medium* runoff, uses the following equation to derive the runoff volume.

   <u>Variable Runoff Formula</u>

$$PR = (100 - IF) * NAPI / PF$$

where;

PR = *Variable percentage runoff (for slow response areas)*

IF = *Fast response runoff factor*

$NAPI$ = *Net Antecedent Precipitation Index*

PF = *Soil Moisture Factor*

NAPI is defined as a 30-day Antecedent Precipitation Index (API_{30}), with evaporation and initial losses subtracted from rainfall. Antecedent Precipitation Index (API_{30}), is derived from the following equation;

$$API_{30} = \Sigma_{n=1,30} [P_{-n} C_p^{n-0.5}]$$

where;

P = *daily rainfall depth*

C = *decay coefficient*

The decay coefficient (Cp) is related to the soil type and effects the magnitude of antecedent rainfall. For example, light sandy soils provide greater drainage which in turn lowers the impact of antecedent rainfall, eventually reducing runoff. The decay coefficient is derived by setting the default soil class in the HydroWorks DSD file. A default soil class of 1 corresponding to light sandy soils was used for this study.

The Soil Moisture Factor (PF) was calibrated using sample flow meters from the study area and entered into the HydroWorks runoff parameter (PRM) file. The value used for the study was 0.24 in (0.02 ft). Note, the soil moisture factor was only used for the *medium response* area (Surface Type Index = 3).

2.4 Modeling Routing

The fast, medium and slow runoff component flows are routed overland and through the ground before entering the sewer system. The routing process reduces the peak flow (ie; attenuation), and delays the timing of the peak (ie; translation). These processes are modeled using a linear reservoir storage equation:

$$S = kq$$

where;

S = *storage volume*

k = *routing constant*

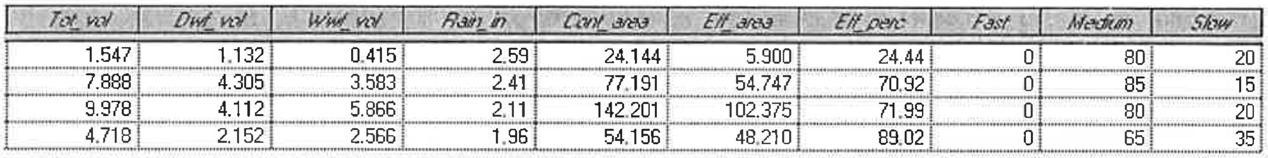
q = *outflow*

The routing constant is defined in the HydroWorks Runoff Parameter (PRM) file and has been set-up accordingly to model fast, medium and slow response runoff flows. The following runoff constant were used for this study:

Surface Index	Surface Runoff Description	Routing Constant
1	Not Used	10
2	Delayed Runoff	1000
3	Variable Runoff	125

2.5 Model Data Files

A) ArcADE Wet Weather (WW) Data File

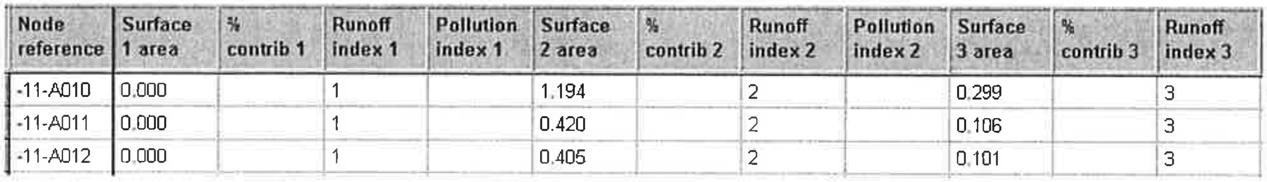


Tot_vol	Dwf_vol	Wwf_vol	Rain_in	Cont_area	Eff_area	Eff_perc	Fast	Medium	Slow
1.547	1.132	0.415	2.59	24.144	5.900	24.44	0	80	20
7.888	4.305	3.583	2.41	77.191	54.747	70.92	0	85	15
9.978	4.112	5.866	2.11	142.201	102.375	71.99	0	80	20
4.718	2.152	2.566	1.96	54.156	48.210	89.02	0	65	35

The above example of an ArcADE wet weather (WW) data file shows the effective area and the distribution between the fast, medium and slow areas. For the Little Rock basin, the 'medium' response areas are used to model delayed inflows and the 'slow' response areas are used to model the immediate inflows contributing from paved surfaces. Note, the 'fast' response area is not used in this study. The table below summarizes the relationship between inflow description, model method, distribution area, HydroWorks surface area index, and runoff index.

Inflow Description	Model Method	WW Distribution	HydroWorks Surface	Runoff Index
Not Used	N / A	Fast	1	1
Delayed Inflow	Fixed Runoff	Medium	2	2
Immediate Inflow	Variable Runoff	Slow	3	3

B) Drainage System Data (DSD) File

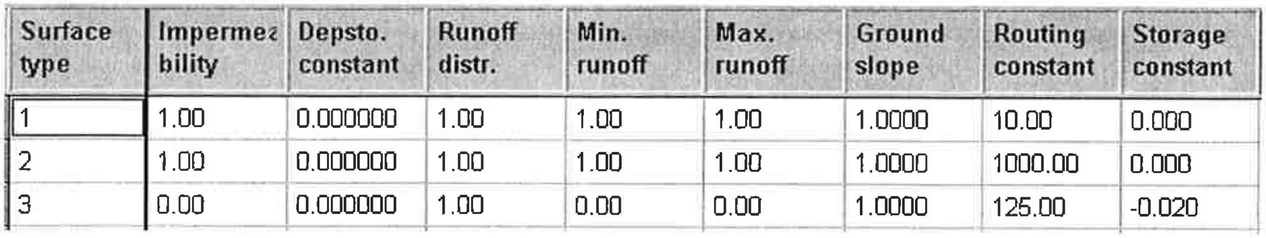


Node reference	Surface 1 area	% contrib 1	Runoff index 1	Pollution index 1	Surface 2 area	% contrib 2	Runoff index 2	Pollution index 2	Surface 3 area	% contrib 3	Runoff index 3
-11-A010	0.000		1		1.194		2		0.299		3
-11-A011	0.000		1		0.420		2		0.106		3
-11-A012	0.000		1		0.405		2		0.101		3

The example HydroWorks DSD file shows three surface areas and corresponding runoff indexes used for modeling wet weather inflows. Surface area 2 is used for modeling 'delayed' inflows, and surface area 3 is used for modeling 'immediate' inflows. The variable runoff equation which is used to model the immediate inflows can only be used for areas defined in surface area 3.

Areas defined in surface areas 1 and 2 are modeled using the fixed runoff equations. For this study, surface area 1 (normally reserved for modeling 'fast' response inflows) was not required. Finally, the default Soil Class is set to 1 in the Node Default record.

C) Runoff Parameter (PRM) File



Surface type	Impermea bility	Depsto. constant	Runoff distr.	Min. runoff	Max. runoff	Ground slope	Routing constant	Storage constant
1	1.00	0.000000	1.00	1.00	1.00	1.0000	10.00	0.000
2	1.00	0.000000	1.00	1.00	1.00	1.0000	1000.00	0.000
3	0.00	0.000000	1.00	0.00	0.00	1.0000	125.00	-0.020

The runoff parameter file (PRM) defines the runoff method, ie; variable or fixed, and the routing constant which governs the attenuation and time lag of the inflow hydrographs. Surface type 2 is used to model the delayed inflow using the fixed runoff equation. The *Impermeability*, *Min. Runoff* and *Max. Runoff* fields define the percentage runoff. For surface types 1 and 2, these fields are set to 1 representing 100% runoff. Alternatively, these fields are set to 0 when using the variable runoff equation as for surface type 3. In addition, the storage constant is defined when using the variable runoff equation. In this case, storage constant = -0.02ft was derived from the initial model calibration.

The routing constants were established during the initial calibration phase based on flow meter observations. As a result, the routing constant for surface type 2 used for modeling the delayed inflows was defined as 1000, and surface type 3, used for modeling the immediate inflows, was defined as 125. Note, the maximum allowable routing constant is 1000.

M E M O R A N D U M

MWH
MONTGOMERY WATSON HARZA

LITTLE ROCK WASTEWATER UTILITY COLLECTION SYSTEM FACILITIES PLAN

TECHNICAL MEMORANDUM - MODEL CALIBRATION

SUBJECT: Model Calibration **DATE:** January 12 2002

PREPARED BY: Cathy Cowley **MW FILE:**

This Technical Memorandum (TM) describes the model calibration phase of the hydraulic modeling task for the Little Rock Wastewater Utility (LRWU) Collection System Facilities Plan. The model will be used to analyze the capacity requirements of the existing trunk sewer system and to verify that proposed trunk facilities will provide adequate capacity for future flows. The model database will be provided to LRWU so that LRWU staff can perform future updates and analyses of area-specific projects.

1. MODEL CALIBRATION OVERVIEW

Model calibration entails comparison of simulated flows to observed meter data. Model parameters are iteratively adjusted to achieve a satisfactory fit between the model and meter data for both dry and wet weather conditions.

1.1 Modeled System

Although the Little Rock collection system was divided into five basins for data validation and model building, the entire system was joined for final calibration. The complete model system contained 4814 nodes, 4847 links, 3 pump stations and 1 gate. During initial calibration, the system was determined to be too interconnected to achieve a good calibration when modeling sections separately. With the entire system joined, hydraulic limitations affecting large areas could be modeled more accurately. For instance, capacity limitations in the South 60 interceptor cause several problems in the Brodie Creek and Rock Creek areas. These problems were only reflected in the combined model, not in the model divided by service area.

The collection system network and pump stations had to be calibrated. Network calibration involved comparison of simulated flows to actual data at each of the flow meters in the system. Parameters governing per capita flows, diurnal curves, groundwater infiltration, and inflow due to runoff were adjusted to obtain accurate mean flowrates and good fits for maximum and minimum flowrates compared to meter data. Data from 63 temporary flow meters were used for network calibration. These 63 meters were in place from March 15, 2000 through May 9, 2000.

Additional data from five permanent flow meters on the main interceptor sewers were used during wet-weather calibration. Meter locations are shown in **Figure 1.1**. Refer to the Flow Monitoring TM for a discussion of meter data and a detailed list of meters.

In addition to the model inflow and runoff properties for network calibration, pump stations must be calibrated to mimic actual operation under various conditions. Design pump curves or test curves, if available, were initially used to model pump performance. These curves were then altered based on reported observed flows or, when actual flows were not available, on reported pump on/off durations and wet-well levels. Due to the sequencing of the LRWU pumps, smaller pumps were calibrated during dry-weather calibration, and larger pumps were calibrated during wet-weather calibration. Pump station calibration is discussed in more detail later in this memorandum.

1.2 Calibration Events

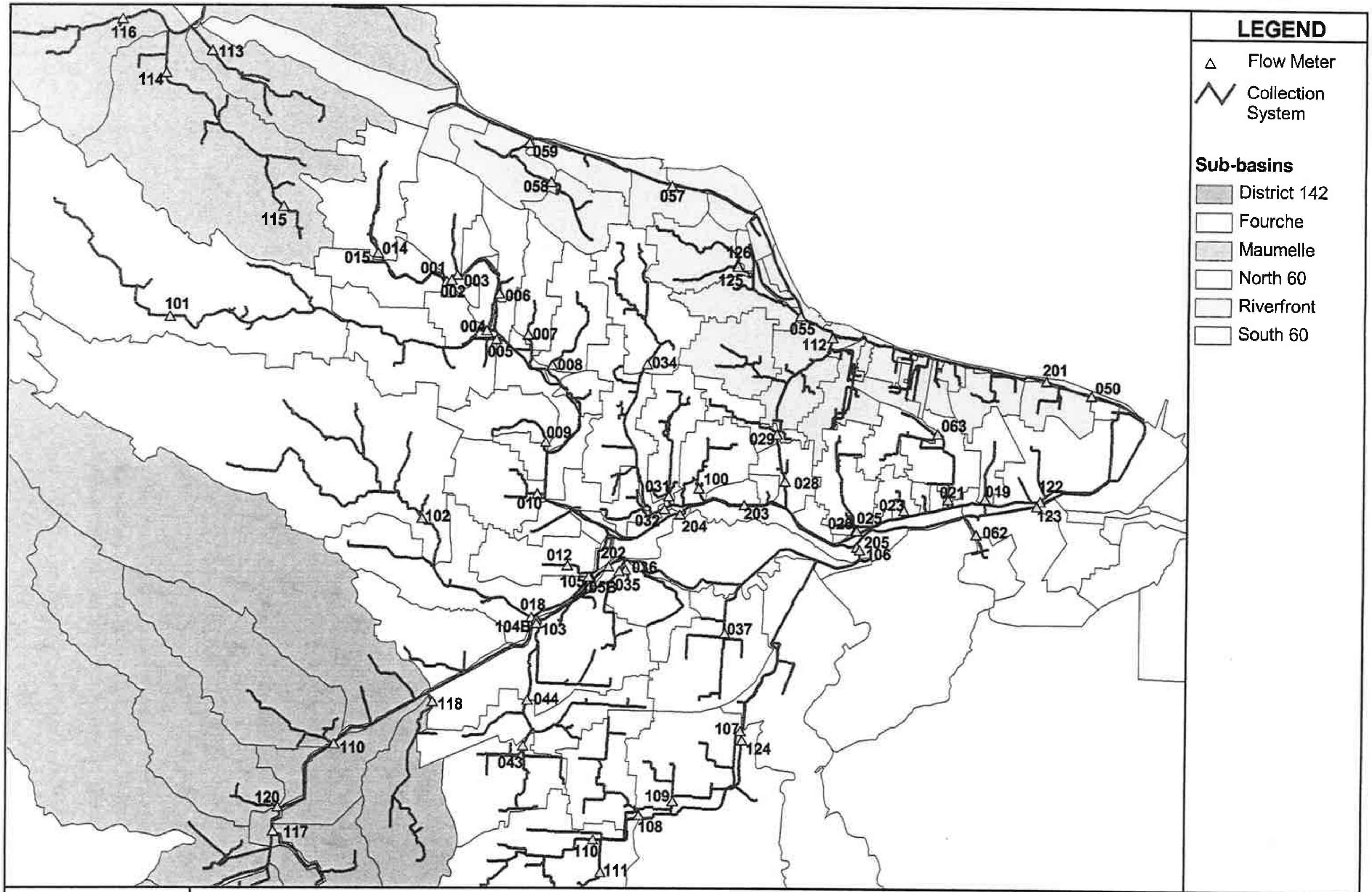
Models in Hydroworks are run for a specified event. An event is a user-defined amount of time that can cover a dry or wet-weather period. Calibration events occur during dates when real data is available, while a design event can either be an actual climatic event with real rainfall data or a duration of time with associated hypothetical conditions.

The model must be calibrated for both dry and wet weather events. The dry weather flow (DWF) event used to calibrate the LRWU collection system model was named "Event X." The wet-weather flow (WWF) calibration event was called "Event A." **Table 1.1** lists the durations and rainfall for these two calibration events and for the design event. The design event is included here because it was an actual rainfall event. Therefore, the calibration could be further verified based on the model response to the design storm compared to observed overflows.

Table 1.1 Calibration and Design Events

Event Name	Event Type	Event Dates	Rainfall (inches)
Event X	DWF Calibration	April 26 – April 27, 2000	0.0
Event A	WWF Calibration	March 15 – March 22, 2000	2.4
Event E	Design	November 22 – November 30, 2000	4.1

Both the dry and wet weather calibration events were chosen from the period from March through May 2000 when the temporary flow meters were in place. Event X was chosen for the DWF calibration event because there was limited precipitation during this period and the several preceding days. Therefore, interference from antecedent conditions was minimal. WWF Event A was chosen as it was the largest rain event while the temporary meters were in place. The WWF calibration event is much longer than the DWF calibration event to allow time to observe the extended response of collection system flows to the actual rainfall event, including both rate of inflow and time required for return to normal dry weather conditions. The design event was chosen because it revealed several capacity problems in the collection system and, as it was the size of a two-year event, met design standards for LRWU.



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LITTLE ROCK WASTEWATER UTILITY HYDRAULIC MODELING / COLLECTION SYSTEM FACILITIES PLAN

FIGURE 1.1 FLOW METER LOCATIONS

January 2002

2. NETWORK CALIBRATION

2.1 Dry Weather Flow Calibration

The objective of DWF calibration is to obtain a good diurnal pattern with the appropriate additional flow from groundwater infiltration (GWI) at each flow meter site. Per capita flows, diurnal profiles, and the amount of flow generated due to GWI can be adjusted to achieve good fits between the model results and the actual meter data. Land use and population information previously entered during the model building phase (refer to the Model Building TM) should not be changed unless a good fit cannot be obtained. **Table 2.1** summarizes the model parameters affecting DWF calibration and the ArcADE and Hydroworks files to which they apply.

Table 2.1 DWF Calibration Parameters and Files

Parameter	Effect	ArcADE Input	Hydroworks File
Per Capita Flow (Residential / Commercial)	Average flow rate (Combined with population/land use)	Sewer Basin Process Options Dialog Box	Wastewater Generator (WWG)
Diurnal Curves	Timing and amplitude of maximum, minimum DWF over 24 hours	Diurnal Analyzer (curves edited in Hydroworks)	Wastewater Generator (.WWG)
GWI	Additional flow	Dry Weather Flow File (dwf.dbf)	Drainage System Data (DSD)
Land Use	Specifies diurnal curve per capita flow	Land Use File (lu.shp)	Drainage System Data (DSD)
Population	Average flow rate, (Combined with per capita flow rate per land use)	Population File (po.dbf / po.shp)	Drainage System Data (DSD)

2.2 Diurnal Patterns

Generally, two diurnal curves are developed during calibration: 100% Residential and 100% Employment (commercial). Hydroworks combines these two curves to create six different curves representing a range of residential/commercial land use combinations. These six curves correspond to the land use index and include 100% residential, 80/20 residential/employment, 60/40, 40/60, 20/80, and 100% employment. For the LRWU collection system model, a seventh curve representing low-income residential areas was also developed. During initial calibration, diurnal profiles in low-income residential areas exhibited much different qualities than in other residential areas. Maximum flows in low-income areas tended to occur later, and higher flowrates were observed throughout the day and later into the night. **Figure 2.1** shows meter data from a primarily residential area in the Little Maumelle service area. Compare this flow pattern to that seen in **Figure 2.2**, meter data from the low-income Barton area of Little Rock. In both figures, the red line shows recorded flows and the green line shows recorded depths for DWF Event X.

Figure 2.1 Dry Weather Flow Meter Data, Little Maumelle

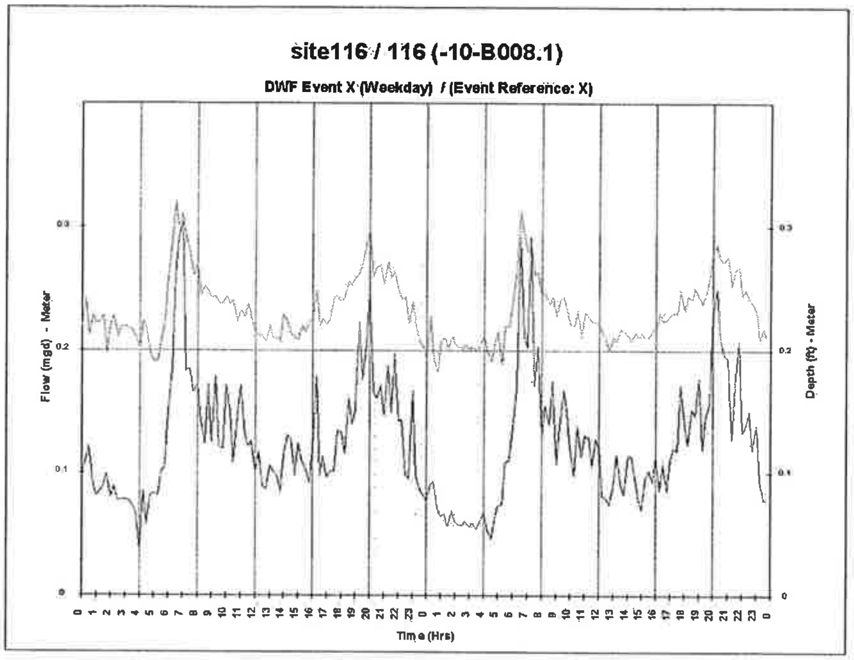
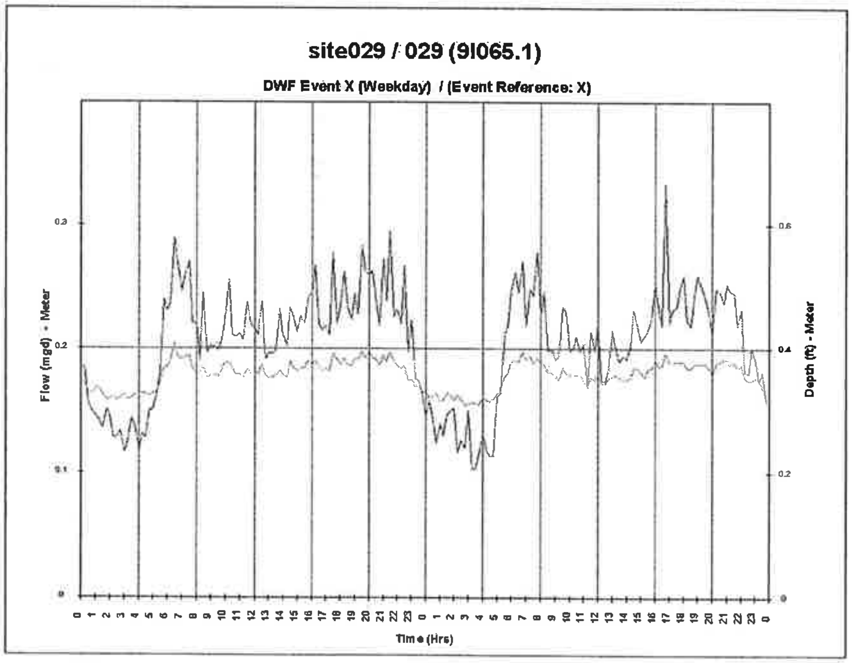
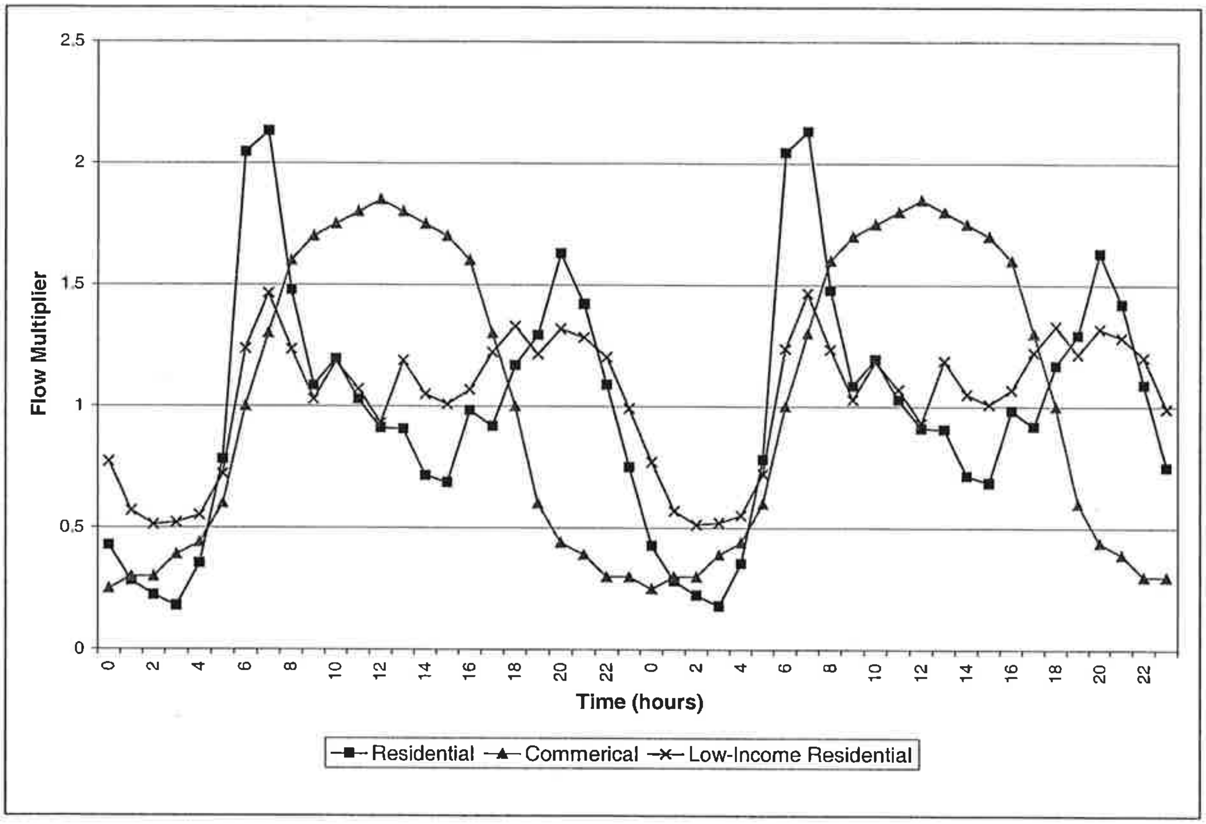


Figure 2.2 Dry Weather Flow Meter Data, North Barton



This area and other areas described by staff at LRWU as low-income could not be properly calibrated using the standard residential curve initially developed. A list of these areas is included in **Attachment 1**. The seventh, low-income residential curve was used only for primarily residential areas. It was not combined with the employment curve to create intermediate diurnal curves. **Figure 2.3** shows the main (residential, employment, and low-income residential) final calibrated diurnal curves used in the LRWU collection system model.

Figure 2.3 Diurnal Profiles: Residential, Commercial, and Low-Income Residential



The two residential diurnal patterns shown in **Figure 2.3** were developed using the Diurnal Profile Analyzer in ArcADE. This tool combines actual data from specified flow meters to develop a diurnal profile for the model. The flow meter data chosen to develop these two curves were from primarily residential or low-income residential flow meter basins, respectively, and were determined to show typical characteristics for these areas. The employment curve used was based on a standard commercial diurnal curve. This standard curve was adjusted during initial calibration based on model results to make it specific to the LRWU system.

2.3 Unit Flow Rates and Industrial Flows

For the LRWU collections system model, residential per capita flows were determined prior to calibration based on population and water use data. Refer to the Model Inflows TM for more information about this process. Employment flows were determined during calibration to be 30 million gallons per equivalent residential unit (ERU). An equivalent residential unit was defined to be one single-family residence. The number of ERU's in a commercial property was based on land use information, if available, or building square footage. See the Model Building TM for more information about ERU's and employment populations.

In flow meter basins 037 and 019 (see **Figure 1.1**), a satisfactory calibration fit could not be obtained using only the per capita flows and diurnal profiles. The two areas were determined to be highly industrial. Flows in industrial areas generally do not exhibit a diurnal profile; rather, they have a much more constant flow throughout the day. Therefore, trade flows based on water use data were added to the model for these two flow meter basins. Refer to the Model Inflows TM for further discussion of trade flows.

2.4 Groundwater Infiltration (GWI)

GWI is applied to the model after the diurnal profiles of the model results compare well with the actual meter data. The DWF Analyzer in ArcADE is used to apply the appropriate amount of GWI. This tool bases the amount of GWI on a comparison between modeled and actual maximum flows for the dry weather event. Due to irregularities in meter data, the GWI had to be manually edited at several locations following the initial estimate from the DWF Analyzer. Refer to the Model Inflows TM for more information about GWI.

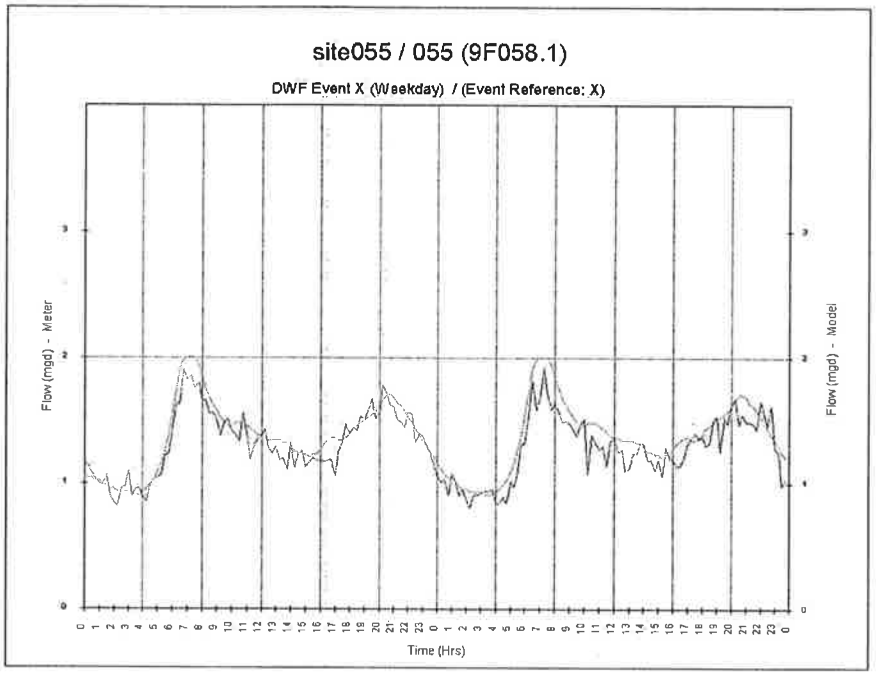
2.5 DWF Calibration Results

Overall the fits between modeled and metered data for the calibrated model during Event X were good. An example of the results from the calibrated model compared to the meter data is shown in **Figure 2.4** for flow meter 055, in the Cantrell area. Graphs for every meter are included in **Attachment 1**. The smooth green line shows the modeled results, while the red line shows the actual meter data. **Table 2.2** shows the statistical comparison of the model results to the meter data.

Table 2.2 Comparison of Model and Meter Data, Site 055

	Meter Data	Model Results	% Error
Average Flow	1.3	1.37	5.4
Maximum Flow	1.93	2.01	4.1
Minimum Flow	0.81	0.91	12.3

Figure 2.4 DWF Calibration Results Example



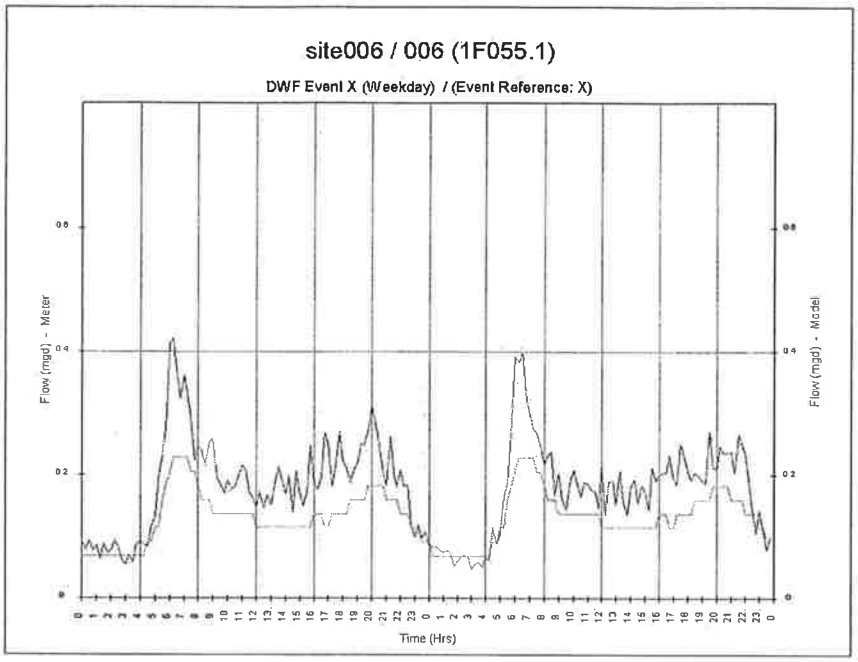
Relatively high percent error can be common for maximum and minimum flow since meter data are much more variable than model results.

Flow meter 6, in the South 60 service area, was statistically the poorest calibrated of all the flow meters. **Figure 2.5** shows the graph of the model and meter flow comparison, and **Table 4** lists the numerical results.

Table 2.3 Comparison of Model and Meter Data, Site 006

	Meter Data (mgd)	Model Results (mgd)	% Error
Average Flow	0.18	0.13	-27.8
Maximum Flow	0.42	0.23	-45.2
Minimum Flow	0.05	0.07	40.0

Figure 2.5 DWF Calibration Results, Site006



Although the comparison between the model results and the meter data is relatively poor at this site, this inaccuracy is not expected to have a serious impact on the final model. The flowrate in this basin is very low compared to downstream areas; this particular basin discharges into a pipe with a maximum dry weather flow of approximately 3 mgd. This situation is true of most of the flow meters that had relatively poor calibration fits. Site 122, on the North 60 interceptor, is the only site that could be a cause for concern, as this is a major interceptor and average modeled flows are approximately 25 percent greater than metered flows. However, the LRWU system is dominated by wet-weather. Although calibration of the diurnal patterns and dry weather flows was necessary, flow meter data demonstrates that the system response to wet-weather overwhelms dry weather diurnal patterns.

2.6 Wet Weather Flow Calibration

The objective of wet weather flow (WWF) calibration is to accurately model the system response to rainfall. Runoff routing and effective area distribution are the main parameters that can be altered to achieve good fits between model results and meter data. **Table 2.4** summarizes the model parameters affecting WWF calibration and the ArcADE and Hydroworks files to which they apply.

Table 2.4 WWF Calibration Parameters and Files

Parameter	Effect/Properties	ArcADE Input	Hydroworks File
Runoff Routing	Specify runoff type, soil moisture, depression storage. Affects the speed and volume of runoff entering system.	N/A	Runoff Parameters (PRM)
Total Effective Area	Total area from which runoff occurs. Affects the total amount of runoff entering system.	Wet-weather flow file	Drainage System Data (DSD)
Effective Area Distribution	Determines the fast, medium, and slow system response.	Wet-weather flow file	Drainage System Data (DSD)

A thorough explanation of runoff routing and effective areas, in general and as applied in the LRWU collection system model, can be found in the Model Inflows TM.

Model runoff parameters in the Hydroworks .prm file were set during initial calibration based on model results from flow meters in the Little Maumelle service area. As described in the Model Inflows TM, runoff routing included fixed and variable runoff components, which accounted for delayed and fast runoff, respectively. The runoff routing parameters also included depression storage equal to approximately 2.5 percent of the total rainfall depth. Modeled depression storage has the effect of preventing some initial rainfall from entering the collection system. As the rainfall event continues, depression storage has successively less effect.

Following initial calibration, the total effective areas and the effective area distributions were edited for each flow meter basin until satisfactory comparisons between model results and meter data were obtained. If the peak flow due to the rainfall event was not high enough, the effective area for the fast response was increased. Likewise, the delayed response was altered to achieve the appropriate trailing response. If the flow was overall too high or too low, the total effective area was adjusted. The WWF file for the calibrated model, which details the effective areas for each flow meter basin, is included in **Attachment 2**.

2.7 WWF Calibration Results

Overall the fits between modeled and metered data for the calibrated model during Event A were good. An example of the results from the calibrated model compared to the meter data is shown in **Figure 2.6** for flow meter 59. **Table 2.5** lists the numerical comparison for this meter. Graphs for every meter are included in **Attachment 1**. The smooth green line shows the modeled results, while the red line shows the actual meter data.

Figure 2.6 WWF Calibration Results Example

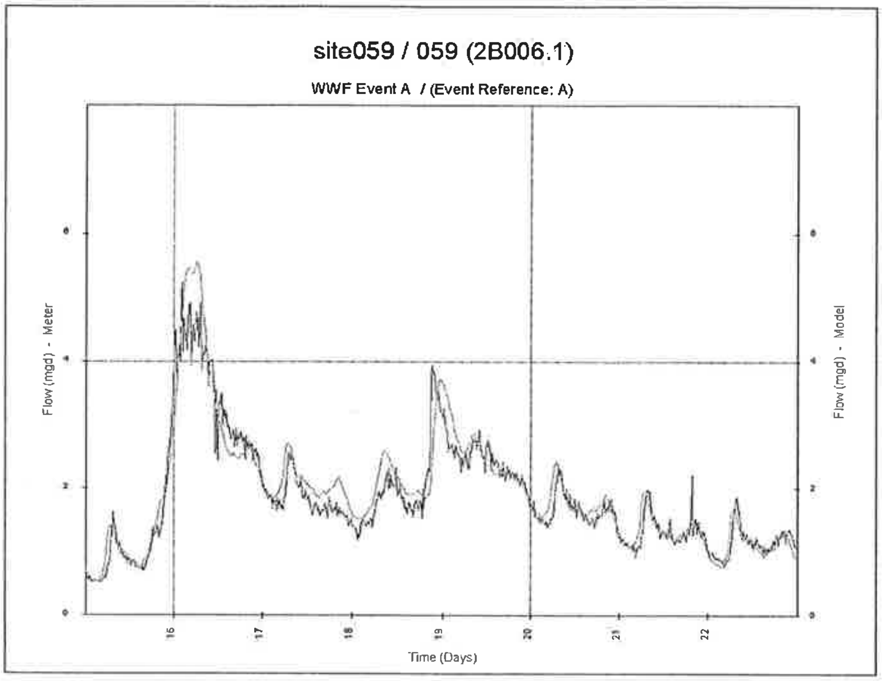


Table 2.5 Comparison of Model and Meter Data, Site 059

	Meter Data (mgd)	Model Results (mgd)	% Error
Average Flow	1.87	1.95	4.3
Maximum Flow	5.24	5.57	6.3
Minimum Flow	0.52	0.53	1.9

Although both of the peak flows due to rainfall were modeled well at this particular site, this result was not generally true of all flow meter sites. The second peak in flow resulted from a much smaller amount of rain than the first peak. This second peak was typically not reproduced well in the model. However, as the first peak was larger and much more significant than the second, this result is not expected to negatively impact the model's usefulness for design purposes.

As seen in the graphs of all meters, included in **Attachment 2**, the quality of the WWF model calibration was somewhat less consistent from meter to meter than the DWF calibration. This result was expected, however, as inflow due to rainfall runoff can vary greatly depending on terrain, soil type, and pipe condition. This variability is normal and does not diminish the effectiveness of the model as a design tool.

3. DESIGN EVENT CALIBRATION

Design storms are based on long-term historical rainfall data. During November 2000, LRWU experienced a significant rainfall event following a prolonged month of antecedent rainfall producing high groundwater conditions. The rainfall duration exceeded 48 hours and generated over 5 inches of total rainfall. For this study, the November 2000 observed rainfall event was used as the 'design event' to identify and develop solutions for the master plan.

The observed rainfall event was quantified in terms of *return period* by comparing the recorded depth and duration with rainfall intensity-duration-frequency (IDF) relationships. The rainfall event equates to a design event with a return period between 2 and 5 years. In addition to meeting LRWU design storm criteria, the November 2000 event was selected for the following reasons;

- Rainfall event exceeds LRWU design criteria
- Provides a realistic spatial distribution of rainfall
- Coincides with reported hydraulic spills / flooding
- Used for confirming model calibration with permanent flow meters
- The storm occurred after an unusually long period of rainfall giving rise to high groundwater I/I creating a *worst-case* scenario.
- Rain data obtained from available rainfall radar data providing an accurate spatial representation of rainfall depths.

The 'design storm' is an observed rainfall event and hence allowed the consultant to verify model predictions against observed flow data obtained from LRWU's permanent flow meters. Initial findings revealed differences between the model and the design storm occurring due to changes in hydrological conditions. The overall effect was proportionally lower inflows for large rainfall events resulting from excessive surcharging and backing up preventing rainfall inflow from entering the system.

The model was calibrated using flow and depth data from four permanent flow meters. The flow meter data was poor eliminating 2 flow meters due to missing data during the design event period. In addition, the remaining flow meters located in the North and South interceptors provided limited data due to surcharged flows 'cutting-off' the peaks. However, the model was primarily calibrated against reported spill locations. Detailed spill reports were obtained during the design event period and plotted in the GIS. This allowed the model spill locations to be compared with observed spills, hence verifying the model predictions. Where necessary, the wet-weather I/I parameters were adjusted. In some cases the model predicts additional overflow locations which were not reported by LRWU. This is due to the unmodeled small diameter pipes reducing in-line storage hence over predicting overflows in the upstream sections of the model.

LITTLE ROCK WASTEWATER UTILITY

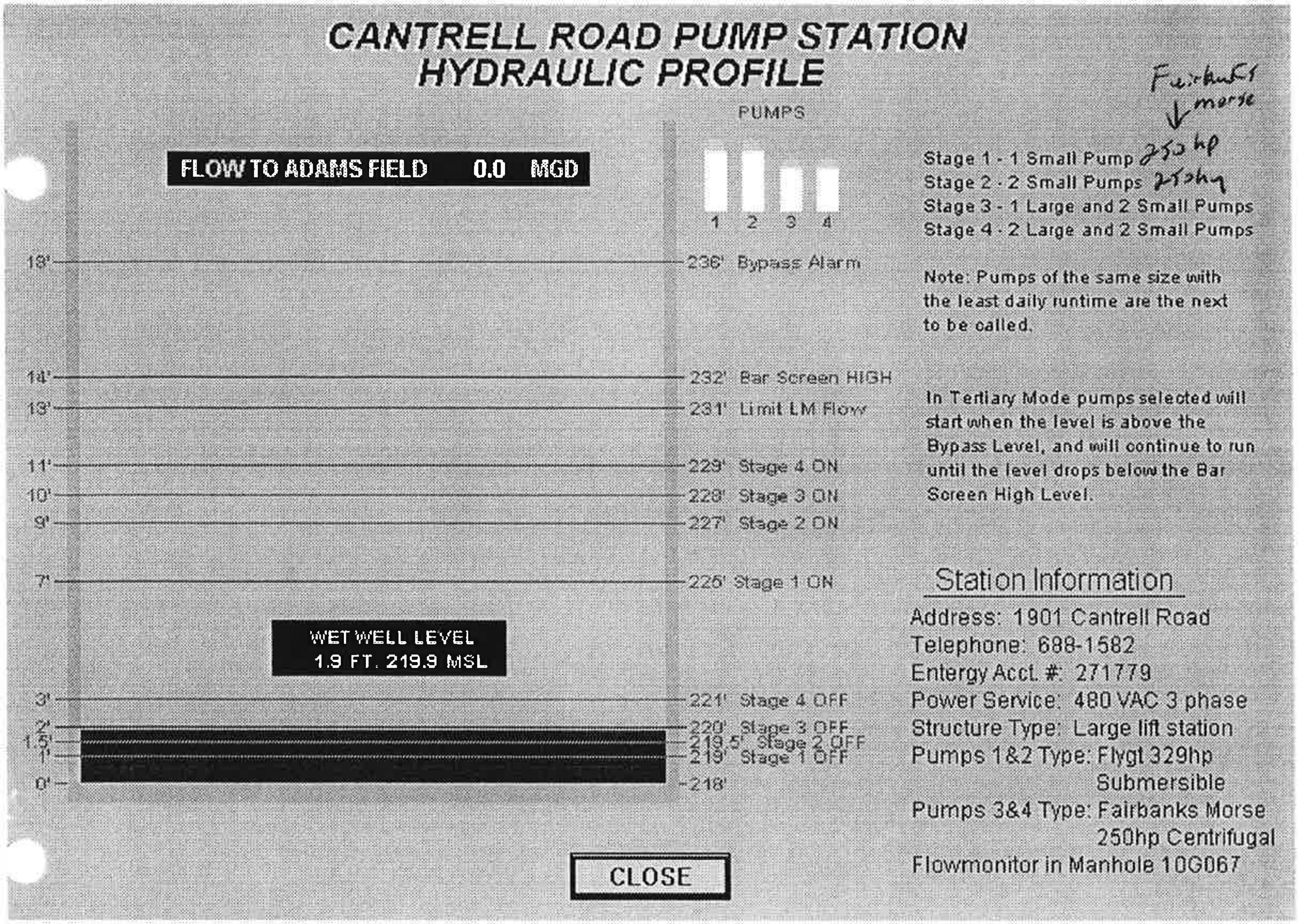
HYDRAULIC MODELING/COLLECTION SYSTEM FACILITY PLAN
SECAP
SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

PUMP STATION
TECHNICAL MEMORANDUM
FINAL DRAFT

APRIL 2001

MONTGOMERY WATSON

LITTLE ROCK
WASTEWATER UTILITY



CANTRELL ROAD PUMP STATION HYDRAULIC PROFILE

FLOW TO ADAMS FIELD 0.0 MGD

WET WELL LEVEL
1.9 FT. 219.9 MSL

Fairbanks
↓ morse

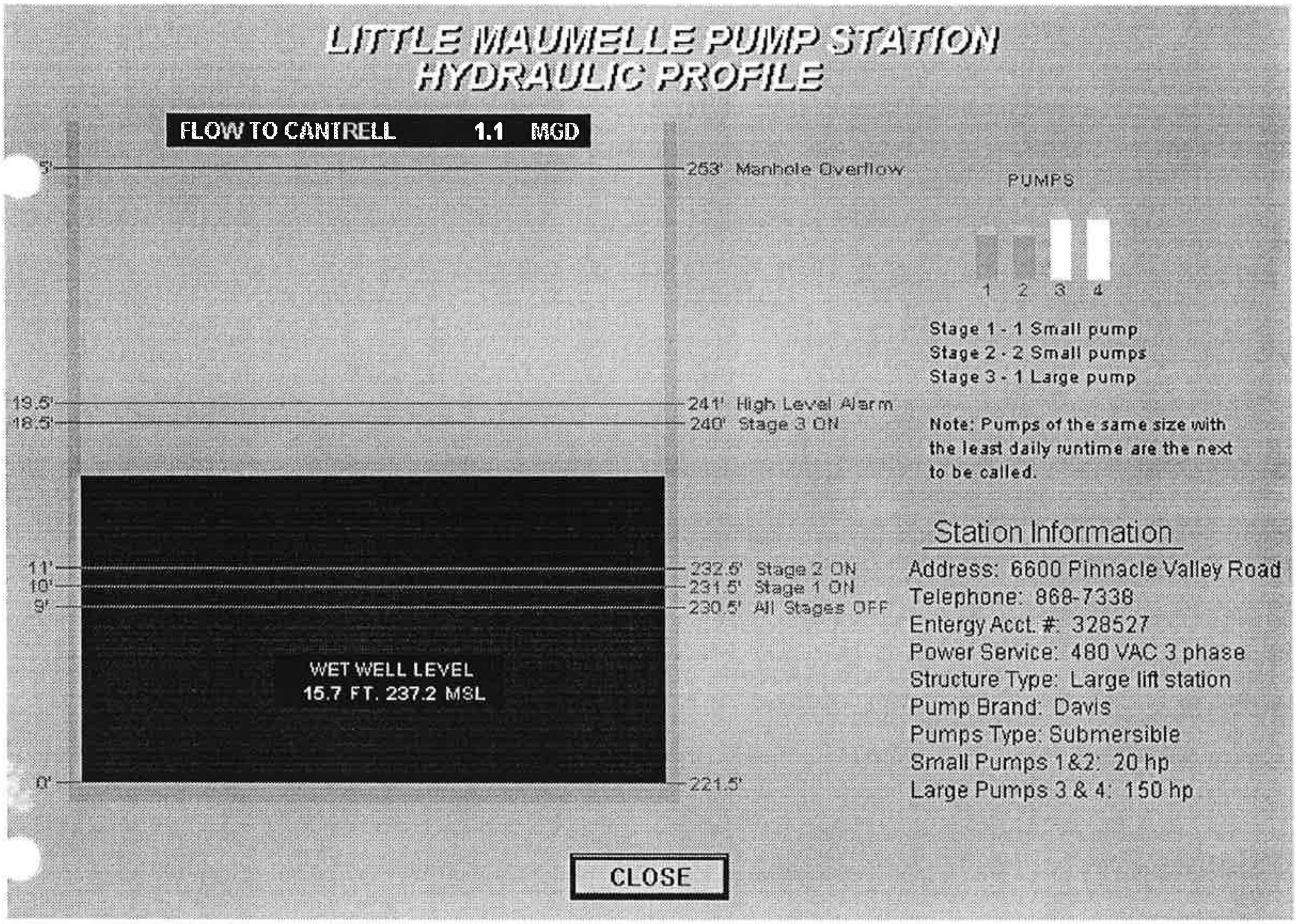
Stage 1 - 1 Small Pump 250 hp
Stage 2 - 2 Small Pumps 250hp
Stage 3 - 1 Large and 2 Small Pumps
Stage 4 - 2 Large and 2 Small Pumps

Note: Pumps of the same size with the least daily runtime are the next to be called.

In Tertiary Mode pumps selected will start when the level is above the Bypass Level, and will continue to run until the level drops below the Bar Screen High Level.

Station Information

Address: 1901 Cantrell Road
Telephone: 688-1582
Entergy Acct. #: 271779
Power Service: 480 VAC 3 phase
Structure Type: Large lift station
Pumps 1&2 Type: Flygt 329hp Submersible
Pumps 3&4 Type: Fairbanks Morse 250hp Centrifugal
Flowmonitor in Manhole 10G067



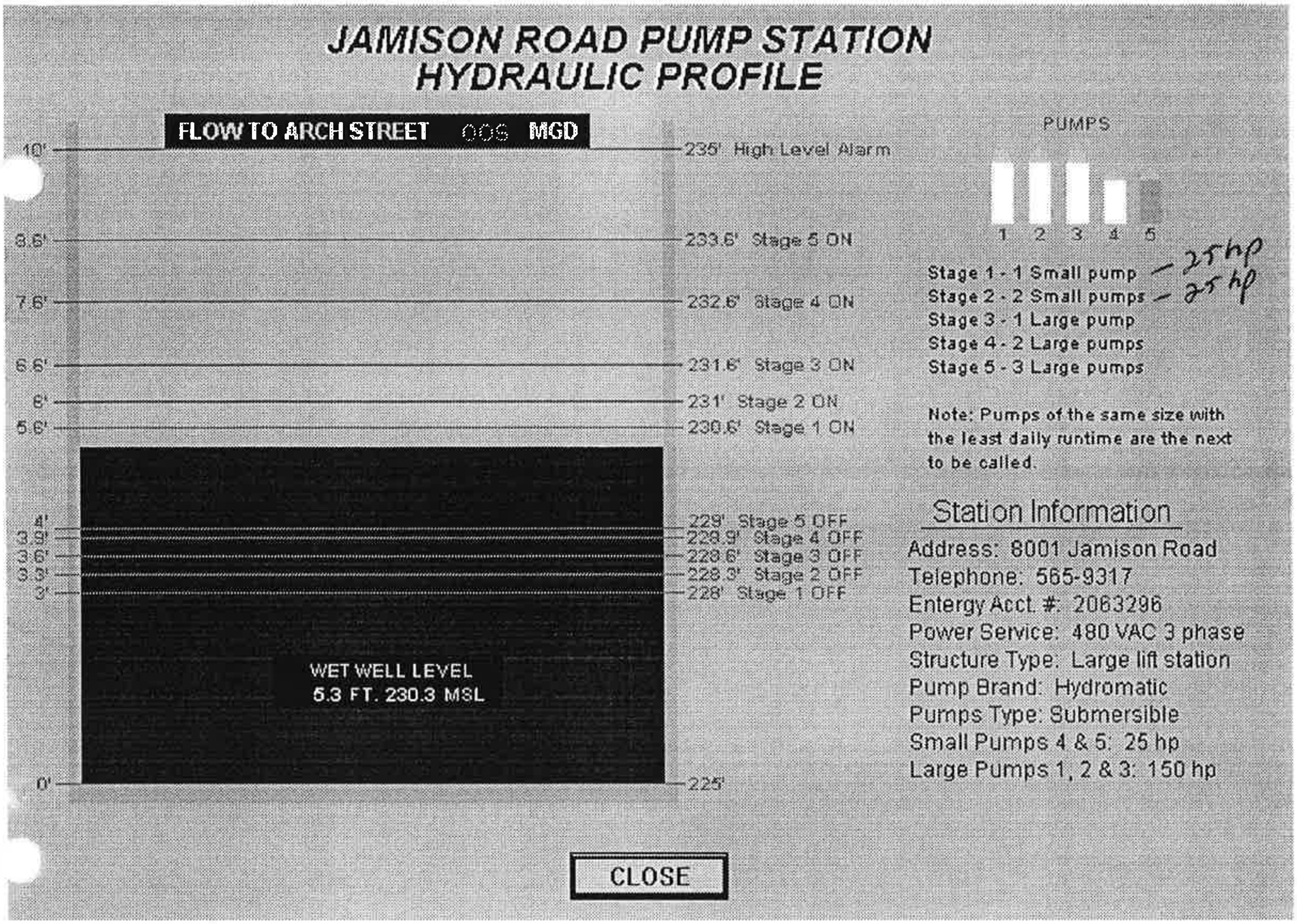
LITTLE MAUMELLE PUMP STATION
HYDRAULIC PROFILE

Stage 1 - 1 Small pump
Stage 2 - 2 Small pumps
Stage 3 - 1 Large pump

Note: Pumps of the same size with the least daily runtime are the next to be called.

Station Information

Address: 6600 Pinnacle Valley Road
Telephone: 868-7338
Entergy Acct. #: 328527
Power Service: 480 VAC 3 phase
Structure Type: Large lift station
Pump Brand: Davis
Pumps Type: Submersible
Small Pumps 1&2: 20 hp
Large Pumps 3 & 4: 150 hp



JAMISON ROAD PUMP STATION
HYDRAULIC PROFILE

FLOW TO ARCH STREET OOS MGD

WET WELL LEVEL
5.3 FT. 230.3 MSL

Stage 1 - 1 Small pump – 25hp
Stage 2 - 2 Small pumps – 25hp
Stage 3 - 1 Large pump
Stage 4 - 2 Large pumps
Stage 5 - 3 Large pumps

Note: Pumps of the same size with the least daily runtime are the next to be called.

Station Information

Address: 8001 Jamison Road
Telephone: 565-9317
Entergy Acct. #: 2063296
Power Service: 480 VAC 3 phase
Structure Type: Large lift station
Pump Brand: Hydromatic
Pumps Type: Submersible
Small Pumps 4 & 5: 25 hp
Large Pumps 1, 2 & 3: 150 hp

PUMP STATION TECHNICAL MEMORANDUM

INTRODUCTION

Background

This Technical Memorandum (TM) has been prepared as part of an overall project entitled "Hydraulic Modeling/Collection System Facility Plan." The Facility Plan will document the analysis of system performance through evaluation of the collection system and pump stations. A modeling effort is also part of the Facility Plan. Modeling will simulate and predict collection system performance with emphases on capacity, hydraulics, overflows and future growth of the system. This TM focuses on the pump station evaluation.

The Little Rock Wastewater Utility (LRWU) owns and operates two wastewater treatment plants. Both plants are located in the eastern part of the city, relatively close to where the Arkansas River begins to flow in a southerly direction. The Adams Field Wastewater Treatment Plant has a design flow of 36 million gallons per day (MGD) with a pumping capacity of 72 MGD, while the Fourche Creek Wastewater Treatment Plant has a design flow of 16 MGD with a pumping capacity of 40 MGD. The LRWU also owns and operates the associated collection system and pumping stations. Maps 1 and 2, found in Appendix A, show the collection system, including major sewer lines, wastewater treatment plants, and pump stations.

Purpose

This TM focuses on three of the pump stations: Little Maumelle, Cantrell, and Jamison. The performance and condition of these pump stations were evaluated as they relate to the Facility Plan. The completed findings will be presented in the Facility Plan.

A straightforward approach was used to gather the information for this TM. Site visits were conducted to assess the condition of each pump station. Crist Engineers, in conjunction with Byrd-Forbes, performed a hydraulic examination as part of this evaluation. Information, such as nameplate data and meter location, was gathered on the pumps and collection system. Interviews were conducted with LRWU staff, including Roy Cannon (Engineering Technician), Bill Hall (Pump and Equipment Supervisor) and Dale Gilbert (Instrumentation Supervisor), in order to understand operation and maintenance (O&M) issues pertaining to the pumps and pump stations. Field evaluation forms, which can be found in Appendices B, C and D for each pump station, were completed to document the findings of the site visits. This TM will present preliminary recommendations based on the findings of the site visits.

COLLECTION SYSTEM DESCRIPTION

The Little Maumelle and Cantrell Pump Stations are located in the northern part of the City of Little Rock, while the Jamison Pump Station is located in the southern part of the City. The Little Maumelle Pump Station is located upstream of the Cantrell Pump Station. Both stations are part of the Adams Field Wastewater Treatment Plant collection system. The Jamison Pump Station pumps wastewater to the Fourche Creek Wastewater Treatment Plant (refer to Maps 1 and 2 in Appendix A).

Little Maumelle Pump Station

The Little Maumelle Pump Station is located at 6600 Pinnacle Valley Road in the northwest part of the City. This pump station was constructed around 1985. Flow enters the pump station from the west through a 36-inch concrete conduit. Figure 1 shows the entrance to the pump station. The Little Maumelle Pump Station has four submersible pumps located in a single wet well. The pump station is equipped with a Polysonic Compu-Flow flow meter, located on the force main in a manhole adjacent to the valve vault. The accuracy of the flow meter has been suspect because of turbulence created by current operational practices of throttling the plug valves on the pump discharge to approximately 25% open. The Little Maumelle Pump Station also has a pig launching port for maintenance of the force main. The Little Maumelle Pump Station does not have a grease mixer.

Figure 1. Little Maumelle Pump Station.

The wet well dimensions are 40 feet deep, 40.5 feet long and 22 feet wide. The invert elevation is 221.66 feet. Pump information is summarized in Table 1. Two flow and head performance points for each pump are shown in Table 1. Plan and section views of the Little Maumelle Pump Station are shown in Figure M-2 found in Appendix B.

Table 1 - Pump Data for Little Maumelle Pump Station

	Pump 1	Pump 2	Pump 3	Pump 4
Manufacturer	Davis EMU	Davis EMU	Davis EMU	Davis EMU
Capacity (gpm)	400, 750	400, 750	2000, 3750	2000, 3750
Head (ft)	42, 55	42, 55	81, 105	81, 105
Horsepower	20	20	150	150
Type	FA152-230 trim Sewage	FA152-230 trim Sewage	FA253-440z trim Sewage	FA253-440z trim Sewage
Installation Date	1985	1985	1985	1985
On / Off Levels (ft)*	231.5/230.5	232.5/230.5	240/230.5	241/230.5
Speed (rpm)	1,750	1,750	1,175	1,175

***The current On/Off Levels can be viewed or printed by accessing SCADA screen LMPS3B (see Appendix B)**

Cantrell Pump Station

The Cantrell Pump Station is located at 1901 Cantrell Road, and is situated centrally in the northern part of the City. It is the oldest of the three pump stations being evaluated, having been constructed around 1969. Figure 2 shows the entrance to the pump station. Wastewater enters the pump station through both a 36-inch and a 42-inch concrete pipe. The 36-inch line serves the Rose Creek Basin and the 42-inch line serves the Rebsamen Basin. Wastewater leaves the pump station through a 30-inch concrete force main. Previously, a venturi meter located in an adjacent vault was the flow measurement device. However, this meter has recently been replaced with a non-invasive Doppler meter attached to a spool piece. The Cantrell Pump Station does not have a grease mixer.

This station has four pumps in a dry well, and a wet well divided into two compartments. The pumps are located in the dry well. The dry well dimensions are a depth of 52 feet, a length of 34 feet, and a width of 22 feet. The wet well is approximately 53.5 feet deep, 17 feet long (each), and 10 feet wide. There is a dividing wall in the wet well with a gated opening. The invert elevation of the influent pipes is 220 feet, and the wet well bottom is 208 feet. Pump information is summarized in Table 2. Plan and section views of the Cantrell Pump Station are shown in Figures M-1 and M-1A found in Appendix C.

Figure 2. Cantrell Pump Station

Table 2 - Pump Data for Cantrell Pump Station

	Pump 1	Pump 2	Pump 3	Pump 4
Manufacturer	Fairbanks Morse	Fairbanks Morse	Flygt	Flygt
Capacity (gpm)	8,200	8,200	6,000	6,000
Head (ft)	78	78	138	138
Horsepower	250	250	329	329
Type	Centrifugal	Centrifugal	Submersible	Submersible
Installation Date	1967	1967	1986	1986
On / Off Levels (ft)	225 / 219	227 / 219.5	228 / 220	229/ 221
Speed (rpm)	880	880	1,185	1,185

***The current On/Off Levels can be viewed or printed by accessing SCADA screen CRPS3B (see Appendix C)**

Jamison Pump Station

The Jamison Pump Station is located at 8001 Jamison Road. The newest of the three pump stations that were evaluated, Jamison Pump Station was constructed around 1995. Figure 3 shows the entrance to the pump station. Wastewater enters the pump station from the south through a 36-inch iron pipe. Wastewater leaves the pump station through a 24-inch pipe. No flow meter is currently in use at this pump station. The station is equipped with a pig launching port, which has never been used. The Jamison Pump Station is equipped with a grease mixer.

Figure 3. Jamison Pump Station.

The Jamison Pump Station has five submersible pumps located in a single wet well. The wet well dimensions are 40 feet deep, 30 feet long and 20 feet wide. The invert elevation is 221.66 feet. Pump information is summarized in Table 3. Three flow and head performance points for each pump are shown on Table 3. Plan and section views of the Jamison Pump Station are shown in Figure M-3 found in Appendix D.

Table 3 - Pump Data for Jamison Pump Station

	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5
Manufacturer	Hydromatic	Hydromatic	Hydromatic	Hydromatic	Hydromatic
Capacity (gpm)	6060, 4200, 3620	6060, 4200, 3620	6060, 4200, 3620	2700, 2085, 800	2700, 2085, 800
Head (ft)	43, 66, 78	43, 66, 78	43, 66, 78	25, 35, 50	25, 35, 50
Horsepower	150	150	150	25	25
Type	Hydromatic S12L	Hydromatic S12L	Hydromatic S12L	Hydromatic S8L	Hydromatic S8L
Installation Date	1993	1993	1993	1993	1993
On / Off Levels (ft)	230.6 / 228	231 / 228.3	231.6 / 228.6	232.6 / 228.9	233.6 / 229
Speed (rpm)	1750	1750	1750	870	870

The current On/Off Levels can be viewed or printed by accesssing SCADA screen JRPS3B (see Appendix D)

METHODOLOGY AND APPROACH

On two consecutive days, November 8, 2000 and November 9, 2000, personnel from LRWU, Montgomery Watson and Crist Engineers conducted site visits. The objective of the site visits was to assess the condition, hydraulics, and O&M procedures of each pump station. The site visits consisted of a visual inspection of each pump station, and focused on pumps, structure, piping, valves, concrete, grinders, and equipment control. Visual observations of wet well interiors were made from top access hatches only—no manned entries of wet wells were performed. Information was obtained regarding the pumps operated at each station, as well as the flows observed at each station. Information was also gathered relating to the O&M procedures employed at each pump station. Maintenance personnel were interviewed and SCADA procedures were reviewed. Digital photographs were taken and printouts of SCADA computer screens were obtained. Photocopies of the field forms utilized to document information can be found in Appendices B, C, and D for each pump station. Findings of the site visits are presented in the following section.

PUMP STATION ASSESSMENTS

Findings of the site visits are presented in this assessment section. Information is presented independently for each of the three pump stations is presented. For each pump station, the findings are placed into four categories: Condition Assessment, Hydraulic Analysis, Operations and Maintenance, and Miscellaneous. The 'Miscellaneous' category consists of odor problems and modifications desired by the operators.

Little Maumelle Pump Station

Wastewater enters the pump station from the west through a 36-inch line. A gate valve is located at the entrance to the wet well (refer to Figure 4). A grinder (refer to Figures 5 and 6) reduces large solids in the wastewater before entering the wet well, where the pumps are located (refer to Figure 7). The Little Maumelle Pump Station has two small pumps (Pumps 1 and 2) and two large pumps (Pumps 3 and 4).

Figure 4. Influent gate at Little Maumelle Pump Station.

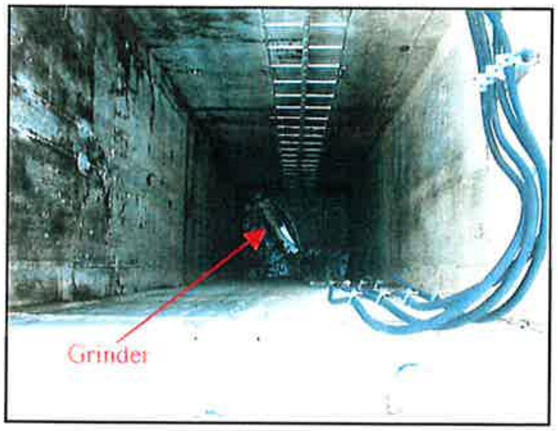


Figure 5. Grinder used at the Little Maumelle Pump Station.

Guide rails are used to install and remove the pumps. The pumps discharge through the dry well wall to a common manifold located underneath the pavement, adjacent to the perimeter of the dry well (refer to Figures 8 and 9). The wastewater is then pumped to the Rebsamen Interceptor, a 30-inch gravity main that eventually flows to the Cantrell Pump Station.

Cantrell then pumps wastewater into the Riverfront Interceptor, which flows to the Adams Field WWTP.

Figure 6. Grinder control panel.

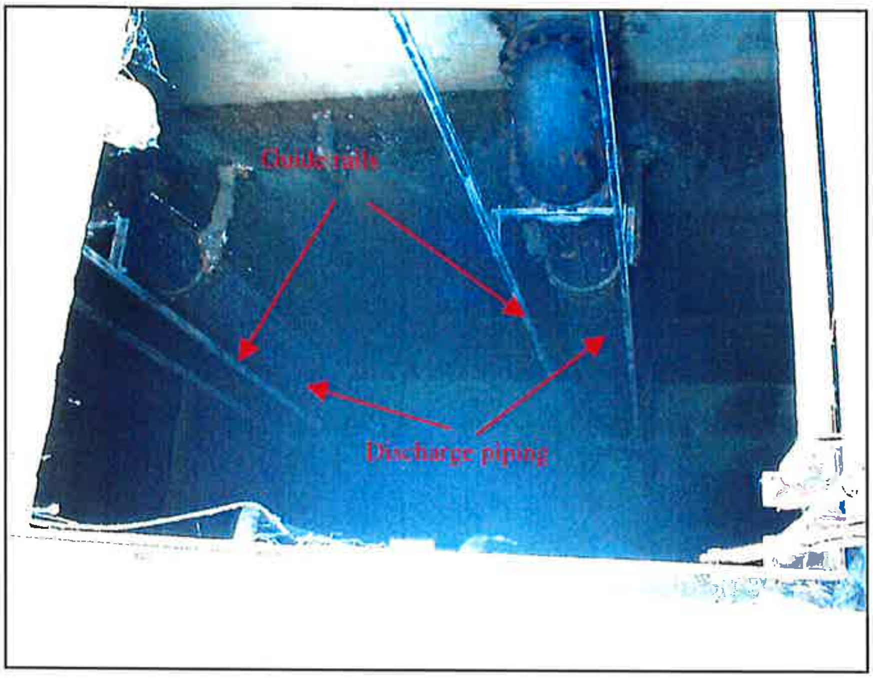


Figure 7. Wet well where submersible pumps are located.

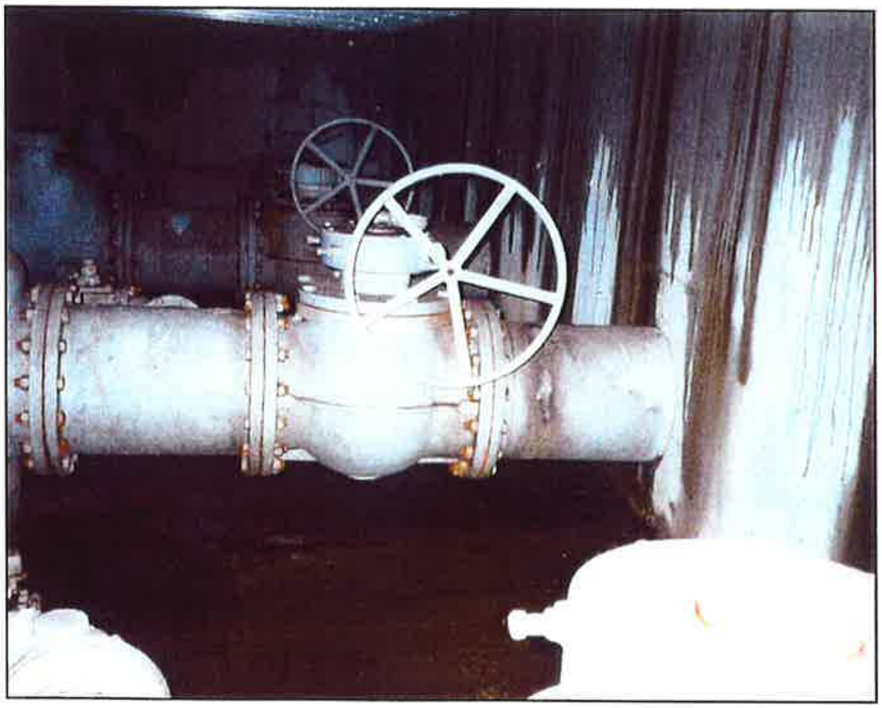


Figure 8. Pump discharge piping in dry well.

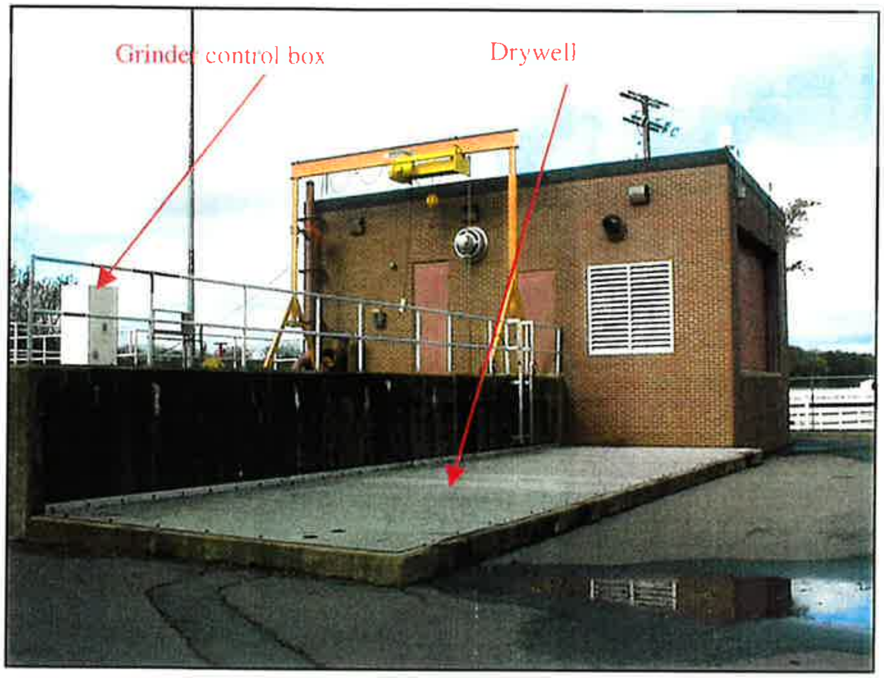


Figure 9. Dry well location.

Condition Assessment

From an overall perspective, the Little Maumelle Pump Station is in good condition.

Equipment

Equipment appeared to be in acceptable operating condition. Except for the grinder controls, the switchgear and controls for the pump station equipment are located in the pump building. The grinder controls are housed in an outside structure, which is protected from the elements. The pump control panels appeared to be in acceptable working order.

Crane

The overhead crane was not operated during the site visit, but site visit personnel were informed that the crane was operational. The crane moves along rails to the end of the loading platform (refer to Figure 10). Currently, an object must be placed onto the platform before the crane is capable of moving the object. Future consideration should be given to modifying either the crane or the loading platform so objects can be removed directly from truck beds without having to be loaded onto the platform.

Figure 10. Crane and loading platform.

Pump Noise

During the visit to the pump station, no unusual pump noises were heard.

Rust

No indications of rust were evident on the piping in the dry well.

Corrosion (Concrete)

No corrosion problems were apparent. Although the wet well walls do not have a protective coating, no degrading or aggressive corrosion of the walls is apparent at this time.

Hydraulic Analysis

During the wet-weather season, the pumps run longer to maintain a normal wet well level. A significant amount of storage volume is available in the upstream line. The original pumps and impellers are still used.

Pump Curves

The pump curves are located in Appendix B.

Flow Tests

As part of a concurrent project, Byrd-Forbes has been contracted with LRWU to perform tests to verify pump capacities and characterize the flows being experienced at each pump station. They will also develop pump curves to demonstrate current pump performance.

Operation and Maintenance

Pumps

Pumps 1 and 2 cannot operate when either Pump 3 or 4 is running. Additionally, Pumps 3 and 4 are interlocked (hard-wired together) so that only one can operate at a time. To operate both large pumps simultaneously, the contactor on the pump that is not running needs to be physically depressed. Additionally, if flows increase downstream and the Cantrell Pump Station is experiencing high flows, the instrumentation at the Cantrell Pump Station signal the Little Maumelle Pump Station to reduce pumping. That signal will shut down the large pump that is operating and turn on the two small pumps.

A current problem exists with condensation accumulation in the motor windings. Every Tuesday, each pump is cycled for 45 minutes to ensure that each motor is functioning properly. Space heaters may be required for these motors.

Currently the two 150 horsepower pumps (Pumps 3 and 4) are throttled, and the two 20 horsepower pumps (Pumps 1 and 2) are not. The discharge valve on each pump is only ¼ open in order to reduce flow because of downstream capacity problems. If the discharge valves were fully open, the potential exists for more downstream sanitary sewer overflows. Currently sanitary sewer overflows have been observed at a manhole located about one-half mile upstream from the Little Maumelle Pump Station.

The pump station is operated based upon wastewater levels in the wet wells measured by a bubbler-type level instrument. Two redundant level instruments, a pressure transducer and a float-type instrument are installed in the wet well. The pump station is operated remotely with an Allen-Bradley SLC 5/03 processor. Radio signals, via Metricom, relay information between the pump station and the Adams Field Wastewater Treatment Plant.

Electrical

Electrical switchgear and motor control centers are operational and have no identifiable problems.

Instrumentation (SCADA)

The SCADA graphics screen for the Little Maumelle Pump Station, found in Appendix B, shows the different pumping scenarios employed at this pump station. Stage 1 calls for the operation of one of the small pumps. Stage 2 calls for both small pumps to operate. At Stage 3, the small pumps cease operation and one large pump begins to operate.

Gages

None noted.

Valves

Air regularly becomes trapped in the force main, thereby decreasing the available capacity of the pipeline.

There are no air/vacuum valves located on the discharge manifold to remove the excess air.

Screens / Grinders

A Muffin Monster grinder reduces the diameter of solids in the wastewater stream prior to reaching the pumps. The Muffin Monster grinder replaced two Weissman grinders, and has been operating successfully since the original installation.

Automatic Generator

An automatic generator (refer to Figure 11) located on-site serves as an emergency power supply. Operating procedures noted that after starting, the generator has to be operated for a minimum period of 30 minutes.

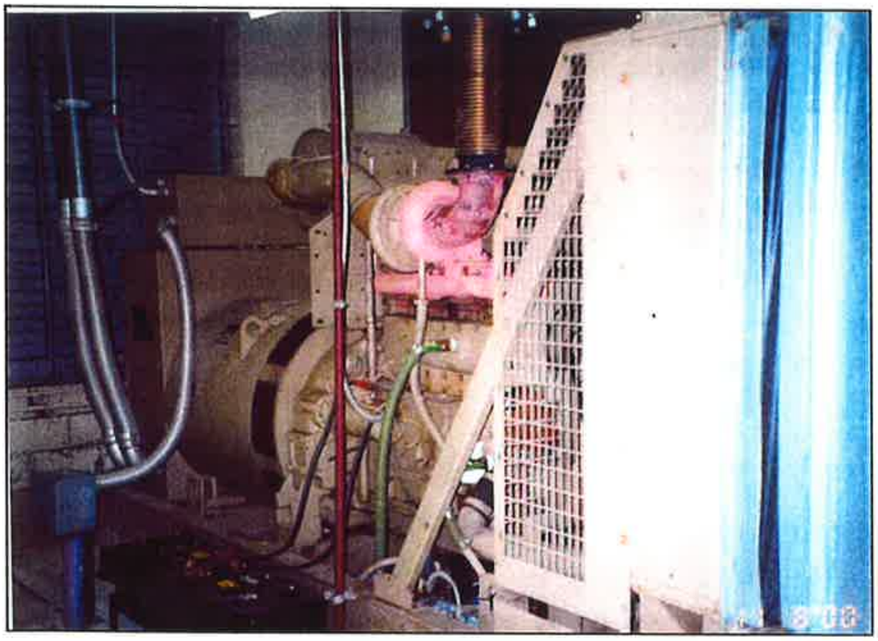


Figure 11. Automatic generator located onsite.

Housekeeping

Asphalt paved areas are showing signs of erosion of the base material.

Figure 12. Deteriorated asphalt.

Maintenance

Operational/maintenance problems noted were condensation in the motors on the pumps and grease build-up on the wastewater surface in the wet well.

Loading and unloading with the crane is difficult because of the limited reach of the crane relative to the drive area.

During high influent flows, the elevation of the grinder chamber permits short-circuiting over the grinders and into the wet well.

Miscellaneous

Odor complaints are currently not a problem at the Little Maumelle Pump Station, although there have been complaints at a discharge manhole in the downstream distribution system. Prior experience with the station and force main has shown a tendency for septicity in the force main during low flow periods.

A Polysonic Compu-Flow flow meter is located on the force main, in a manhole adjacent to the valve vault (refer to Figures 13 and 14). The Little Maumelle Pump Station also has a pig launching port for maintenance of the force main.

Figure 13. Manhole to be used for location of flow meter.

Figure 14. Flow meter

Cantrell Pump Station

Wastewater enters this pump station through both the Rebsamen Interceptor (42-inch line from the west) and Rose Creek (36-inch line from the east). A sluice gate is located on each influent line for flow control (refer to Figure 15). Two additional gates are installed to direct the combined wastewater flows into each half of a segregated wet well. The wet well is sub-divided by a concrete wall. A 36-inch square opening at the bottom of the wall is equipped on the east face with an Armco 55-10 gate to permit flow between the two chambers, if necessary. The gate remains open under normal operating conditions. Bar screens are located inside each wet well to keep solids from entering the wet well and subsequently impacting the operation of the pumps (refer to Figure 16). The bar screens were installed under a separate contract approximately 15 years ago, after the pump station was constructed.

Figure 15. Influent gate valves.

Figure 16. Bar screen currently being repaired.

The Cantrell Pump Station is equipped with four pumps located in the dry well. Two of the pumps are submersible pumps being operated in a dry well application (refer to Figure 17). A close up photograph of the Fairbanks Morse pumps, drive shafts, and motors are shown in Figures 18 through 20.

Figure 17. Close up of the four pumps used at the Cantrell Pump Station.

Figure 18. Close up of Fairbanks Morse pumps

Figure 19. Close up of the Fairbanks Morse motors.

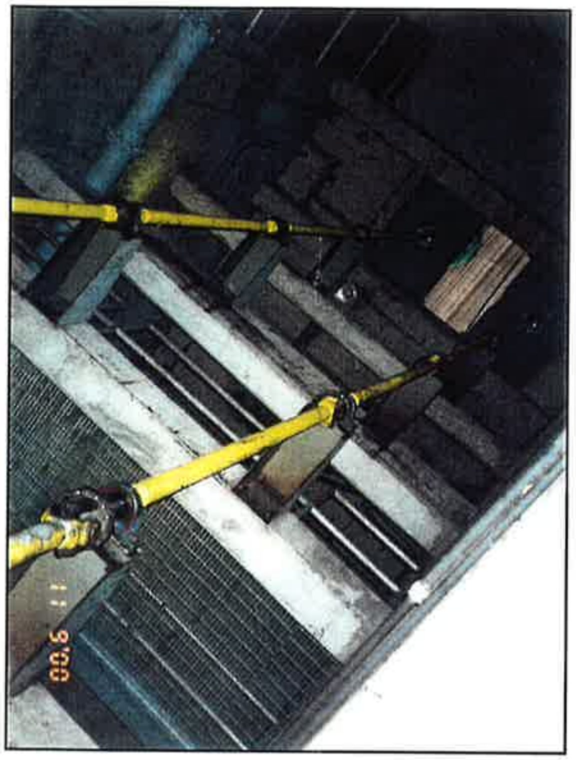
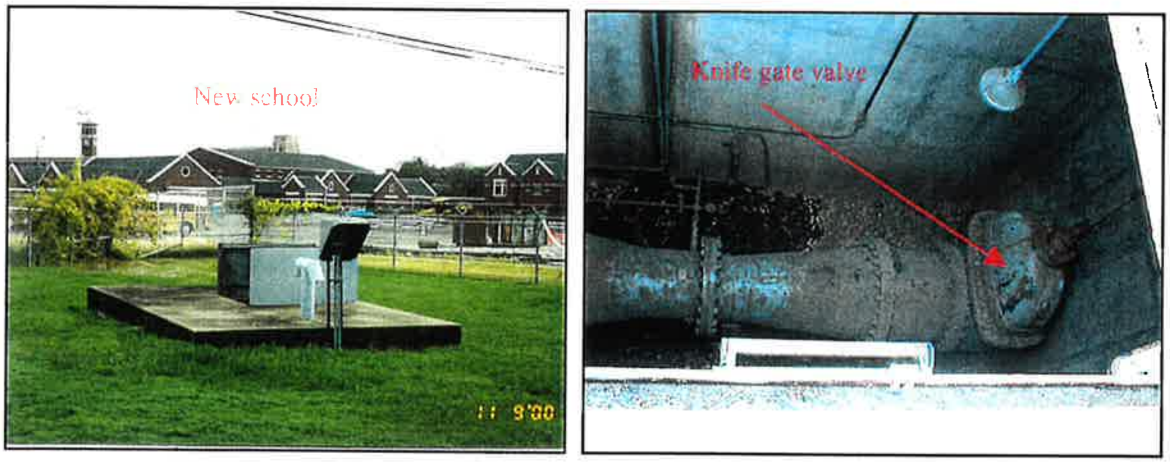


Figure 20. Extended drive shafts for Fairbanks Morse pumps.

Wastewater leaves the pump station, flowing through piping in the nearby vault shown in Figure 21. The old venturi meter (refer to Figure 23) was replaced with a new spool piece and strap-on Polysonic Compu-Flow meter for measurement of wastewater flow leaving the pump station (refer to Figure 22). The position of the knife gate valve remained as shown in Figure 23.



Figures 21 and 23. Meter vault located adjacent to pump station; Old venturi meter.

Figure 22. Flow Meter

Condition Assessment

Equipment

Equipment appeared to be operating adequately during the site visit, with two exceptions. One bar screen was out of service and undergoing extended repair (refer to above Figure 164) and Pump Number 1 was experiencing a high degree of cavitation.

The bar screens are located in the building over the wet well in a very limited space condition. The screens have been noted as a source of odor problems, however, there was no evidence of corrosion in the upper portion of the wet well.

Both Flygt pumps (Pumps 1 and 2) are experiencing excessive cavitation. The hydraulic condition of the pump station needs to be evaluated to determine the cause of the cavitation.

Crane

Figure 24 shows the crane that transports objects (primarily pumps and motors) into and out of the dry well. The interior floor slab has hatches that can be raised to allow access to the lower levels of the dry well. LRWU staff noted that the crane is operational and has no apparent operating problems.

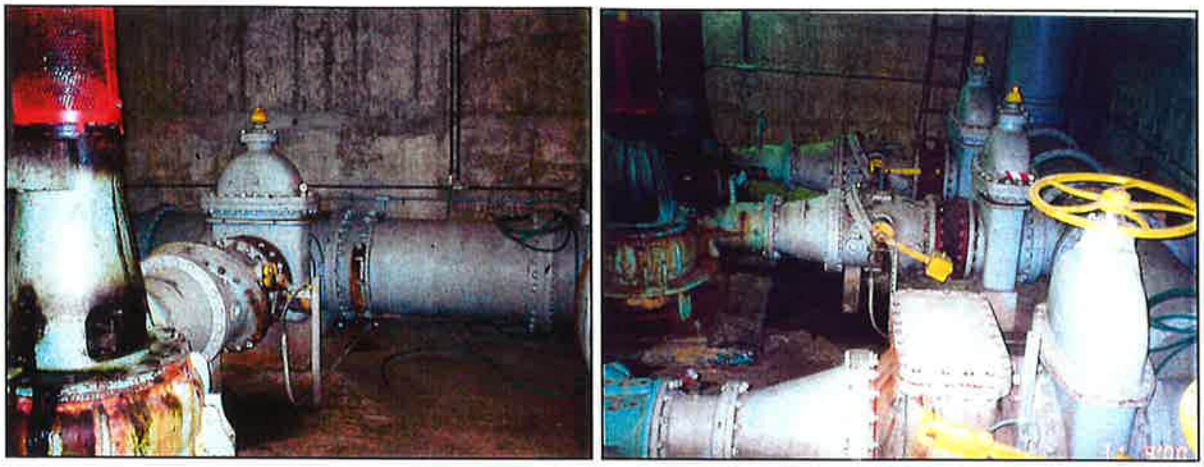
Figure 24. Overhead crane used at the Cantrell Pump Station.

Pump Noise

At the time of the site visit, Pump Number 1 (a Flygt pump) was emitting a loud noise during operation. The pump has since been dismantled by LRWU maintenance, and the source of the noise has been suggested to be cavitation.

Rust

A significant amount of rust was detected on the pumps and discharge piping. Figures 17 and 18, shown above, indicate rust on the pump volutes and flanges. Figures 25 and 26, below, also confirm the presence of rust on the flanges of the discharge piping. The condition of the return flow line to the wet well (Figure 27) should be assessed for clogging and operation.

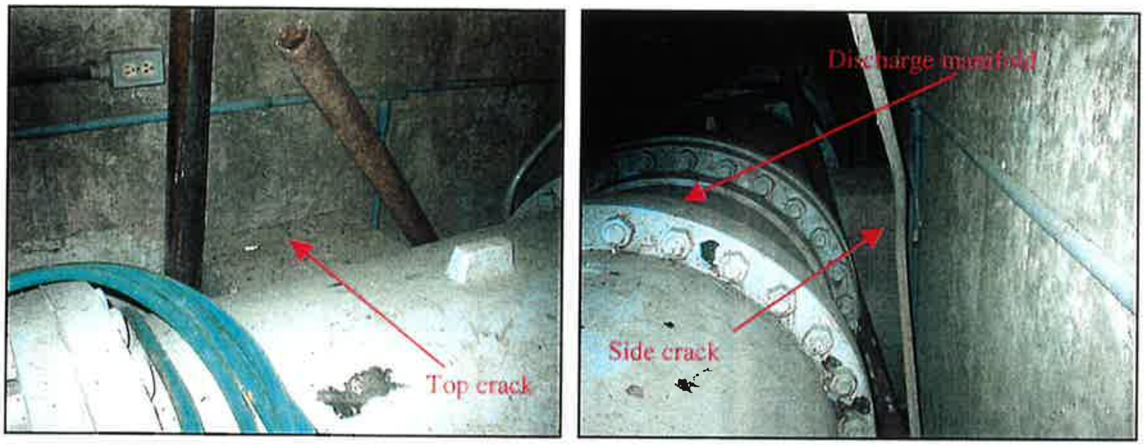


Figures 25 and 26. Presence of rust on flanges and discharge piping.

Figure 27. Drain/return line into wet wells off of discharge manifold.

Corrosion (Concrete)

During the site visit, no corrosion was observed on the upper portion of the wet well. However, a crack in the thrust block where Pump 2 connects with the discharge manifold was identified. Photographs of the crack are shown in Figures 28 and 29. Cracks were observed on the top and side of the thrust block.



Figures 28 and 29. Crack in a thrust block for the discharge manifold.

Hydraulic Analysis

Pump Curves

The original pump curves are located in Appendix C. LRWU will perform pump tests and develop new performance curves.

Flow Meter

A venturi meter, located in an adjacent vault, was previously used to monitor flow; however, the meter has recently been replaced with a non-invasive Polysonic Compu-Flow Doppler-type meter attached to a spool piece.

Flow Tests

As part of a concurrent project, Byrd-Forbes has been contracted with LRWU to perform tests to characterize the flows being experienced at each pump station. They will also develop pump curves to demonstrate current pump performance.

Operation and Maintenance

Pumps

The pumps are located in a dry well at the base of the pump station. Pumps 1 and 2 are actually submersible pumps being operated in a dry well application. Pump 1 was experiencing cavitation problems during the site visit. The motors for Pumps 3 and 4 are located on the ground-floor elevation of the pump station (refer to Figure 19). The operating pressure in the discharge manifold was 42 psi at the time of the site visit. All pumps in this station operate at a constant speed. The bottom of the pump station has a dual sump system.

The two Fairbanks Morse pumps (Pumps 3 and 4) start first, followed by the two Flygt pumps. All four pumps can operate at once. Initially, the pump station had three Fairbanks Morse pumps, but the third was removed and replaced with the two Flygt pumps. This replacement occurred at the same time as the bar screen installation, approximately 15 years ago (Plans dated August 1986). The Flygt pumps (Pumps 1 and 2) have experienced cavitation problems since they were installed. Although the rated capacity of the two Flygt pumps is larger than the Fairbanks Morse pumps, they currently pump less than the Fairbanks Morse pumps. The impellers on the Flygt pumps were trimmed at one time, but the trimmed impellers were removed and replaced with impellers of the original size. The pumps are currently not throttled and the discharge valves are wide open.

During the inspection, missing bolts were detected on the Flygt pumps. Seal water and lubrication oil was leaking from the motor-shaft coupling on the Fairbanks Morse pumps.

The Cantrell Pump Station is operated based upon wet well wastewater levels measured by a bubble-type level instrument. Redundant level instruments include a pressure transducer and a float-type instrument. The Cantrell Pump Station is capable of being operated remotely through the use of an Allen-Bradley SLC 5/03 processor. The communication system uses radio signals, via Metricom, and relays information between the pump station and the Adams Field Wastewater Treatment Plant.

Per LRWU, the Cantrell Pump Station has the capability to operate in a "tertiary" mode. During periods of high stormwater flow, the Cantrell Pump Station will call for the Little Maumelle Pump Station to completely shut down, thereby minimizing overflows in the collection system upstream of the Cantrell Pump Station.

Electrical

Electrical switchgear and motor control centers are operational and have no identifiable problems. No external hook-up for emergency power exists.

Instrumentation (SCADA)

The SCADA graphics screen for the Cantrell Pump Station, found in Appendix C, shows the different pumping scenarios employed at this pump station. Stage 1 calls for operation of one of the small pumps. Stage 2 calls for both small pumps to operate. At Stage 3, both small pumps continue operating and one large pump (3 or 4) begins to operate. At Stage 4, all four pumps (two large and two small) are operating.

Operational conditions are available for observation via the SCADA system

Gages

There is one pressure gage located on the end of the discharge header pipe.

Valves

Upon review, the valves are operational. Only exterior rust problems were observed.

There are no air/vacuum valves located on the discharge manifold to remove the excess air.

Screens / Grinders

The screening equipment is a maintenance issue. One set of screens is currently out of service.

Housekeeping

Due to recent development adjacent to the pump station site, it was noted that the site aesthetics no longer match the surrounding development. Also, it was noted that there are low spots around the pump station that cause water ponding. The entrance road between pump station site fence and Cantrell Road is in disrepair.

Maintenance

The bar screens are very high maintenance and continuously under repair.

The station's odor generation problems are increasing due to material falling from conveyor and bar screens in the bar screen room. The trash bin also generates odor problems when located outside the bar screen room (refer to Figure 30).

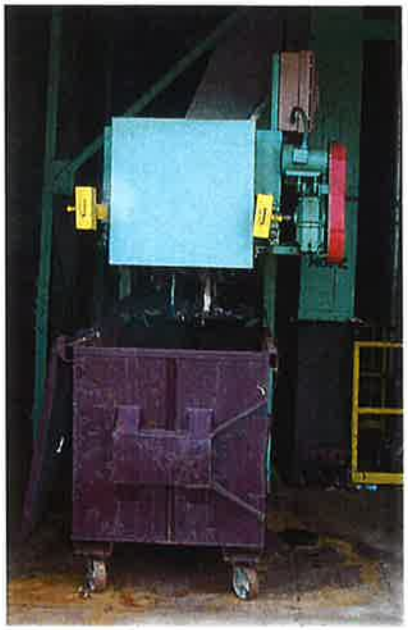


Figure 30. Dumpster and conveyor belt.

Miscellaneous

The thrust block where the piping from Pump 2 joins the common discharge manifold is cracked and should be repaired prior to further complications.

The gate valve located downstream of the new meter has not been exercised for several years. Determination of the integrity of the valve is critical. After exiting the vault, the sewer line follows an upward slope for about 3,000 feet. The gate valve is the isolation for maintenance and/or removal of the meter. By opening the valve on the drain/return line (refer to Figure 27), wastewater can be drained from the gate valve, when closed, back to the invert elevation of the drain/return line. Should the valve fail to close properly, and the drain/return line valve be in the open position, the wastewater contents in the 3,000 feet of force main would backflow towards the pump station and discharge into the wet well through the drain/return line.

Currently, no simple method exists to drain the lower portion of the discharge header and column for access and maintenance, since its centerline elevation is approximately 30 below the invert of the 10-inch diameter drain/return line. In order to drain the lower portion, the check valves would have to be held partially open, and the wet well level would have to be drawn down to below the level in the discharge column. Wastewater could then travel backwards through the pumps and into the wet well. LRWU staff have suggested the installation of a drain line either into the wet well or into the dry well sump. Suggestions have also been made for installation of a new valve below the return line so that any return flow would not enter the column and header. Maintenance and repair could then be conducted safely.

The LRWU staff would prefer grinders in place of the bar screens. The bar screens are high maintenance compared with grinders.

Procurement of an emergency generator has been suggested by LRWU staff based on the high incidence of power outages and the need for pump station reliability to prevent overflow situations.

The Cantrell Pump Station is equipped with a blower system consisting of a dry well blower and two wet well exhaust blowers (refer to Figures 31 and 32).

Figure 31. East side dry well and wet well blowers.

Figure 32. West side wet well blower.

Jamison Pump Station

Wastewater enters the Jamison Pump Station from the south through a 36-inch sewer line. A gate valve is located on the influent line to adjust the flow. The flow is then directed into two channels, each with its own gate valve and grinder (refer to Figures 33 and 34). Two Muffin Monster grinders protect the pumps by grinding up solids in the wastewater stream prior to entering the wet well.

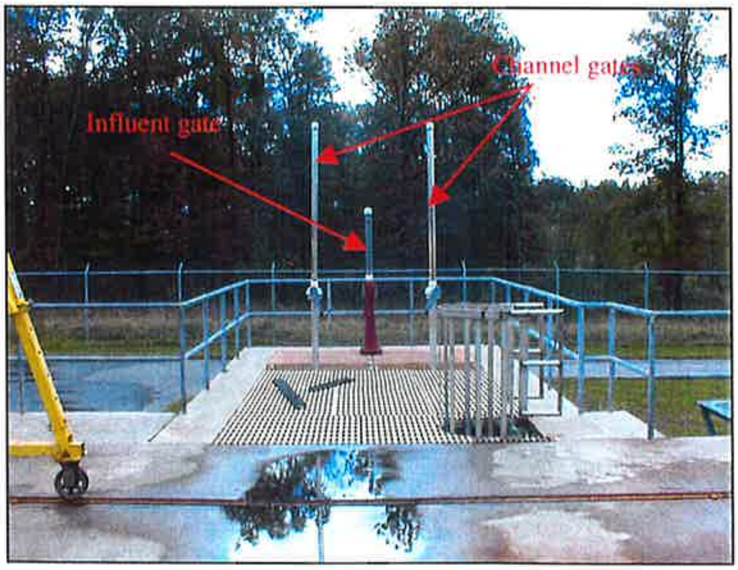


Figure 33. Influent structure with operators.

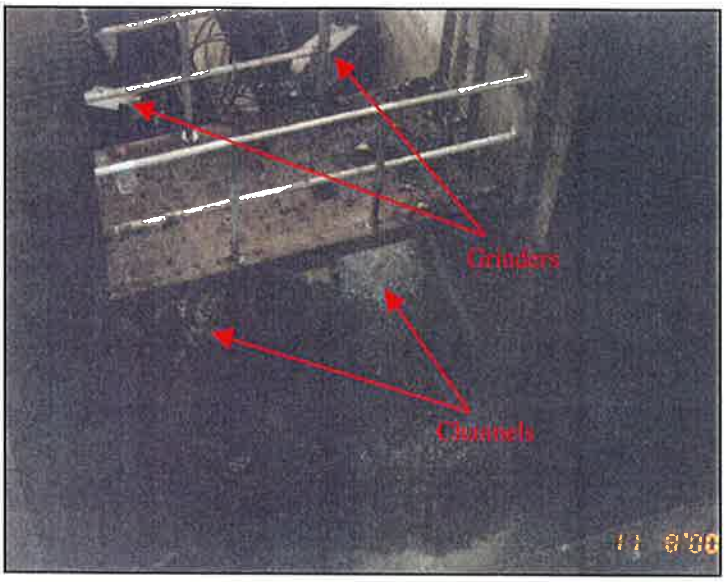


Figure 34. Influent wastewater channels and grinders.

Five submersible pumps are located in the wet well: two small pumps (Pumps 4 and 5) and three larger pumps (Pumps 1 through 3). The pumps discharge to a common manifold, which is located in an open dry well (refer to Figures 36 and 37). The pumps discharge wastewater into a 24-inch line. The discharge line from each pump has a check valve, a plug valve and a bypass line. The bypass lines are used to drain wastewater from the manifold.

The Jamison Pump Station is equipped with a grease mixer that is operational.

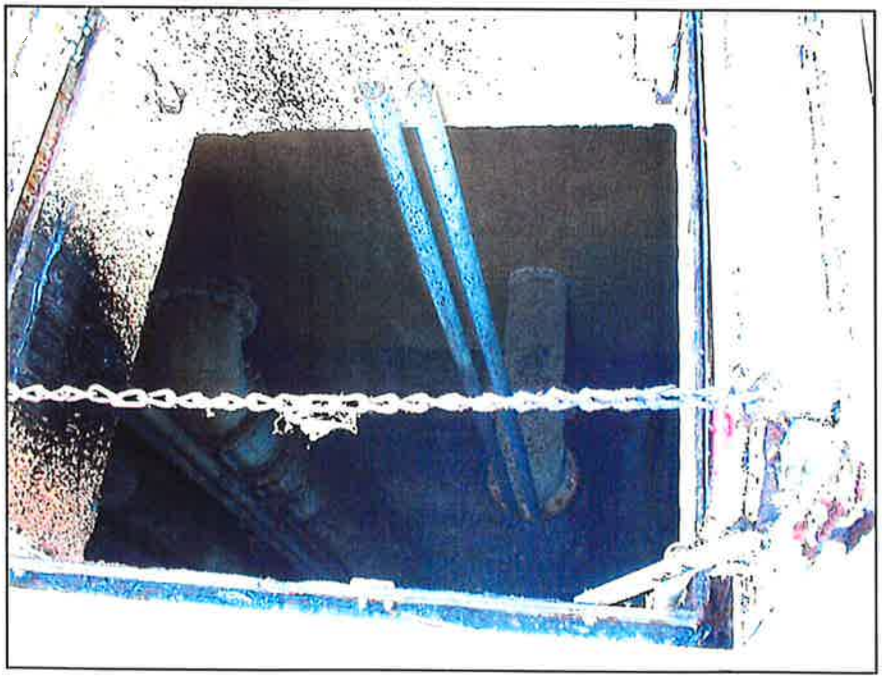


Figure 35. Discharge piping leading from pumps to discharge manifold in dry well.

Figures 36 and 37. Dry well containing discharge manifold.

Condition Assessment

Equipment

The equipment appeared to be in satisfactory operational condition. The Jamison Pump Station has a pig launching port for maintenance of the force main (refer to Figure 38). The port is located outside the structure, and is equipped with an associated pressure gage and air release valve for proper operation.

Figure 38. Pig Launch

Crane

The staff has indicated that the crane is in satisfactory condition (refer to Figure 39). The platform is designed so that equipment can be lifted directly from a loading truck onto the top of the wet well structure.

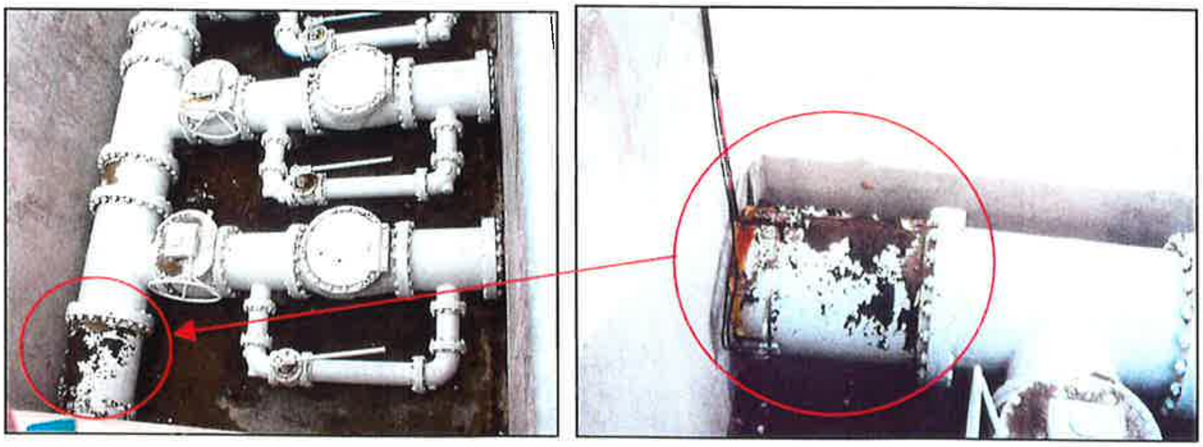
Figure 39. Crane used at Jamison Pump Station.

Pump Noise

According to the LRWU staff, no excessive vibration has been noticed of late, although they did note that during the first five and one-half years of operation, the pumps had excessive pump vibration. The manufacturer attempted, without success, to resolve the vibration problem. LRWU attributes the cease in vibration problems to a change in hydraulic conditions. No changes were made to the pumps or impellers. No vibration problems have been experienced with any of the pumps over the past year. During the site visit, no unusual pump noises were noticed.

Rust

Signs of rust exist on the discharge manifold (see Figures 40 and 41). The protective coating is deteriorating.



Figures 40 and 41. Rusted area on discharge manifold.

Corrosion (Concrete)

No degradation of the structure was evident. A protective coating has been applied to the walls of the wet well for corrosion protection.

Hydraulic Analysis

Very few overflows are associated with this pump station.

Pump Curves

The pump curves are located in Appendix D.

Flow Tests

As part of a concurrent project, Byrd-Forbes has been contracted with LRWU to perform tests to characterize the flows at the pump station. They will also develop pump curves to demonstrate current pump performance.

Operation and Maintenance

Pumps

The impellers on the large pumps were previously replaced, but now the original impellers are in use. The large pumps for this pump station are oversized. The smaller pumps cannot operate if a larger pump is running. By design, whenever a larger pump starts, power to the two small pumps (Pumps 4 and 5) is disconnected. Pumps of identical capacity get equal run time. The automatic control system is set to operate the pump with the least accumulated run time. The pumps are not throttled and the discharge valves are wide open. The larger pumps were previously throttled, but that is no longer the operational condition.

The Jamison Pump Station is operated based upon water levels in the wet wells, measured by a bubbler-type level instrument. Redundant level instrumentation includes a pressure transducer and a float-type instrument. The pumps can be operated remotely with an Allen-Bradley SLC 5/03 processor. Radio signals, via Metricom, relay information between the pump station and the Fourche Creek Wastewater Treatment Plant.

Electrical

The switchgear and the motor control center are currently operating properly.

Instrumentation (SCADA)

The SCADA graphics screen for the Jamison Pump Station, found in Appendix D, shows the different pumping scenarios employed at this pump station. Stage 1 calls for one of the small pumps to operate. Stage 2 calls for both small pumps to operate. At Stage 3, the small pumps stop, and one large pump begins to operate. At Stage 4, two large pumps are operating. The three large pumps are all in operation at Stage 5.

Gages

A pressure gauge is located on the discharge manifold (refer to Figure 42). At the time of the visit, the pressure gauge was not working properly.

Figure 42. Pump header pressure gauge.

Valves

The pump valves and isolation valves were operational during the site visit.

There is an air release valve located on the pig launch to remove excess air.

Screens / Grinders

Muffin Monsters are located in the incoming flow chamber and properly operating.

Housekeeping

Nothing noted at this time by LRWU staff.

Maintenance

Nothing noted at this time by LRWU staff.

Miscellaneous

A flow meter had been installed on the discharge manifold in the dry pit, but the meter is not currently operational due to turbulent flow patterns created from improper installation location.

The Jamison Pump Station is the only one of the three visited that has fiberglass grating (refer to Figure 43).

Figure 43. Fiberglass grating over influent and grinders

The Jamison Pump Station is equipped with a wet well exhaust fan (refer to Figure 44).

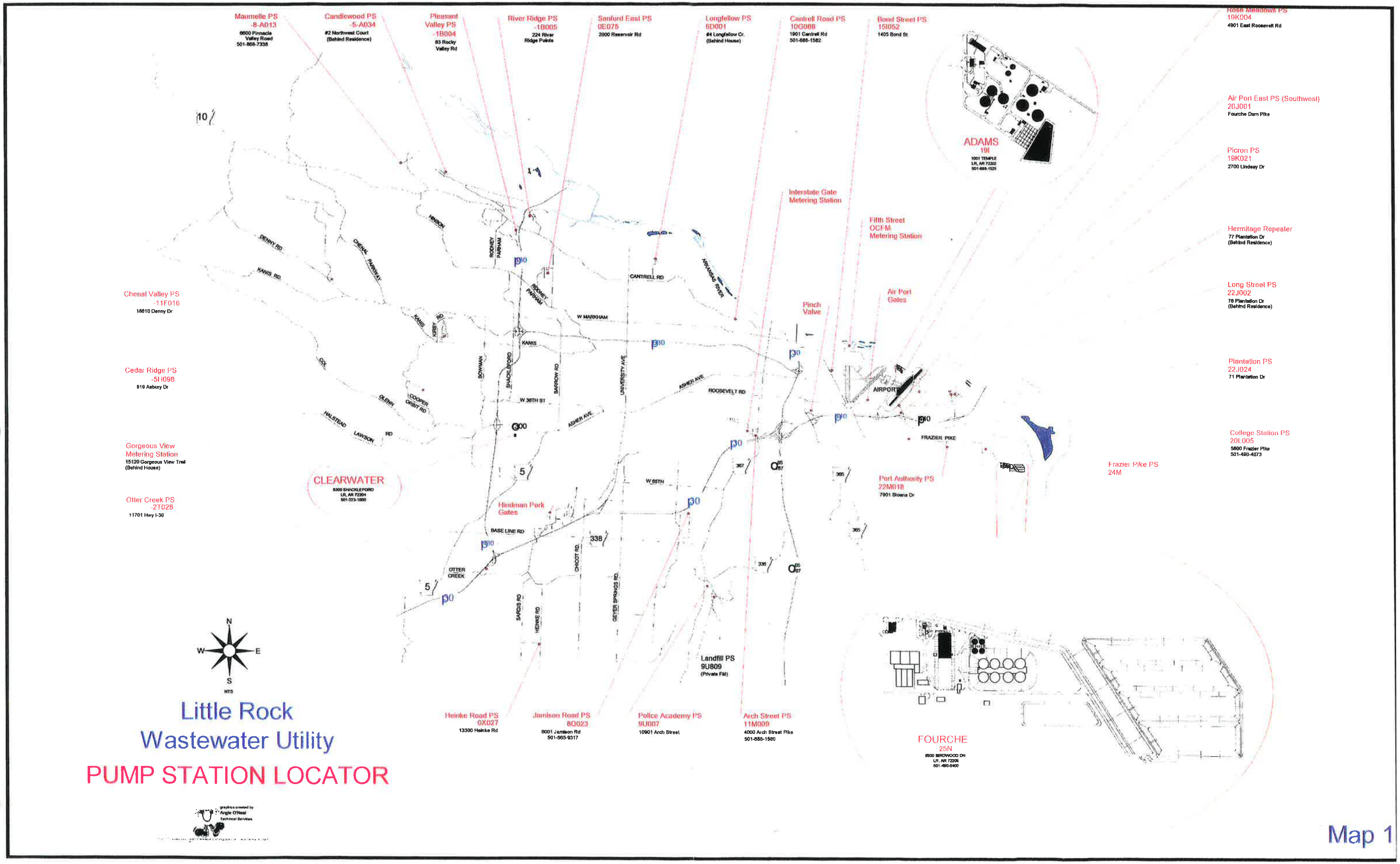
Figure 44. Wet well exhaust fan.

No backup generator is located on-site and no external hookups exist. LWRU staff is making an effort to procure emergency power capability.

The Jamison Pump Station has the capability to divert flow from the incoming gravity system to an adjacent collection system.

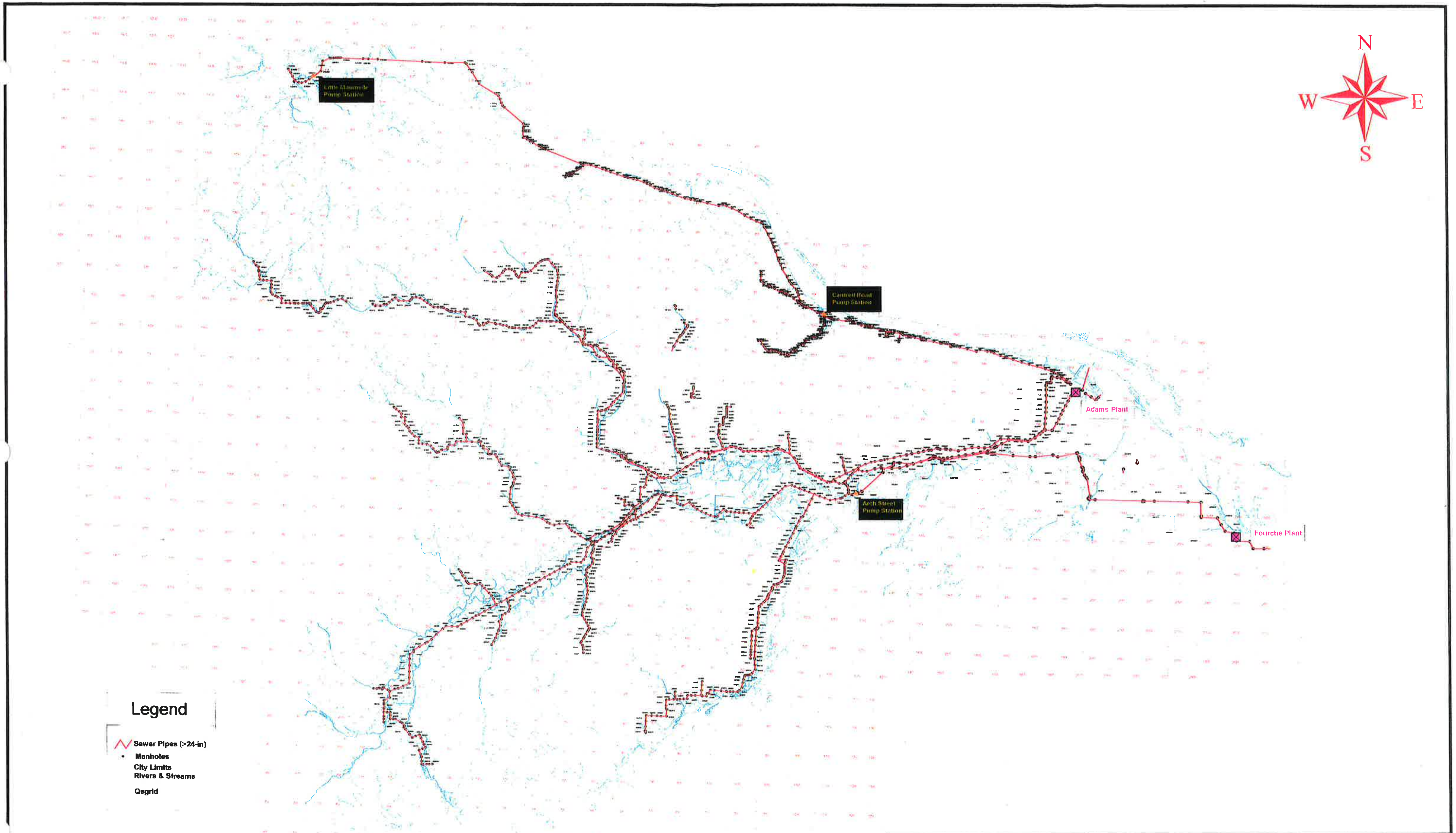
RECOMMENDATIONS

Final recommendations and construction and capital costs for recommended improvements will be presented in the Facility Plan.



Little Rock
Wastewater Utility
PUMP STATION LOCATOR

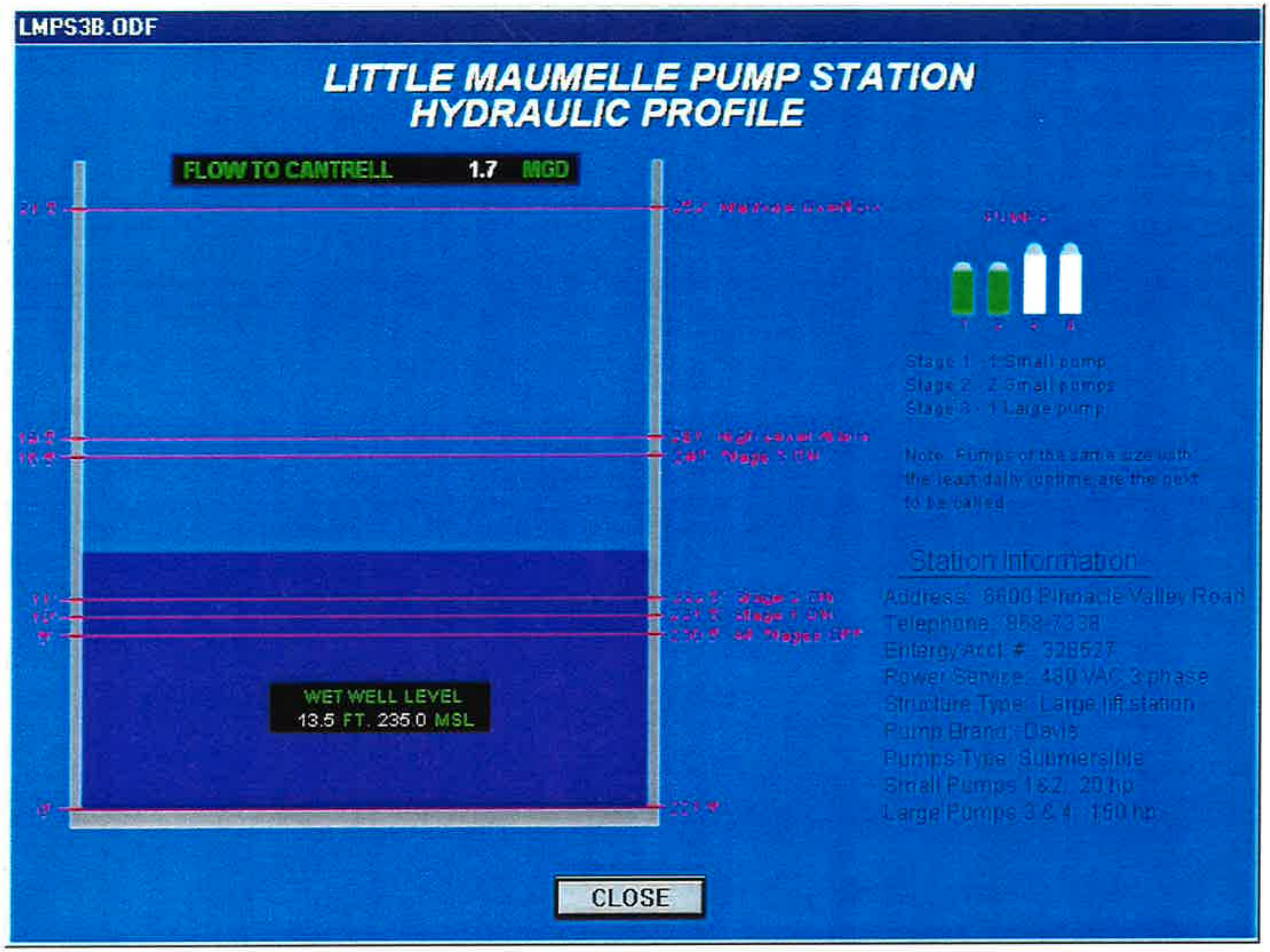
Map 1



MONTGOMERY WATSON

Little Rock Wastewater Utility

Map 2
Collection System (24-inch & larger)



LITTLE MAUMELLE PUMP STATION
HYDRAULIC PROFILE

WET WELL LEVEL
13.5 FT. 235.0 MSL

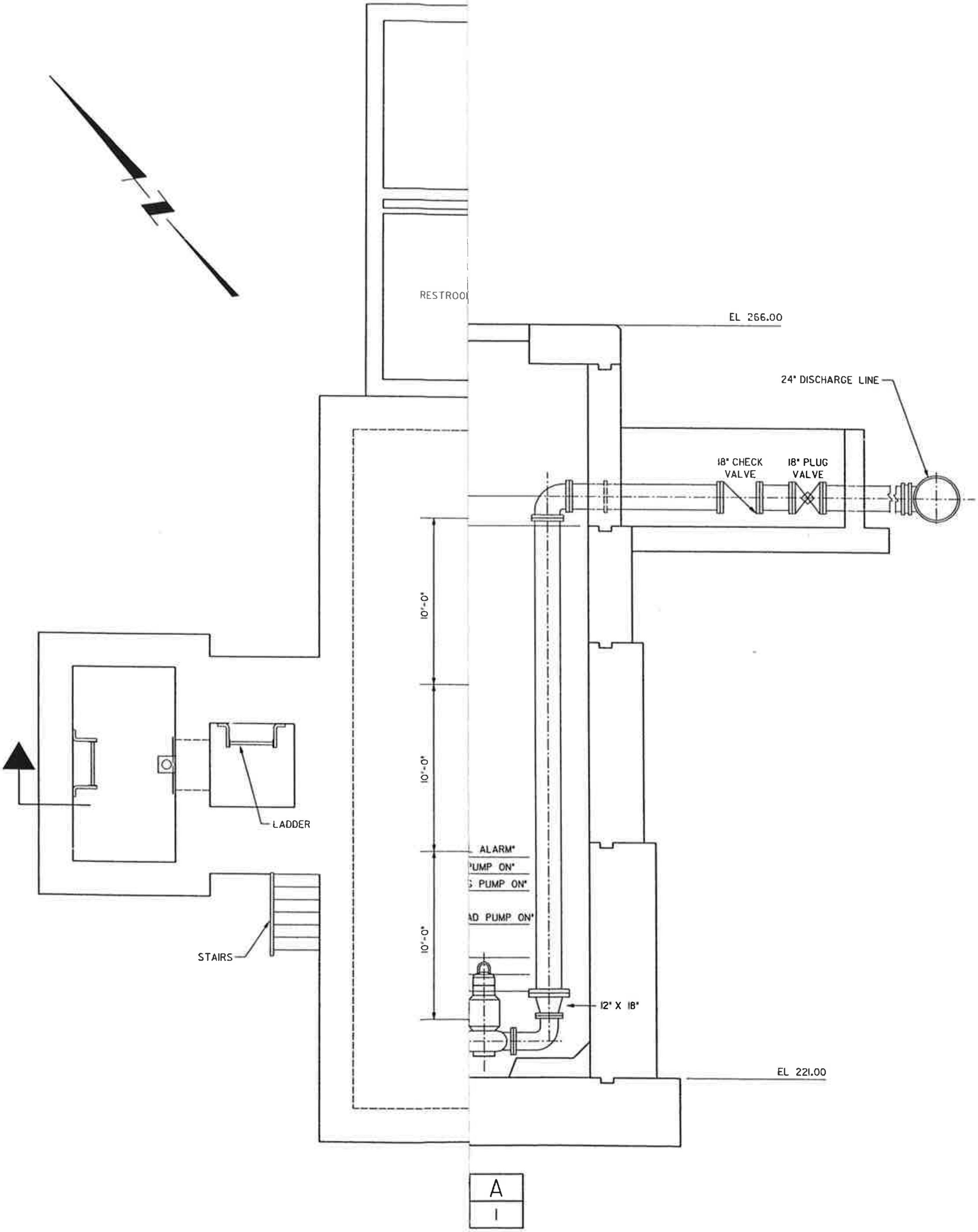
Stage 1 - 1 Small pump
Stage 2 - 2 Small pumps
Stage 3 - 1 Large pump

Note: Pumps of the same size with the least daily runtime are the next to be called

Station Information

Address: 8600 Pinnacle Valley Road
Telephone: 868-7338
Entergy Acct #: 328527
Power Service: 480 VAC 3 phase
Structure Type: Large lift station
Pump Brand: Davis
Pumps Type: Submersible
Small Pumps 1&2: 20 hp
Large Pumps 3 & 4: 150 hp

MONTGOMERY WATSON



S

LITTLE MAUMELLE
PUMP STATION

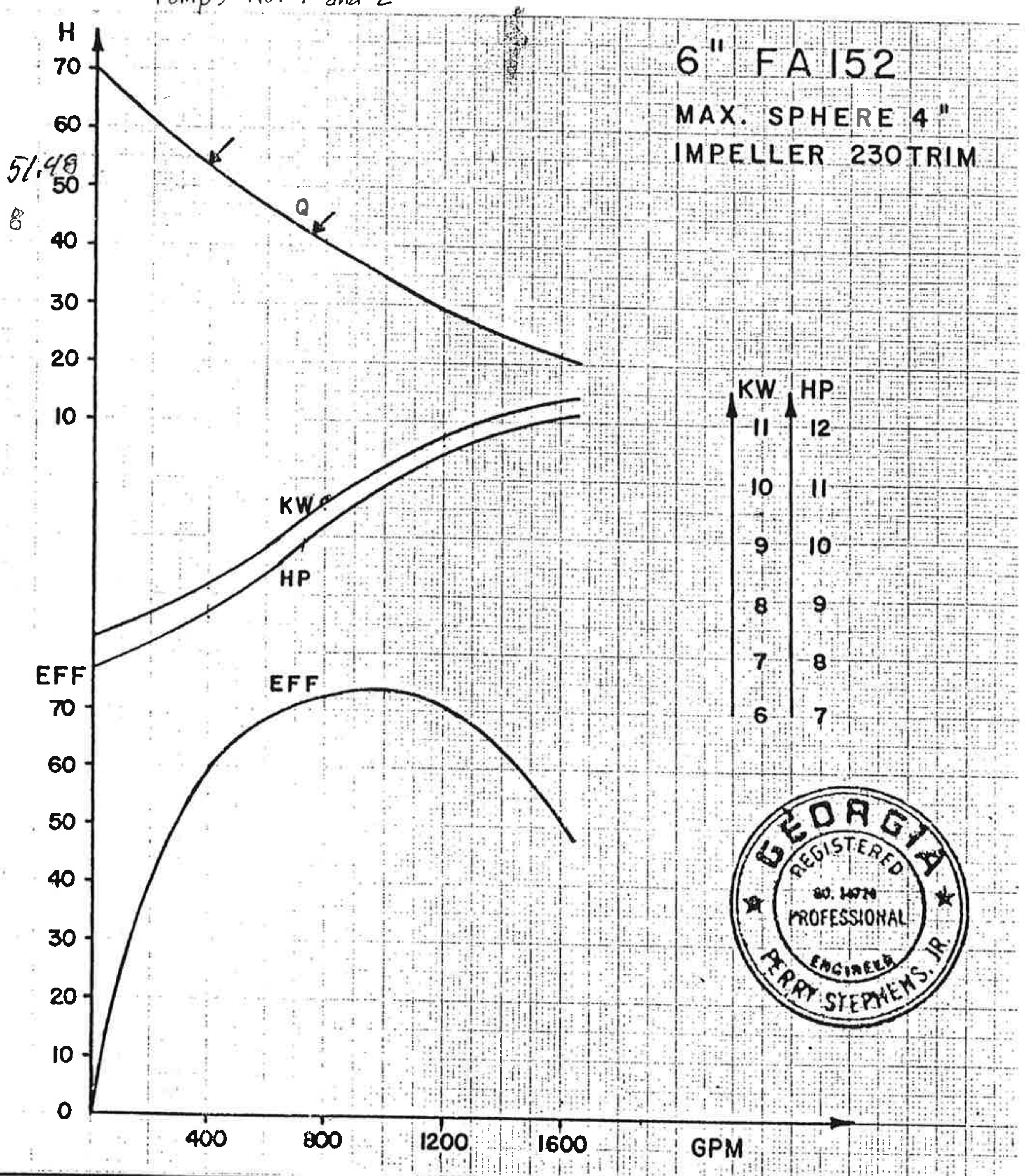
FIGURE
M-2

JOB No. *
No.
$$$$$$$$$directory/filename$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Plot Date: $$$$date$$$
$$time$$

MONTGOMERY WATSON

LITTLE MAUMELLE PUMP STATION

Pumps No. 1 and 2



PERRY STEPHENS, JR.

LEGEND

Q = Pump Capacity

H = Total Head in Feet

KW = Kilowatt Input of Motor

HP = Horsepower Required at Pump Shaft

EFF = Pump Efficiency

PERFORMANCE CURVES BASED ON CLEAR WATER AT AMBIENT TEMPERATURE

DAVIS EMU

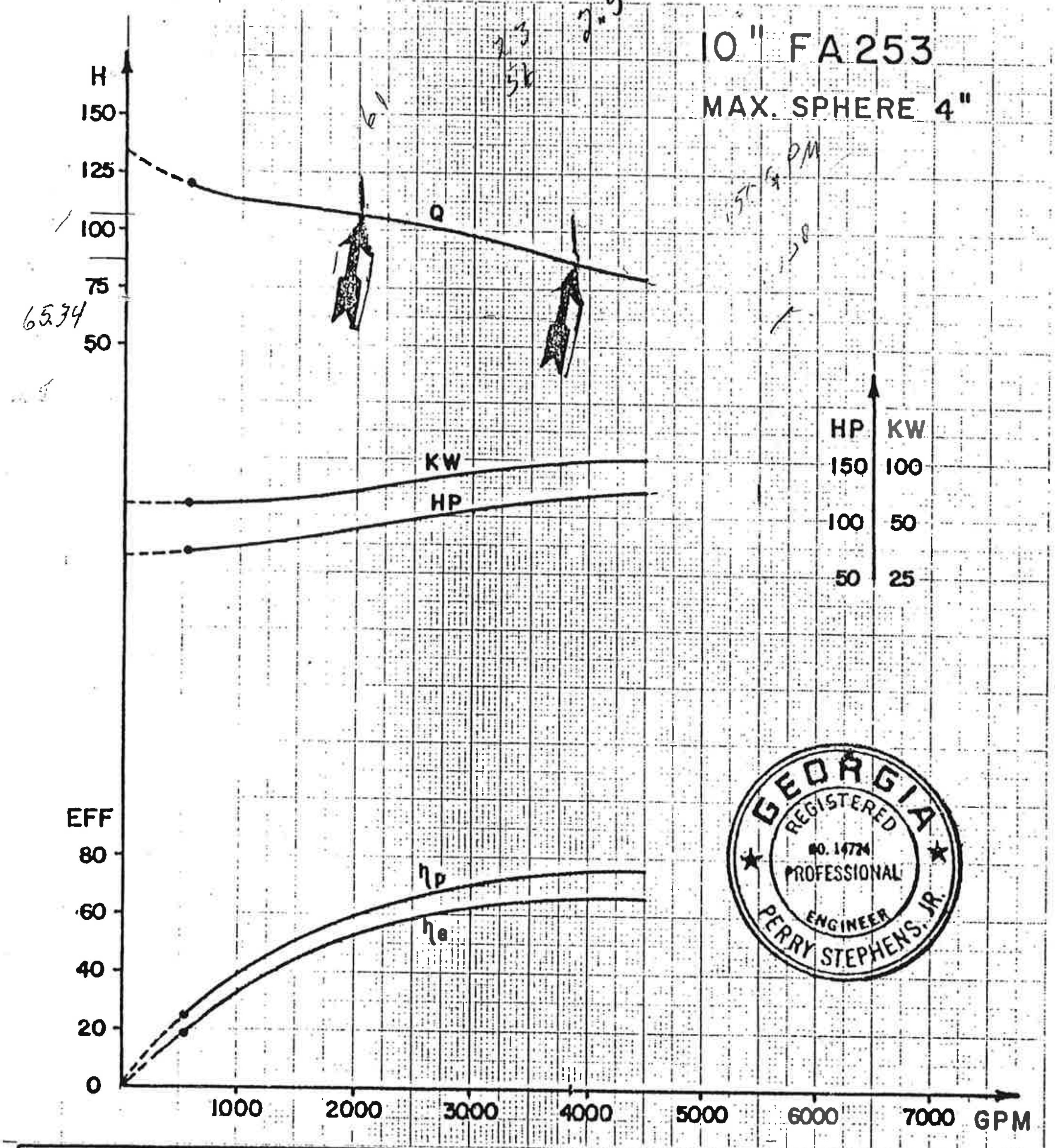
DAVIS WATER & WASTE INDUSTRIES, INC.

SUBMERSIBLE SEWAGE PUMPS

MOTOR FK202-4/22	VOLTAGE 230/460
RATED HP 20	RATED AMPS 56/28
FREQUENCY 60 Hz	R. P. M. 1720
SUBJECT TO REVISIONS	NO. 6D.17188

LITTLE MAUMELLE PUMP STATION

Pumps No. 3 and 4



NO. 14724
PERRY STEPHENS, JR.

LEGEND

Q = Pump Capacity

H = Total Head in Feet

KW = Kilowatt Input of Motor

HP = Horsepower Required at Pump Shaft

EFF = Pump Efficiency

PERFORMANCE CURVES BASED ON CLEAN WATER

DAVIS EMU

SUBMERSIBLE SEWAGE PUMPS

MOTOR FK34.1-6/60	VOLTAGE 230/460
RATED HP 150	RATED AMPS 380/190
FREQUENCY 60 Hz	R.P.M. 1140
SUBJECT TO REVISIONS	NO. SD 17660

MONTGOMERY WATSON

Little Rock Wastewater Utility Facility Plan
Pump Station Evaluation
Field Inspection Form

Date 9/10/2000

Pump Station: Maumelle

Address: Pinnacle Valley Road

Description:

Pump Physical Data

	Pump 1	Pump 2	Pump 3	Pump 4	Future Pump 5	Pump 6
Manufacturer	Davis EMU	Davis EMU	Davis EMU	Davis EMU		
Capacity	750 gpm	3,750 gpm	2,000 gpm	400 gpm		
Head TDH	42'	81'	105'	55'		
Horsepower	20	150	150	20	350	350
Type	FA152-230 trim Submer Sewage	FA253-440 z "	FA253-440 z "	FA152-230 trim "		
Installation Date	1985	1985	1985	1985		
* ON/OFF	227/226	230/226	232/226	228/226		
Speed	1750 rpm	1175 rpm	1175 rpm	1750 rpm		

Comments:
Submersible Pumps
SMALL Pumps turn off when large pumps turn on.

Wet Well

Height 40'
Length = 22'
width 40' 6"

Revised ON/OFF (1988)

244 - Alarm ON
241 - Enable ON
239 - Large Lead ON
238 - Small Pumps OFF
232 - Small Lag ON
231 - Small Lead ON
230 - All OFF

Condition Assessment

Pumps

Upstream Pipe
36" and Future 36" Pipe ~~[illegible] to 36" pipe entering wetwell~~

Downstream Pipe

Meter

Valves

Wet Well

Dry Well

I&C

Electrical

~~Other~~ Sewage Grinder Units

Other

Operation & Maintenance

Pumps

Upstream Pipe

Downstream Pipe

Meter

Valves

Wet Well

Dry Well

I&C

Electrical

Other

Other

Current Problems

Equipment

Other

Field Testing & Data

Existing Data

Photo List

1

2

3

4

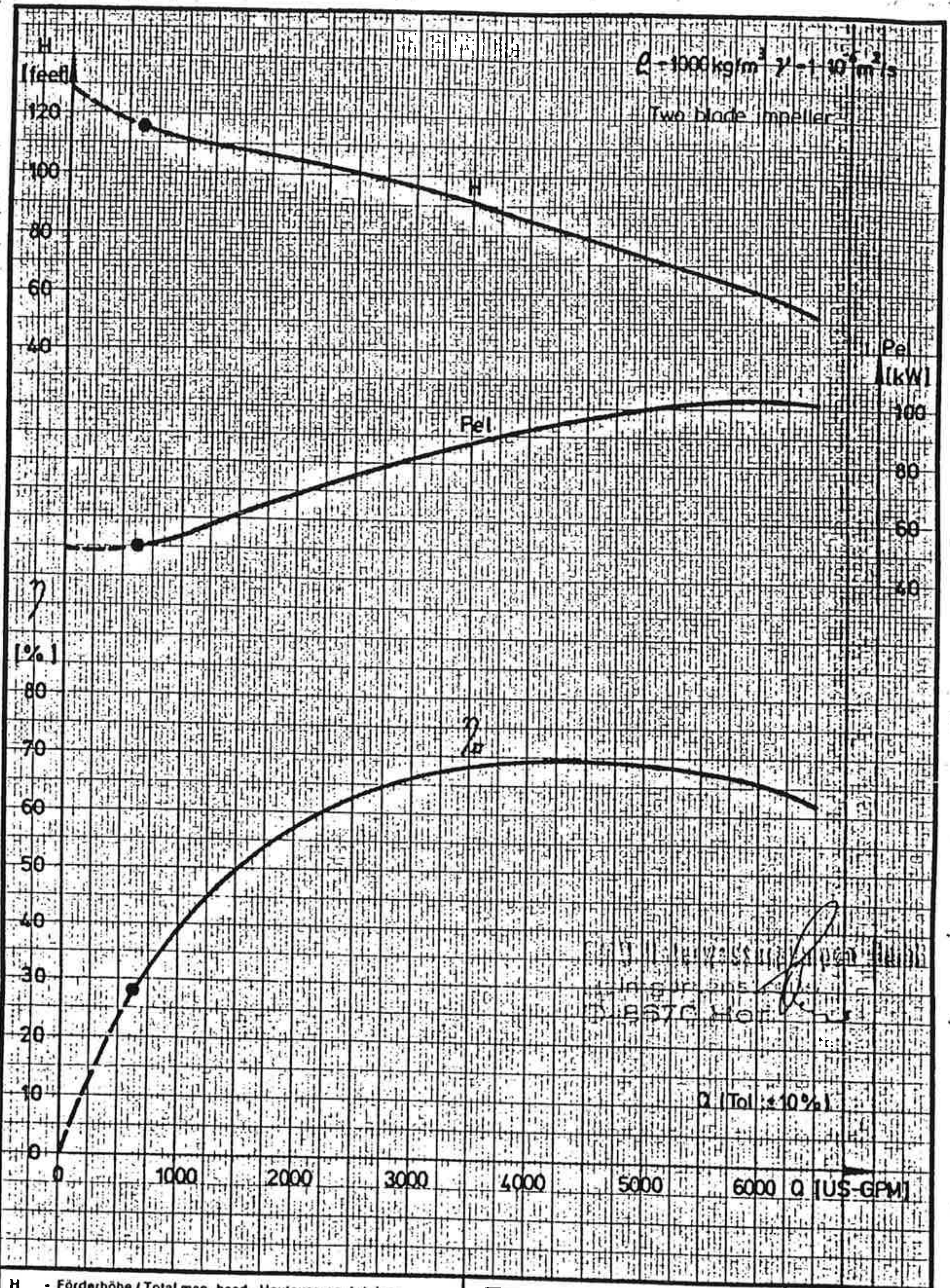
5

6

7

8

FA 253-440 Z



H - Förderhöhe / Total man. head - Hauteur man. totale- / Prevalenza manometrica totale

η_E - Gesamtwirkungsgrad, Pumpe und Motor / Overall efficiency pump and motor / Rendement total pompe et moteur / Rendimento totale pompa e motore

η_P - Pumpenwirkungsgrad / Pump efficiency / Rendement pompe Rendimento pompa

J - Stromaufnahme / Current consumption / Consommation de courant / Corrente assorbita

Q - Förderstrom / Capacity / Débit / Portata

Pel - kW-Aufnahme des Motors / kW input of motor / kW absorbés par le moteur kW assorbiti dal motore

P - Kraftbedarf an der Pumpenwelle / Power requirement at pump shaft / Puissance nécessaire à l'axe de pompe / Potenza necessaria all'asse pompa

garantierter Betriebspunkt nach DIN 1944 III

Motortype: FK 34.1-6/60

Spannung: 460 V

Nennleistung: 150 Hp 110 kW

Nennstrom: 190 A

Frequenz: 60~

Drehzahl:

A. Nr.:

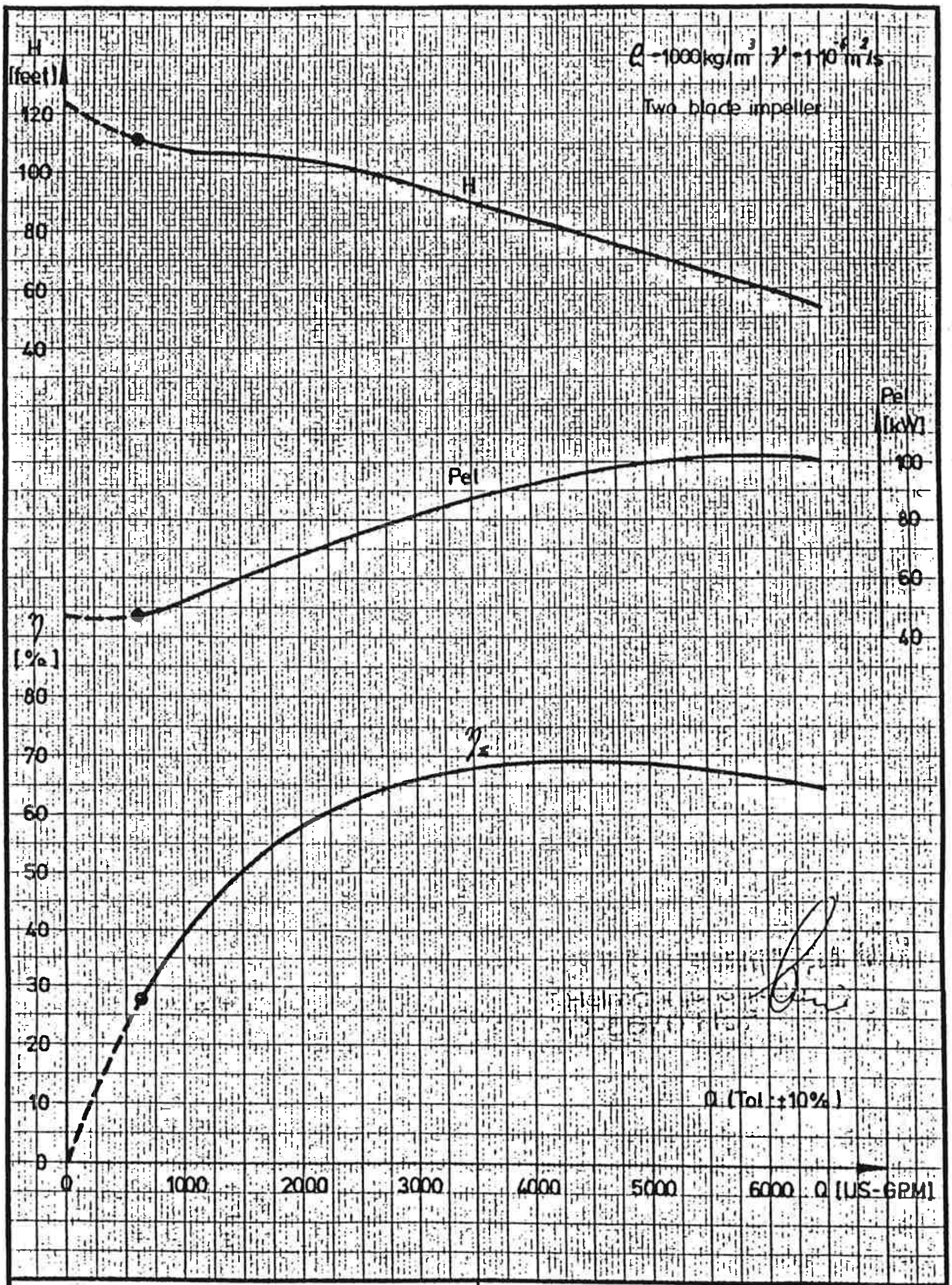
Bemerkung:

gez.: 18.7.86 W.ST.

gepr.:

Nr. (Masch. Nr.) 185 291

FA 253-440 Z



H	- Förderhöhe / Total man. head - Hauteur man. totale- / Prevalenza manometrica totale
η_Σ	- Gesamtwirkungsgrad, Pumpe und Motor / Overall efficiency pump and motor / Rendement total pompe et moteur / Rendimento totale pompa e motore
η_P	- Pumpenwirkungsgrad / Pump efficiency / Rendement pompe Rendimento pompa
J	- Stromaufnahme / Current consumption / Consommation de courant / Corrente assorbita
Q	- Förderstrom / Capacity / Débit / Portata
Pel	- kW-Aufnahme des Motors / kW input of motor / kW absorbés par le moteur kW assorbiti dal motore
P	- Kraftbedarf an der Pumpenwelle / Power requirement at pump shaft / Puissance nécessaire à l'axe de pompe / Potenza necessaria all'asse pompa

garantierter Betriebspunkt nach DIN 1944 III

Bemerkung:

Motortype: FK34.1-6/60

Spannung: 460 V

gez.: 18.7.86 W.ST.

Nennleistung: 150Hp110 kW

Nennstrom: 190 A

gepr.:

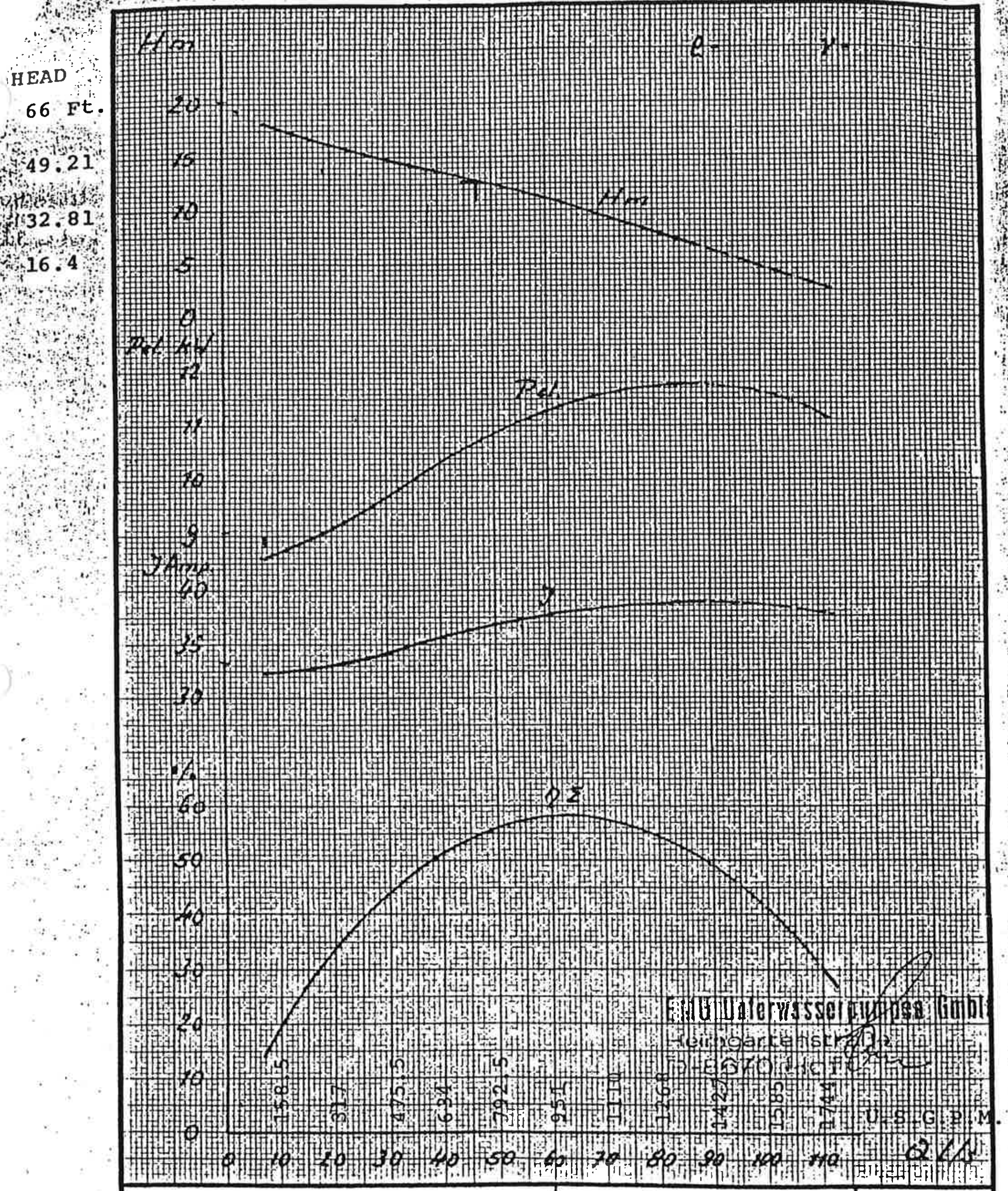
Frequenz: 60 ~

Nr. (Masch. Nr.) 185 292

Drehzahl: 11[illegible]0 U/min

A. Nr.:

FA 152 - 21



EMU Unterwasserpumpen GmbH
Heingartenstraße
D-8570 ...

H - Förderhöhe / Total man. head - Hauteur man. totale- / Prevalenza manometrica totale

η_E - Gesamtwirkungsgrad, Pumpe und Motor / Overall efficiency pump and motor / Rendement total pompe et moteur / Rendimento totale pompa e motore

η_P - Pumpenwirkungsgrad / Pump efficiency / Rendement pompe Rendimento pompa

J - Stromaufnahme / Current consumption / Consommation de courant / Corrente assorbita

Q - Förderstrom / Capacity / Débit / Portata

Pel - kW-Aufnahme des Motors / kW input of motor / kW absorbés par le moteur kW assorbiti dal motore

P - Kraftbedarf an der Pumpenwelle / Power requirement at pump shaft / Puissance nécessaire à l'axe de pompe /

garantierter Betriebspunkt nach DIN 1944 III

Bemerkung:

Motortype: FK202-4/22

Spannung: 230/460 V

gez.: 18.7.86

Nennleistung: 20HP 14.7 kW

Nennstrom: 56 A

gepr.:

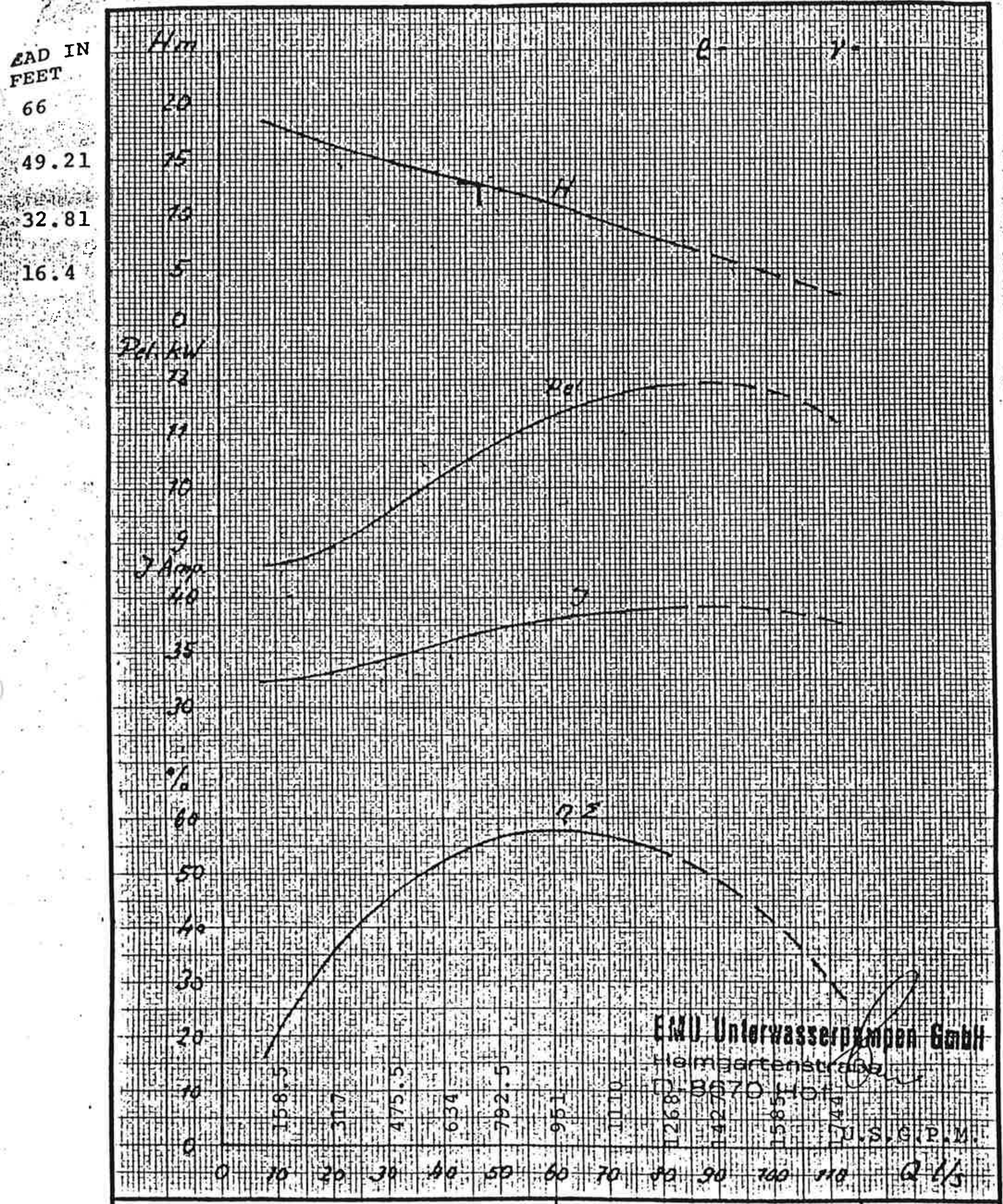
Frequenz: 60 Hz

Nr. (Masch. Nr.) 185293.

Drehzahl:

A. Nr.:

FA 152- 2



EMU Unterwasserpumpen GmbH
Heimgartenstraße
D-8670 Hof

H - Förderhöhe / Total man. head - Hauteur man. totale- / Prevalenza manometrica totale

ηε - Gesamtwirkungsgrad, Pumpe und Motor / Overall efficiency pump and motor / Rendement total pompe et moteur / Rendimento totale pompa e motore

ηP - Pumpenwirkungsgrad / Pump efficiency / Rendement pompe Rendimento pompa

J - Stromaufnahme / Current consumption / Consommation de courant / Corrente assorbita

Q - Förderstrom / Capacity / Débit / Portata

Pel - kW-Aufnahme des Motors / kW input of motor / kW absorbés par le moteur kW assorbiti dal motore

P - Kraftbedarf an der Pumpenwelle / Power requirement at pump shaft / Puissance nécessaire à l'axe de pompe / Potenza necessaria all'asse pompa

garantierter Betriebspunkt nach DIN 1944 III

Bemerkung:

Motortype: FK202 - 4/22

Spannung: 230/460 V

gez.: N.7.86 Gl

Nennleistung: 20 HP 14,7 kW

Nennstrom: 56 / A

gepr.:

Frequenz: 60 Hz

Nr. (Masch. Nr.) 185 294

Drehzahl:

A. Nr.:

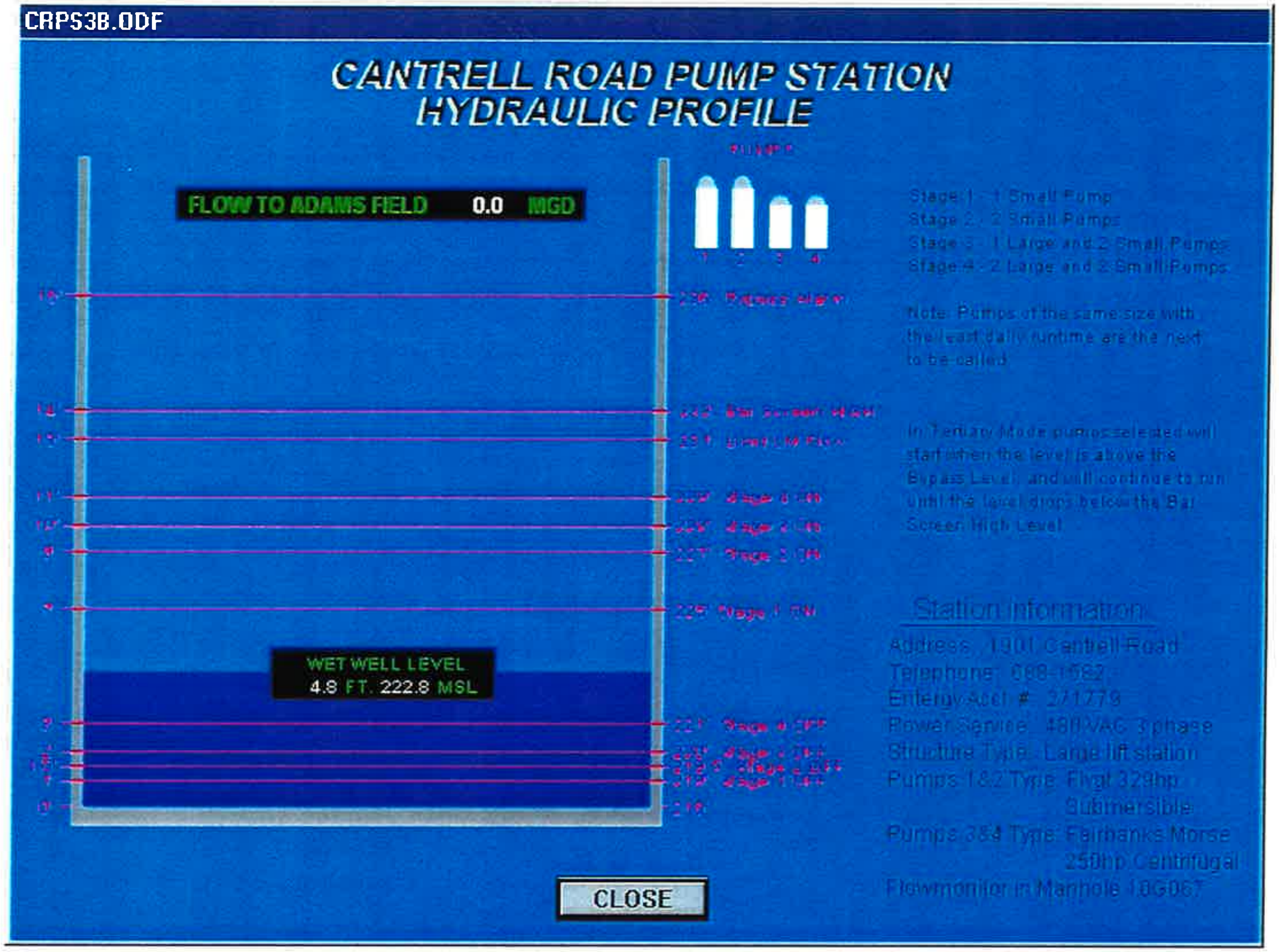
SYSTEM CURVE DATA FOR LITTLE MAUMELLE PUMP STATION

Force Main (gpm)	TDH AT W. Well Elev. 230	TDH AT W. Well Elev. 242
200	24.6	12.6
400	24.9	12.9
800	25.8	13.8
1,200	27.4	15.4
1,600	29.4	17.4
2,000	32.0	20.0
2,400	35.0	23.0
2,800	38.5	26.5
3,000	40.4	28.4
4,000	51.7	39.7
5,000	65.8	53.8
6,000	82.5	70.5
8,000	123.8	111.8

NOTE: DYNAMIC HEAD LOSS OF FITTINGS INCLUDED; ACTUAL DUCTILE IRON PIPE DIAMETERS USED FOR CALCULATIONS; HAZEN-WILLIAMS COEFFICIENT = 130

Appendix C

MONTGOMERY WATSON



CANTRELL ROAD PUMP STATION HYDRAULIC PROFILE

FLOW TO ADAMS FIELD 0.0 MGD

WET WELL LEVEL
4.8 FT. 222.8 MSL

Stage 1 - 1 Small Pump
Stage 2 - 2 Small Pumps
Stage 3 - 1 Large and 2 Small Pumps
Stage 4 - 2 Large and 2 Small Pumps

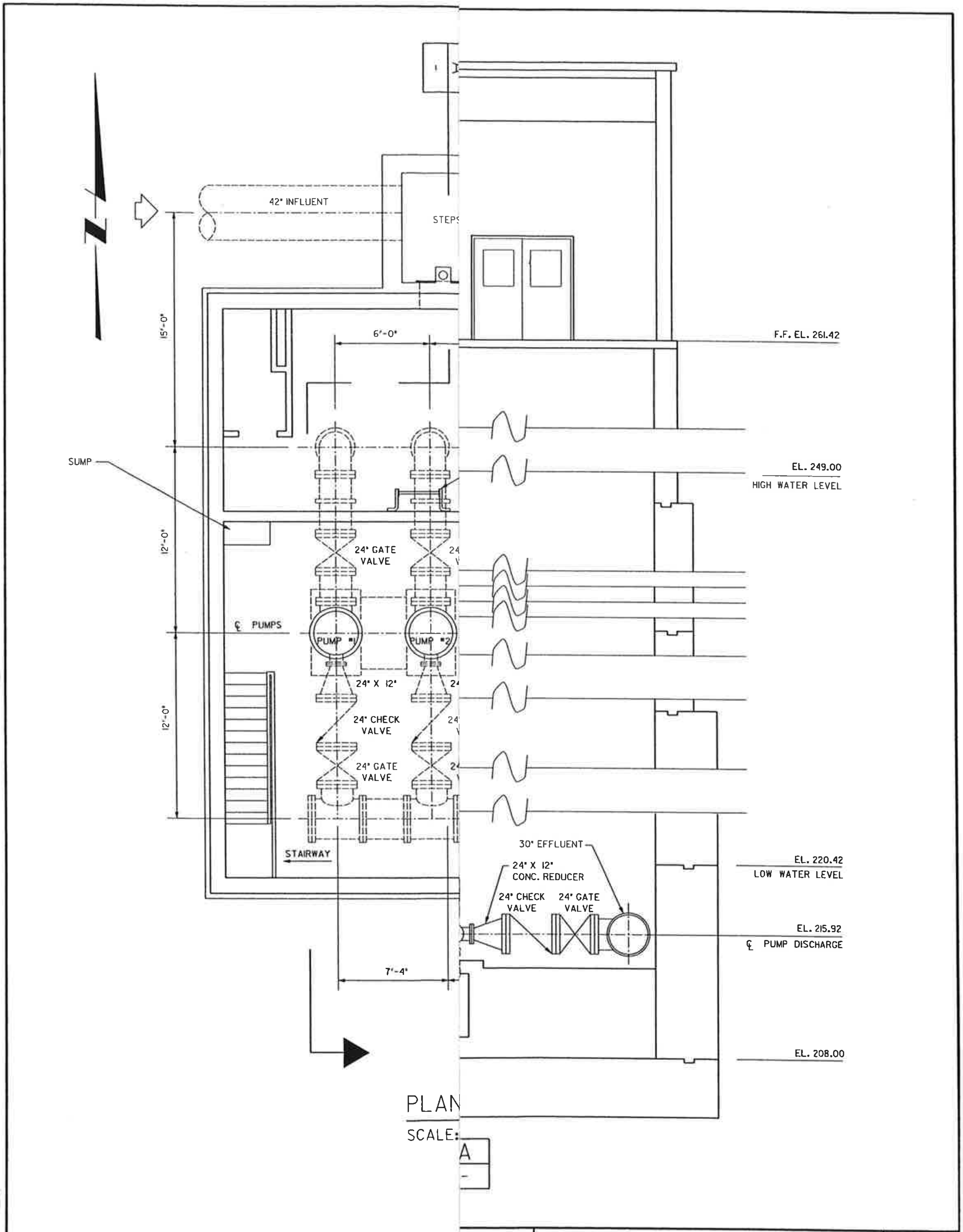
Note: Pumps of the same size with the least daily runtime are the next to be called.

In Tertiary Mode pumps selected will start when the level is above the Bypass Level, and will continue to run until the level drops below the Bar Screen High Level.

Station Information

Address: 1901 Cantrell Road
Telephone: 688-1682
Entergy Acct. #: 271779
Power Service: 480VAC 3 phase
Structure Type: Large lift station
Pumps 1&2 Type: Flygt 329hp
Submersible
Pumps 3&4 Type: Fairbanks Morse
250hp Centrifugal
Flowmonitor in Manhole 18G067

MONTGOMERY WATSON



SAS

CANTRELL ROAD
PUMP STATION
PLAN & SECTION A

FIGURE

M-1

JOB No. • No. $$$$$$$$directory/filename$$$$$$$$$$$$$$$$$$$$$$$$$$$ Plot Date: $$$$date$ $$time$$

AS

CANTRELL ROAD
PUMP STATION
SECTION B

FIGURE

M-1A

MONTGOMERY WATSON

FLYGT

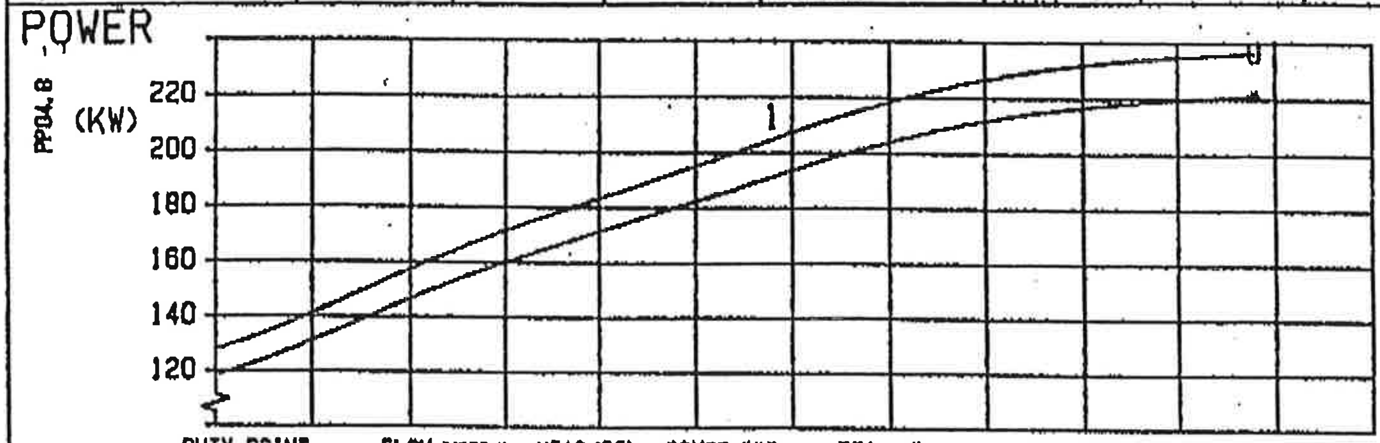
PERFORMANCE CURVE

CANTRELL PUMP STATION
Pumps Nos. 1 and 2

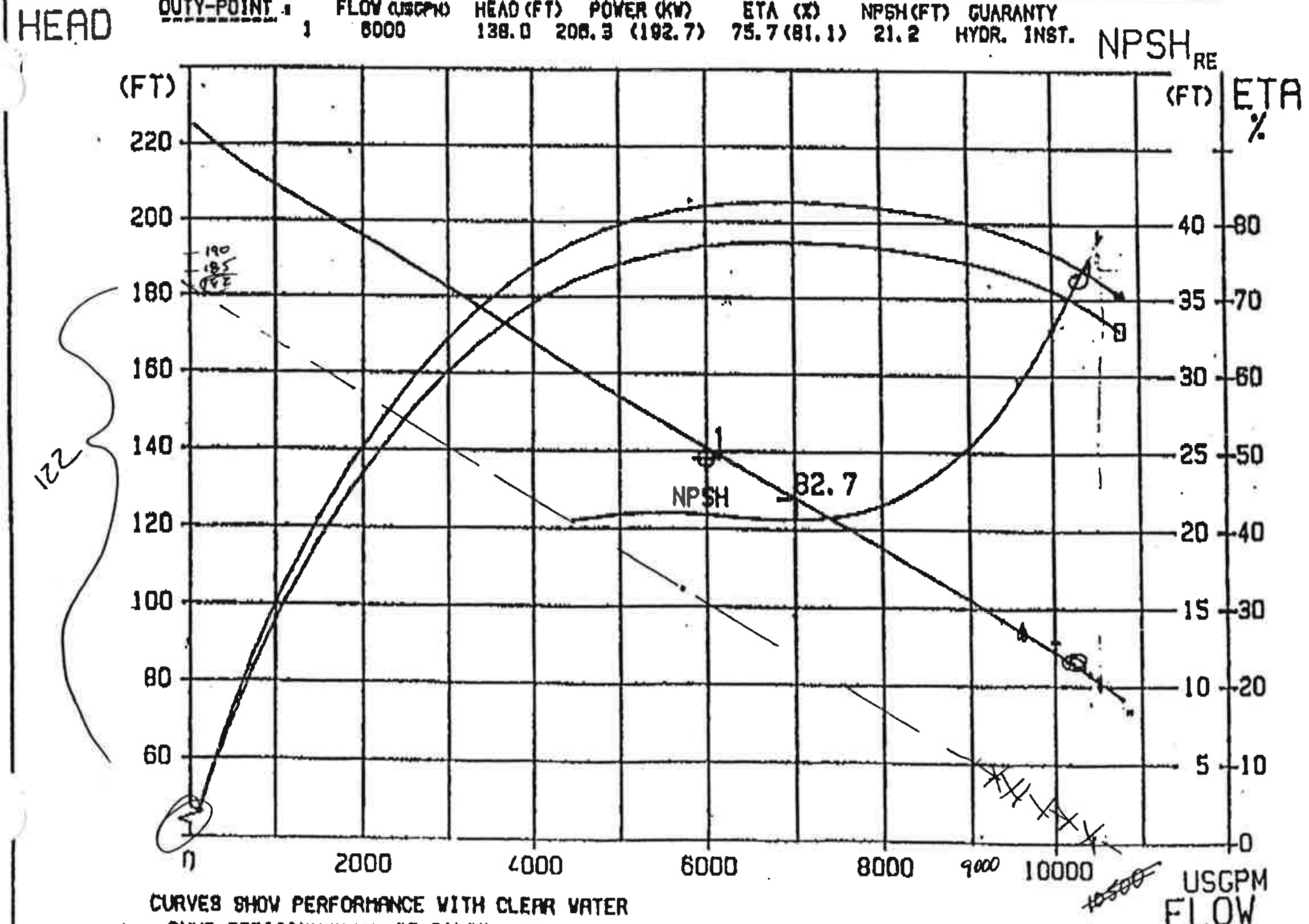
DATE 1986-08-05	PROJECT CANTRELL ROAD PUMP STATION	ISSUE 1	PROD 3311

NO. OF BLADES....... 3
IMPELLER THROUGHLET... 103*103 CIRC.
TOT.MOM.OF INERTIA...... 7.88 KGM*
RATED SPEED........ 1185 RPM
POLES 6 FREQ 60 HZ
VOLTAGE...... 460 V
MOTOR SHAFT POWER........ 245 KW
STARTING TORQUE....... 2615 NM
MAX TORQUE....... 5690 NM
RATED CURRENT..... 385 A
STARTING CURRENT...... 2595 A
CURVE NO 63-632
IMPELLER DIAMETER 515 MM
MOTORTYPE 51-56-6 /38
GEARTYPE RATIO

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS FI	0.88	0.82	0.74
MOTOR EFFICIENCY	93.0%	93.5%	92.5%
GEAR EFFICIENCY			



DUTY-POINT	FLOW (USGPM)	HEAD (FT)	POWER (KW)	ETA (%)	NPSH (FT)	GUARANTY
1	6000	138.0	208.3 (192.7)	75.7 (81.1)	21.2	HYDR. INST.



CURVES SHOW PERFORMANCE WITH CLEAR WATER
* : PUMP EFFICIENCY/SHAFT POWER
O : OVERALL EFFICIENCY/INPUT POWER

S = ~~0.01783333~~ = 0.013556
Given Flow Head = ~~[illegible]~~ 182 − Flow * Slope

airbanks Morse
Pump Corporation

SUBMITTAL CURVE

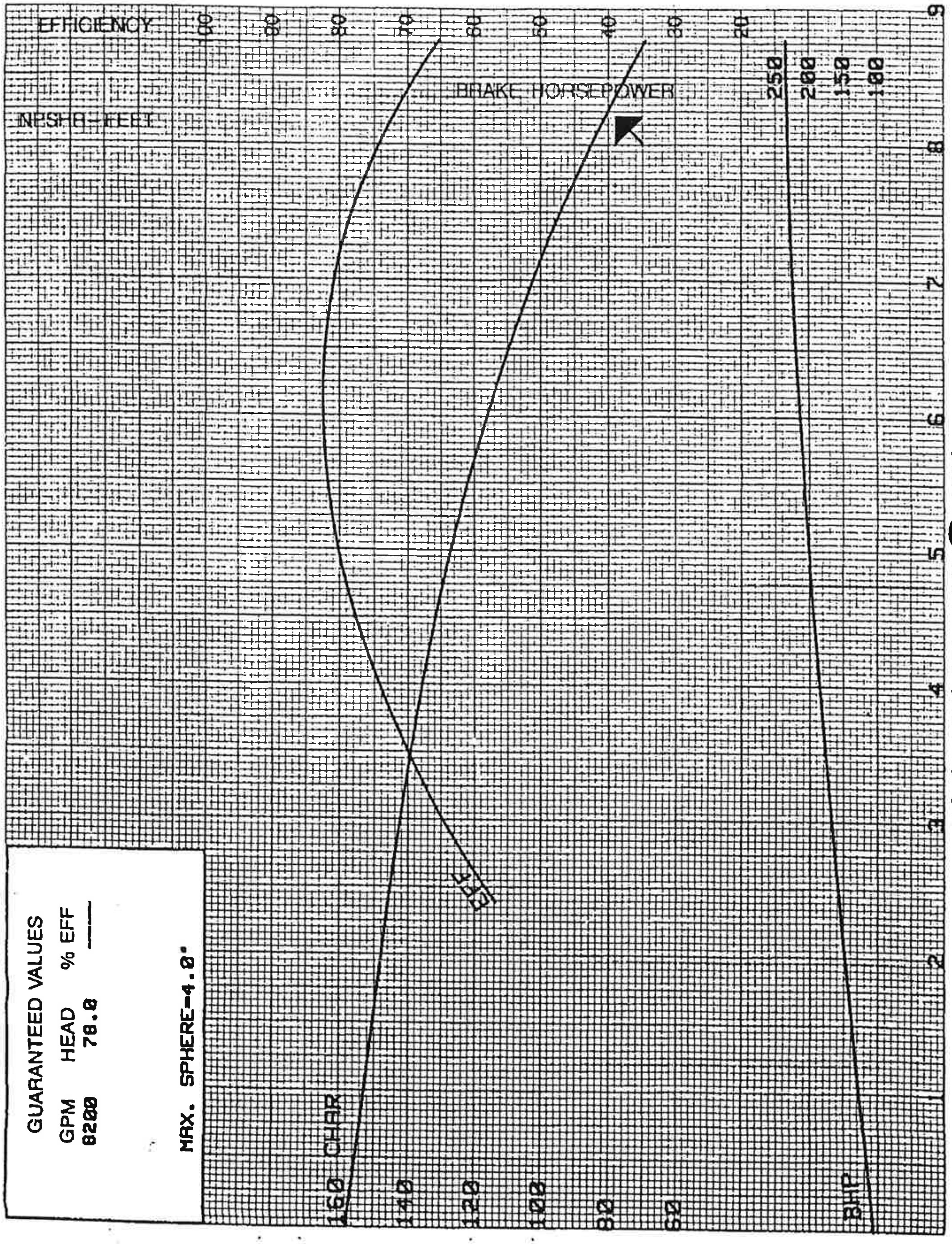
HIS CURVE IS BASED ON ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED.

NO. STAGES ONE
REFERENCE OWNTEST
PLOTTED BY JCM
DATE 4/6/92

SIZE - MODEL 14-5713
IMPELLER DES. L14D1M
IMPELLER DIA. 24.38"
RPM(S) 880

CANTRELL PUMP STATION
Pumps Nos. 3 and 4

PUMP PERFORMANCE CURVE



GUARANTEED VALUES		
GPM	HEAD	% EFF
8200	78.0	——

MAX. SPHERE-4.0"

CURVE NO. K2M1-043177
CKPC-20270

Little Rock Wastewater Utility Facility Plan
Pump Station Evaluation
Field Inspection Form

Date 9/10/2000

Pump Station: Cantrell

Address: Cantrell Road

Description:
36" and 39" incoming pipes, wet well, dry well, 4 pumps in dry well

Pump Physical Data

Sump
Peco Type SL
No 1½ TO 7

	Large Pump 1	Large Pump 2	Small Pump 3	Small Pump 4
Manufacturer				[illegible]
Capacity			8[illegible] gpm 78	8[illegible] 78 gpm
Head				
Horsepower	328	328 [illegible] [illegible]	[illegible] 250	250
Type				
Installation Date	1967	1967	1967	1986
On/off	225/219	229/ 220	227/218.5	230/ 220.5
Speed			880	880

Comments:

Wet Well (2)
Depth ≈ [illegible] 53'5"
width ~~15' 10½"~~ [illegible] 15' 10"
length ≈ ~~10 feet~~ 9'10"
invert = 208

Dry Well
Depth ≈ [illegible] 52
Width 34
Length 22

Condition Assessment

Pumps

Upstream Pipe
36" Extra Standard Clay, 39" Renforced Concrete

Downstream Pipe
30" CIP, Discharge Elevation 246

Meter ~~Station~~
Venturi

Valves

Wet Well

Dry Well

I&C

Electrical

~~Other~~ Meter Vault
$\overset{L}{20} \times \overset{W}{10} \times \overset{H}{17}$

Other

Operation & Maintenance

Pumps

Upstream Pipe

Downstream Pipe

Meter

Valves

Wet Well

Dry Well

I&C

Electrical

Other

Other

Current Problems

Equipment

Other

Field Testing & Data

Existing Data

Photo List

1 ____________________

2 ____________________

3 ____________________

4 ____________________

5 ____________________

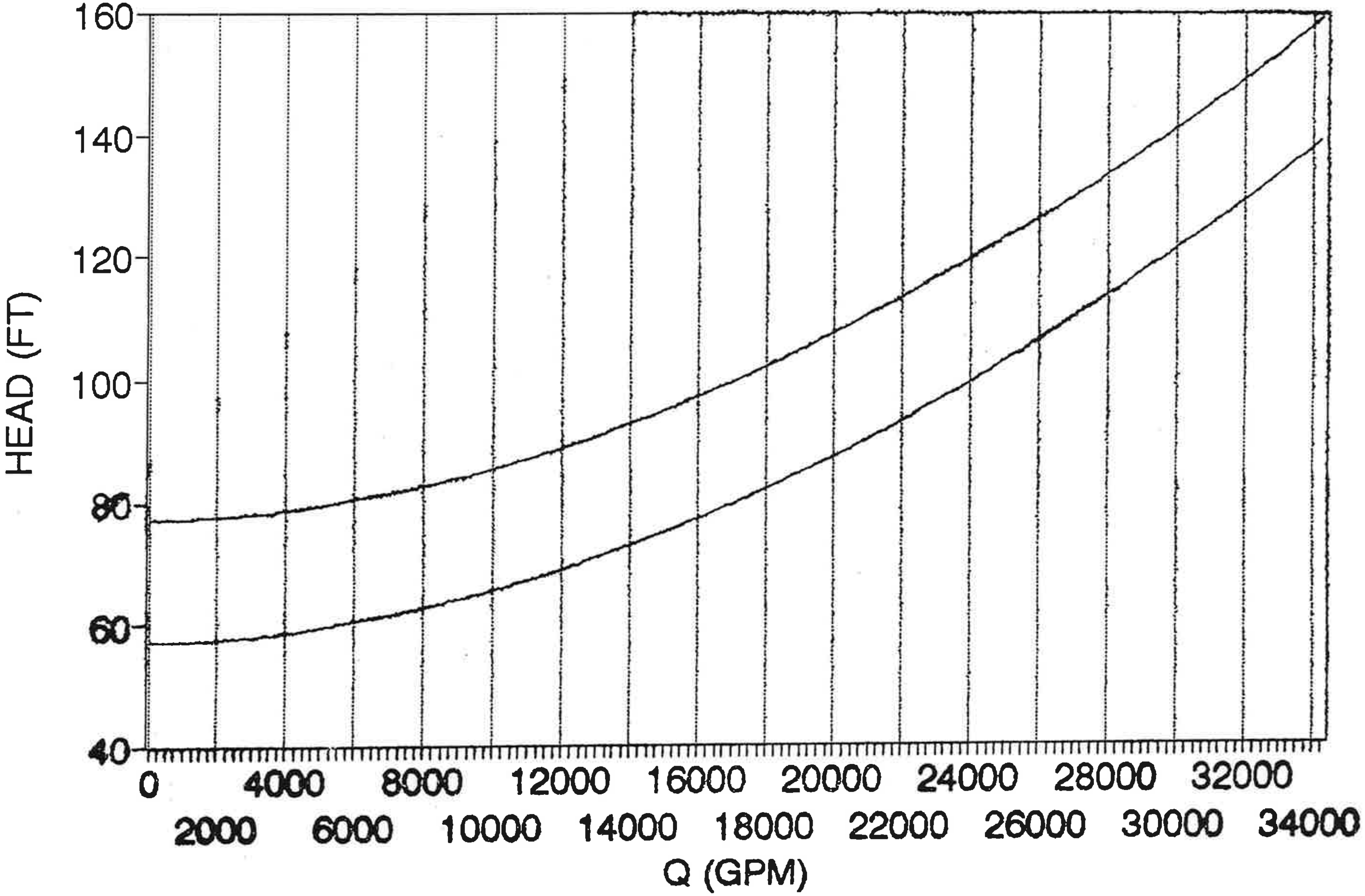
6 ____________________

7 ____________________

8 ____________________

CANTRELL ROAD PUMP STATION

SYSTEM CURVE



Pump Corporation

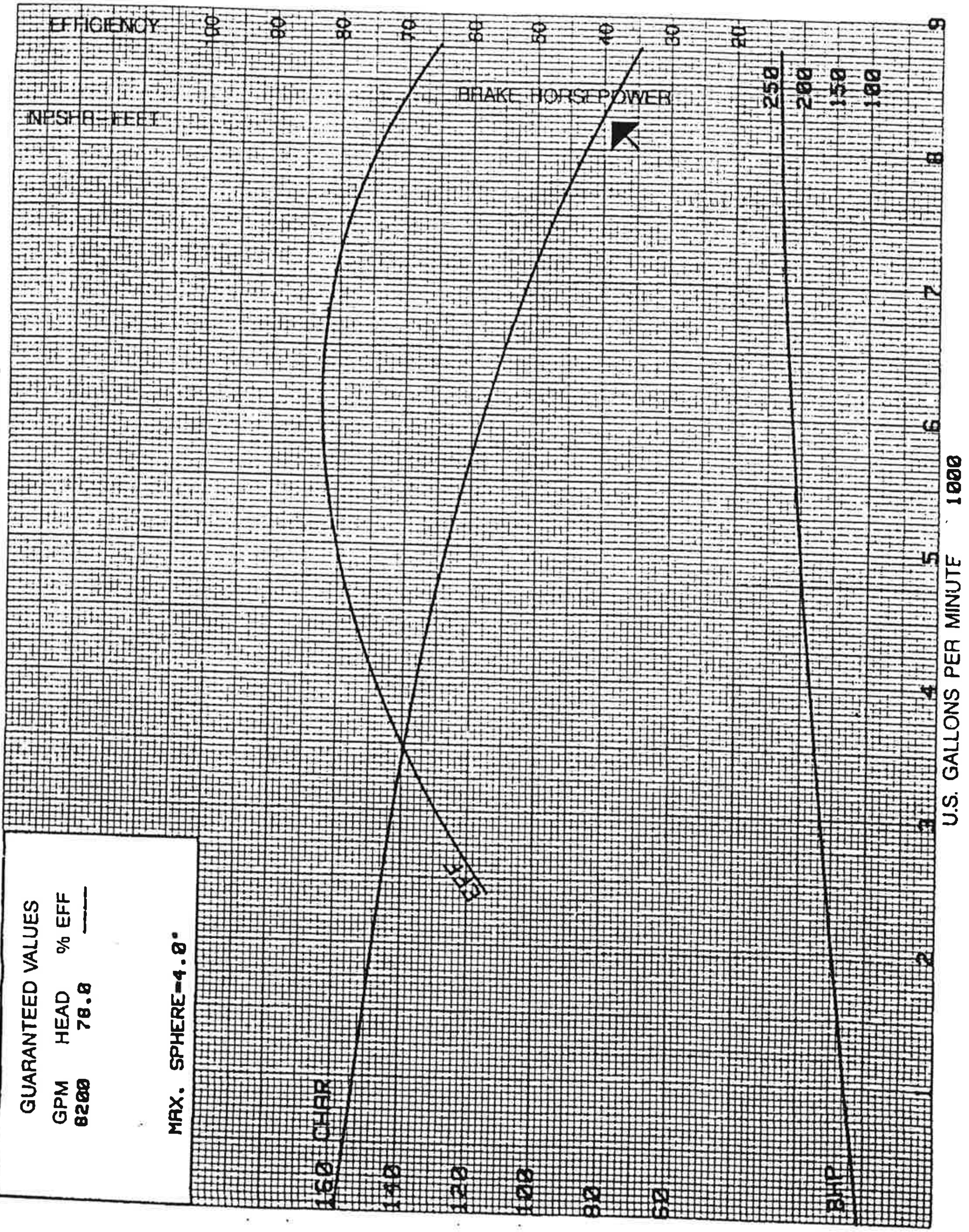
SUBMITTAL CURVE

HIS CURVE IS BASED ON ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED.

NO. STAGES ONE
REFERENCE OWNTEST
PLOTTED BY JCM
DATE 4/6/92

SIZE-MODEL 14-5713
IMPELLER DES. L14D1M
IMPELLER DIA. 24.38"
RPM(S) 880

PUMP PERFOR NCE CURVE



GUARANTEED VALUES

GPM	HEAD	% EFF
8200	78.8	___

MAX. SPHERE=4.0"

CURVE N

K2M1-043177
CKPC-20270

Pump Corporation

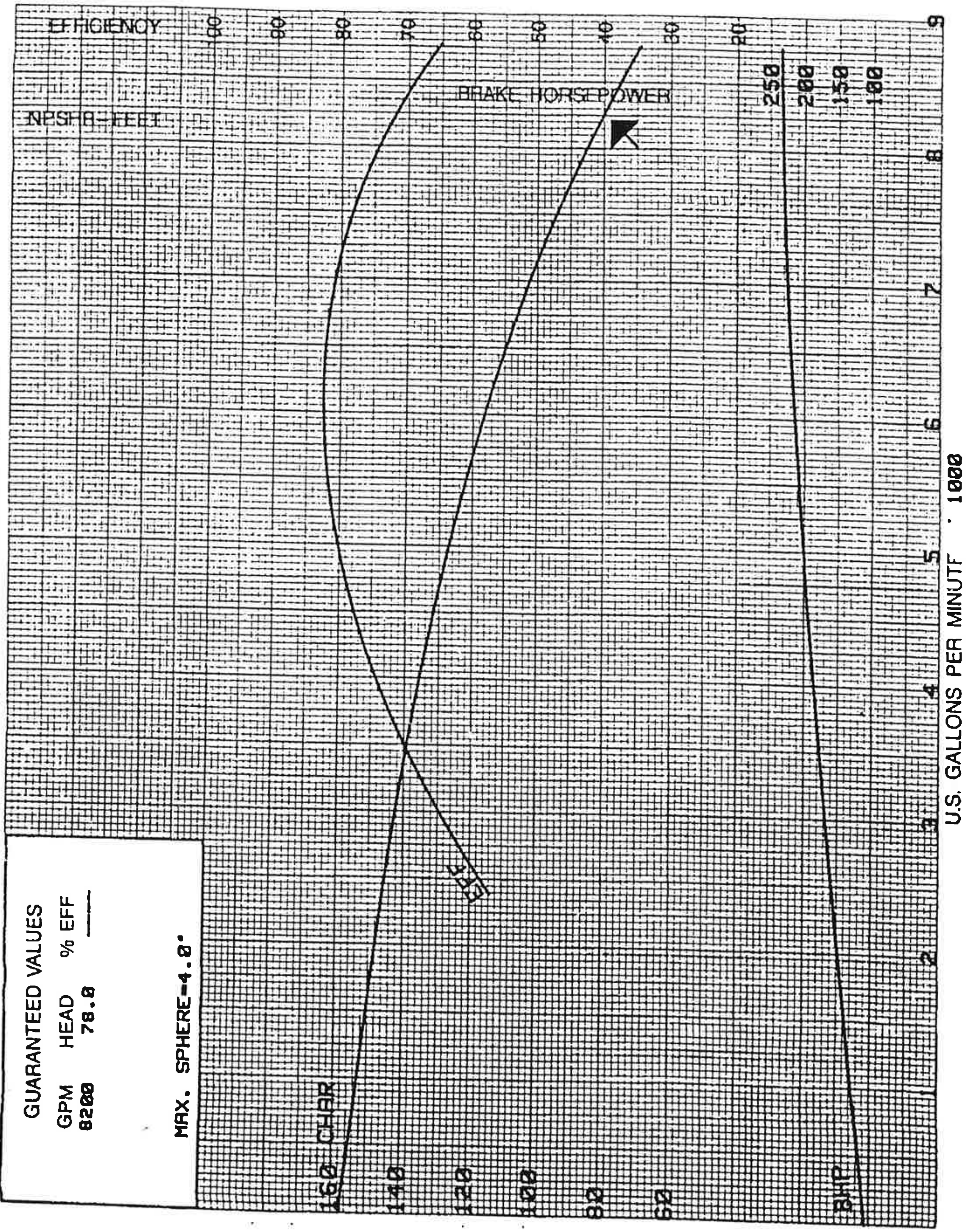
SUBMITTAL CURVE

HIS CURVE IS BASED ON ACTUAL
TEST PERFORMANCE OF A SIMILAR
PUMP. ONLY THE INDICATED
POINT(S) IS GUARANTEED.

NO. STAGES ONE
REFERENCE OWNTEST
PLOTTED BY JCM
DATE 4/6/92

SIZE-MODEL 14-5713
IMPELLER DES. L14D1M
IMPELLER DIA. 24.38"
RPM(S) 880

PUMP PERFORMANCE CURVE



CURVE K2M1-043177
CKPC-20270

GUARANTEED VALUES

GPM HEAD % EFF
8200 78.0 ———

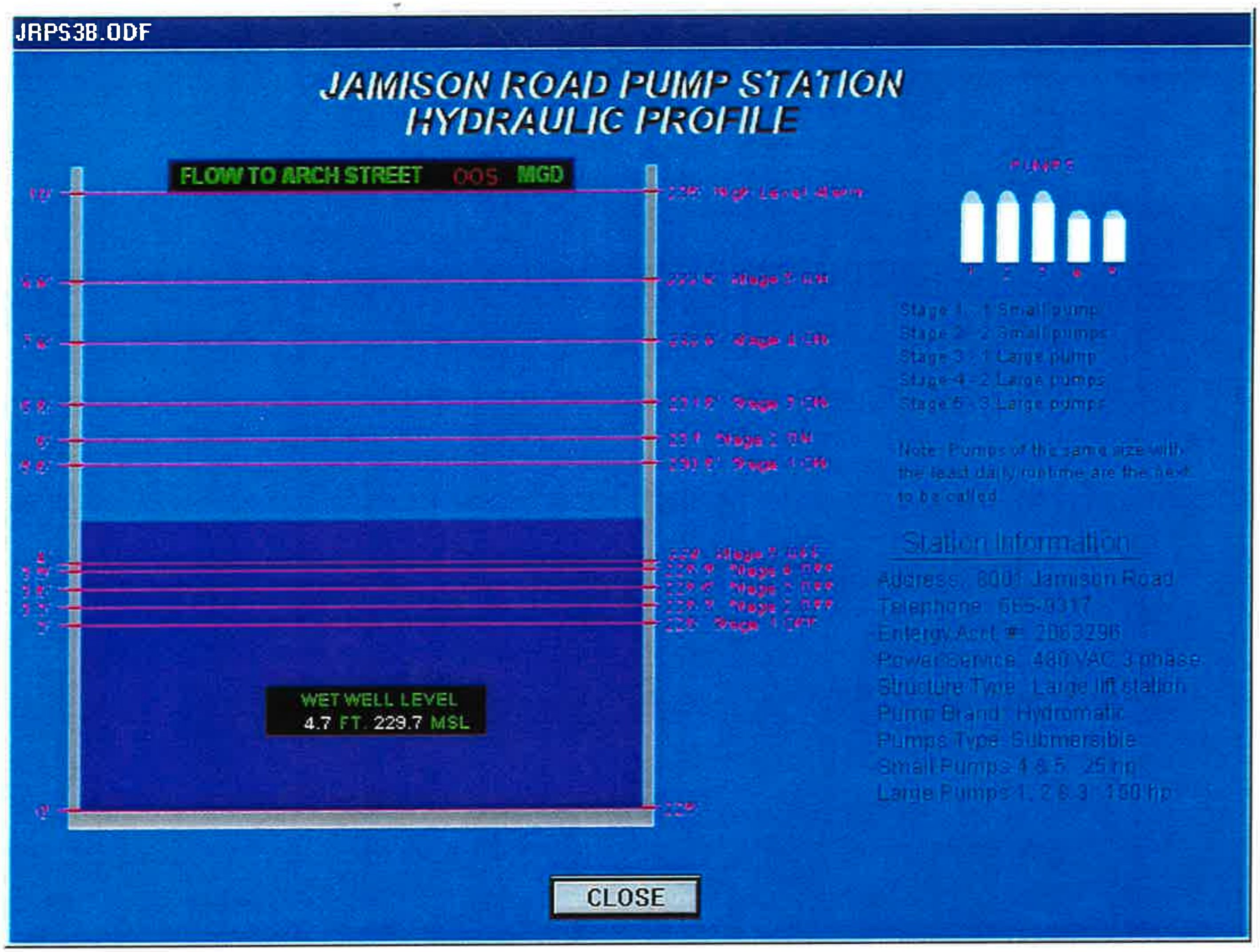
MAX. SPHERE=4.0"

```
                                                                  05-07-199
                                                                  15:18:02




            Pump Data for Cantrell Road P/S at Little Rock Ark.

====================================================================================
                                            PUMP # 1      PUMP # 2      PUMP # 3
                                            --------      --------      --------
    Pump Shut-off Head (FT) ---------        226.0         166.0         195.0
  ----------------------------------------------------------------------------------
    25% of Flow
        A) Pump Head (FT) ------------       189.0         155.0         183.0
        B) Pump Flow (GPM) -----------        2500          2350          4700
  ----------------------------------------------------------------------------------
    50% of Flow
        A) Pump Head (FT) ------------       154.0         140.0         165.0
        B) Pump Flow (GPM) -----------        5000          4700          9400
  ----------------------------------------------------------------------------------
    75% of Flow
        A) Pump Head (FT) ------------       122.0         117.0         138.0
        B) Pump Flow (GPM) -----------        7500          7050         14100
  ----------------------------------------------------------------------------------
    100% of Flow
        A) Pump Head (FT) ------------        88.0          85.0         100.0
        B) Pump Flow (GPM) -----------       10000          9400         18800
  ----------------------------------------------------------------------------------
    Motor rated hp ------------------          328           250           500
    Motor % Efficiency --------------           93            93            93
    VFD rated hp --------------------          328           250           500
    VFD % Efficiency ----------------           96            96            96
====================================================================================
```



JAMISON ROAD PUMP STATION
HYDRAULIC PROFILE

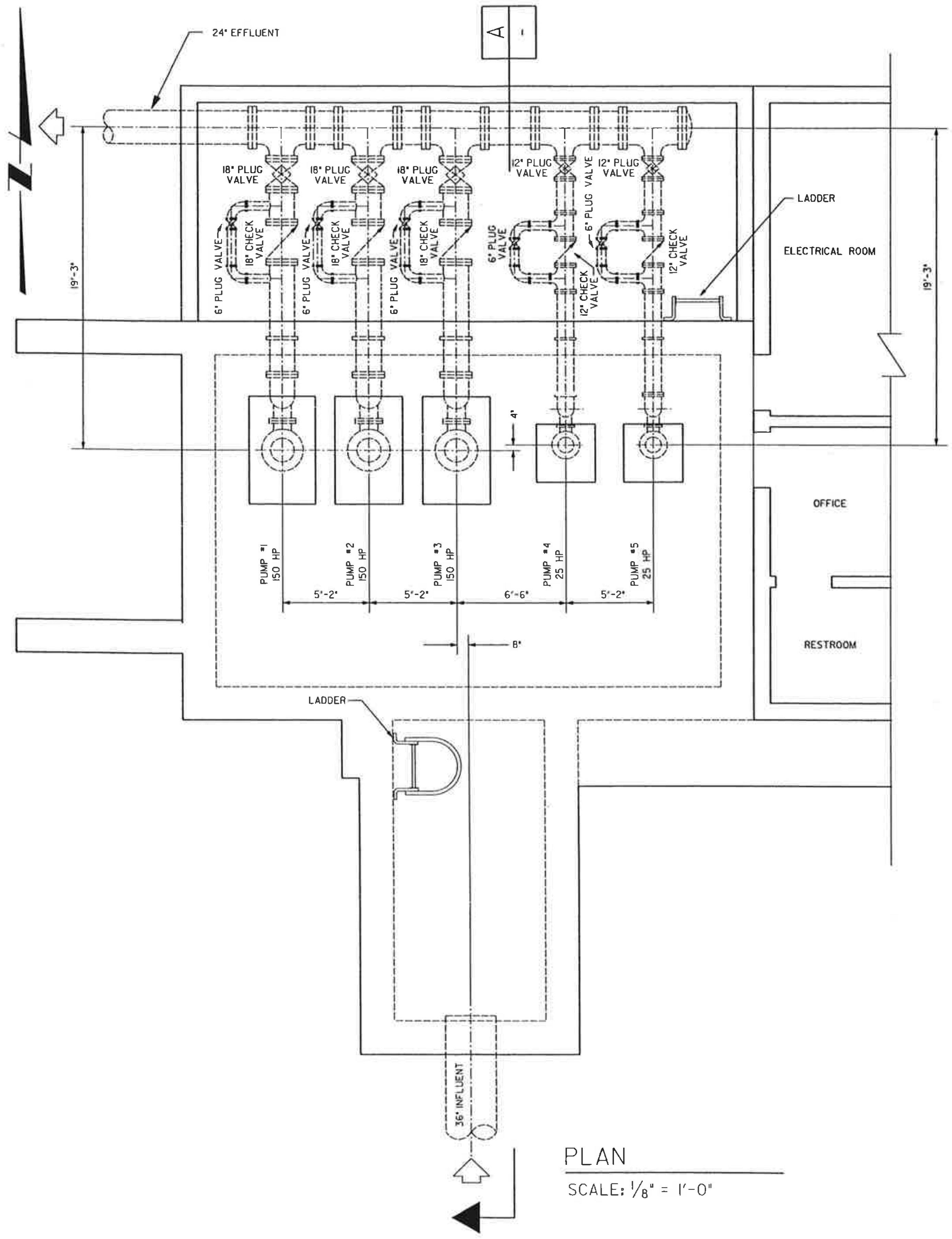
WET WELL LEVEL
4.7 FT. 229.7 MSL

Stage 1 - 1 Small pump
Stage 2 - 2 Small pumps
Stage 3 - 1 Large pump
Stage 4 - 2 Large pumps
Stage 5 - 3 Large pumps

Note: Pumps of the same size with the least daily runtime are the next to be called.

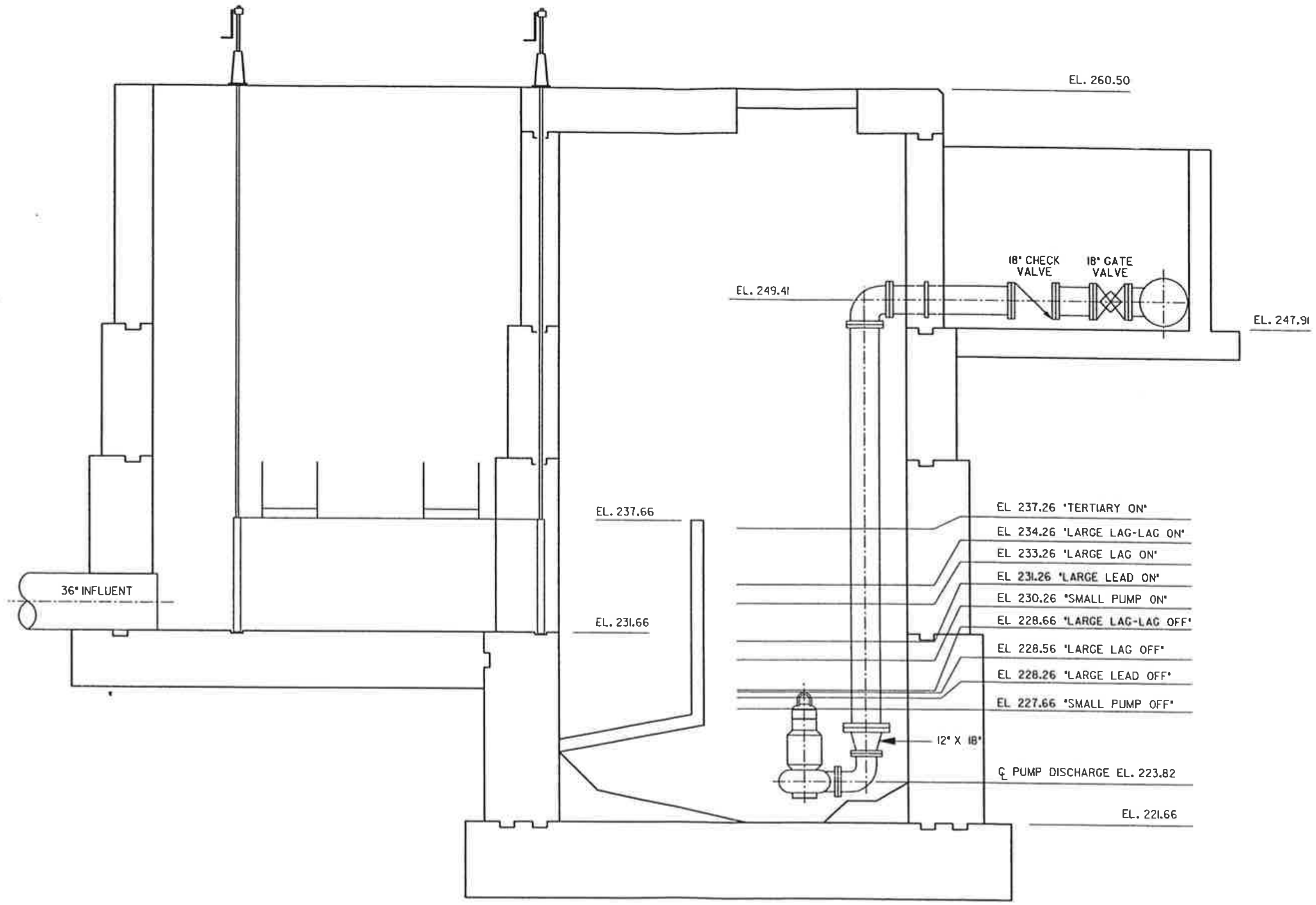
Station Information

Address: 8001 Jamison Road
Telephone: 665-9317
Entergy Acct #: 2063296
Power Service: 480 VAC 3 phase
Structure Type: Large lift station
Pump Brand: Hydromatic
Pumps Type: Submersible
Small Pumps 4 & 5: 25 hp
Large Pumps 1, 2 & 3: 150 hp



PLAN

SCALE: 1/8" = 1'-0"



SECTION A -

SCALE: 1/8" = 1'-0"

SCALE				FIGURE
1/8" = 1'-0"	**MONTGOMERY WATSON** Dallas, Texas	CITY OF LITTLE ROCK, ARKANSAS PUMP STATION PLAN & SECTION	JAMISON ROAD PUMP STATION	M-3

JOB No. • ____ : No. $$$$$$$$$$directory/filename$$$$$$$$$$$$$$$$$$$$$$$$$$$ Plot Date: $$$$date$$ $$time$$

MONTGOMERY WATSON

5.8

12 | 70
60
100
96
4

Little Rock Wastewater Utility Facility Plan
Pump Station Evaluation
Field Inspection Form

Date__________

Pump Station: Jamson

Address: ____________________

Description: 5 Submersible

Pump Physical Data

Small ~~T~~ ?

	Small Pump 1	Large Lead Pump 2	Large Lag Pump 3	Large Lag Lag Pump 4	Small Pump5
Manufacturer	Hydromatic	Hidro	Hidro	Hidromatic	Hydromatic
Capacity					
Head					
Horsepower	25	150	150	750	25
Type	Hydromatic 58L	Hydromatic 512L	Hydromatic 512L	Hydromatic 512L	Hydromatic 58L
Installation Date	1993	1993	1993	1993	1993
On/off	235.26 / 227.66	231.26 / 228.26	233.26 / 228.56	237.26 / 228.66	~~[illegible]~~
Speed (rpm)	870	1750	1750	1750	870

Comments: ____________________

Wet Well -

Height ≈ 40 feet

length = 30 feet

Width = 20 feet

Condition Assessment

Pumps

Upstream Pipe

Downstream Pipe

Meter

Valves

2 12" Plug Valves 2 12" Check Valves

3 18" Plug Valves 3 18" Check Valves

Wet Well

Dry Well

I&C

Electrical

Other Grinders

Other

Operation & Maintenance

Pumps

Upstream Pipe

Downstream Pipe

Meter

Valves

Wet Well

Dry Well

I&C

Electrical

Other

Other

Current Problems

Equipment

Other

Field Testing & Data

Existing Data

Photo List

1

2

3

4

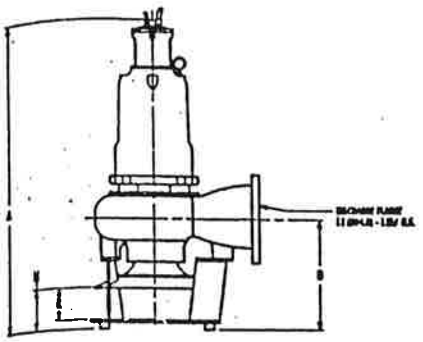
5

6

7

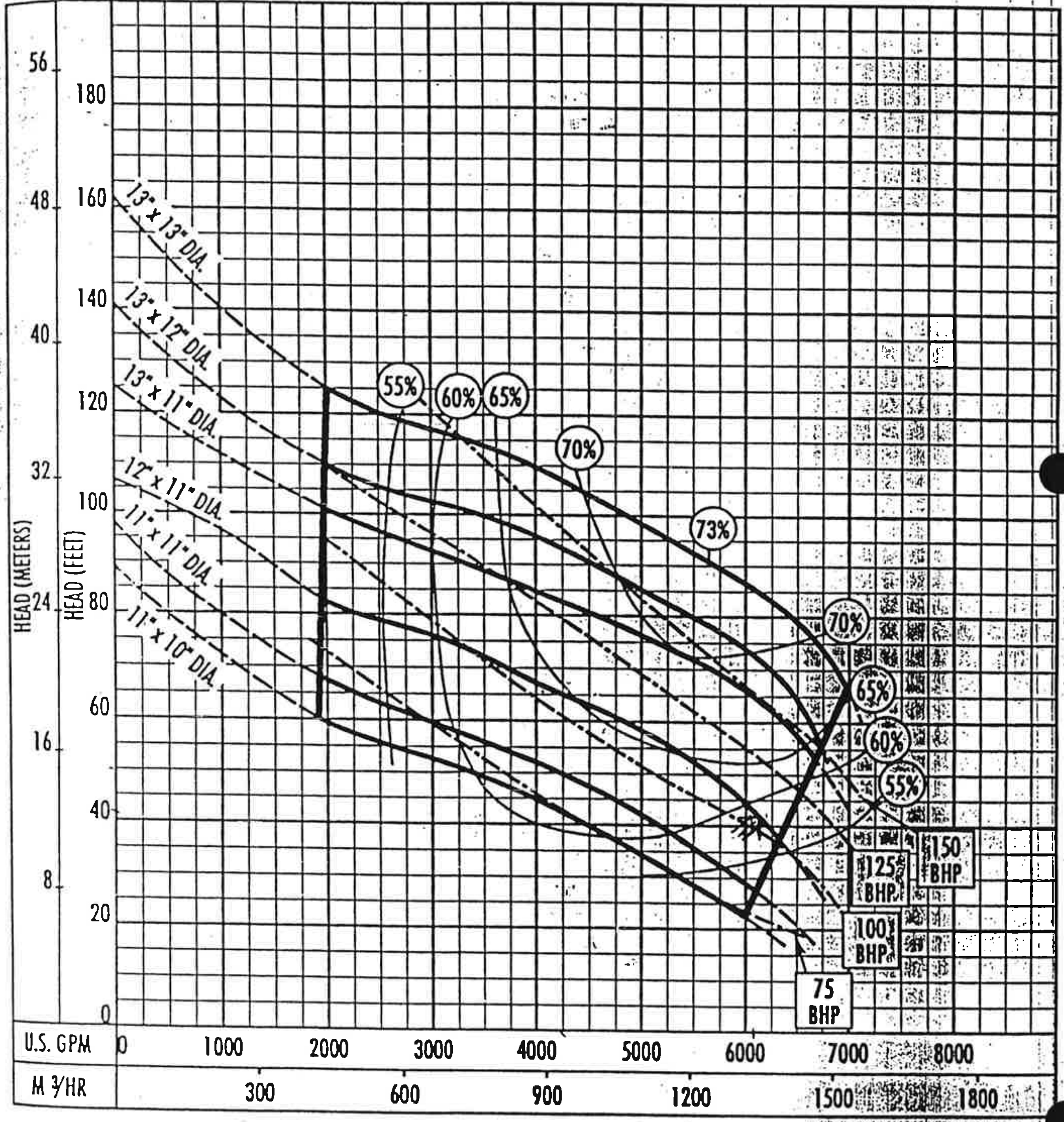
8

PRELIMINARY
Dated **APRIL 1993**



Performance Curve S12L/S12LX

RPM: **1750** Discharge: **12"** Solids: **6"**



The curves reflect maximum performance characteristics without exceeding full load (Nameplate) horsepower. All pumps have a service factor of 1.2. Operation is recommended in the bounded area with operational point within the curve limit. Performance curves are based on actual tests with clear water at 70° F. and 1280 feet site elevation.

AURORA PUMP

HYDROMATIC™ PUMPS

PAGE ____ OF ____

PUMP MODEL S8L ________ RPM 870

HORSEPOWER 25 __ IMPELLER DIAMETER 15"

DISCHARGE SIZE 8 ____ SOLID SIZE 4 ____

DESIGN OPERATING CONDITIONS OF:

________ GPM at ________ FEET TDH

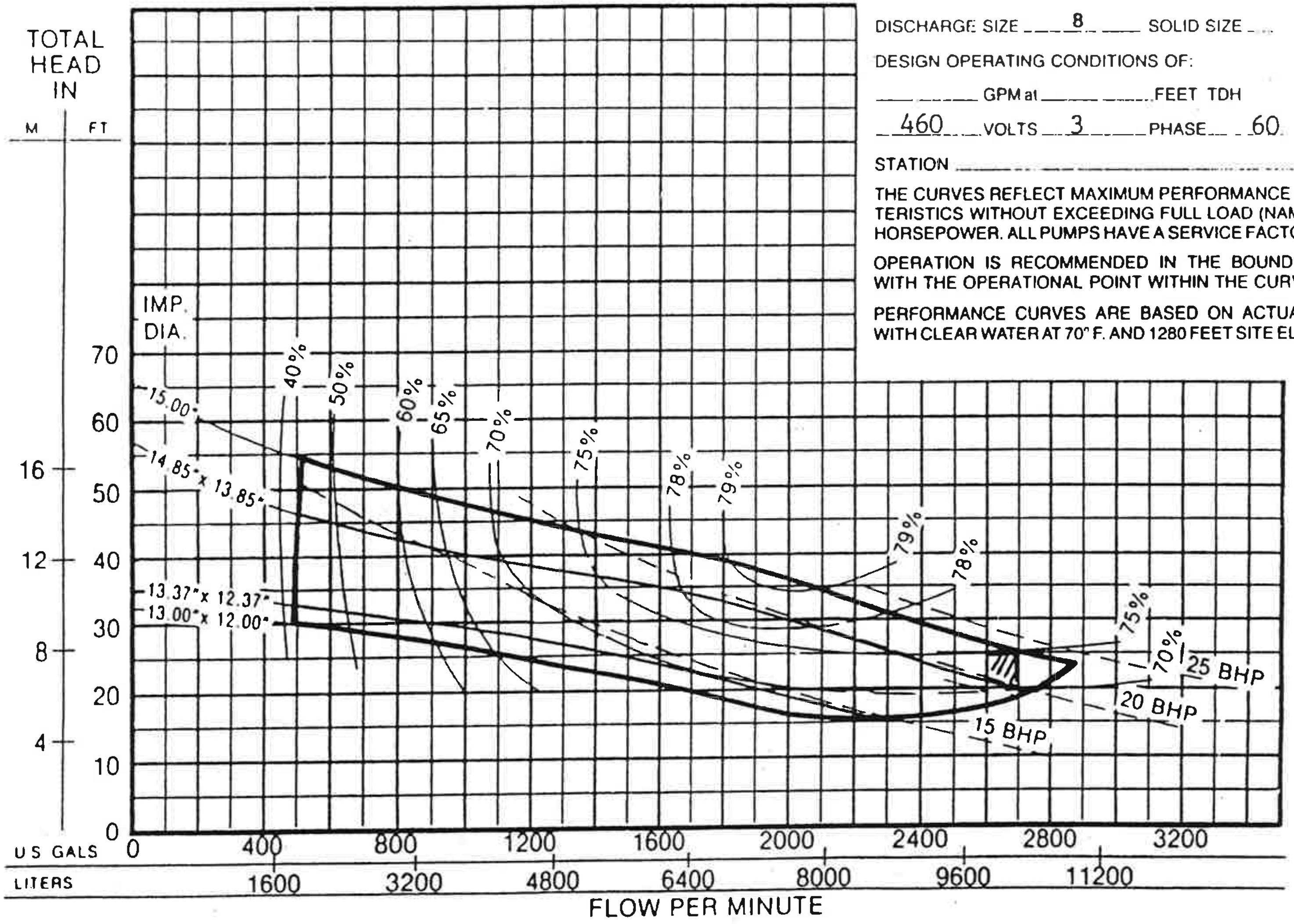
460 VOLTS 3 PHASE 60 HERTZ

STATION ________________

THE CURVES REFLECT MAXIMUM PERFORMANCE CHARACTERISTICS WITHOUT EXCEEDING FULL LOAD (NAMEPLATE) HORSEPOWER. ALL PUMPS HAVE A SERVICE FACTOR OF 1.2.

OPERATION IS RECOMMENDED IN THE BOUNDED AREA WITH THE OPERATIONAL POINT WITHIN THE CURVE LIMIT.

PERFORMANCE CURVES ARE BASED ON ACTUAL TESTS WITH CLEAR WATER AT 70° F. AND 1280 FEET SITE ELEVATION.

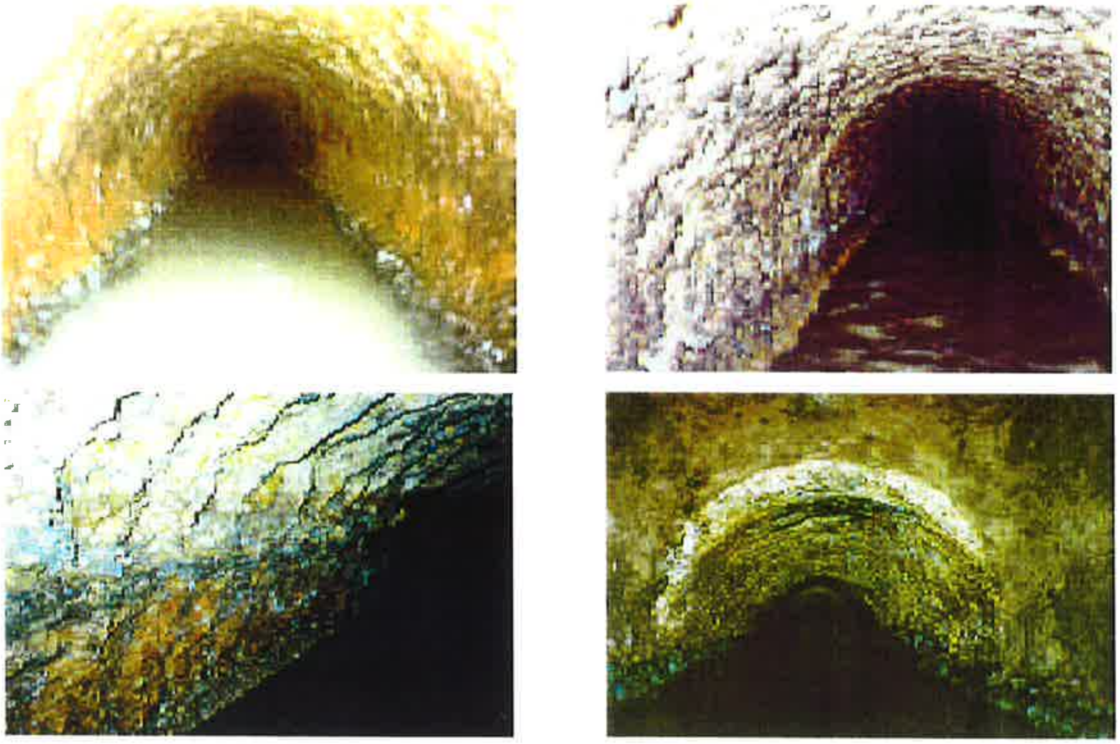


HYDROMATIC™ PUMPS

AURORA PUMP GS
A UNIT OF GENERAL SIGNAL

PERFORMANCE CURVE
S8L/S8LX

NC3110 · 6/91



LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING/COLLECTION SYSTEM FACILITY PLAN
SECAP
SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

LARGE DIAMETER
SEWER INVESTIGATION
TECHNICAL MEMORANDUM
FINAL DRAFT

JUNE 2001

MONTGOMERY WATSON

LITTLE ROCK
WASTEWATER UTILITY

LARGE DIAMETER PIPELINE INVESTIGATION TECHNICAL MEMORANDUM

INTRODUCTION

Background

This Technical Memorandum (TM) is being prepared as part of an overall project entitled "Hydraulic Modeling/Collection System Facility Plan." The Facility Plan will document the analysis of system performance through evaluation of the collection system and pump stations. A modeling effort is also be part of the Facility Plan, and is being undertaken to simulate and predict collection system performance with emphases on capacity, hydraulics, overflows and future growth of the system.

The Little Rock Wastewater Utility (LRWU) Department owns and operates two wastewater treatment plants. Both plants are located in the eastern part of the city, relatively close to where the Arkansas River begins to flow in a southerly direction. The Adams Field Wastewater Treatment Plant has a design flow of 36 million gallons per day (MGD) with a pumping capacity of 72 MGD, while the Fourche Creek Wastewater Treatment Plant has a design flow of 16 MGD with a pumping capacity of 40 MGD. The LRWU also owns and operates the associated collection system and pumping stations

Purpose

This TM focuses on the large diameter sanitary sewer pipelines. The evaluation covered approximately 30,000 linear feet of pipeline ranging from 24-inch diameter to 60-inch diameter. The purpose of this TM is to evaluate the general condition, corrosion, and debris sediment characteristics of the pipelines.

This evaluation is limited to the specific pipelines that have been inspected by Closed Circuit Television (CCTV) by LRWU, data supplied by the LRWU, and pipeline information acquired by Sonex, a Montgomery Watson subcontractor. Inspections performed and data acquired for this evaluation include:

- closed circuit television (CCTV) completed in 1998 by LRWU
- sonar investigations of pipeline diameter completed in 2000 by Sonex
- maintenance records and repair work orders from the LRWU
- external condition reports as made available
- mapping (ArcInfo GIS) of large diameter sanitary sewer routes
- geotechnical information along the Riverfront, South and Brodie Creek Interceptors

COLLECTION SYSTEM DESCRIPTION

The LRWU large diameter gravity pipeline segments (those greater than 24 inches in diameter) of the collection system are shown on Figure 1. The figure shows the large diameter sections of the system as interceptors and their relationship with the collection system and the treatment system. Table 1 shows the diameter, length, and inspection information for each sewer segment investigated as well as the results of the various inspections.

Sanitary flow travels generally from the west to the east, similar to the flow direction of the Arkansas River. The collection system flows into two wastewater treatment plants on the eastern end of the city. The Riverfront Interceptor, serving the northern part of Little Rock, follows the general south bank of the Arkansas River and discharges into the Adams Field Wastewater Treatment Plant. Sanitary flows from the southern part of Little Rock travel from a number of interceptors to the North and South Interceptors, and ultimately to the Fourche Creek Wastewater Treatment Plant.

METHODOLOGY AND APPROACH

Definitions of terminology, and a succinct classification system, are important in evaluations of this type. Adjectives and designations with similar meanings are often used interchangeably when discussing pipelines. Findings, as presented herein, have been categorized into types as follows:

Defects

Pipeline defects or conditions showing damage to the pipeline or structures. A glossary section has been developed and included in this Technical Memorandum as Appendix A – Definition of Terms.

Features

Include connections, bends and other features constructed in the pipeline.

External Conditions

Include groundwater, surface development and foundation conditions.

The measurement of the structural condition of a sanitary sewer that has been constructed underground is a challenge, and the conclusions are by necessity conservative. Most sanitary sewers possess structural defects after years of service. The service life of sewers is influenced by many factors, including but not limited to: soil movement, soil migration, groundwater levels and fluctuations, internal surcharges, foundation conditions, overhead vegetation, placement during installation, and surface loads. Many of these factors that can deteriorate sanitary sewers are not evident from either internal or surface inspections.

Defects may or may not cause a sanitary sewer to fail. Catastrophic failure is rare, but very damaging when it occurs. Structural failure has generally not been shown to be a good predictor of catastrophic failure. Often sewers with structural failures have exhibited good service life beyond the identification of the structural failure.

This investigation relies on a collection of defect information, feature information and external conditions information. Defects are descriptions of damage to the integrity of the interior of the pipeline. Features are conditions within the pipeline, and external conditions are those conditions external to the pipeline. Examples of a defect are a cracked pipe. Features may include bends or connections which can change the velocity of flow and increase debris amounts. External conditions may include pipe foundation, groundwater and surface features.

Data were gathered for this investigation from previous CCTV studies conducted by the LRWU and a sonar investigation (Sonex) conducted by a Montgomery Watson subcontractor. Data were also obtained from the LWRU relative to GIS system mapping and geotechnical investigations. The CCTV and Sonex investigations provided information with respect to the level of corrosion and extent of debris in the inspected pipelines. The findings of corrosion and debris were summarized in Table 1 by pipeline segment.

Sewer System Maintenance Records

The collected sewer system maintenance records show areas that have required past maintenance or repairs. If an area shows an unusual number of repairs or maintenace activities,that may indicates areas where the construction techniques, pipe material, or external conditions may not be conducive to maintaining long-term sanitary sewer service. These concentrations of activities may suggest areawide solutions to problems identified in these findings. That information will be, reviewed and comparisons made for inclusion in the final Facility Planning Report.

Closed Circuit Television (CCTV) Inspection

CCTV information collected from 1995 through 2000 showing about 48,000 linear feet of large diameter sewer was provided to Montgomery Watson for review and evaluation. In addition to the video tapes, data obtained during the CCTV inspections included information on pipeline segments, manhole designations, plan and televised length, and pipe size and material. The video tapes were recorded by a pan-and-tilt color camera without audio. Generally, pipeline segments were televised from upstream to downstream. Areas inspected with CCTV are shown on Figure 2. Montgomery Watson viewed each video tape, and transcribed video tape information on a specially-prepared Sewer Video Evaluation Form. The forms can be found in Appendix D - Sewer Video Evaluation Forms (bound separately). These forms document not only inspection information, but also Montgomery Watson observations.

For CCTV inspections, corrosion is typically classified using the descriptions below and the visual observation photographs shown in Figure A-1. Because the sewers were not physically inspected, therefore, the pH and penetration descriptions are indications of anticipated conditions and not measured conditions. Corrosion was determined solely on loss of concrete and reinforcing bar exposure based on visual observation using the CCTV video

1. *Light Corrosion* is characterized by a slightly depressed pH (<6.0), and a concrete surface that can be penetrated with a sharp instrument under moderate hand pressure with the removal of some concrete material. The original concrete surface is fully recognizable and aggregate may or may not be exposed. Concrete loss ranges from 0 to 0.5 inches.

2. *Moderate Corrosion* is characterized by some concrete loss with aggregate slightly exposed, but the original concrete surface is still distinguishable. The surface may have a thin covering of pasty material that is easily penetrated. There is generally a depressed wall pH (<5.0). Concrete loss ranges from 0.5 to 2 inches.

3. *Severe Corrosion* is characterized by significant and measurable concrete loss, or by the presence of active corrosion. Aggregate, and occasionally reinforcing steel, are exposed. The original concrete surface is not distinguishable. The surface is covered with soft, pasty corrosion products where active scouring is not present. There is generally a depressed wall pH (<0.3) indicating active corrosion. Concrete loss ranges is greater than 2 inches.

4. *Extreme Corrosion* is characterized by corrosion so extensive that the wall of the sewer has been completely corroded and earth can be observed behind the sewer wall. Concrete is physically missing.

Understandably, where there is *no corrosion*, normal pH ranges (around 6.0) are applicable. A normal concrete surface is defined as that which cannot be penetrated or removed by a sharp instrument under moderate hand pressure. The surface of the concrete may have visible biological growth (slime build) and moisture, but the concrete is normal and the aggregate is not exposed.

Sonar Investigation

As a component of Montgomery Watson's evaluation process, a number of sewers were inspected using sonar. Those areas that were investigated using sonar are shown on Figure 3. The sonar device, and the procedure for operating the device, is described in detail in Appendix B – Sonex Theory and Equipment. The sonar investigation measures the diameter of the pipeline above and below the water level. The measured diameter is compared to the constructed diameter. The differences above water are considered to be a function of corrosion, and the differences below water are considered to be a function of the amount of debris that has accumulated in the pipeline.

Sonar investigations are a valuable tool in the investigation of corrosion. However, understanding the limitations of data supplied solely from sonar investigation is critical when evaluating the data. The sonar investigation measures only the geometric cross section of the conduit. That measurement is then compared to the original design of the pipeline. Average measurements are taken, which suggest an overall corrosion level within the pipeline. Maximum measurements are instantaneous measurements that show either depressions or bulges in the pipe cross section. These can be defects, or they can be constructed variations. An instantaneous larger diameter may be a localized pit or spalling of pipe material, or the increase in diameter could reflect an open joint, lift hole or some other constructed feature not indicative of a defect. An instantaneous decrease in diameter may indicate a blister or deformation, or the decrease could relfect grease or other debris adhered to the pipeline surface indicating a cleaning requirement, but not a structural defect.

Measuring internal pipeline geometry with sonar or other devices assesses corrosion. The Sonar caliper system is a precise method of measuring pipeline internal diameter and cross section. The precision of the Sonar method is reported to be within 0.25 inches.

Variations in measurements are also a function of the pipeline manufacturing tolerances and the precision of the measurement device. Most of the pipelines evaluated are reinforced concrete pipe. According to ASTM A-76, the allowable manufacturing tolerances are the larger of 3/8" (0.375") or 1% of the pipe diameter. As an example, manufacture of a 48" diameter pipeline would be ruled by a tolerance of 1% of the pipe diameter, or 0.48". The minimum 3/8" (0.375") tolerance would apply to manufacture of 27" to 36" pipe diameters.

Exposure of reinforcing steel is considered severe corrosion. Reinforcing steel is placed in reinforced concrete pipelines at the midpoint of the pipewall thickness for single strands of reinforcing and one inch from the surface for double strands of reinforcing. The depth to reinforcing varies based on pipeline diameter and it ranges from 1.5 inches for 24 inch diameter to 3 inches for 60 inch diameter for single strand reinforcing and 1 inch for double strand reinforcing. 2 inches has been selected as the indicator of severe corrosion for this evaluation.

Sonex provides information for pipeline cross-section based on average measurements and maximum measurements. Average measurements are used for most of the evaluation procedures since the maximum measurements can be influenced by localized dimensional abnormalities conditions such as joints and does not reflect an overall corrosion condition. The maximum results should be reviewed when making structural repairs since they are more indicative of those types of failures.

For purposes of this discussion, the following corrosion classifications and measurements have been used for this evaluation:

0 – None	0.0 – 0.3 inches, <1% of diameter
1 – Light	0.3 – 0.8 inches, <2% of diameter
2 – Moderate	0.8 – 2.0 inches
3 – Severe	>2.0 inches
4 – Extreme	Pieces missing

The Sonex data shows a continuous reading of pipeline interior wall profile. The data collector also collects maximum readings and reports those readings for each profile. Interpretation of these different data records was based on the average measurement being the most important for the determination of corrosion since corrosion is generally an average condition.

If the pipeline profile measurements showed more than 10% of the pipeline length had corrosion in any category, the most severe category observed was used in the interpretation of the data.

The maximum category was determined by counting the occurances of measurements and assigning the category with the majority of the measurements. This is an indication of the maximum condition.

These classifications differ from CCTV observations since the CCTV is a visual estimate based on the observer's experience. The sonar investigation is a measurement of the pipe diameter and is not subjected to the interpretation of visual obsrevations.

The extent of accumulated debris in the pipelines was also measured during the Sonex investigations. The following classifications have been made as a function of the reported depth of debris:

0 – None	0 – 2 inches
1 – Light	>2 – 6 inches
2 – Moderate	>6 – 12 inches
3 – Severe	>12 inches
4 – Extreme	Blocked

A very limited comparison of pipeline segments investigated by both sonar and CCTV is presented in the following section.

PIPELINE ASSESSMENTS

CCTV and Sonex Evaluation data are made from two different reference points. The CCTV data is collected from a visual reference point that is based on a no corrosion point of zero. The Sonex data is collected from a manufacturing reference point that is based on no corrosion ranging between the assumed pipeline diameter and the allowable manufacturing variations of that pipeline diameter. CCTV observations of corrosion are visual estimates of corrosion depth subject to variations by observer, while the Sonex measurements are direct pipeline measurements. To accommodate for those differences, the following correlation from descriptors to measurements are used in this report

Table 2

Pipeline Assessment Parameters

Corrosion Descriptor	CCTV visual estimates	Sonex measurements
None	0	0-0.3 inches
Light	0.0-0.5 inches	0.3-0.8 inches
Moderate	0.5-2.0 inches	0.8-2.0 inches
Severe	> 2.0 inches	> 2.0 inches
Extreme	Pieces missing	Pieces missing

The "None, Light and Moderate" categories have different measurements for their description. The reference point the measurements are taken from causes these differences.

The Severe category is the same in both investigation techniques since it represents sufficient material loss from the pipe wall structure to warrant significant and immediate concern.

This section of the TM presents the findings of the pipeline evaluations. Table 1, found in Appendix C, is a comprehensive tabulation of the pipeline segments that were televised and/or investigated with sonar. The table is in an EXCEL spreadsheet format and is fully searchable, allowing the LRWU to locate any pipeline segment information based on upstream manhole, downstream manhole, defect, pipe size/diameter or other listed parameter. Table 1 represents a tabulation of all of the data supplied or collected to date. The table permits a thorough review of the data collected for each pipeline segment to allow observation and comparison between the investigation techniques.

The majority of the pipelines that were reviewed showed no apparent defects, corrosion or debris. All pipelines with investigation information are shown on Table 1. Specific defects and their locations are also noted in Table 1. The internal inspection information presented in Table 1 should be reviewed prior to starting new projects and spot repairs. During those construction or repair activities, any defects noted in the tabulation should be assessed and repaired, if appropriate. Only those segments that showed defects, corrosion or debris are discussed further.

Distances shown in Table 1 for the sonar and caliper investigation are based on measurements from the manhole in which the sonar investigation was initiated (the start manhole). The locator column indicates the equation to provide general locations to the defect from the nearest manhole. However, if field location of the defect is required, the full measurement from the start manhole to the defect should be used.

Defects, corrosion and debris information is shown on Figures 4, 5, and 6. Figure 7 shows those pipelines that have undergone inspection by both CCTV and sonar investigation.

CCTV and Sonex Comparison

Five pipeline segments were inspected using both CCTV and sonar investigation techniques. These five segments allow a limited comparison between the two types of inspection techniques. The five pipe segments and the results are shown on Table 3.

Table 3

CCTV and Sonar Investigation Corrosion Comparison

Pipe Segment	CCTV Result	Sonar Investigation Average Result	Sonar Investigation Maximum Result
6C001-6C004	Light to Moderate	Light	Light to Moderate
13G001-13G003	Light	Light	Light to Moderate
6K108-7K109	None to Light	None	None
8N012-8N004	None	None to Light	None to Moderate
8N010-8N009	None	Light	Light

These comparisons show that four of the five segments received the same general corrosion rating when the CCTV results are compared to the sonar results.

Condition and Typical Recommended Actions

These findings indicate that the large pipe diameter sewers in the Little Rock Wastewater Utility (LRWU) system are generally in good working condition. Segments with noted defects are described in the discussion below. The average and maximum conditions observed, and the actions typically recommended to the utility based on the condition assessment, are presented in Table 3. These recommended actions may be applied to the maintenance and/or repair of each segment evaluated.

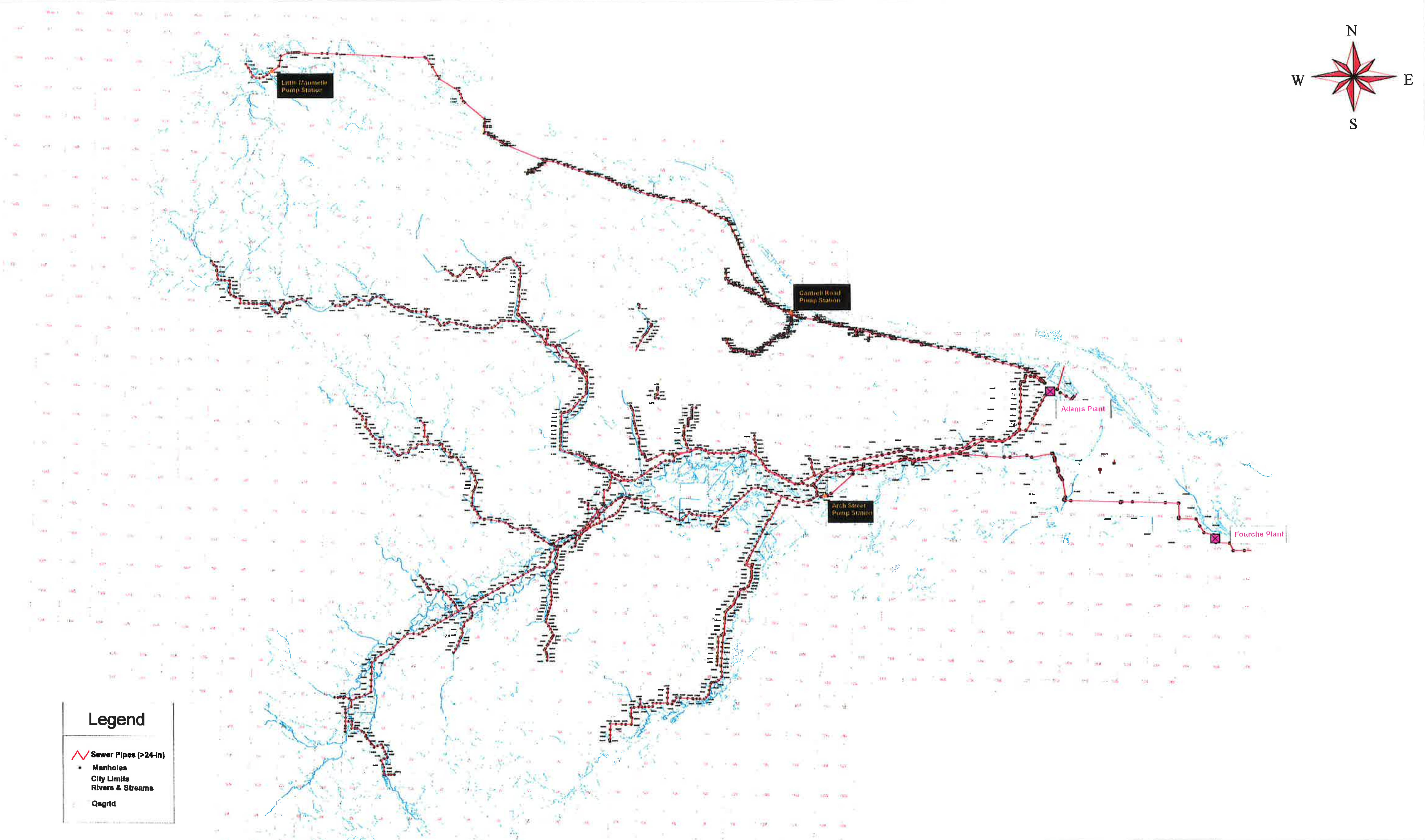
Table 4

Recommended Action based on Condition Assessment

Defect Category	CCTV or Average Sonic Condition	Maximum Sonic Condition	Recommendation
Debris	Light	Light	No Action
	Moderate or Severe	Moderate or Severe	Clean, inspect
Corrosion	None	None	No Action
	Light	Light	Reinspect (5-10 years)
	Light	Moderate or Severe	Reinspect (0-5 years)

	Moderate	Moderate or Severe	Rehab or replace (1-3 years)
	Severe	Severe	Rehab or replace now

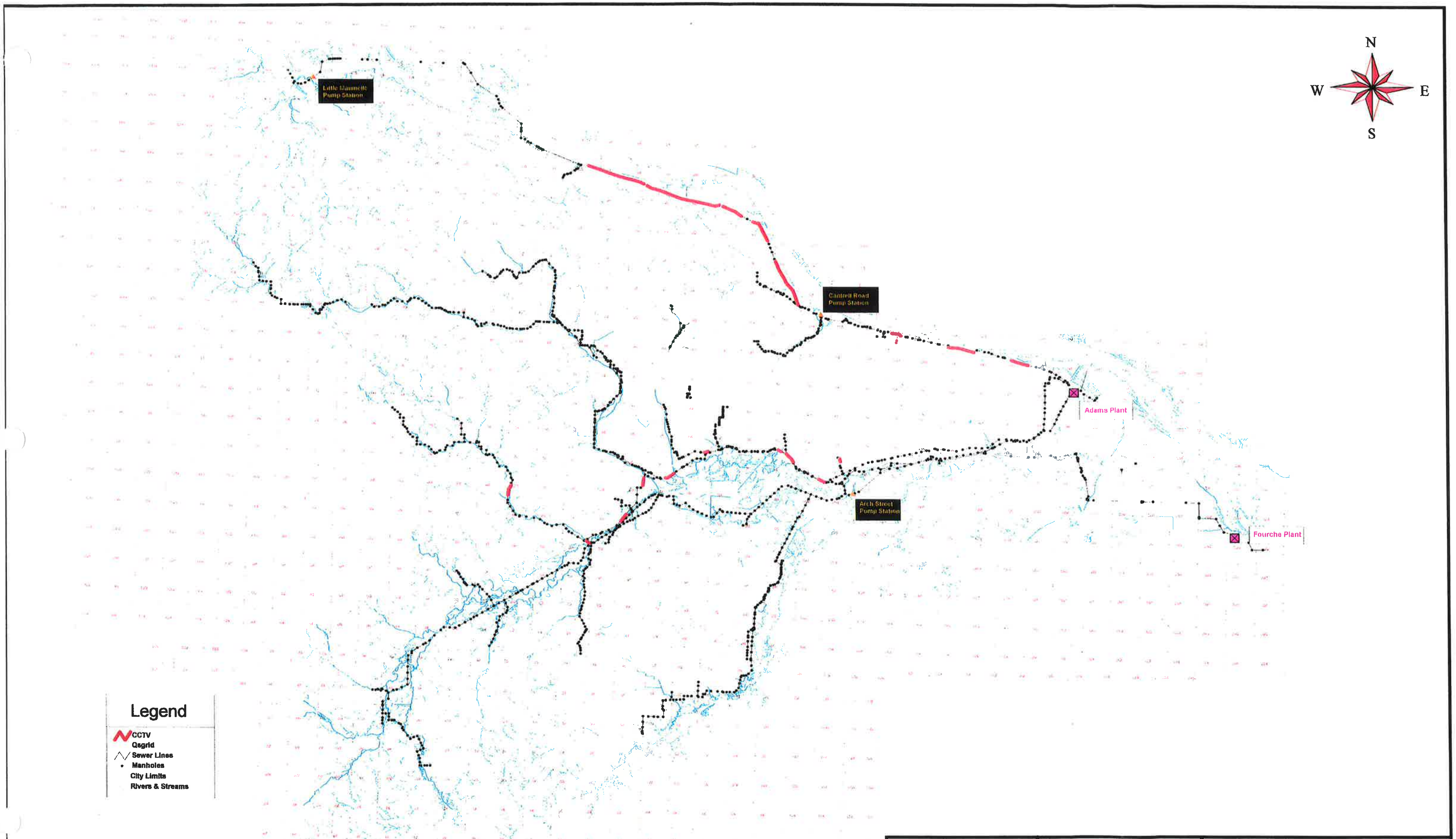
Table 5 shows each pipeline segment, its corrosion and/or debris evaluation condition and its recommendation .



MONTGOMERY WATSON

Little Rock Wastewater Utility

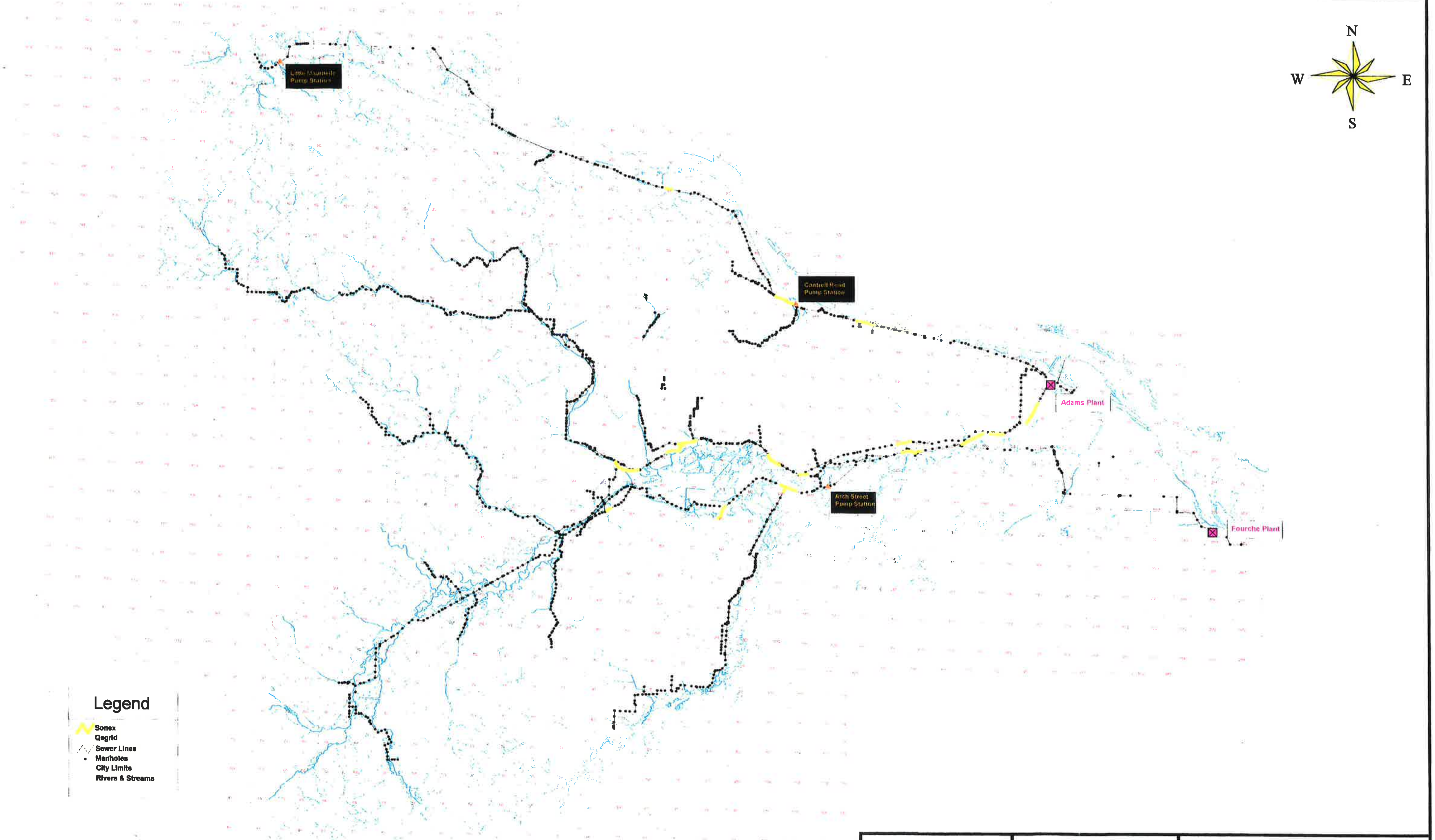
Figure 1
Overall System Map



MONTGOMERY WATSON

Little Rock Wastewater Utility

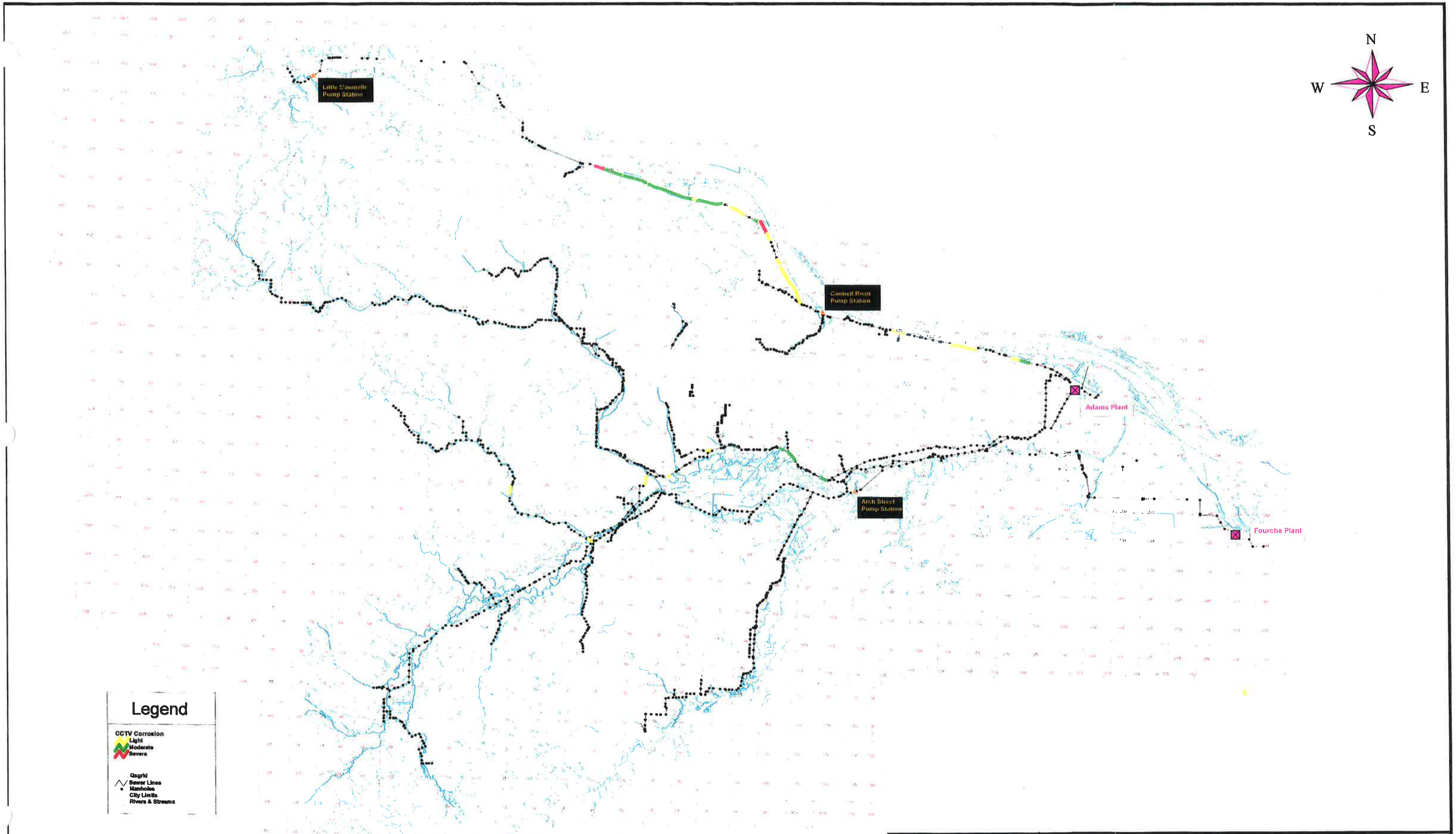
Figure 2
Pipes Inspected by CCTV



MONTGOMERY WATSON

Little Rock
Wastewater Utility

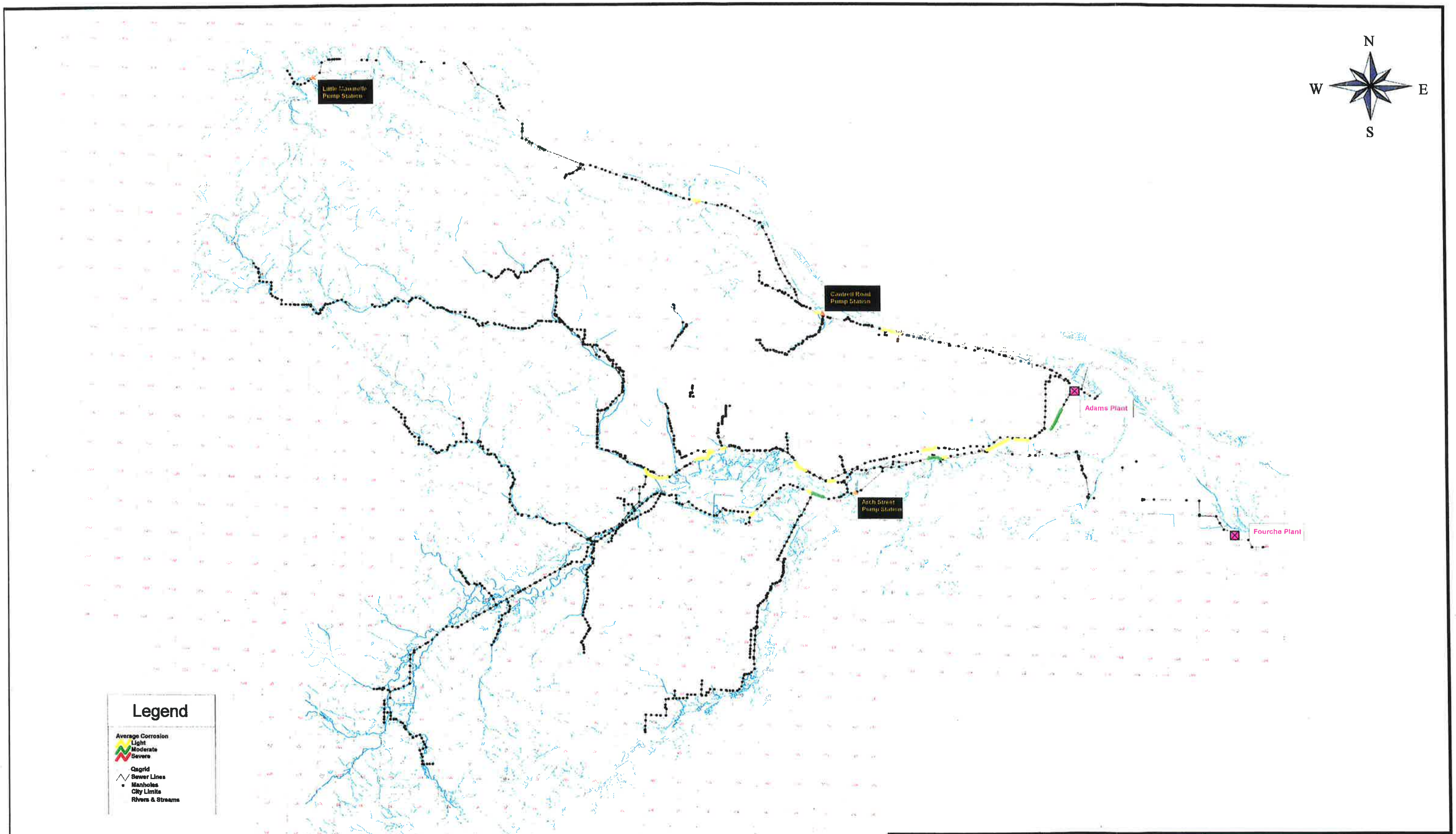
Figure 3
Pipes inspected by Sonex



MONTGOMERY WATSON

Little Rock Wastewater Utility

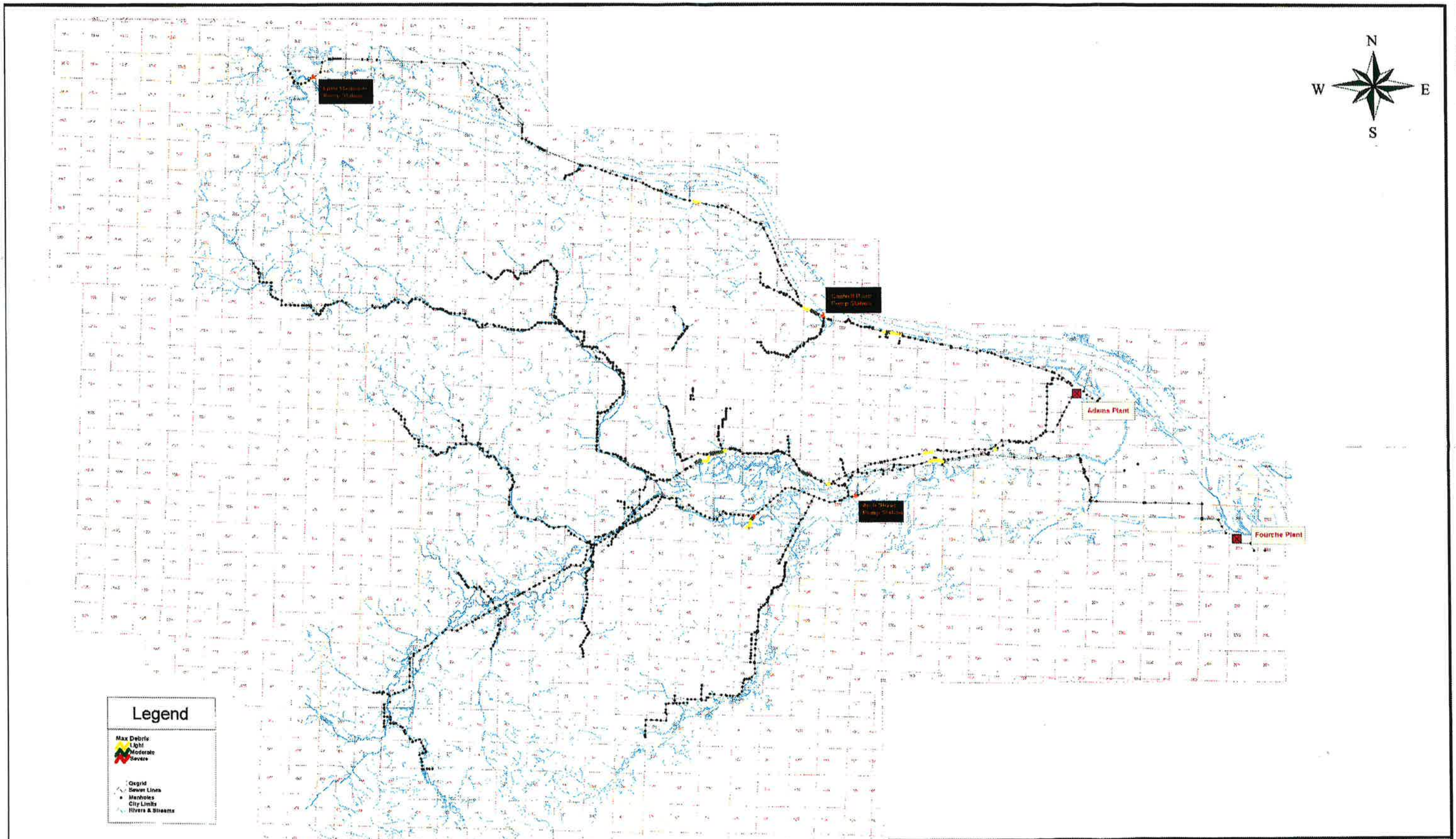
Figure 4
Corrosion found by CCTV



MONTGOMERY WATSON

Little Rock Wastewater Utility

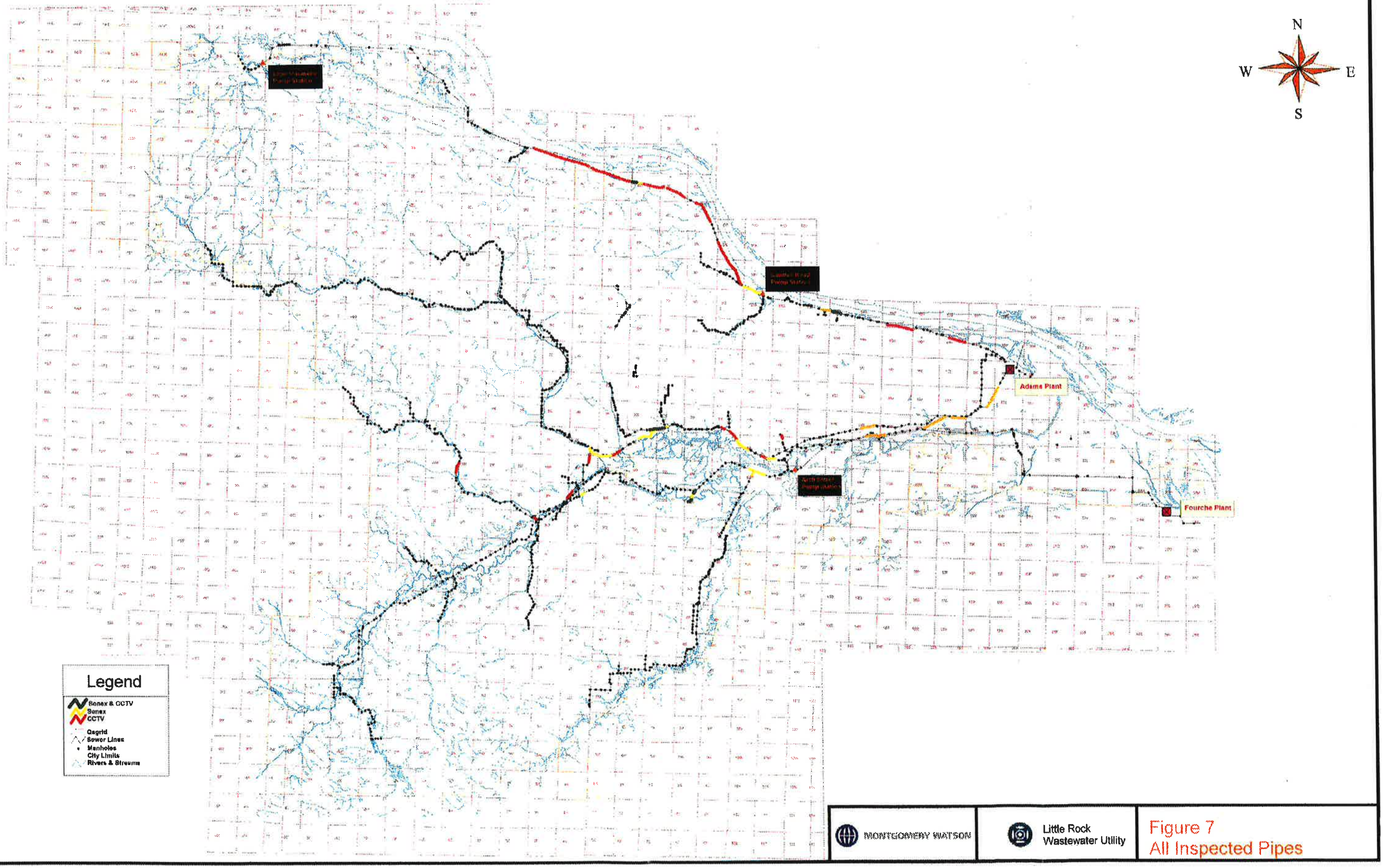
Figure 5
Corrosion found by Sonex



MONTGOMERY WATSON

Little Rock Wastewater Utility

Figure 6
Debris found by Sonex



MONTGOMERY WATSON

Little Rock
Wastewater Utility

Figure 7
All Inspected Pipes

APPENDIX A
DEFINITION OF TERMS

SEWER DEFECTS - STRUCTURAL

Break Pieces of the sewer conduit are noticeably displaced, differentially, and some pieces could be missing (see Figure A-5). Thus, a hole in the fabric of the sewer is also classified as broken. A broken sewer is the most structurally serious defect. A chipped sewer wall is not coded as broken, but should be entered into the general comments section of the coding sheet as such.

Crack Crack line visible on the sewer wall, with the pieces of the wall still in place (see Figure A-3). The crack may be either longitudinal (i.e., following the longitudinal axis of the sewer) or circumferential (i.e., around the periphery of the sewer). Cracks are not themselves serious defects, but are indicative of the initial stages of sewer deterioration. Multiple cracks are a combination of both longitudinal and circumferential cracks.

Collapse Structural integrity of the sewer conduit has been completely lost and deformation is greater than 10 percent (see Figure A-5). Percentage loss of cross-section is estimated to the nearest 5 percent.

Corrosion The destruction of a cementitious wastewater component and its material properties because of a reaction with its surroundings (the sewage environment). Usually, a defect observable specifically in the soffit, generally above the springings of the sewer conduit, and in the proximity of force main discharges (see Figure A-1).

Corrosion (Reinforcing Steel)

1. *Exposed* is characterized, as a minimum, as being able to see rib lines in the pipe. This is an indication that the concrete has deteriorated past the steel and that there is only a thin layer of concrete covering the steel. The worst case under this category is that the steel is exposed either slightly or in its entirety and is starting to rust.

2. *Corroded* is characterized by the steel being exposed and showing signs of corrosion and loss in diameter.

3. *Missing* is characterized by missing rebar or fully corroded steel.

Deformation A measure of the vertical and horizontal reduction or change in cross-section of a sewer as a result of self-weight or external forces. Three levels of deformation are normally reported. These are:

- 0-5 *percent deformation* is acceptable, may not need structural upgrading, and normally requires monitoring.

- 5-10 *percent deformation* requires some form of structural enhancement, possibly a lining;

- >10 *percent deformation* is a collapse condition and the sewer needs replacing.

Note that with brick sewers, some misshapen cross-sections may have been built into the original sewer. Note also that plastic pipes can deform without structural defects. Normally a built-in deformation of 6 percent is allowable in plastic sewers.

For inspection purposes, deformation is normally recorded to the nearest 5 percent.

Fracture Wall of sewer visibly open along the length and/or circumference of the sewer with the pieces of the sewer wall in place (see Figure A-4). The fracture may be either longitudinal (i.e., following the longitudinal axis of the sewer) or circumferential (i.e., around the periphery of the sewer. The sewer may be seen to suffer from some distortion. The defect is indicative of the secondary stage of sewer deterioration and constitutes a more serious problem than a crack. Multiple fractures are a combination of both longitudinal and circumferential fractures.

Open Joint Adjacent conduit sections are open at the joint (see Figure A-2). Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t;
- *medium* - 1 < t , 1.5;
- *large* - 1.5 t.

Joint Displaced Adjacent conduit sections are not concentric at the joint (see Figure A-2). Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t;
- *medium* - 1 < t < 1.5;
- *large* - > 1.5 t.

Surface Damage Surface of sewer conduit is damaged by either spalling, wear, erosion, or any other deleterious mechanism other than corrosion (see **Corrosion**).

SEWER DEFECTS - SERVICE

Debris Grease, rocks, sand, and silt in a sewer line, excluding items mechanically attached to the line such as intruding service connections, intruding pipe and joint materials. Debris could be the cause of turbulence in the conduit and a reduction in hydraulic capacity. Percentage loss is normally given to the nearest 5 percent.

Debris is normally identified by the following characteristics:

- *Debris.* Pebbles, wood chippings, brick and other material that could cause turbulence and reduction in hydraulic capacity;

- *Silt.* Silt mud and other organic (e.g. sludge) and non organic (sand) material;

- *Grease.* Deposits of grease and similar material at the flow line or soffit within the sewer.

Encrustation Deposits left on the wall or joint of a sewer by the effect of infiltrating groundwater containing dissolved salts. Normally described as being light, medium or heavy, and characterized by loss of percentage cross-sectional area, thus:

- *light* - > 5 percent;
- *medium* - 5 < loss < 20 percent;
- *heavy* > 20 percent loss.

Ground Water Infiltration Water entering sewers and manholes via defective joints and connections, broken pipes, fractured manholes, etc., due to the effects of a high ground water table. Various levels of ground water infiltration are identified, namely:

- *Seeper* The slow ingress of infiltration through sewer/manhole structures, identified by glistening effect of the water under the influence of survey lighting apparatus;
- *Dripper* Infiltration characteristically dripping into the wastewater system through sewer/ manhole structural defects;
- *Runner* Infiltration running into the wastewater system through sewer/manhole structural defects;
- *Gusher* Infiltration entering the wastewater system under hydrostatic pressure via structural defects.

Obstruction An obstruction in the sewer conduit resulting in stoppage of the inspection or survey. Obstructions can be:

- *General*, e.g., shopping cart;
- *Mechanical*, e.g., water main;
- *Structural*, e.g., prop. mechanism;
- *Strata*, e.g., rock fall.

SEWER DEFECTS - PROTECTIVE LINING

Blister A concentrated swelling of the *protective coating* over the host conduit.

Bulge A concentrated swelling of the *protective liner* over the host conduit.

Degradation Break down by biological action of the protective liner, protective coating or host conduit.

Delimitation Separation of internal layers of the protective lining material. Loss of internal bonding - chemical or mechanical.

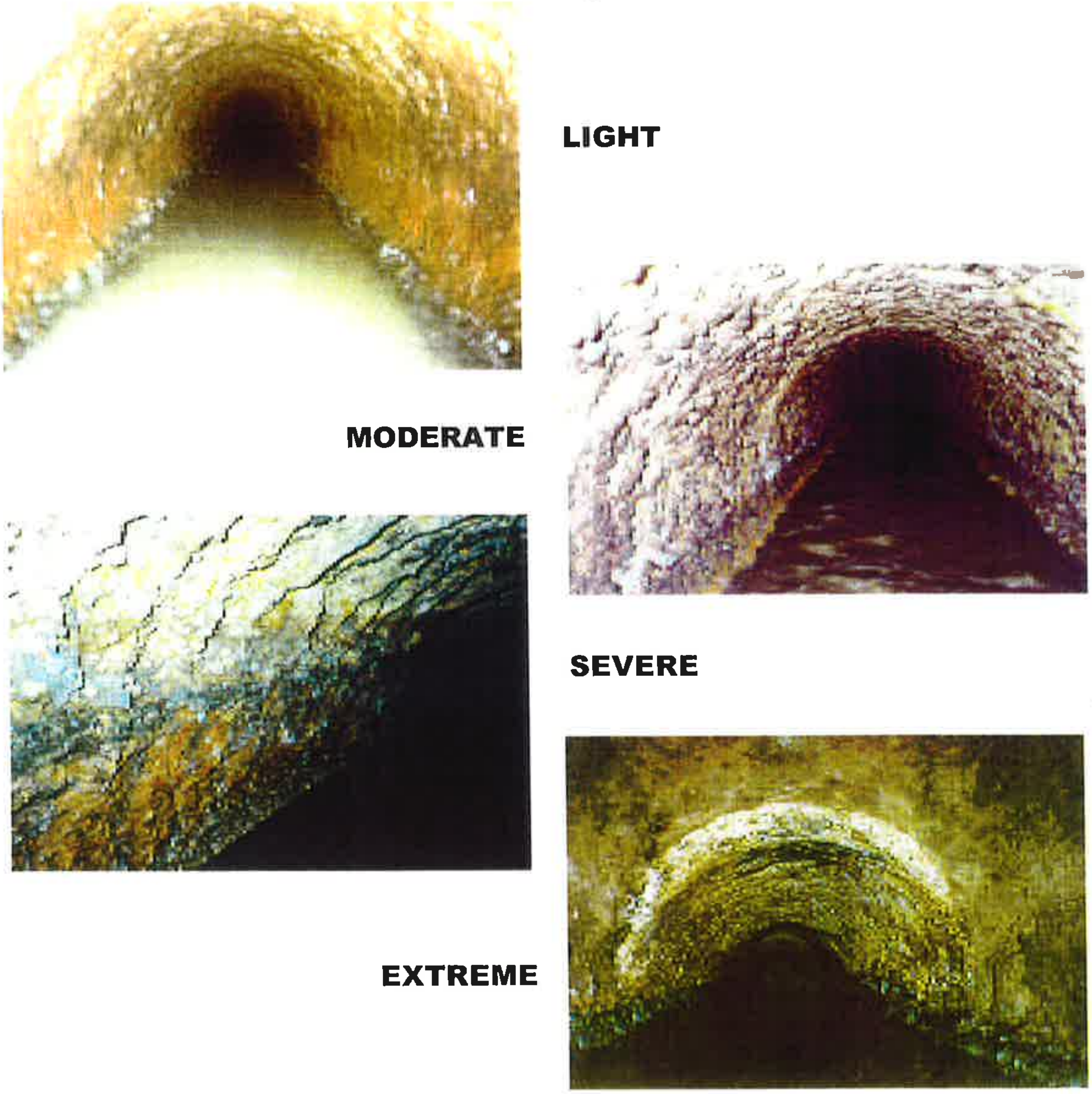
Detached Extensive separation of the protective lining material or protective coating from the host conduit.

Missing Where the sewer conduit has no protective coating or protective lining, though the sewer conduit is indicated on as-built drawings, or on job files.

Tear When the protective lining has become torn.

Weld Failure The opening up of the weld between adjacent pieces of protective lining due to physical or chemical breakdown.

Wrinkle The incorporation of a longitudinal or circumferential fold, typically in a CIPP lining due to stretching or excessive material. Normally the wrinkle should not exceed more than 1 percent of diameter for protective linings equal to or greater than 24 inches, and more than 2 percent of diameter for protective linings in sewers less than 24 inches.



LIGHT

MODERATE

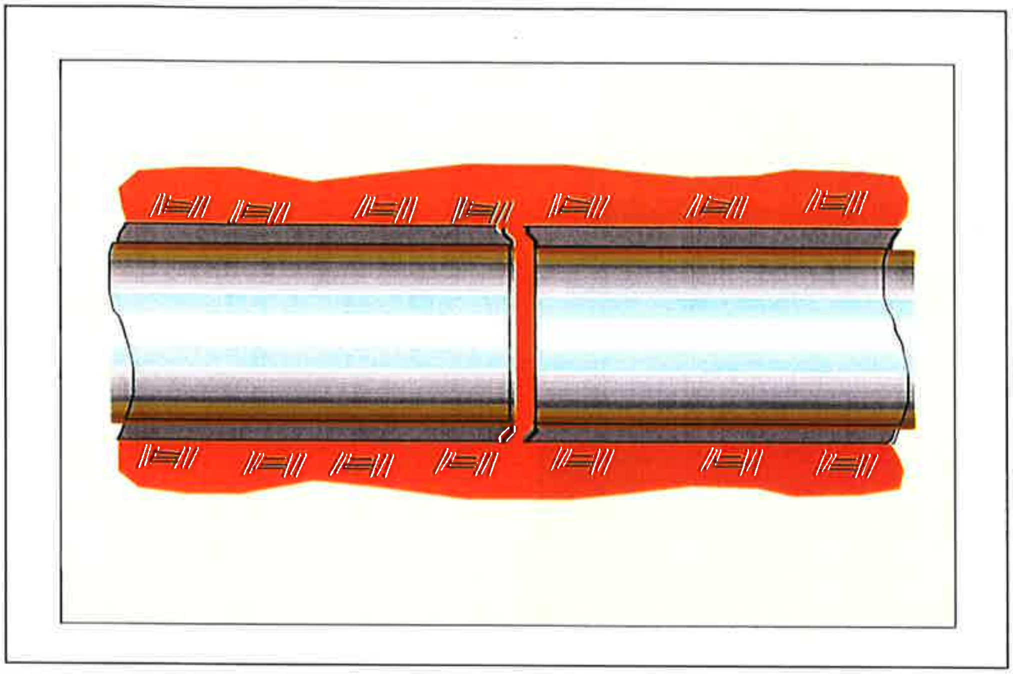
SEVERE

EXTREME

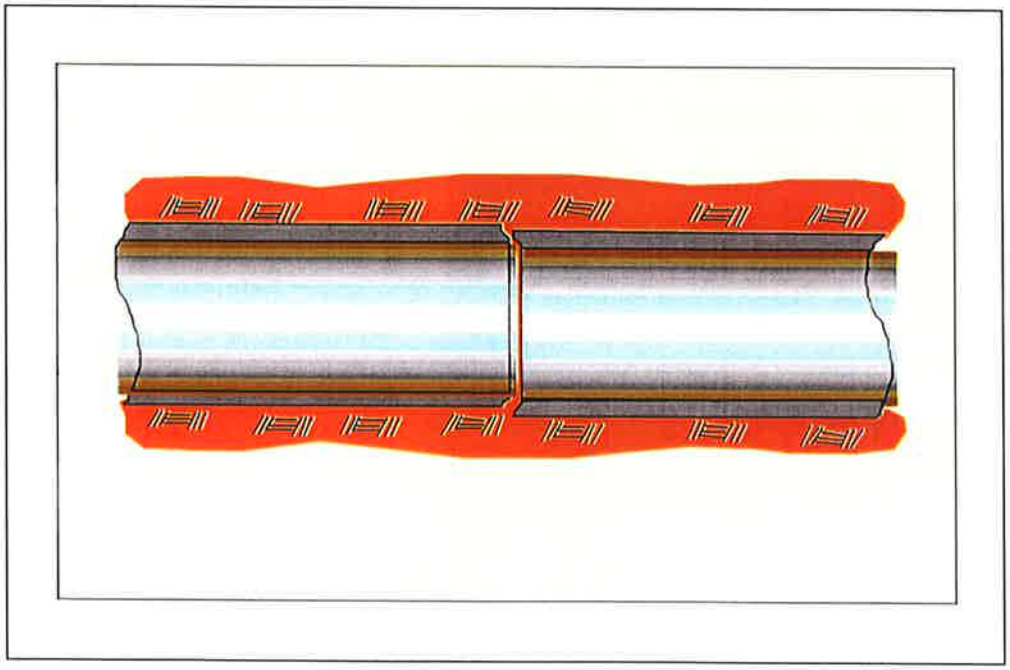
Surface of pipe damaged by gas, generally hydrogen sulfide (rotten egg smell), arising from septic sewage. Can be associated with trade waste or spillage if gases are corrosive.

The gas combines with condensing water to form a weak sulfuric acid which attackes the cement content of concrete, leaving the aggregate exposed or dropping away. A characteristic of warm/hot climates, slow flows, slack gradients or backfalls or pumped flows where the rising main exits into the gravity sewer.

FIGURE A-1
CORROSION OF CONCRETE

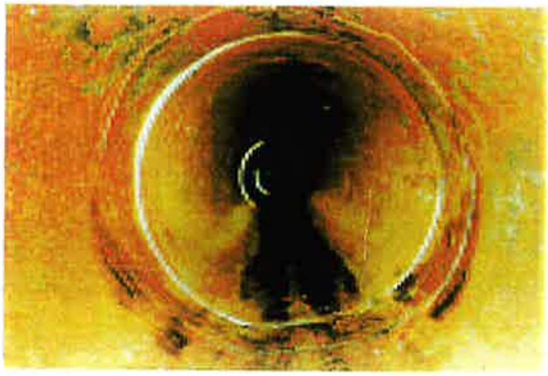


Open Joint, Medium. Adjacent pipes are longitudianlly displaced at the joint.



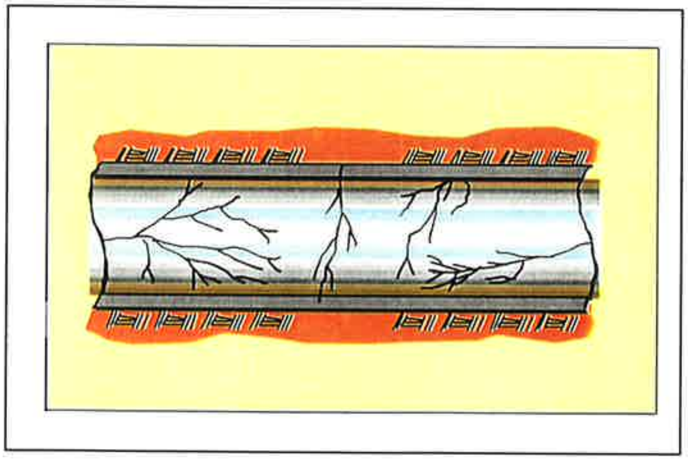
Joint Displaced, Medium. The spigot of a pipe is not concentric with the socket of the adjacent pipe.

FIGURE A-2
OPEN AND DISPLACED JOINTS



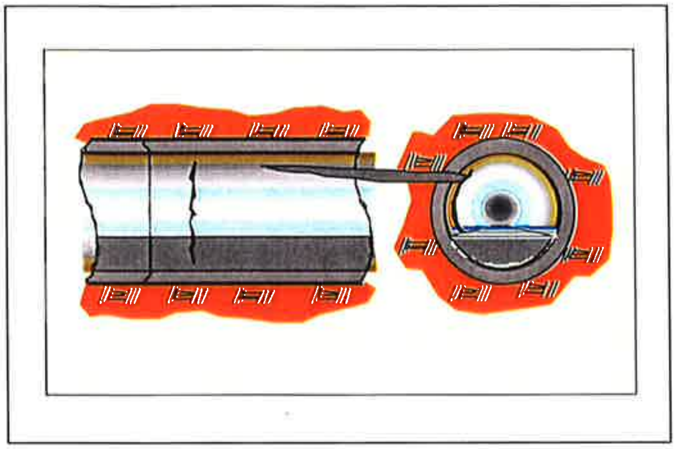
Cracked Circumferential. Crack lines visible on pipe wall, pieces all still in place. Defect runs at approximate right angles to axis of sewer.

Cracked Longitudinal. Crack lines visible on pipe wall, pieces all still in place. Defect runs at approximate right angles to axis of sewer.



Cracked Multiple. Crack lines visible on pipe wall, pieces all still in place. Defect runs at approximate right angles to axis of sewer. Combination of both longitudinal and circumferetial.

FIGURE A-3
CRACKS



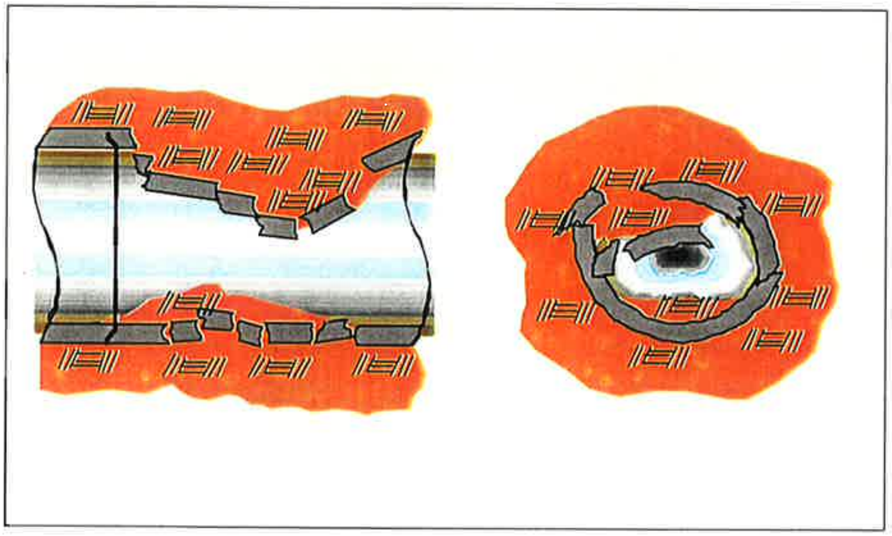
Fracture Circumferential. When a crack becomes open on the pipe wall and the pieces are all still in place. The defect runs approximately along the axis of the sewer.

Fracture Longitudinal. When a crack becomes open on the pipe wall and the pieces are all still in place. The defect runs approximately along the axis of the sewer.

Fracture Multiple. When a crack becomes open on the pipe wall and the pieces are all still in place. The defect runs approximately along the axis of the sewer. Combination of both longitudinal and circumferetial (that cannot be easily identified and coded as either one).

FIGURE A-4
FRACTURES

Broken. Pieces of the pipe are noticeably displaced. Some pieces could be missing. A hole in the fabric of the sewer is also classified as "broken." A chipped pipe is not classified as broken.



Collapsed. Complete loss of structural integrity of the pipe. Most of the cross-secional area is lost.

FIGURE A-5
BROKEN AND COLLAPSED PIPES

FIGURE A-6
LOOSE AND MISSING MANHOLE BRICKS

FIELD OPERATIONS

The SONEX SONIC CALIPER™ was used to inspect the lines for corrosion loss and debris accumulations. The corrosion was measured with the SONIC CALIPER™ and debris measured with the Mechanical Caliper™.

A pull cable was floated to the downstream manhole. The SONAR SYSTEM was inserted at the upstream manhole, pulled downstream and extracted at the downstream manhole.

SONIC CALIPER™ THEORY

Sound travels at a uniform velocity within any specific medium. This property is the basis for all sonic and ultrasonic distance-measuring systems from marine navigation to medical imaging. A sonic pulse is transmitted toward a target. The travel time for the echo is measured and multiplied by the known sonic velocity to determine the round-trip distance to the target.

Sonic transducers are used to transmit and receive the sonic pulses. These are piezoelectric devices that convert mechanical energy to electrical energy and vice versa. The most familiar sonic transducer may be the sportsman's fish finder transducer.

The SONEX SONIC CALIPER™ has a single, rotating, transducer. This transducer protrudes from the end of a tube containing circuitry that generates and receives the sonic pulses, rotating motor, slip rings that convey the pulse to and from the transducer, and batteries that power the unit. The rotating transducer takes fifty distance measurements during each rotation. The rotation speed is 36 RPM.

The float- or skid-mounted Sonar System is inserted through the manhole and floated or pulled through the pipe to the next manhole. The unit is connected to a computer in the instrument van by a four- or seven-conductor steel cable. A cable meter records the distance from the manhole to the tool. Caliper electronics pulse the transducer fifty times per rotation. The tool is pulled at a speed that allows for One rotation for every foot of pipe inspected.

Travel times for each set of fifty sonic readings are stored in the computer, shown on the monitor, and used to draw a pipe cross section for each data station. The cable meter footage is also shown.

One time count, in air equals about 0.027 inches and in water, about 0.029 inches. The system can resolve the distance to within two counts, so the practical resolution of the SONIC CALIPER™ is better than 0.054 and 0.058 in air and water respectively. Accuracy depends on the determination of the sonic velocity, determination of the position of the tool in the pipe, and the amount of turbulence that might disturb the position of the tool.

SONIC CALIPER™ EQUIPMENT

The SONIC CALIPER™ used to inspect the pipelines for the L.R.W.U. measures the inside circumference of the pipe using sonic-ranging distance measurement. Sonic pulses emitted from a rotating transducer are echoed back to the transducer from the wall of the pipe or the top of the debris. Distance is calculated using the elapsed travel time and the determined velocity of sound through the air (or water) at the time of the inspection.

The SONAR SYSTEM can send pulses through air to inspect the pipe above the flow, or through water to inspect the underwater portion of the pipe. The power levels and signal amplification must be changed to go from air to water so it is not practical to run both air and water at the same time.

The SONAR SYSTEM has a single, continuously rotating transducer. Fifty distance readings are taken for each rotation, and can be taken over any arc of the 360-degree rotation.

The tool was drawn through the line at a speed that allowed for roughly one rotation for every foot of pipe inspected. Sonic-distance readings were used to draw cross sections of the pipe during the inspection; and were stored on disk and hard drive for analysis and presentation after the fieldwork was complete.

The SONIC CALIPER™ can resolve distances to within less than 0.06inches. Absolute accuracy depends upon calibration, and the stability of the tool in the pipe. Occasionally factors such as turbulence, splash, alignment and other line conditions may interfere with a rotational scan of the pipe. Where this occurs these scans may be omitted from the view programs, noticeable as generally brief blank sections.

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
Brodie	2O001	3O002		CPR	628	0	M144	1	641.4	1246	Routine	153273	8/16/99							Smooth									
Brodie	2O001	3O002																											
Brodie	2O001	3O002	42	CPR			M144										0.25												
Brodie	3O002	3O001		CPR	261	700	M144	2	268.3	1248	Investigation	153274	8/16/99							Smooth									
Brodie	3O002	3O001	42	CPR			M144										0.25												
Brodie	3N003	3N004		CPR	840	955	M144	3	850.6	1248	Investigation	153275	8/16/99							Smooth									
Brodie	3N003	3N004	42	CPR			M144										0.25												
Brodie	3N004	3N005																											
Brodie	3N004	3N005	42	CPR	485	1638	M144	4	495	1248	Investigation	153340	8/17/99																
Brodie	3N005	4N089																		Smooth									
Brodie	3N005	4N089												499				Obstruction (?Roots)	M										
Brodie	3N005	4N089	42	CPR	781	2091	M144	5	794.4	1248	Investigation	153341	8/17/99				0.25												
Brodie	4N089	4N014																											
Brodie	4N089	4N014	42	CPR	683	2772	M144	6	690.3	1248	Investigation	153342	8/17/99				0.25			Smooth									
Brodie	4N014	4M016																											
Brodie	4N014	4M016													(?Joint Leak)			Crustation (?Joint Leak)											
Brodie	4N014	4M016	42	CPR	688	3361	M144	7	735.7	1248	Investigation	153343	8/17/99				0.25			Smooth									
Brodie	4M016	4M015																											
Brodie	4M016	4M015	42	CPR	741	3880	M144	8	754.9	1248	Investigation	153396	8/18/99				0.25			Smooth									
Brodie	4M014	4M013																											
Brodie	4M014	4M013	42	CPR	317	4397	M144	9	332.9	1248	Investigation	153397	8/18/99				0.30	Crust on pipe wall		Smooth									
South 60	5L051	5L050																											
South 60	5L051	5L050	48	CPR	645	4651	M144	10	644.1	1248	Investigation	153730	8/26/99				0.30			Smooth									
South 60	5L059	5L053																											
South 60	5L059	5L053												215		L													
South 60	5L059	5L053	48	CPR	208	5277	M144	11	209.4	1248	Investigation	153733	8/26/99				0.40			Smooth									
South 60	5L053	5L052																											
South 60	5L053	5L052												248	Connection Submerged			Moderate; Debris (Silt)	M										
South 60	5L053	5L052	48	CPR	656	5452	M144	12	656	Cannot Locate Info							0.40			Smooth									
North 60	10L009	10L008																											
North 60	10L009	10L008	48	CPR	594	5642	M144	13	603.7	1248	Investigation	154035	8/30/99				0.30	Light Roots at Many Joints		Quiescent									
North 60	9K009	9K008																											
North 60	9K009	9K008												0				Lining coated(?)											
North 60	9K009	9K008												315	Crack-2 joints			Crack-2 joints											
North 60	9K009	9K008												560				Roots											
North 60	9K009	9K008												573				Scaling											
North 60	9K009	9K008	48	CPR	581	0	M146	1		Cannot Locate Info						M				Quiescent									
North 60	9K008	9K007																											
North 60	9K008	9K007	48	CPR	468	735	M146	2	466.4	1248	Investigation	154317	8/31/99																
North 60	9K007	9L012																											
North 60	9K007	9L012												284		M		Spawling											
North 60	9K007	9L012												420				20% Full											
North 60	9K007	9L012												663	Joint leak at (?) 9 o'clock			Joint leak at (?) 9 o'clock											
North 60	9K007	9L012	48	CPR	663	1256	M146	3	670.8	1248	Investigation	154318	8/31/99			M	0.40	Smooth											
North 60	9L012	9L011																											
North 60	9L012	9L011	48	CPR	356	1915	M146	4	356.5	1248	Investigation	154319	8/31/99			M	0.40	Quiescent											
Rebsamen	7C007	7C006																											
Rebsamen	7C007	7C006												360				Right bend											
Rebsamen	7C007	7C006	42	CPR	383	2227	M146	5	385.9	1248	Investigation	154421	9/1/99			M	0.20	Quiescent											
Rebsamen	7C006	7C005																											
Rebsamen	7C006	7C005	42	CPR	329	2658	M146	6	347.7	1248	Investigation	154422	9/1/99																
Rebsamen	7C005	7C008																											
Rebsamen	7C005	7C008												74	Break in crown color	L		Wall corrosion; break in crown color; patchy											
Rebsamen	7C005	7C008	42	CPR	565	2964	M146	7	561.2	1248	Investigation	154423	9/1/99																
Brodie	OM056	OM055																											
Brodie	OM056	OM055												80	3 holes-right			3 holes-right											
Brodie	OM056	OM055												105				Displaced joint(?); obstruction(?)	M										
Brodie	OM056	OM055												190				Obstruction	M										
Brodie	OM056	OM055	24	CPR	194	3278	M146	8	194.4	1248	Investigation	154478	9/2/99			--	Low			Fast									
Brodie	OM055	OM054																											
Brodie	OM055	OM054												10				Debris	L										
Brodie	OM055	OM054												80				Debris	L										
Brodie	OM055	OM054												139				Jump											
Brodie	OM055	OM054	24	CPR	168	3393	M146	9	172.6	1248	Investigation	154479	9/2/99																
Brodie	OM054	OM053																											
Brodie	OM054	OM053												19				Blockage	M										
Brodie	OM054	OM053												76				Connection and slime											
Brodie	OM054	OM053												79				Connection											
Brodie	OM054	OM053												83				Jump											
Brodie	OM054	OM053												179				Connection											
Brodie	OM054	OM053												182				Connection											
Brodie	OM054	OM053												244				Jump											

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
Brodie	OM054	OM053												254				Jump											
Brodie	OM054	OM053												264				Jump											
Brodie	OM054	OM053												328				Connection											
Brodie	OM054	OM053												332				Connection											
Brodie	OM054	OM053												461				Connection											
Brodie	OM054	OM053												466				Connection											
Brodie	OM054	OM053												510				Debris	M										
Brodie	OM054	OM053												545				Jump											
Brodie	OM054	OM053												573-580				Debris	M										
Brodie	OM054	OM053	24	CPR	605	3535	M146	10	598.9	1248	Investigation	154480	9/2/99			L													
Brodie	OM053	OM052																											
Brodie	OM053	OM052	24	CPR	485	4029	M146	11	462.9	1248	Investigation	154481	9/2/99																
Brodie	OM052	ON029																											
Brodie	OM052	ON029	24	CPR	214	4470	M146	12	249.7	1248	Investigation	154482	9/2/99																
Brodie	ON003	ON002																											
Brodie	ON003	ON002	36	CPR	593	4685	M146	13	596.3	1248	Investigation	154583	9/7/99																
Brodie	ON002	ON001																											
Brodie	ON002	ON001	36	CPR	721	5187	M146	14	720.5	1248	Investigation	154584	9/7/99																
Brodie	ON001	1N024																											
Brodie	ON001	1N024	36	CPR	568	5394	M146	15	571.9	1248	Investigation	154585	9/7/99																
Brodie	1N024	1N023																											
Brodie	1N024	1N023	36	CPR	534	5745	M146	16	529.1	1248	Investigation	154586	9/7/99																
Rebsamen	8D096	8D006																											
Rebsamen	8D096	8D006												234		S													
	8D096	8D006												413		M													
	8D096	8D006												445		S													
	8D096	8D006	42	CPR	513	0	M147	1	426.4	1248	Investigation	154619	9/8/99				0.20			Smooth									
	8D004	8D003																											
	8D004	8D003												0		L													
	8D004	8D003												50		L													
	8D004	8D003												437		S		(?)Debris	L										
	8D004	8D003	42	CPR	693	1006	M147	2	696.2	1248	Investigation	154621	9/8/99				0.20			Smooth									
	8D003	8D002																											
	8D003	8D002												50		L													
	8D003	8D002												549		L													
	8D003	8D002	42	CPR	545	2112	M147	3	551	1248	Investigation	154671	9/9/99				0.20			Smooth									
	9E002	9E043																											
	9E002	9E043	42	CPR	407	2496	M147	4	407.9	1248	Investigation	154672	9/9/99	50		L	0.30			Smooth									
	9E043	93012																											
	9E043	93012												130				(?)Debris	L										
	9E043	93012												207				(?)Debris	L										
	9E043	93012												333				(?)Debris	L										
	9E043	93012												350				(?)Debris	L										
	9E043	93012	42	CPR	419	2844	M147	5	418.7	1248	Investigation	154673	9/9/99				0.30			Smooth									
	9E012	9E019																											
	9E012	9E019	42	CPR	815	3220	M147	6	826.3	1248	Investigation	154674	9/9/99	50		L	0.20			Smooth									
	9E019	9F011																											
	9E019	9F011	42	CPR	409	3619	M147	7	450.5	1248	Investigation	154751	9/13/99	50		L	0.30			Smooth									
	9F011	9F009																											
	9F011	9F009	42	CPR	329	3986	M147	8	293.6	1248	Investigation	154752	9/13/99	50		L	0.20			Smooth									
	9F009	9F012																											
	9F009	9F012	42	CPR	30	4276	M147	9	31.3	1248	Investigation	154753	9/13/99	0		L	0.20			Smooth									
	9F012	9F013																											
	9F012	9F013												442				(?)Debris	L										
	9F012	9F013	42	CPR	674	4335	M147	10	667.3	1248	Investigation	154754	9/13/99	50		L	0.20			Smooth									
	9F013	9F016																											
	9F013	9F016												0		L	0.25			Smooth									
	9F013	9F016												100		L	0.30			Quiescent									
	9F013	9F016												148	Crown Shot			Crown Shot											
	9F013	9F016												177	SAG			50% full											
	9F013	9F016												190	SAG			70% full											
	9F013	9F016												220	SAG			80% full											
	9F013	9F016	42	CPR	262	4887	M147	11	262.6	1248	Investigation	154755	9/13/99																
	9F016	9F018																											
	9F016	9F018												50		L	0.70			Quiescent									
	9F016	9F018												107	SAG			80% full											
	9F016	9F018												220	SAG			90% full											
	9F016	9F018	42	CPR	288	5067	M147	12	287.3	1248	Investigation	154756	9/13/99																
	9F018	9F022																											
	9F018	9F022												530				Flaking slime layer											
	9F018	9F022												748	SAG			80% full											
	9F018	9F022												781				Crown view											
	9F018	9F022												830						Turbulent influent									
	9F018	9F022	42	CPR	837	5234	M147	13	841.6	1248	Investigation	154790	9/14/99	50		L	0.20			Smooth									
	8C002	8D094																											
	8C002	8D094												200		L													
	8C002	8D094												243				Debris(?)	L										
	8C002	8D094												315		M		Worse corrosion in area											
	8C002	8D094	42	CPR	423	0	M148	1	426.7	1248	Investigation	154793	9/14/99			L	0.20			Smooth									
	8D094	8D096																											

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	8D094	8D096												84				Bend											
	8D094	8D096	42	CPR	91	738	M148	2	84.6	1248	Investigation	154794	9/14/99			L	0.20			Smooth									
	6C005	7C007																											
	6C005	7C007												32				Shiny wall											
	6C005	7C007												325				Debris(?)	L										
	6C005	7C007												465				Debris(?)	L										
	6C005	7C007												597		M		Corrosion											
	6C005	7C007												690		M		Corrosion											
	6C005	7C007												700		M		Corrosion											
	6C005	7C007																											
	6C005	7C007	42	CPR	1056	1018	M148	3	1072.2	1246	Routine	83533	8/23/96			M	0.20			Smooth									
	6C002	6C003																											
	6C002	6C003												63		S		Ribs(?)											
	6C002	6C003												88		S		Ribs(?); coated(?)											
	6C002	6C003	36	CPR	8	2114	M148	4	4.9	1248	Investigation	154854	9/15/99			M	0.25			Turbulent									
	6C002	6C003																			6C001+393-8		-	-	-	-			
	6C003	6C004												186				Shiny surface											
	6C003	6C004												252				Debris(?)	L										
	6C003	6C004												253-494				Several stops-debris(?)	L										
	6C003	6C004	36	CPR	497	2127	M148	5	507.4	1246	Routine	83521	8/2/96			L	0.20			Smooth									
	6C003	6C004																			6C001 + 393	394.8-409.3			L	L			
	6C003	6C004																			6C001 + 393	409.3-484.0	L	M	L	M			
	6C003	6C004																			6C001 + 393	484.0-499.5			L	L			
	6C003	6C004																			6C001 + 393	499.5-529.5	L	M	L	L			
	6C003	6C004																			6C001 + 393	529.5-544.2	L	M					
	6C003	6C004																			6C001 + 393	559.2-603.9			L	L			
	6C003	6C004																			6C001 + 393	649.4-664.1	L	L					
	6C003	6C004																			6C001 + 393	679.4-724.4	L	L					
	6C003	6C004																			6C001 + 393	724.4-739.6	L	L	L	L			
	6C003	6C004																			6C001 + 393	784.1-798.8			L	L			
	6C003	6C004																			6C001 + 393	798.8-814.6			M	M			
	6C003	6C004																			6C001 + 393	814.6-829.1	L	M	L	M			
	6C003	6C004																			6C001 + 393	829.1-858.8	L	L					
	6C004	6C005												175		M		Debris(?); higher corrosion	L										
	6C004	6C005												435				Debris(?)	L										
	6C004	6C005												646				Drop in invert; flow turbulent; no corrosion											
	6C004	6C005	36	CPR	647	2803	M148	6	649.6	1248	Investigation	154856	9/15/99			L	0.20			Smooth									
	4B001	4B002																											
	4B001	4B002	30	CPR	330	3371	M148	7	336.3	1248	Investigation	154893	9/16/99			M	0.50			Smooth									
	4B002	4B003																											
	4B002	4B003												100	Rebar-Ribs														
	4B002	4B003												291			0.40												
	4B002	4B003												375			0.25												
	4B002	4B003												647				Brick invert drop											
	4B002	4B003	30	CPR	647	3574	M148	8	651.6	1246	Routine	77710	11/2/95			M	0.50			Smooth									
	4B003	4B004																											
	4B003	4B004	30	CPR	299	4004	M148	9	299.9	1248	Investigation	154895	9/16/99			M	0.25			Smooth									
	4B004	4B005																											
	4B004	4B005	30	CPR	336	4238	M148	10	342.1	1248	Investigation	154896	9/16/99				0.25			Smooth									
	4B005	4B006																											
	4B005	4B006												468				MH box brick(?)											
	4B005	4B006	30	CPR	467	4447	M148	11	471.7	1248	Investigation	154897	9/16/99			M	0.20			Smooth									
	4B006	4C041																											
	4B006	4C041	30	CPR	383	4761	M148	12	385.1	1248	Investigation	155184	9/20/99			M	0.20			Smooth									
	4C041	5C001																											
	4C041	5C001	30	CPR	278	4987	M148	13	282.6	1246	Routine	77766	11/3/95			M	0.25			Smooth									
	5C001	5C002																											
	5C001	5C002	30	CPR	107	5141	M148	14	106.7	1248	Investigation	155186	9/20/99			M	0.25			Smooth									
	5C002	5C003																											
	5C002	5C003	30	CPR	409	5226	M148	15	412.1	1248	Investigation	155187	9/20/99			M	0.20			Smooth									
	5C003	5C004																											
	5C003	5C004	30	CPR	496	5472	M148	16	500.9	1248	Investigation	155188	9/20/99			M	0.20			Smooth									
	5C004	5C005																											
	5C004	5C005												504				MH lined/coated(?)											
	5C004	5C005	30	CPR	504	5732	M148	17	499.6	1248	Investigation	155189	9/20/99			M	0.20			Smooth									
	5C005	5C006																											
	5C005	5C006												407		M		Worst corrosion area											
	5C005	5C006	30	CPR	728	0	M149	1	732	1246	Routine	80270	11/6/95			M	0.15			Smooth									
	5C006	6C001																											
	5C006	6C001												50															
	5C006	6C001	30	CPR	514	1050	M149	2	520.7	1246	Routine	80275	11/6/95			M	0.15			Smooth									
	6C001	6C002																											
	6C001	6C002	30	CPR	385	1542	M149	3	384.6	1246	Routine	83502	11/6/95			M	0.15			Smooth									
	6C001	6C002																			6C001 + 0.0		-	-	-	-			
River Front	13G001	13G002																											

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	13G001	13G002	54	CPR	538	1862	M149	4	546	1248	Investigation	155328	9/23/99			L	0.20			Smooth									
	13G001	13G002																			12G037+1028	1047.0-1062.5	L	L					
	13G001	13G002																			12G037+1028	1136.8-1166.5			L	L			
	13G001	13G002																			12G037+1028	1166.5-1181.2	L	L	L	L			
	13G001	13G002																			12G037+1028	1181.2-1211.7			L	L			
	13G001	13G002																			12G037+1028	1211.7-1226.2	L	M					
	13G001	13G002																			12G037+1028	1257.0-1346.1	L	M					
	13G001	13G002																			12G037+1028	1376.1-1391.4	L	M					
	13G001	13G002																			12G037+1028	1406.9-1436.9	L	M					
	13G001	13G002																			12G037+1028	1451.9-1466.1	L	M					
	13G001	13G002																			12G037+1028	1496.3-1511.3	L	M					
	13G002	13G003																											
	13G002	13G003	54	CPR	180	2261	M149	5	207.1	1248	Investigation	155329	9/23/99			L	0.20			Smooth									
	13G002	13G003																			12G037+1574	1601.5-1668.7	L	M					
	13G002	13G003																			12G037+1574	1700.0-1715.3	L	M					
	13G002	**13G003**																			12G037+1574	1730.2-1780.9	L	M					
	13G003	13G004																											
	13G003	13G004	54	CPR	124	2557	M149	6	116.3	1248	Investigation	155330	9/23/99			L	0.20			Smooth									
	15G002	15G013																											
	15G002	15G013	54	CPR	843	2749	M149	7	Cannot Locate Info							L	0.20			Smooth									
	15G013	15G014																											
	15G013	15G014	54	CPR	780	3169	M149	8	688.07	1248	Investigation	155816	9/27/99			L	0.15			Smooth									
	15G014	15H110																											
	15G014	15H110	54	CPR	748	3705	M149	9	845.1	1248	Investigation	155817	9/27/99			L	0.15			Smooth									
	16G001	16H001																											
	16G001	16H001	60	CPR	694	4043	M149	10	694.9	1248	Investigation	155818	9/27/99			L	0.20			Smooth									
Rebsamen	2B004	2B005																											
	2B004	2B005	30	Liner	508	4488	M149	11	511.3	1248	Investigation	156062	10/5/99				0.25			Turbulent									
	2B005	3B001																											
	2B005	3B001												63		S		Rebar ribs(?)											
	2B005	3B001												88		S		Rebar ribs(?), Coated(?)											
	2B005	3B001	30	Liner	596	4655	M149	12	602.4	1248	Investigation	156063	10/5/99			M	0.25			Turbulent									
	3B001	3B002																											
	3B001	3B002												109		S		Rebar ribs											
	3B001	3B002												231		S		Rebar ribs											
	3B001	3B002												340		S		Corrosion											
	3B001	3B002	30	CPR	339	5086	M149	13	341.5	1246	Routine	74080	10/30/95			M	0.20			Smooth									
	3B002	3B003																											
	3B002	3B003												196	Crack(?)			Crack(?)											
	3B002	3B003	30	CPR	453	5312	M149	14	453.7	1248	Investigation	156065	10/6/99			M	0.20			Smooth									
	3B003	3B004																											
	3B003	3B004												112	Leaky joint(?)			Leaky joint(?)											
	3B003	3B004	30	CPR	621	5588	M149	15	627.1	1248	Investigation	156188	10/6/99			M	0.20			Smooth									
Brodie	4M014	4M013																											
	4M014	4M013												275				Flaking at crown of pipe											
	4M014	4M013	42	CPR	301	0	M150	1	332.9	1248	Investigation	153397	8/18/99																
	4M013	4M012																											
	4M013	4M012	42	CPR	245	412	M150	2	Cannot Locate Info					50			4 inches			Quiescent									
	4M012	4L013																											
	4M012	4L013												414				Debris	L										
	4M012	4L013												516	Conn or I&I			Conn or I&I											
	4M012	4L013												538	Conn or I&I			Conn or I&I											
	4M012	4L013	42	CPR	655	801	M150	3	Cannot Locate Info					50		L													
South 60	5L052	5L051																											
	5L052	5L051	36	CPR	297	1826	M150	4	300	1248	Investigation	156017	10/4/99				0.70			Smooth									
Rebsamen	3B004	3B044																											
	3B004	3B044	30	CPR	695	2081	M150	5	698.3	1246	Routine	74091	11/1/95	50		M	0.20			Smooth									
	3B044	3B005																											
	3B044	3B005												179	(?) Leak			(?) Leak											
	3B044	3B005												460	Connection with leak			Connection with leak											
	3B044	3B005												695		L													
	3B044	3B005	30	CPR	72	2868	M150	6	70.4	1248	Investigation	156190	10/6/99																
	3B005	3B006																											
	3B005	3B006	30	CPR	202	3005	M150	7	206.7	1246	Routine	74094	10/31/95	50		M	0.25			Smooth									
	3B006	4B001																											
	3B006	4B001												50		M	0.25			Smooth									
	3B006	4B001	30	CPR	521	3142	M150	8	515.6	1248	Investigation	156248	10/7/99	350		M	0.20			Smooth									
River Front	17H002	17H003																											
	17H002	17H003	60	CPR	799	3543	M150	9	799.2	1248	Investigation	156249	10/7/99	100		L	0.15			Smooth									
	17H003	17H004																											
	17H003	17H004	60	CPR	756	4124	M150	10	755.2	1248	Investigation	156250	10/7/99	516		M	0.25												
Lower Swaggerty	11K168	11L041																											
	11K168	11L041												22				Debris	L										
	11K168	11L041												120	Dripping			Dripping											
	11K168	11L041	24	Vylon PVC	270	0	Misc.	1	297.8	1248	Investigation	143187	8/5/99				0.15			Smooth									
	11L041	11L040																											
	11L041	11L040	24	Vylon PVC	398	434	Misc.	2	409	1248	Investigation	143189	8/5/99				0.15			Smooth									
	11L040	11L024																											

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	11L040	11L024	24	Vylon PVC	172	823	Misc.	3	175.7	1248	Investigation	143190	8/5/99				0.15			Smooth									
	11L024	11L023																											
	11L024	11L023	24	Vylon PVC	326	1068	Misc.	4	331.3	1248	Investigation	143191	8/5/99				0.15			Smooth									
	11L023	11L042																											
	11L023	11L042																Slime and scum buildup											
	11L023	11L042	24	Vylon PVC	248	1350	Misc.	5	251.4	1248	Investigation	143192	8/5/99				0.15			Smooth									
Port	22M002	22M001																											
	22M002	22M001												49				Concentration at point											
	22M002	22M001	24	CPN	79	1615	Misc.	6	88	1248	Investigation	157182	10/25/99				0.10			Smooth									
Brodie-Hindman-Div	2O024	2O025															No flow												
	2O024	2O025	24	DIP	65	1847	Misc.	7	67.8	1245	Final Inspection	115515	5/3/99																
	2O025	2O026																											
	2O025	2O026	24	DIP	224	1926	Misc.	8	224.9	1245	Final Inspection	115516	5/3/99			L	No Flow												
	2O026	2O007																											
	2O026	2O007	24	DIP	98	2090	Misc.	9	106.1	1245	Final Inspection	115517	5/3/99			L	0.00												
65th Industrial Relay	8N012	8N004																											
	8N012	8N004	24	Hobas	293	2221	Misc.	10	298.9	1248	Investigation	143186	8/4/99				0.20	Scum buildup		Smooth									
	8N004	8N012																			8N004+0.0	6.5-21.5			M	M			
	8N004	8N012																			8N004+0.0	21.5-37.5			L	M			
	8N004	8N012																			8N004+0.0	37.5-56.6	L	M	L	M			
	8N004	8N012																			8N004+0.0	56.6-66.7	L	M	M	S			
	8N004	8N012																			8N004+0.0	66.7-80.7			M	M			
	8N004	8N012																			8N004+0.0	80.7-143.8			S	S			
	8N004	8N012																			8N004+0.0	143.8-298.0			M	M			
65th Industrial	8N010	8N009																											
	8N010	8N009	24	CIP	276	2404	Misc.	11	341.5	1246	Routine	90695	6/27/96				No Flow												
	8N009	8N010																			8N004+1049.0	1049.0-1471.4			L	L			
Rebsamen	7C008	7C009																											
	7C008	7C009	42	CPN	1260	3103	Misc.	12	696	1248	Investigation	144632	4/22/99			L	0.25			Smooth									
	7C009	7C010																											
	7C009	7C010												240		L		Light corrosion											
	7C009	7C010	42	CPN	620	3773	Misc.	13	647.1	1248	Investigation	144634	4/20/99				0.25			Smooth									
Rock Creek	3H074	3H076																											
	3H074	3H076	24	CPR	216	4221	Misc.	14	228.9	1248	Investigation	170745	6/12/00				No Flow												
North 60	10L008	10L007																											
	10L008	10L007	48	CPR	581	4345	Misc.	15	300	1248	Investigation	156017	10/4/99			M	0.20			Smooth									
Rebsamen	3B044	3B005																											
	3B044	3B005	30	CPR	73	4679	Misc.	16	592.4	1248	Investigation	154036	8/30/99	50		M	0.15			Smooth									
South 60	5L052	5L051																											
	5L052	5L051	36	CPR	297	4770	Misc.	17	300	1248	Investigation	156017	10/4/99				0.40			Smooth									
North 60	6K108	6K109																											
	6K108	6K109												50		L													
	6K108	6K109	30	CPR	224	0	M201	1	330.7	1248	Investigation	172463	7/10/00	224		L													
	6K108	6K109																			6K104+34.0	63.2-78.0	L	L					
	6K108	6K109																			6K104+34.0	93.5-183.2	L	M					
	6K108	6K109																			6K104+34.0	213.4-245.7	L	L					
	6K109	7K108	42	CPR	517	477	M201	2	413.6	1248	Investigation	172487	7/10/00																
	6K109	7K108			413																6K109+0.0	0.0-60.2			M	M			
	6K109	7K108																			6K109+0.0	60.2-135.5			L	M			
	6K109	7K108																			6K109+0.0	135.5-151.2			M	M			
	6K109	7K108																			6K109+0.0	151.2-405.6			L	L			
	6K109	7K108																			6K109+0.0	450.3-517.0			L	L			
	4L016	4L012																			4L016+0.0								
	4L016	4L012																			4L016+0.0	396.1-410.9	L	L					
	4L012	4L011																			4L016+445.0								
	4L012	4L011																			4L016+445.0	452.2-467.2	L	M					
	4L012	4L011																			4L016+445.0	542.7-557.2	L	L					
	4L012	4L011																			4L016+445.0	633.2-647.9	L	L					
	4L012	4L011																			4L016+445.0	677.4-692.3	L	M					
	4L012	4L011																			4L016+445.0	722.3-737.6	L	M					
	4L011	5M030																			4L016+752.0								
	4L011	5M030																			4L016+752.0	812.3-827.3							
	4L011	5M030																			4L016+752.0	872.8-887.3	L	L					
	4L011	5M030																			4L016+752.0	902.0-932.8	L	M					
	4L011	5M030																			4L016+752.0	1082.0-1187.0	L	M					
	4L011	5M030																			4L016+752.0	1247.1-1262.6	L	M					
	5M030	5M031																			4L016+1309.0								
	5M030	5M031																			4L016+1309.0	1437.4-1468.2	L	M					
	5M030	5M031																			4L016+1309.0	1512.6-1603.4	L	M					
	5M030	5M031																			4L016+1309.0	1648.3-1888.0	L	M					
	5M030	5M031																			4L016+1309.0	1902.7-1918.5	L	L					
	5M031	5L055																			4L016+1944.0								
	5M031	5L055																			4L016+1944.0	1947.4-2008.9	L	L					
	5M031	5L055																			4L016+1944.0	2039.2-2129.1	L	M					
	5M031	5L055																			4L016+1944.0	2159.6-2324.3	L	M					
	5L055	5L059																			4L016+2308.0								

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	5L055	**5L059**																			4L016+2308.0	2354.0-2377.6	M	M					
	4N017	4N010																			4N017+0.0								
	4N010	4N009																			4N017+254.0								
	4N009	4N008																			4N017+478.0								
	4N009	4N008																			4N017+478.0	585.9-600.9			L	M			
	4N009	4N008																			4N017+478.0	692.2-707.2			L	M			
	4N009	4N008																			4N017+478.0	707.2-722.2	L	L					
	4N009	4N008																			4N017+478.0	781.9-841.9			L	L			
	4N008	4N004																			4N017+872.0								
	4N008	4N004																			4N017+872.0	961.8-976.8			L	L			
	4N008	4N004																			4N017+872.0	1097.0-1112.2			L	L			
	4N004	4N003																			4N017+1333.0								
	4N004	4N003																			4N017+1333.0	1434.8-1449.5			L	L			
	4N003	**4N002**																			4N017+1608.0								
	4N002	4N001																			4N002+0.0								
	4N001	5N001																			4N002+318.0								
	5N001	5M008																			4N002+624.0								
	5M008	5M007																			4N002+1032.0								
	5M007	5M006																			4N002+1446.0								
	5M006	**5M005**																			4N002+1742.0								
	6K030	6K126																			6K030+0.0								
	6K030	6K126																			6K030+0.0	505.7-526.9	L	L					
	6K126	6K107																			6K030+540.0								
	6K107	6K106																			6K030+570.0								
	6K107	6K106																			6K030+570.0	712.4-727.1			L	L			
	6K106	**6K104**																			6K030+833.0								
	6K104	6K108																			6K104+0.0								
	6K104	6K108																			6K104+0.0	2.6-17.6	L	M					
	6K104	6K108																			6K104+0.0	17.6-32.8	M	M					
	7K108	7K013																			6K109+413.0								
	7K108	7K013																			6K109+413.0	517.0-549.4			L	L			
	7K108	7K013																			6K109+413.0	564.4-939.4			L	L			
	7K013	7K012																			6K109+967.0								
	7K013	7K012																			6K109+967.0	1045.1-1150.1			L	L			
	7K013	7K012																			6K109+967.0	1180.4-1195.6	L	M	L	L			
	7K013	7K012																			6K109+967.0	1195.6-1225.6			L	L			
	7K013	7K012																			6K109+967.0	1225.6-1240.6	L	L	L	L			
	7K013	7K012																			6K109+967.0	1240.6-1270.1			L	L			
	7K013	7K012																			6K109+967.0	1270.1-1285.8	L	L	L	L			
	7K013	7K012																			6K109+967.0	1285.8-1360.3			L	L			
	7K013	7K012																			6K109+967.0	1360.3-1375.0	L	L	L	M			
	7K013	7K012																			6K109+967.0	1375.0-1483.3			L	M			
	7K013	**7K012**																			6K109+967.0	1483.3-1493.9	L	M					
	6L012	6I021																			6L012+0.0								
	6L012	6I021																			6L012+0.0	72.2-87.0	L	M					
	6L012	6I021																			6L012+0.0	117.0-132.7	L	L					
	6L012	6I021																			6L012+0.0	444.2-489.4	L	M	L	M			
	6L012	6I021																			6L012+0.0	489.4-609.6			L	M			
	6L021	6L020																			6L012+603.0								
	6L021	6L020																			6L012+603.0	609.6-624.4	L	L	L	L			
	6L021	6L020																			6L012+603.0	624.4-669.9			L	L			
	6L021	6L020																			6L012+603.0	669.9-684.6	L	L	L	L			
	6L021	6L020																			6L012+603.0	684.6-714.6			L	L			
	6L021	6L020																			6L012+603.0	714.6-744.0	L	L	L	L			
	6L021	6L020																			6L012+603.0	745.2-761.1			L	L			
	6L021	6L020																			6L012+603.0	761.1-835.8	L	L	L	L			
	6L021	6L020																			6L012+603.0	835.8-850.3			L	L			
	6L021	6L020																			6L012+603.0	850.3-911.0	L	M	L	M			
	6L021	6L020																			6L012+603.0	911.0-925.7	M	M	L	L			
	6L021	6L020																			6L012+603.0	925.7-956.0	L	M	L	L			
	6L020	6L019																			6L012+953.0								
	6L020	6L019																			6L012+953.0	956.0-970.5	M	M	L	L			
	6L020	6L019																			6L012+953.0	970.5-985.7			L	L			
	6L020	6L019																			6L012+953.0	985.7-1015.9	L	L	L	L			
	6L020	6L019																			6L012+953.0	1015.9-1030.7	M	M	L	L			
	6L020	6L019																			6L012+953.0	1046.2-1060.4	L	L	L	L			
	6L020	6L019																			6L012+953.0	1060.4-1091.2	L	L					
	6L020	6L019																			6L012+953.0	1120.4-1306.0	L	M					
	6L019	6L018																			6L012+1306.0								
	6L019	6L018																			6L012+1306.0	1306.0-1355.1	L	M					
	6L019	6L018																			6L012+1306.0	1369.8-1400.3	L	M					
	6L019	6L018																			6L012+1306.0	1429.5-1445.0	L	M					
	6L019	6L018																			6L012+1306.0	1475.3-1490.0	L	L					
	6L019	6L018																			6L012+1306.0	1505.0-1558.2	L	M					
	6L019	6L018																			6L012+1306.0	1558.2-1565.0			L	L			
	6L019	6L018																			6L012+1306.0	1565.0-1610.2	L	M	L	L			

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	6L019	6L018																			6L012+1306.0	1610.2-1625.7			L	L			
	6L019	6L018																			6L012+1306.0	1670.2-1685.2	L	L					
	6L018	6K116																			6L012+1698.0								
	6L018	6K116																			6L012+1698.0	1715.4-1775.1	L	M					
	6L018	6K116																			6L012+1698.0	1820.1-1910.6	L	M					
	6L018	**6K116**																			6L012+1698.0	1925.3-1995.6	L	M					
	8N002	8N004																			8N002+0.0								
	8N002	8N004																			8N002+0.0	266.7-281.9							
	8N002	8N004																			8N002+0.0	402.4-416.6	L	L					
	8N002	**8N004**																			8N002+0.0	476.6-492.3	L	L					
	8N012	8N008																			8N004+298.0								
	8N012	8N008																			8N004+298.0	298.0-516.8			M	M			
	8N012	**8N008**																			8N004+298.0	516.8-579.0			L	L			
	8N008	8N009																			8N004+579.0								
	8N008	8N009																			8N004+579.0	579.0-656.4			L	L			
	8N008	8N009																			8N004+579.0	706.5-764.4			L	L			
	8N008	8N009																			8N004+579.0	803.2-1049.0			L	L			
	9F053	10F005																			9F053+0.0								
	9F053	10F005																			9F053+0.0	145.5-160.5			L	L			
	9F053	10F005																			9F053+0.0	760.3-775.0			L	L			
	10F005	10G070																			9F053+775.0								
	10F005	10G070																			9F053+775.0	775.0-790.3	L	M	L	L			
	10F005	10G070																			9F053+775.0	790.3-950.3			L	M			
	10G070	10G069																			9F053+1337.0								
	10G070	10G069																			9F053+1337.0	1355.6-1375.8	L	M					
	10G070	10G069																			9F053+1337.0	1385.6-1430.3	L	M					
	10G069	**10G086**																			9F053+1546.0								
	9L008	9L007																			9L008+0.0								
	9L008	9L007																			9L008+0.0	37.4-52.9	L	L					
	9L008	9L007																			9L008+0.0	202.8-232.5	L	L					
	9L008	9L007																			9L008+0.0	262.8-277.8	L	L					
	9L007	10L006																			9L008+570.0								
	9L007	10L006																			9L008+570.0	610.1-625.1	L	M					
	10L006	10L005																			9L008+859.0								
	10L006	10L005																			9L008+859.0	901.6-1037.6			M	M			
	10L006	10L005																			9L008+859.0	1037.6-1336.6			L	M			
	10L006	**10L005**																			9L008+859.0	1412.7-1426.9			L	M			
	9L010	10L012																			9L010+0.0								
	9L010	10L012																			9L010+0.0	226.0-240.5	L	M					
	9L010	10L012																			9L010+0.0	255.5-270.7	L	M					
	9L010	10L012																			9L010+0.0	285.0-315.5	L	M					
	9L010	10L012																			9L010+0.0	315.5-330.7	L	M	L	L			
	9L010	10L012																			9L010+0.0	330.7-420.9	L	M					
	10L012	10L011																			9L010+418.0								
	10L012	10L011																			9L010+418.0	450.1-495.9			L	M			
	10L012	10L011																			9L010+418.0	526.7-601.9	L	M					
	10L012	10L011																			9L010+418.0	632.1-691.8	L	M					
	10L012	10L011																			9L010+418.0	707.1-782.6	L	M					
	10L012	10L011																			9L010+418.0	782.6-811.8	M	M					
	10L012	10L011																			9L010+418.0	811.8-856.8	L	M					
	10L012	**10L011**																			9L010+418.0	902.8-937.9	L	M					
	10L001	11L085																			10L001+0.0								
	11L085	11L007																			10L001+230.0								
	11L085	**11L007**																			10L001+230.0	233.1-329.8	L	M					
	10L007	11L017																			10L007+0.0								
	10L007	11L017																			10L007+0.0	2.8-32.8			L	L			
	11L017	11L110																			10L007+200.0								
	11L017	**11L110**																			10L007+200.0	243.7-365.7	L	M					
	10M002	10M003																			10M002+0.0								
	10M002	10M003																			10M002+0.0	19.3-34.8	L	L					
	10M002	10M003																			10M002+0.0	215.2-259.4	L	L					
	10M002	10M003																			10M002+0.0	274.6-304.4	L	L					
	10M003	10M004																			10M002+312.0								
	10M003	10M004																			10M002+312.0	424.6-471.1	L	L					
	10M003	10M004																			10M002+312.0	485.1-546.6	L	M					
	10M003	10M004																			10M002+312.0	556.4-824.0	M	M					
	10M004	10M005																			10M002+824.0								
	10M004	**10M005**																			10M002+824.0	824.0-1358.8	M	M					
	10M017	**10M003**																			10M017+0.0								
	12G037	12G017																			12G037+0.0								
	12G037	12G017																			12G037+0.0	21.0-66.0	L	M					
	12G037	12G017																			12G037+0.0	81.5-216.2	L	M					

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	12G037	12G017																			12G037+0.0	232.4-246.1	L	M	L	L			
	12G037	12G017																			12G037+0.0	246.1-261.9			L	L			
	12G037	12G017																			12G037+0.0	261.9-276.1	L	L	L	L			
	12G037	12G017																			12G037+0.0	276.1-306.4			L	M			
	12G037	12G017																			12G037+0.0	306.4-321.9	L	M	L	L			
	12G017	12G016																			12G037+330.0								
	12G017	12G016																			12G037+330.0	351.6-366.1			L	M			
	12G017	12G016																			12G037+330.0	381.6-411.1	L	M					
	12G017	12G016																			12G037+330.0	411.1-426.3	L	M	L	M			
	12G017	12G016																			12G037+330.0	426.3-441.6			L	L			
	12G017	12G016																			12G037+330.0	441.6-456.0	L	L					
	12G017	12G016																			12G037+330.0	486.8-501.3	L	M					
	12G017	12G016																			12G037+330.0	537.0-582.5	L	M					
	12G017	12G016																			12G037+330.0	597.2-642.0	L	L					
	12G017	12G016																			12G037+330.0	658.0-673.0	L	M					
	12G017	12G016																			12G037+330.0	673.0-687.2			L	L			
	12G016	13G001																			12G037+330.0								
	12G016	13G001																			12G037+688.0	687.2-717.2	L	M	L	L			
	12G016	13G001																			12G037+688.0	717.2-732.7	L	M					
	12G016	13G001																			12G037+688.0	762.2-777.4	L	M					
	12G016	13G001																			12G037+688.0	822.4-837.1	L	L					
	12G016	13G001																			12G037+688.0	852.1-867.6			L	L			
	12G016	13G001																			12G037+688.0	867.6-882.6	L	M	L	L			
	12G016	13G001																			12G037+688.0	942.3-972.3	L	M					
	12G016	13G001																			12G037+688.0	1000.2-1032.5	L	M					
	14K016	14K025																			14K016+0.0								
	14K016	14K025																			14K016+0.0	35.3-138.5			L	L			
	14K016	14K025																			14K016+0.0	138.5-152.7	L	L	L	L			
	14K016	14K025																			14K016+0.0	152.7-197.9			L	L			
	14K016	14K025																			14K016+0.0	197.9-213.2	L	M	L	L			
	14K016	14K025																			14K016+0.0	213.2-228.4			L	L			
	14K016	14K025																			14K016+0.0	228.4-242.6	L	M	L	L			
	14K016	14K025																			14K016+0.0	288.1-302.6	L	M					
	14K016	14K025																			14K016+0.0	333.4-377.6			L	L			
	14K016	14K025																			14K016+0.0	377.6-393.1	L	M	L	L			
	14K016	14K025																			14K016+0.0	393.1-408.6			L	L			
	14K016	14K025																			14K016+0.0	408.6-422.8	L	M	L	L			
	14K016	14K025																			14K016+0.0	422.8-482.8			L	L			
	14K025	14K028																			14K016+483.0								
	14K025	14K028																			14K016+483.0	483.6-499.6	L	M	L	L			
	14K025	14K028																			14K016+483.0	499.6-513.8			L	L			
	14K025	14K028																			14K016+483.0	513.8-528.8	L	L	M	M			
	14K025	14K028																			14K016+483.0	528.8-604.6	L	M	L	L			
	14K025	14K028																			14K016+483.0	604.6-648.8			L	L			
	14K025	14K028																			14K016+483.0	648.8-694.3	L	M	L	L			
	14K025	14K028																			14K016+483.0	694.3-723.7	L	M					
	14K028	14K037																			14K016+725.0								
	14K028	14K037																			14K016+725.0	754.5-783.7	M	M					
	14K028	14K037																			14K016+725.0	783.7-814.0	L	L					
	14K028	14K037																			14K016+725.0	858.7-903.9	L	M	L	L			

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	14K028	14K037																			14K016+725.0	903.9-933.6	L	M					
	14K028	14K037																			14K016+725.0	963.6-1012.0	L	M					
	14K028	14K037																			14K016+725.0	1026.9-1117.4	L	M					
	14K028	14K037																			14K016+725.0	1132.4-1147.9	L	M					
	14K028	14K037																			14K016+725.0	1162.7-1177.1	L	M					
	14K028	14K037																			14K016+725.0	1192.6-1281.8	L	M					
	14K028	**14K037**																			14K016+725.0	1297.6-1311.3	L	M					
	14K051	15K012																			14K051+0.0								
	14K051	15K012																			14K051+0.0	90.5-150.4	L	M					
	14K051	15K012																			14K051+0.0	165.4-210.4	L	M					
	14K051	15K012																			14K051+0.0	256.2-285.4	L	M					
	14K051	**15K012**																			14K051+0.0	331.4-335.8	L	L					
	14K047	14K057																			14K047+0.0								
	14K047	14K057																			14K047+0.0	3.5-48.5	L	M	L	M			
	14K047	14K057																			14K047+0.0	48.5-63.7	M	M	L	M			
	14K047	14K057																			14K047+0.0	63.7-93.5	L	M	L	M			
	14K047	14K057																			14K047+0.0	93.5-108.5	L	M					
	14K047	14K057																			14K047+0.0	124.0-169.5			L	M			
	14K047	14K057																			14K047+0.0	169.5-183.7	M	M	L	L			
	14K047	14K057																			14K047+0.0	184.2-203.0			L	L			
	14K057	14K048																			14K047+203.0								
	14K057	14K048																			14K047+203.0	203.0-229.7			L	L			
	14K057	14K048																			14K047+203.0	229.7-244.7	M	M	M	M			
	14K057	14K048																			14K047+203.0	244.7-259.2	L	M					
	14K057	14K048																			14K047+203.0	259.2-289.9	L	M	L	L			
	14K057	14K048																			14K047+203.0	289.9-304.4	L	M					
	14K057	14K048																			14K047+203.0	304.4-320.2	L	M	L	L			
	14K057	14K048																			14K047+203.0	320.2-334.9	L	M					
	14K057	14K048																			14K047+203.0	334.9-379.6	M	M					
	14K057	14K048																			14K047+203.0	379.6-394.6	L	L	L	L			
	14K057	14K048																			14K047+203.0	394.6-409.4	M	M	L	L			
	14K057	14K048																			14K047+203.0	409.4-425.4	M	M					
	14K057	14K048																			14K047+203.0	425.4-439.6	M	M	L	L			
	14K057	14K048																			14K047+203.0	439.6-445.0			L	L			
	14K048	14K049																			14K047+445.0								
	14K048	14K049																			14K047+445.0	445.0-484.8			L	L			
	14K048	14K049																			14K047+445.0	484.8-500.6	L	L					
	14K048	14K049																			14K047+445.0	559.5-574.5	L	M	L	L			
	14K048	14K049																			14K047+445.0	634.8-650.5	L	M					
	14K048	14K049																			14K047+445.0	650.5-664.5	M	M					
	14K048	14K049																			14K047+445.0	828.7-844.4			L	L			
	14K048	14K049																			14K047+445.0	844.4-860.2	M	M	L	L			
	14K048	14K049																			14K047+445.0	860.2-941.1	M	M					
	14K049	14K050																			14K047+943.0								
	14K049	14K050																			14K047+943.0	941.1-971.4	L	L	L	L			
	14K049	14K050																			14K047+943.0	971.4-1050.7	M	M					
	14K049	14K050																			14K047+943.0	1050.7-1066.2	L	M	L	L			

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

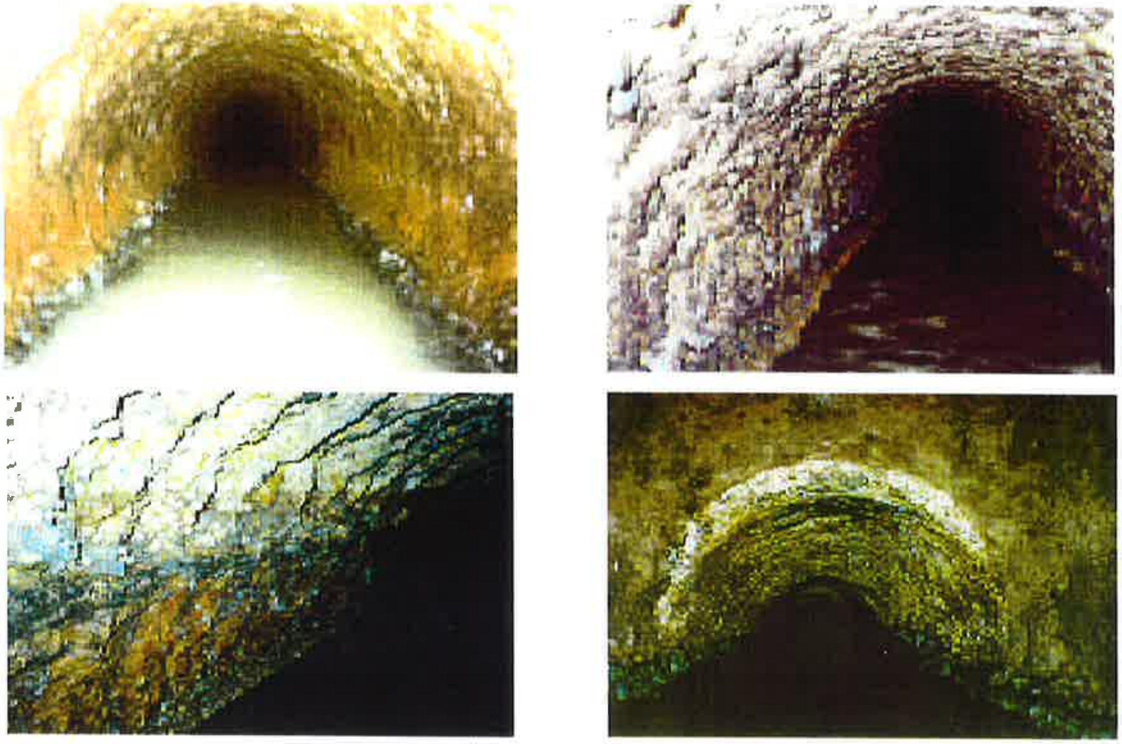
Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	14K049	14K050																			14K047+943.0	1066.2-1082.2			L	L			
	14K049	14K050																			14K047+943.0	1082.2-1114.6	L	M	L	L			
	14K049	14K050																			14K047+943.0	1114.6-1129.6	M	M					
	14K049	14K050																			14K047+943.0	1129.6-1176.9	L	M					
	14K049	14K050																			14K047+943.0	1208.7-1229.0	L	M					
	14K050	14K051																			14K047+1229.0								
	14K050	14K051																			14K047+1229.0	1229.0-1240.7	L	M					
	14K050	14K051																			14K047+1229.0	1288.8-1351.9			L	M			
	14K050	**14K051**																			14K047+1229.0	1351.9-1382.9	L	L	L	L			
	16K005	16K004																			16K005+0.0								
	16K005	16K004																			16K005+0.0	140.5-155.5	M	M					
	16K005	16K004																			16K005+0.0	155.5-185.2	L	L					
	16K005	16K004																			16K005+0.0	230.2-306.2	L	M					
	16K005	16K004																			16K005+0.0	493.9-553.8	L	M					
	16K005	16K004																			16K005+0.0	553.8-598.8	L	M	L	L			
	16K005	16K004																			16K005+0.0	598.8-613.8	M	M	L	L			
	16K005	16K004																			16K005+0.0	613.8-628.3	M	M					
	16K005	16K004																			16K005+0.0	628.3-673.5	L	M					
	16K005	16K004																			16K005+0.0	673.5-679.0	L	M	L	L			
	16K004	16K003																			16K005+679.0								
	16K004	16K003																			16K005+679.0	679.0-685.0	L	M	L	L			
	16K003	16K002																			16K005+685.0								
	16K003	16K002																			16K005+685.0	685.0-704.0	L	M	L	L			
	16K003	16K002																			16K005+685.0	704.0-734.0	L	M					
	16K003	16K002																			16K005+685.0	833.1-923.5	L	M					
	16K003	16K002																			16K005+685.0	923.5-938.3	M	M					
	16K003	16K002																			16K005+685.0	938.3-942.0	L	M					
	16K002	16K001																			16K005+942.0								
	16K002	16K001																			16K005+942.0	942.0-968.5	L	M					
	16K002	16K001																			16K005+942.0	1103.4-1163.4	L	M					
	16K002	16K001																			16K005+942.0	1163.4-1193.1	M	M					
	16K002	16K001																			16K005+942.0	1193.1-1208.1	L	L					
	16K002	16K001																			16K005+942.0	1420.6-1458.0	L	M					
	16K001	17K010																			16K005+1458.0								
	16K001	17K010																			16K005+1458.0	1458.0-1480.9	L	M					
	16K001	17K010																			16K005+1458.0	1495.6-1541.1	L	M					
	16K001	17K010																			16K005+1458.0	1541.1-1555.6	M	M					
	16K001	17K010																			16K005+1458.0	1555.6-1691.0	L	M					
	16K001	17K010																			16K005+1458.0	1928.1-1943.6	L	M					
	16K001	17K010																			16K005+1458.0	1958.0-1973.0	L	M					
	16K001	17K010																			16K005+1458.0	2153.0-2167.7	L	M					
	16K001	17K010																			16K005+1458.0	2167.7-2183.7	M	M					
	16K001	**17K010**																			16K005+1458.0	2183.7-2194.1	L	M					
	17K010	17K009																			17K010+0.0								
	17K010	17K009																			17K010+0.0	293.8-308.8	L	L					
	17K010	17K009																			17K010+0.0	461-6-491.5	L	L					
	17K009	17K008																			17K010+589.0								

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	17K009	17K008																			17K010+589.0	613.6-643.6	L	M					
	17K009	17K008																			17K010+589.0	659.9-674.3	M	M					
	17K009	17K008																			17K010+589.0	674.3-719.6	L	M					
	17K008	17K007																			17K010+768.0								
	17K008	17K007																			17K010+768.0	824.0-839.5	L	L					
	17K008	17K007																			17K010+768.0	868.7-914.5	L	M					
	17K008	17K007																			17K010+768.0	928.7-958.9	L	M					
	17K008	17K007																			17K010+768.0	988.7-1049.7	L	M					
	17K008	17K007																			17K010+768.0	1137.5-1167.0	L	M					
	17K008	17K007																			17K010+768.0	1182.3-1196.7	L	L					
	17K007	17K006																			17K010+1200.0								
	17K007	17K006																			17K010+1200.0	1211.5-1332.2	L	M					
	17K007	17K006																			17K010+1200.0	1347.2-1361.9	L	M					
	17K007	17K006																			17K010+1200.0	1377.4-1391.6	L	M					
	17K007	17K006																			17K010+1200.0	1406.6-1422.1	L	M					
	17K007	17K006																			17K010+1200.0	1466.9-1481.9	L	M					
	17K007	17K006																			17K010+1200.0	1496.6-1511.6	L	M					
	17K007	17K006																			17K010+1200.0	1526.8-1542.1	L	M					
	17K007	17K006																			17K010+1200.	1542.1-1556.8	M	M					
	17K007	17K006																			17K010+1200.0	1649.9-1665.6	L	M					
	17K007	**17K006**																			17K010+1200.0	1679.4-1709.6	L	M					
	18J013	18J014																			18J013+0.0								
	18J013	18J014																			18J013+0.0	3.5-36.3	M	M					
	18J013	18J014																			18J013+0.0	36.3-63.7	L	M					
	18J013	18J014																			18J013+0.0	78.5-153.7	L	M					
	18J013	18J014																			18J013+0.0	153.7-169.2	M	M					
	18J013	18J014																			18J013+0.0	169.2-258.9	L	M					
	18J013	18J014																			18J013+0.0	273.9-289.4	M	M					
	18J013	18J014																			18J013+0.0	289.4-303.9	L	M					
	18J013	18J014																			18J013+0.0	319.1-333.9	L	M					
	18J013	18J014																			18J013+0.0	333.9-349.4	M	M					
	18J013	18J014																			18J013+0.0	349.4-363.8	L	M					
	18J013	18J014																			18J013+0.0	379.4-423.8	L	M					
	18J013	18J014																			18J013+0.0	439.3-453.8	L	M					
	18J013	18J014																			18J013+0.0	453.8-469.1	M	M					
	18J013	18J014																			18J013+0.0	469.1-539.6	L	M					
	18J013	18J014																			18J013+0.0	539.6-554.1	M	M					
	18J013	18J014																			18J013+0.0	554.1-644.3	L	M					
	18J013	18J014																			18J013+0.0	674.8-719.8	L	M					
	18J013	18J014																			18J013+0.0	734.8-755.0	L	M					
	18J014	18J015																			18J013+755.0								
	18J014	18J015																			18J013+755.0	755.0-840.0	L	M					
	18J014	18J015																			18J013+755.0	840.0-854.7	M	M					
	18J014	18J015																			18J013+755.0	854.7-869.4	L	M					
	18J014	18J015																			18J013+755.0	884.2-899.7	L	M					
	18J014	18J015																			18J013+755.0	899.7-914.4	M	M					
	18J014	18J015																			18J013+755.0	914.4-929.2	L	M					
	18J014	18J015																			18J013+755.0	929.2-974.9	M	M					
	18J014	18J015																			18J013+755.0	974.9-989.9	L	M					
	18J014	18J015																			18J013+755.0	1004.9-1034.6	L	M					
	18J014	18J015																			18J013+755.0	1050.1-1087.6	M	M					
	18J014	18J015																			18J013+755.0	1088.9-1119.4	L	M					
	18J014	18J015																			18J013+755.0	1164.4-1208.0	L	M					
	18J015	19J001																			18J013+1208.0								
	18J015	19J001																			18J013+1208.0	1208.0-1239.1	L	M					
	18J015	19J001																			18J013+1208.0	1239.1-1374.0	M	M					
	18J015	19J001																			18J013+1208.0	1374.0-1419.5	L	M					

Table TME-1: Large Diameter Pipeline Investigation Condition Database Table

Interceptor Designation	Interceptor Reach Manhole Designation		Pipe Information			CCTV Inspection Data															Sonic Observation Data						External Conditions		
	Upstream	Downstream	Diameter in inches	Material	Length in feet	Reference Footage	CCTV Tape #	Line Segment	Televised Length	ACT Key	ACT Desc.	WONO	Date	Reference Footage	Defect	Corrosion	Flow Depth	Feature	Debris	Velocity	Locator	Reference Footage	Corrosion Average	Corrosion Max	Debris Average	Debris Max	Geotech	Surface	Ground-water
	18J015	19J001																			18J013+1208.0	1419.5-1449.2	M	M					
	18J015	19J001																			18J013+1208.0	1449.2-1464.5	L	M					
	18J015	19J001																			18J013+1208.0	1464.5-1480.0	M	M					
	18J015	19J001																			18J013+1208.0	1494.0-1540.0	L	L					
	18J015	19J001																			18J013+1208.0	1540.0-1599.2	M	M					
	18J015	19J001																			18J013+1208.0	1599.2-1614.4	L	M					
	18J015	19J001																			18J013+1208.0	1614.4-1630.0	M	M					
	19J001	19I001																			18J013+1630.0								
	19J001	19I001																			18J013+1630.0	1630.0-1636.9	M	M					
	19J001	19I001																			18J013+1630.0	1639.0-1669.2	L	M					
	19J001	19I001																			18J013+1630.0	1669.2-1684.8	M	M					
	19J001	19I001																			18J013+1630.0	1684.8-1699.0	L	M					
	19J001	19I001																			18J013+1630.0	1699.0-1759.0	M	M					
	19J001	19I001																			18J013+1630.0	1759.0-1774.2	L	M					
	19J001	19I001																			18J013+1630.0	1774.2-1790.0	M	M					
	19J001	19I001																			18J013+1630.0	1790.0-1834.7	L	M					
	19J001	19I001																			18J013+1630.0	1834.7-2014.3	M	M					
	19J001	19I001																			18J013+1630.0	2014.3-2029.1	L	M					
	19J001	19I001																			18J013+1630.0	2029.1-2071.0	M	M					



LITTLE ROCK WASTEWATER UTILITY

HYDRAULIC MODELING/COLLECTION SYSTEM FACILITY PLAN
SECAP
SYSTEM EVALUATION AND CAPACITY ASSURANCE PLAN

LARGE DIAMETER
SEWER INVESTIGATION
APPENDIX D
FINAL DRAFT

JUNE 2001

MONTGOMERY WATSON

LITTLE ROCK
WASTEWATER UTILITY

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Little Rock Wastewater Master Plan
Job No. 147004
Incoming Document No. ________

CCTV OF LARGE DIAMETER SEWER INTERCEPTORS SEGMENTS

Provided to Montgomery Watson

INTERCEPTOR	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	LENGTH FEET	PIPE SIZE INCHES	PIPE MATERIAL	TAPE NUMBER	LINE SEGMENT NUMBER	LOCATION COUNTER	COMMENTS
BRODIE	2O001	3O002	628	42	CPR	M144	1	0	
BRODIE	3O002	3O001	261	42	CPR	M144	2	700	
BRODIE	3N003	3N004	840	42	CPR	M144	3	955	
BRODIE	3N004	3N005	485	42	CPR	M144	4	1638	
BRODIE	3N005	4N089	781	42	CPR	M144	5	2091	
BRODIE	4N089	4N014	683	42	CPR	M144	6	2772	
BRODIE	4N014	4M016	688	42	CPR	M144	7	3361	
BRODIE	4M016	4M015	741	42	CPR	M144	8	3880	
BRODIE	4M014	4M013	317	42	CPR	M144	9	4397	
SOUTH 60	5L051	5L050	645	48	CPR	M144	10	4651	
SOUTH 60	5L059	5L053	208	48	CPR	M144	11	5277	
SOUTH 60	5L053	5L052	656	48	CPR	M144	12	5452	
NORTH 60	10L009	10L008	594	48	CPR	M144	13	5642	
NORTH 60	9K009	9K008	581	48	CPR	M146	1	0	
NORTH 60	9K008	9K007	468	48	CPR	M146	2	735	
NORTH 60	9K007	9L012	663	48	CPR	M146	3	1256	
NORTH 60	9L012	9L011	356	48	CPR	M146	4	1915	
REBSAMEN	7C007	7C006	383	42	CPR	M146	5	2227	
REBSAMEN	7C006	7C005	329	42	CPR	M146	6	2658	LATERAL LEFT
REBSAMEN	7C005	7C008	565	42	CPR	M146	7	2964	
BRODIE	OM056	0M055	194	24	CPR	M146	8	3278	
BRODIE	0M055	0M054	168	24	CPR	M146	9	3393	
BRODIE	0M054	0M053	605	24	CPR	M146	10	3535	
BRODIE	0M053	0M052	485	24	CPR	M146	11	4029	
BRODIE	0M052	0N029	214	24	CPR	M146	12	4470	
BRODIE	0N003	0N002	593	36	CPR	M146	13	4685	
BRODIE	0N002	0N001	721	36	CPR	M146	14	5187	
BRODIE	0N001	1N024	568	36	CPR	M146	15	5394	
BRODIE	1N024	1N023	534	36	CPR	M146	16	5745	
REBSAMEN	8D096	8D006	513	42	CPR	M147	1	0	415 LEFT MAIN LIVE
REBSAMEN	8D004	8D003	693	42	CPR	M147	2	1006	196 LEFT MAIN LIVE, 594 LEFT MAIN CLEAR I/I
REBSAMEN	8D003	8D002	545	42	CPR	M147	3	2112	198 LEFT MAIN LIVE
REBSAMEN	9E002	9E043	407	42	CPR	M147	4	2496	9 LEFT MAIN LIVE, 406 LEFT MAIN LIVE (MH)
REBSAMEN	9E043	9E012	419	42	CPR	M147	5	2844	402 RIGHT MAIN LIVE
REBSAMEN	9E012	9E019	815	42	CPR	M147	6	3220	
REBSAMEN	9E019	9F011	409	42	CPR	M147	7	3619	409 LEFT MAIN LIVE (MH)
REBSAMEN	9F011	9F009	329	42	CPR	M147	8	3986	329 RIGHT MAIN LIVE (MH)
REBSAMEN	9F009	9F012	30	42	CPR	M147	9	4276	
REBSAMEN	9F012	9F013	674	42	CPR	M147	10	4335	
REBSAMEN	9F013	9F016	262	42	CPR	M147	11	4887	262 LEFT MAIN LIVE (MH)
REBSAMEN	9F016	9F018	288	42	CPR	M147	12	5067	
REBSAMEN	9F018	9F022	837	42	CPR	M147	13	5234	53 LEFT STUB LINE
REBSAMEN	8C002	8D094	423	42	CPR	M148	1	0	423 RIGHT MAIN LIVE (MH)
REBSAMEN	8D094	8D096	91	42	CPR	M148	2	738	

CCTV OF LARGE DIAMETER SEWER INTERCEPTORS SEGMENTS

Provided to Montgomery Watson

INTERCEPTOR	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	LENGTH FEET	PIPE SIZE INCHES	PIPE MATERIAL	TAPE NUMBER	LINE SEGMENT NUMBER	LOCATION COUNTER	COMMENTS
REBSAMEN	6C005	7C007	1056	42	CPR	M148	3	1018	
REBSAMEN	6C002	6C003	8	36	CPR	M148	4	2114	8 RIGHT MAIN LIVE (MH)
REBSAMEN	6C003	6C004	497	36	CPR	M148	5	2127	
REBSAMEN	6C004	6C005	647	36	CPR	M148	6	2803	
REBSAMEN	4B001	4B002	330	30	CPR	M148	7	3371	DETERIORATING
REBSAMEN	4B002	4B003	647	30	CPR	M148	8	3574	DETERIORATING
REBSAMEN	4B003	4B004	299	30	CPR	M148	9	4004	
REBSAMEN	4B004	4B005	336	30	CPR	M148	10	4238	DETERIORATING
REBSAMEN	4B005	4B006	467	30	CPR	M148	11	4447	
REBSAMEN	4B006	4C041	383	30	CPR	M148	12	4761	
REBSAMEN	4C041	5C001	278	30	CPR	M148	13	4987	278 RIGHT MAIN LIVE (MH)
REBSAMEN	5C001	5C002	107	30	CPR	M148	14	5141	
REBSAMEN	5C002	5C003	409	30	CPR	M148	15	5226	
REBSAMEN	5C003	5C004	496	30	CPR	M148	16	5472	
REBSAMEN	5C004	5C005	504	30	CPR	M148	17	5732	
REBSAMEN	5C005	5C006	728	30	CPR	M149	1	0	
REBSAMEN	5C006	6C001	514	30	CPR	M149	2	1050	
REBSAMEN	6C001	6C002	385	30	CPR	M149	3	1542	
RIVER FRONT	13G001	13G002	538	54	CPR	M149	4	1862	538 RIGHT MAIN LIVE (MH)
RIVER FRONT	13G002	13G003	180	54	CPR	M149	5	2261	
RIVER FRONT	13G003	13G004	124	54	CPR	M149	6	2557	124 BEND TO LEFT (END)
RIVER FRONT	15G002	15G013	843	54	CPR	M149	7	2749	330 LEFT STUB (15G012)
RIVER FRONT	15G013	15G014	780	54	CPR	M149	8	3169	
RIVER FRONT	15G014	15H110	748	54	CPR	M149	9	3705	134 LEFT STUB
RIVER FRONT	16G001	16H001	694	60	CPR	M149	10	4043	
REBSAMEN	2B004	2B005	508	30	LINER	M149	11	4488	
REBSAMEN	2B005	3B001	596	30	LINER	M149	12	4655	
REBSAMEN	3B001	3B002	339	30	CPR	M149	13	5086	
REBSAMEN	3B002	3B003	453	30	CPR	M149	14	5312	199 RIGHT STUB I/I
REBSAMEN	3B003	3B004	621	30	CPR	M149	15	5588	113 JOINT LEAK I/I
BRODIE	4M014	4M013	301	42	CPR	M150	1	0	CAMERA NOT TO MANHOLE
BRODIE	4M013	4M012	245	42	CPR	M150	2	412	CAMERA NOT TO MANHOLE
BRODIE	4M012	4L013	655	42	CPR	M150	3	801	TAPED PULLING BACK / TAPE ENS AT 351' BACK
SOUTH 60	5L052	5L051	297	36	CPR	M150	4	1826	
REBSAMEN	3B004	3B044	695	30	CPR	M150	5	2081	179' STUB R I&I / 453' BAD JOINT I&I
REBSAMEN	3B044	3B005	72	30	CPR	M150	6	2868	
REBSAMEN	3B005	3B006	202	30	CPR	M150	7	3005	
REBSAMEN	3B006	4B001	521	30	CPR	M150	8	3142	
RIVERFRONT	17H002	17H003	799	60	CPR	M150	9	3543	
RIVERFRONT	17H003	17H004	756	60	CPR	M150	10	4124	
LOWER SWAGGERTY	11K168	11L041	270	24	VYLON PVC	MISC	1	0	121' TAP ON TOP I&I STREAM / SOME EGG SHAPE
LOWER SWAGGERTY	11L041	11L040	398	24	VYLON PVC	MISC	2	434	SOME EGG SHAPE
LOWER SWAGGERTY	11L040	11L024	172	24	VYLON PVC	MISC	3	823	SOME EGG SHAPE
LOWER SWAGGERTY	11L024	11L023	326	24	VYLON PVC	MISC	4	1068	SOME EGG SHAPE

CCTV OF LARGE DIAMETER SEWER INTERCEPTORS SEGMENTS

Provided to Montgomery Watson

INTERCEPTOR	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	LENGTH FEET	PIPE SIZE INCHES	PIPE MATERIAL	TAPE NUMBER	LINE SEGMENT NUMBER	LOCATION COUNTER	COMMENTS
LOWER SWAGGERTY	11L023	11L042	248	24	VYLON PVC	MISC	5	1350	SOME EGG SHAPE / Bad I&I IN MANHOLE
PORT	22M002	22M001	79	24	CPN	MISC	6	1615	50' L ROOTS
BRODIE-HINDMAN-DIV	2O024	2O025	65	24	DIP	MISC	7	1847	
BRODIE-HINDMAN-DIV	2O025	2O026	224	24	DIP	MISC	8	1926	
BRODIE-HINDMAN-DIV	2O026	2O007	98	24	DIP	MISC	9	2090	BAR IN FRONT OF PIPE IN BOX
5TH INDRUSTRAL RELAY	8N012	8N004	293	24	HOBAS	MISC	10	2221	293' OUTSIDE DROP
65TH INDRUSTRAL	8N010	8N009	276	24	CIP	MISC	11	2404	
REBSAMEN	7C008	7C009	1260	42	CPN	MISC	12	3103	638' TEE RISER MANHOLE
REBSAMEN	7C009	7C010	620	42	CPN	MISC	13	3773	
ROCK CREEK	3H074	3H076	216	24	CPR	MISC	14	4221	58' TOP L TAP LIVE
NORTH 60	10L008	10L007	581	48	CPR	MISC	15	4345	561' L MED ROOTS
REBSAMEN	3B044	3B005	73	30	CPR	MISC	16	4679	
SOUTH 60	5L052	5L051	297	36	CPR	MISC	17	4770	145' &151' JOINT LEAKS I&I
NORTH 60	6K108	6K109	224	30	CPR	M201	1	0	
NORTH 60	6K109	7K108	517	42	CPR	M201	2	477	419 BORED HOLE IN TOP OF PIPE

BRODIE 1 - 9

/

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 20 , 30
Tape Number M 144
Inspection Date 8/16/99 (641 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 20 001
Dnstream Manhole 30 002

Total Length of Survey 628

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	–	25% L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Too Dark (see next segment)
Can't see crown

Defect Report

Footage	Feature	Notes
411		GOOD VIEW
630	LARGE MH	NO CORROSION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3N
Tape Number M144
Inspection Date 8/16/99 (850)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3N003
Dnstream Manhole 3N004

Total Length of Survey 840

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	–	25% – L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity:
T – turbulent
L - laminar
Q – quiescent

General Notes:

Looks New

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area____________________
Grid Location 3N
Tape Number M144
Inspection Date 8/17/99 (494)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date____________________
Upstream Manhole 3N004
Dnstream Manhole 3N005

Total Length of Survey 485

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	–	25% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
237		Good shot of crown
485	MH	LARGE - 14 corrosion

5

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3N , 4N
Tape Number M144
Inspection Date 8/17/99 (794)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3N005
Dnstream Manhole 4N089

Total Length of Survey 781

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	—	-	25 % L	—
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
40		light corrosion in crown
355		CROWN VIEW & PAN
499	OBSTRUCTION	x 2 at JOINTS (ROOTS?)
780	MH LARGE	No corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 30
Tape Number M144
Inspection Date 8/16/99 (268)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 30002
Dnstream Manhole 30001

Total Length of Survey 261

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0			25% L	-
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
261	MH	LARGE - AG CORROSION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 4M

Tape Number M144

Inspection Date 8/18/99 (332)

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 4M014

Dnstream Manhole 4M013

REPEAT

Total Length of Survey 317

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100	0			30 %. L	
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Crust on pipe wall

Defect Report

Footage	Feature	Notes
77		good view
127		50 % full
232		CAMERA TIP
↓	SUBMERGED	
	CAMERA	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4M
Tape Number M144
Inspection Date 8/18/99 (754)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4M016
Dnstream Manhole 4M015

Total Length of Survey 741

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100	0	–	–	25% L	
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Mod corrosion - slightly more staining and flaking

Defect Report

Footage	Feature	Notes
503		good shot
740	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4N, 4M
Tape Number M144
Inspection Date 8/17/99 (735)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4N014
Dnstream Manhole 4M016

Total Length of Survey 688

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	–	25 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

foggy lens

Defect Report

Footage	Feature	Notes
71	Crustation	joint leak ? No flow
688	MH	LARGE No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4N
Tape Number M144
Inspection Date 8/17/00 (690)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4N089
Dnstream Manhole 4N014

Total Length of Survey 682

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	-	-	25% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
65		GOOD VIEW
240		Out of Focus
400		GOOD VIEW
680	MH	CONNECTION w/ FLOW

SOUTH 60 10 - 13

10

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5L
Tape Number M144
Inspection Date 8/26/99 (644 ft)

Diameter 48
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5L051
Dnstream Manhole 5L050

no tape 150

Total Length of Survey 645

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			30 ?. L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

Footage	Feature	Notes
223		GOOD VIEW
649	END MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5L
Tape Number M144
Inspection Date ?? (710 ft)

Diameter 48
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5L053
Dnstream Manhole 5L052 (5L048??)

Total Length of Survey 656

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			40 ? L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

approaching level 2 corrosion

Defect Report

Footage	Feature	Notes
248	DEBRIS OR	CONNECTION SUBMERGED
655		stopped short of MH

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 5L

Tape Number M144

Inspection Date 8/26/99 (209 ft)

Diameter 48"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 5L059

Dnstream Manhole 5L053

Total Length of Survey 208

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			40 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
215	MH	LIGHT CORROSION

NORTH 60 - 13

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 10L
Tape Number M144
Inspection Date 8/30/99 (603 ft)

Diameter 48
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 10L 009
Dnstream Manhole 10L 008

Total Length of Survey 594

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	-	-	30 7. 0	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

heavy crust / slime layer

light roots

Defect Report

Footage	Feature	Notes
594	MH	No CORROSION

1c

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location OM

Tape Number M146

Inspection Date 9/2/99 (249)

Diameter 24"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole OM052

Dnstream Manhole OM029

Total Length of Survey 214

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location OM
Tape Number M146
Inspection Date 9/2/99 462 ft

Diameter 24"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole OM053
Dnstream Manhole OM052

Total Length of Survey 485

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location OM

Tape Number M146

Inspection Date 9/2/99 598

Diameter 24

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole OM054

Dnstream Manhole OM053

Total Length of Survey 605

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location
Tape Number M146
Inspection Date 9/2/99

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other
Upstream Manhole OM054
Dnstream Manhole OM053

Total Length of Survey 605

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1 0				
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

16 corrosion

Defect Report

Footage	Feature	Notes
19	Blockage	
26	CONNECTION	& Rotation Minor RT
83	Jump	
79	Connection	
179	"	10 O'Clock
182	"	10: o Clock
244	Jump	
254	"	
264	"	
332	Connection	
328	"	
461	"	
466	"	
510	debris	
545	Jump	
573 - 580	debris	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location OM
Tape Number M146
Inspection Date 9/2/99 (172 ft)

Diameter 24"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole OM055
Dnstream Manhole OM054

Total Length of Survey 168

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location
Tape Number M146
Inspection Date 9/2/99

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other
Upstream Manhole OM055
Dnstream Manhole OM054

Total Length of Survey 168

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Needs cleaning

Defect Report

Footage	Feature	Notes
10	debris	large jumps No Corrosion
80	debris	
139	jumps	

BRODIE 8-16

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area SW
Grid Location OM
Tape Number M/46
Inspection Date 9/2/95 (194)

Diameter 24"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole OM056
Dnstream Manhole OM 055

Total Length of Survey 194

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location
Tape Number M1 46
Inspection Date 9/2/99

Diameter 24"
Material(circle one) PVC , Clay , Concrete , Other CPR
Upstream Manhole OM056
Dnstream Manhole OM 055

Total Length of Survey 174

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			low fast	None
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Defect Report

Footage	Feature	Notes
105		
~~102~~ ~~107~~	displaced	joint ? obstruction ?
190	Obstruction,	
194	MH	
80	3 holes -	right

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location ON , 1N
Tape Number M146
Inspection Date 9/7/99 (571)

Diameter 36"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole ON001
Dnstream Manhole ON024

Total Length of Survey 568

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity:
T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location ON
Tape Number M146
Inspection Date 9/7/99 (720)

Diameter 36"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole ON002
Dnstream Manhole ON001

Total Length of Survey 721

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location ON
Tape Number M146
Inspection Date 9/7/99 596

✗ Diameter 36"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole ON003
Dnstream Manhole ON002

Total Length of Survey 593

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location ON
Tape Number M146
Inspection Date 9/7/99 529

Diameter 36
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole ON024
Dnstream Manhole ON023

Total Length of Survey 534

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area Rebsamen
Grid Location
Tape Number
Inspection Date 9 | 1 | 99

Diameter 42
Material(circle one) PVC , Clay , [✓ Concrete] , Other
Upstream Manhole 7C005
Dnstream Manhole 7C008

Total Length of Survey 565

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Defect Report

Footage	Feature	Notes
74	Wall corrosion	
	breaks in	corrosion color
	patchy	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 7C
Tape Number M146
Inspection Date 9/1/99 561 ft

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 7C005
Dnstream Manhole 7C008

Total Length of Survey 565

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area [illegible] REDSKIMER TRUNK

Grid Location

Tape Number 146

Inspection Date 709

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Upstream Manhole 7C006

Dnstream Manhole 7C005

Total Length of Survey 329

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Defect Report

Footage	Feature	Notes
329	CONNECTION	
	No MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area________________
Grid Location 7C
Tape Number M146
Inspection Date 9/1/99 347 ft

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date________________
Upstream Manhole 7C006
Dnstream Manhole 7C005

Total Length of Survey 329

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area Rebsamen trunk
Grid Location
Tape Number 146
Inspection Date

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Upstream Manhole 7C007
Dnstream Manhole 7C006

Total Length of Survey 383

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	2	—	—	80 20% 0	—
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Crown keyway - evidence of corrosion

Defect Report

Footage	Feature	Notes
360	Right Bend	

REBSAMEN 5-7

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area UPSTREAM OF #1
Grid Location 7C
Tape Number M146
Inspection Date 9/1/99 385

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 7C007
Dnstream Manhole 7C006

Total Length of Survey 383

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area ____________
Grid Location 9K
Tape Number M146
Inspection Date 8/31/99 (670 ft)

Diameter 48"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date ____________
Upstream Manhole 9K007
Dnstream Manhole 9L012

Total Length of Survey 663

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area upstream of # 6
Grid Location 9K & 9L
Tape Number 146
Inspection Date

Diameter 48"
Material(circle one) PVC , Clay , Concrete , Other
Upstream Manhole 9K007
Dnstream Manhole 9L012

Total Length of Survey 663

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

1- 5

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	2			4.7 L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

spring line corrosion

Defect Report

Footage	Feature	Notes
284	spalling	
420		20% full
560		
663		JOINT LEAK @ ? 9 o'clock

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area____________
Grid Location 9K
Tape Number M146
Inspection Date 8/31/99 466 ft

Diameter 48"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date____________
Upstream Manhole 9K008
Dnstream Manhole 9K007

Total Length of Survey 468

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Original data

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area UPSTREAM OF # 6
Grid Location 9K
Tape Number M146
Inspection Date 8/31/99

(VIDEO 2 TIMES)
407 - full

Diameter 48"
Material(circle one) PVC , Clay , Concrete , Other
Upstream Manhole 9K00~~8~~ 9
Dnstream Manhole 9K00~~7~~ 8

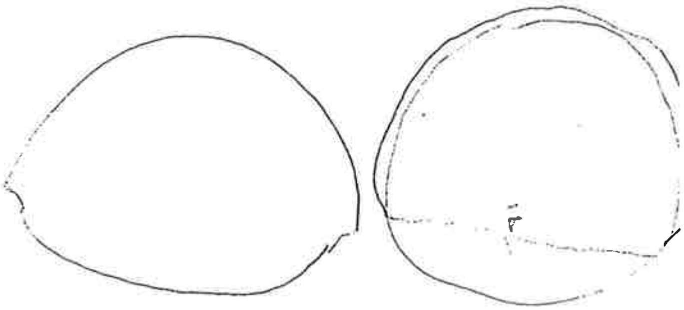
Total Length of Survey 466.40 ft

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Debris	Flow Depth		Lining	REBAR
0	2 +	?	1/4	Q	~~None~~ ?	
50					Coated ??	
100						
150						
200						
250						
300						
350						
400						
450						
~~500~~						
~~550~~						
~~600~~						

* BEST ~~SHAPE~~ CONDITION
WORST CONDITION



Defect Report

Footage	Feature	Location	Notes
5.0	START		
315	Crack	10 o'clock -	2 JOINTS
470	LEFT BEND		
560	ROOTS	LEFT HAND SIDE	
573	Freeling	9 o'clock	
580.6	END		
GENERAL			
MINERAL /			
CALCIFICATION			
JOINTS ARE VISIBLE			
SLIME LAYER			

Verify coating type if any ?

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area______________________________
Grid Location_______________________
Tape Number_______________________
Inspection Date______________________

Diameter__________________
Material(circle one) PVC , Clay , Concrete , Other_______________
Upstream Manhole 9K008
Dnstream Manhole 9K007

Total Length of Survey__________________

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Defect Report

Footage	Feature	Notes

NORTH 6D 1-4

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area UPSTREAM OF # 6
Grid Location 9K
Tape Number M146
Inspection Date

Diameter 48"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9K009
Dnstream Manhole 9K008

Total Length of Survey 581

Survey Dir.(circle one) [✓ Upstream → Dnstream] Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area upstream of #6
Grid Location 9L
Tape Number 146
Inspection Date 8-31-99

Diameter 48
Material(circle one) PVC , Clay , Concrete , Other CPR
Upstream Manhole 9L012
Dnstream Manhole 9L011

Total Length of Survey 356

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	2	–	–	40 % 9	None
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

General Notes:

Lens has water spots & Cloudy

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9L
Tape Number M146
Inspection Date 8/31/99 356

Diameter
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9L012
Dnstream Manhole 9L011

Total Length of Survey 356

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 8D
Tape Number M147
Inspection Date 9/8/99 (550)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 8D003
Dnstream Manhole 8D002

Total Length of Survey 545

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/	–	–	20% – L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
~~550~~ 549	/	–	–	20% – L	
~~600~~					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

Footage	Feature	Notes
198	CONNECTION	9:00, FLOWING,
410	?	CAMERA STOPPED
549	END MH	GOOD COND.

2

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 8D
Tape Number M147
Inspection Date 7/8/99 (656)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPP
Installation Date
Upstream Manhole 8D004
Dnstream Manhole 8D003

Total Length of Survey 693

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	/	–	–	20 % – L	–
50	/	–	–	20 % – L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

693 END

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
66	CONNECTION	NO FLOW, 9:00, GOOD COND.
193	"	FLOW, 9:00, "
437	DEBRIS ?	CAMERA STOP, HEAVIER CORROSION
491	"	" "
593	CONNECTION	FLOW, 9:00,
693	END MH	GOOD CONDITION

RADSAMEN 1 - 13 1

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area UPSTREAM OF # 1
Grid Location 8D
Tape Number M 147
Inspection Date 9/8/99

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 8D096
Dnstream Manhole 8D006

Total Length of Survey 513

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0	–	–	20 % - L	–
50	0	–	–	20 % – L	–
100	0	–	–	20 % - L	–
150					
200					
250					
300					
350					
400					
~~450~~ 413	1	–	–	20 %	–
500	1	–	–	20 %	–
~~550~~ END	0	–	–	20 %	–
~~600~~					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

good condition
slight slime layer
Joints are slightly visible

Defect Report

Footage	Feature	Notes
105	CONNECTION	9:00 NO FLOW
234	corrosion	Heavier slime on corrosion
250	Corrosion	back to light slime layer
412	CONNECTION	FLOWING 9:00
445	CORROSION	RIBS ARE MORE VISIBLE
513	END MH	NO LEAKS
		GOOD CONDITION
		NO CORROSION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 7E

Tape Number M 147

Inspection Date 7/9/97 407 ft

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 9E002

Dnstream Manhole 9E043

Total Length of Survey 407

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	–	–	30% - L	–
100					
150					
200					
250					
300					
350					
400 406	END				
~~450~~					
~~500~~					
~~550~~					
~~600~~					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens
Camera Turned sideways

Defect Report

Footage	Feature	Notes
406	CONNECTION	9:00, GOOD COND, NO FLOW
406	END - 16 MH	

6

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9E
Tape Number M 147
Inspection Date 9/9/99 (826)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9E012
Dnstream Manhole 9E019

Total Length of Survey 815

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/	–	–	20 % – L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

812

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

Footage	Feature	Notes
181	?	CAMERA STOPPED
440	V BEND	STEEP SLOPE, 10% flow depth
812	END MH	GOOD COND

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 9E , 9F

Tape Number M 147

Inspection Date 9/13/99 (450 ft)

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 9E019

Dnstream Manhole 9F011

Total Length of Survey 409

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	—	—	30 % - L	—
100					
150					
200					
250					
300					
350					
400					
~~450~~					
~~500~~					
~~550~~					
~~600~~					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
293	V. slope	higher V.
371	MH ?	
408	CONNECTION	11:00 , FLOWING
409	MH ??	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________

Grid Location 9E

Tape Number M 147

Inspection Date 9/9/99 418 ft

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date__________

Upstream Manhole 9E043

Dnstream Manhole 9E012

Total Length of Survey 419

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100	1	–	–	30% – L	–
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

Footage	Feature	Notes
130	DEBRIS ?	CAMERA TILTED DOWN
136		CORRECTED
207	DEBRIS ?	CAMERA TILT DOWN
333	"	"
350	DEBRIS	9:00 FAST CURRENTS
402	CONNECTION	FLOWING, 3:00, LG CORROSION
409	MH	GOOD CONDITION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9F
Tape Number M147
Inspection Date 9/13/99 31 ft

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9F009
Dnstream Manhole 9F012

Total Length of Survey 30

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	/	—	—	30 % L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
0 - 20	BEND	
30	MH	GOOD CONDITION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9F
Tape Number M1 47
Inspection Date 9/13/99 (293 ft)

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9F011
Dnstream Manhole 9F009

Total Length of Survey 329

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	* 1	–	–	2V ? - L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

foggy lens

* should be physically inspected

Defect Report

Footage	Feature	Notes
112	?	CAMERA STOP
327	connection	3:00, plowing, No Corrosion
327	MH ??	

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Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9F
Tape Number M147
Inspection Date 9/13/99 667 ft

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9F012
Dnstream Manhole 9F013

Total Length of Survey 674

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	—	—	20 2. 6	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

CAMERA TILTED 0 - 140

Slow pull, several stops

Foggy lens

Defect Report

Footage	Feature	Notes
17	GOOD VIEW	
122	"	
263	?	COUNTER STOP
273		CAMERA STOP
		low flow
292		COUNTER STOP
346		"
442	DEBRIS ?	low flow
499		Camera stops - counter ON
539		COUNTER STOP
664	BEND	
665	MH	good condition

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Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9F
Tape Number M147
Inspection Date 9/13/99 262 ft

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9F013
Dnstream Manhole 9F016

Total Length of Survey 262

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1	–	–	25 % L	–
50					
100	1			30 % - P	
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

foggy lens

Defect Report

Footage	Feature	Notes
123	–	TOO FOGGY
148		CROWN SHOT
177		1/2 full Q
190		70 % full
220		80 % full
265	CONNECTION	FLOWING 10:00 1/4 SUBMERGED
		No CORROSION
265	MH ??	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 9F
Tape Number M147
Inspection Date 9/13/99 287 ft

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 9F016
Dnstream Manhole 9F018

Total Length of Survey 288

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	–	–	70% P	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
107		8' 7. pull
220		90 9. pull
288	MH	No CORROSION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 9F

Tape Number M147

Inspection Date 9/14/99 (841 ft)

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 9F018

Dnstream Manhole 9F022

Total Length of Survey 837

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/	–	–	20 % L	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

3 flow lines in pipe

Defect Report

Footage	Feature	Notes
54	CONNECTION	9:00 water El. at invert
		light corrosion
228		
247		
301		STUCK
353		STUCK
414		STUCK
501		STUCK
502		low flow
530		flaking slime layer
748	CONNECTION ?	12:00 80 % full
781		CROWN VIEW
830	MH	Turbulent - influent

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4B
Tape Number M148
Inspection Date 9/16/99 330 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4B001
Dnstream Manhole 4B002

Total Length of Survey 330

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	At Ribs	-	50% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

NO FOG - GOOD VIEW

Defect Report

Footage	Feature	Notes
248	wet camera	?
278	FOG	
331	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4B
Tape Number H114B
9/16/99 Inspection Date 11/2/95 651 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4B002
Dnstream Manhole 4B003

Total Length of Survey 647

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0				50% L	
50	2	RIBS			
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
100	RIBS	
291	Camera re-set ?	
	lower flow	to 7% ??
375	25 % flow	
642		CONNECTION @ 2:00
647	MH	BRICK
		INVERT DROP

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4B
Tape Number M148
Inspection Date 9/16/99 299 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4B003
Dnstream Manhole 4B004

Total Length of Survey 299

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0				25% L	
50	2	RIBS			
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Low Flow

Defect Report

Footage	Feature	Notes
299	MH BOX	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4B
Tape Number M148
Inspection Date 9/16/99 342 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4B004
Dnstream Manhole 4B005

Total Length of Survey 336

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50				25% 6	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Not as corroded as up stream

Defect Report

Footage	Feature	Notes
188	CONNECTION	- LG FLOW 3:00
335	MH BOX	

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Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location 4B
Tape Number M148
Inspection Date 9/19/99 471 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date__________
Upstream Manhole 4B005
Dnstream Manhole 4B006

Total Length of Survey 467

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2			20% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
$46\overset{6}{0}$	MH 20x	BRICK ?

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4B , 4C
Tape Number M114B
Inspection Date 9/20/99 385 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4B006
Dnstream Manhole 4C041

Total Length of Survey 383

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		20 L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
381	MH	MH - No Corrosion

/3

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4C, 5C
Tape Number M148
9/20/95 — Inspection Date 11/3/95 282 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4C041
Dnstream Manhole 5C001

Total Length of Survey 278

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	Ribs		25 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
256	TILTED CAMERA	
250	CONNECTION	3:10 flowing

14

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5C
Tape Number M148
Inspection Date 9/20/99 106 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5C001
Dnstream Manhole 5C002

Total Length of Survey 107

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50 2	2125			25 D. C	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
105	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5C
Tape Number M148
Inspection Date 9/20/99 412 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5C002
Dnstream Manhole 5C003

Total Length of Survey 409

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		20 7. L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
412	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5C
Tape Number M1148
Inspection Date 9/20/99 500 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5C003
Dnstream Manhole 5C004

Total Length of Survey 496

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		2" 7. L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
352	GOOD	VIEW
495	MH	LARGE

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5C
Tape Number M148
Inspection Date 9/20/99 500 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5C004
Dnstream Manhole 5C005

Total Length of Survey 504

Survey Dir.(circle one) [✓ Upstream → Dnstream] Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	C	RIBJ		20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
40 504	GOOD VIEW	
504	MH BOX	MH LINED / COATED ??

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6C
Tape Number M148
Inspection Date 9/15/99 SH

* Diameter 36
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 6C002
Dnstream Manhole 6C003

Total Length of Survey 8

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

No footage - only one shot of connection

Defect Report

Footage	Feature	Notes
8	CONNECTION	3:00 flowing
		No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6C
Tape Number M148
9/15/99 Inspection Date 8/2/96 507 ft

Diameter 36
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 6C003
Dnstream Manhole 6C004

Total Length of Survey 497

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	–	–	20% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
186	SHINEY	SURFACE
252	STOP -	DEBRIS ??
↓	Several Stops	- Debris ?
495	MH	No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 6 C

Tape Number M148

Inspection Date 9/15/99 1.49 ft

Diameter 42

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 6C004

Dnstream Manhole 6C005

Total Length of Survey 647

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1	–	–	20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy

Defect Report

Footage	Feature	Notes
175	DEBRIS ?	HIGHER CORROSION
	VERT BEND	??
380	GOOD VIEW	
435	DEBRIS ?	
646	drops in invert	
		Q = Turbulent 16 Corrosion
646	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6C, 7C
Tape Number M148
9/15/99 — Inspection Date 8/22/96 (1072 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
CPN ?
Upstream Manhole 6C005
Dnstream Manhole 7C007

Total Length of Survey 1056

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0		–	–	20% L	–
50	2	No RIBS	VISIBLE		
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

CROWN IS VISIBLE

FOGGY

Defect Report

Footage	Feature	Notes
32	SHINEY WALL	
325	CAMERA STOP	- DEBRIS ??
465	"	"
597	GOOD VIEW	- CORROSION
690	Good View	"
700	"	"
1040	BEND	
1055	MH	No Corrosion

REBSAMEN 1 - 17

1

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 8C, 8D

Tape Number M148

Inspection Date 9/14/99 (426 ft)

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 8C002

Dnstream Manhole 8D094

Total Length of Survey 423

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1 (LIGHT)			20? - L	
50					
100					
150					
200	1 (LIGHT)				
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

FOGGY

low flow during taping

appears to be worse on left side of pipe

can't see "ribs"

Defect Report

Footage	Feature	Notes
243	DEBRIS ?	Camera stopped
315	Worse Corrosion	in area
421	CONNECTION	at 3:00, Flowing
		No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 8D
Tape Number M148
Inspection Date 9/14/99 (84 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 8D094
Dnstream Manhole 8D096

Total Length of Survey 91

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
84	DEND	
105	MH	12:00

REDSAMEN 11-15

11

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 2B

Tape Number M149

Inspection Date 10/5/99 511 ft

* Diameter 30

Material(circle one) PVC , Clay , Concrete , Other LINER

Installation Date

Upstream Manhole 2B004

Dnstream Manhole 2B005

Total Length of Survey 508

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0			25% T	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
78	good View	
514	BRKK MH	16 [illegible]

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 2B , 3B
Tape Number M149
Inspection Date 10/5/99 602 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other LINER
Installation Date
Upstream Manhole 2B005
Dnstream Manhole 3B001

Total Length of Survey 596

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

Ribs & rebar? exposed in sections

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2			25% T	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Camera Tilted

Defect Report

Footage	Feature	Notes
63	RIBS ???	
88	〃	Coated ???
594	BRICK MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area____________________
Grid Location 3B
Tape Number M149
Inspection Date 10/30/95 341 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CDR
Installation Date____________________
Upstream Manhole 3B001
Dnstream Manhole 3B002

Total Length of Survey 339

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

Rebar / Rebar? exposed in section ?

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2			2, 9, L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Camera tilted

Defect Report

Footage	Feature	Notes
109	RIBS	
231	RIBS	
245	Corrected View	(distant flow line)
340	END	Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3B
Tape Number M149
Inspection Date 10/6/99 453 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3B002
Dnstream Manhole 3B003

Total Length of Survey 453

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		20). L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
196	3:00	Crack ?
450	M/H	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area____________________
Grid Location 3B
Tape Number M149
Inspection Date 10/6/99 627 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date____________________
Upstream Manhole 3B003
Dnstream Manhole 3B004

Total Length of Survey 621

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		2, 9. L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
112	tube leaky	joint ?
386	good view	
620	BRICK MH	

1

REBSAMEN 1 - 3

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________

Grid Location 5C

Tape Number M149

9/21/99 Inspection Date 11/6/95 732 ft

Diameter 30"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date__________

Upstream Manhole 5C005

Dnstream Manhole 5C006

Total Length of Survey 728

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		15 ". L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Don't rehab but re-inspect in future

Defect Report

Footage	Feature	Notes
407	WORST AREA	
727	MH	

2

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5C, 6C
Tape Number M149
9/21/99 Inspection Date 11/6/95 520 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5C006
Dnstream Manhole 6C001

Total Length of Survey 514

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	2WS		15%. L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
160	GOOD VIEW	
357	CONNECTION	3:00 NO FLOW
514	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6C
Tape Number M149
9/21/95 Inspection Date 11/6/95 384 ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 6C001
Dnstream Manhole 6C002

Total Length of Survey 385

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS		15% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
338	GOOD VIEW	
385	MH	Turbulent

RIVER FRONT 4 - 10

4

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 13G
Tape Number M149
Inspection Date 9/23/99 546 ft

Diameter 54
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 13G001
Dnstream Manhole 13G002

Total Length of Survey 538

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy Tape

Defect Report

Footage	Feature	Notes
425	GOOD VIEW	
537	CONNECTION	3:00 flowing full
END		

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 13G
Tape Number M149
Inspection Date 9/23/99 207 ft

Diameter
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 13G002
Dnstream Manhole 13G003

Total Length of Survey 180

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Too Foggy

Defect Report

Footage	Feature	Notes
185	MH	12:00
		No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 13G
Tape Number M149
Inspection Date 9/23/99 116 ft

Diameter 54"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 13G003
Dnstream Manhole 13G004

Total Length of Survey 124

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
117	BEND	GOOD VIEW
END		

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 15 G
Tape Number M149
Inspection Date 9/23/99 843 ft

Diameter 54"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 15G002
Dnstream Manhole 15G013

MH 15G012 @ 69 ft

Total Length of Survey 843

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1			21 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy

Defect Report

Footage	Feature	Notes
330	Connection	9:00 flow No Corrosion
840	MH	12:00
	END	No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 15 G
Tape Number M149
Inspection Date 9/27/99 6:38 1+

Diameter 54"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 15G 013
Dnstream Manhole 15G014

Total Length of Survey 780

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/			15 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy

Defect Report

Footage	Feature	Notes
780	END MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 15G , 15H
Tape Number M149
Inspection Date 9/27/99 845 ft

Diameter 54
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 15G014
Dnstream Manhole 15H110

Total Length of Survey 248

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	1 ?			15 L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy

Defect Report

Footage	Feature	Notes
606	Duct View	
747	END MH	No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 16G, 16H
Tape Number M149
Inspection Date 9/27/99 694 ft

* Diameter 60
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 16G001
Dnstream Manhole 16H001

Total Length of Survey 694

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0-1			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

foggy

Defect Report

Footage	Feature	Notes
698	MH End	14 Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 16G , 16H

Tape Number M149

Inspection Date 9/27/99 694 ft

Diameter 60

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 16G001

Dnstream Manhole 16H001

Total Length of Survey 694

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0-1			20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

foggy

Defect Report

Footage	Feature	Notes
678	MH END	14 Corrosion

REDSAMEN 5-8

5

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3B
Tape Number M150
Inspection Date 11/1/95 10/6/99 698 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3B004
Dnstream Manhole 3B044

Total Length of Survey 695

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	RIBS	–	20 % L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
160		Counter stopped
179	LEAK ?	2" TAP ?, JOINT LEAK, 3:00
[illegible]		
460	CONNECTION	2:00 (LARGE) w/ leak
507		Camera stops
532		" "
695	END MH	w/ FLOW, CORROSION

7

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

10/6/99

Area

Grid Location 3B

Tape Number M150

Inspection Date 10/31/95 206 ft

Diameter 30

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 3B005

Dnstream Manhole 3B006

Total Length of Survey 202

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	–	-	25% L+	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
160		GOOD VIDEO
200		JUNCTION BOX
		NO TURBULANCE

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3B , 4B
Tape Number M150
Inspection Date 10/7/99 515 ft

Diameter 3 0
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3B006
Dnstream Manhole 4B001

Total Length of Survey 521

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	-	-	25% L	-
100					
150					
200					
250					
300					
350	2			20 % L	
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

GOOD VIDEO

Defect Report

Footage	Feature	Notes
177	Debris ?	CAMER STOP
350		
521	END MH	GOOD CONDITION

6

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3B
Tape Number M150
Inspection Date 10/6/99 70ft

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3B044
Dnstream Manhole 3B005

Total Length of Survey 72

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	2	–	–	25 % L +	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
72	END MH	BRICK

3

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 4M , 4L
Tape Number M150
Inspection Date 10/2/99

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 4M012
Dnstream Manhole 4L013

Total Length of Survey [✓ 655] 394

Survey Dir.(circle one) ~~Upstream → Dnstream~~ , [✓ Dnstream → Upstream]

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/	–	MIN	NO FLOW	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Pulled through backwards

304 ft TOTAL

Defect Report

Footage	Feature	Notes
655		START
516	CONN OR I&I	
414	DEBRIS	
	↓	
357	END	– STOP.
538	CONN OR I&I	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location 4M
Tape Number M150
Inspection Date 10/2/99

Diameter 42"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date__________
Upstream Manhole 4M013
Dnstream Manhole 4M012

Total Length of Survey 245

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	None	4" Q	–
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
43	V BEND	Depth increases to 8"
255	END MH	No CORROSION

BRODIE 1 - 3 1

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________

Grid Location 4M

Tape Number M150

Inspection Date 8/18/99 332 ft

Diameter 42"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date__________

Upstream Manhole 4M014

Dnstream Manhole 4M013

Total Length of Survey 301

Survey Dir.(circle one) [✓ Upstream → Dnstream] Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100	0	-	NONE	4" (NO FLOW)	-
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

New pipe ?

Defect Report

Footage	Feature	Notes
126	DEBRIS - LOG	
275		Flaking at crown of pipe
300	END MH	

SOUTH LO

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 5L

Tape Number M/50

Inspection Date 10/4/99 300 ft

Diameter 36"

Material(circle one) PVC , Clay , Concrete , Other CPR

Installation Date

Upstream Manhole 5L052

Dnstream Manhole 5L051

Total Length of Survey 297

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0	–	–	70% L	
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report NONE

Footage	Feature	Notes

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location__________
Tape Number 150 (second tape)
Inspection Date__________

Diameter__________
Material(circle one) PVC , Clay , Concrete , Other__________
Installation Date__________
Upstream Manhole 5L052
Dnstream Manhole 5L051

Total Length of Survey__________

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	0				
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

RIVERFRONT 9-10

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 17 H
Tape Number M150
Inspection Date 10/7/99 799 ft

Diameter 60
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 17H002
Dnstream Manhole 17H003

Total Length of Survey 799

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100	1 ?	—	—	25% L	
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

Footage	Feature	Notes
1.		GOOD MH
635		BEST VIEW
799	MH	GOOD CONDITION

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location__________
Tape Number__________
Inspection Date 10/7/99

Diameter 60"
Material(circle one) PVC , Clay , Concrete , Other__________
Installation Date__________
Upstream Manhole 17H003
Dnstream Manhole 17H004

Total Length of Survey__________

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	?			25% ?	
100					
150					
200					
250					
300					
350					
400					
450					
~~500~~ 516	/				
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy - out of Focus ?

Defect Report

Footage	Feature	Notes
1	MH	GOOD CONDITION
516		BEST VIEW
741		GOOD VIEW
	MH	GOOD CONDITION

BRODIE - HINDMAN DIV 7-9

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 20
Tape Number MISC
Inspection Date 5/3/99 67 ft

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other DIP
Installation Date
Upstream Manhole 20 024
Dnstream Manhole 20 025

Total Length of Survey 65

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			No flow	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
65	Junct.	Box

8

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 20
Tape Number MISC
Inspection Date 5/3/99 (224 ft)

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other DIP
Installation Date
Upstream Manhole 20 Ø25
Dnstream Manhole 20 Ø26

Total Length of Survey 224

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1			No FLOW	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

light corrosion → gets worse

Defect Report

Footage	Feature	Notes
223	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location 20
Tape Number MISC.
Inspection Date 5/3/99 106 ft

Diameter__________
Material(circle one) PVC , Clay , Concrete , Other DIP
Installation Date__________
Upstream Manhole 20 026
Dnstream Manhole 20 007

Total Length of Survey 98

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1			0	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
98	MH	w/ flow – No Corrosion

REBSAMEN

16

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3B
Tape Number MISC
Inspection Date 10/6/99 73 ft

Diameter 30"
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3B044
Dnstream Manhole 3B005

Total Length of Survey 73

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log 16 ribs

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1-2			15 % L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
73	MH	

ROCK CREEK

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 3H
Tape Number MISC.
Inspection Date 6/12/00 (228 ft)

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 3H074
Dnstream Manhole 3H076

Total Length of Survey 216

Survey Dir.(circle one) [✓ Upstream → Dnstream] Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	D			16 flow	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
60	jt leak	
214	MH	

SOUTH 60

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 5L
Tape Number MISC
Inspection Date 10/4/99 297 ft

Diameter 36
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 5L052
Dnstream Manhole 5L051

Total Length of Survey 297

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			40 7. L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
290	MH	16 Corrosion

REDSAMEN 12-13

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 7C
Tape Number MISC.
Inspection Date 4/22/99 (696 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPN
Installation Date
Upstream Manhole 7C008
Dnstream Manhole 7C009

Total Length of Survey 1260

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	1			25% L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Lens foggy

Defect Report

Footage	Feature	Notes
1255	MH	No Corrosion

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 7C
Tape Number MISC
Inspection Date 4/20/99 (647 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPN
Installation Date
Upstream Manhole 7C009
Dnstream Manhole 7C010

Total Length of Survey 620

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity		Lining
0	0			25'9"	L	
50						
100						
150						
200						
250						
300						
350						
400						
450						
500						
550						
600						

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
240	light Corrosion	
618	MH	No Corrosion

65TH INDUSTRIAL

11

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area__________
Grid Location 8N
Tape Number MISC
Inspection Date 6/27/96 341 ft

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other C/P
Installation Date__________
Upstream Manhole 8N010
Dnstream Manhole 8N009 ← 8N008 - 8N012 ??

Total Length of Survey 276

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes

65TH INDUSTRIAL RELAY

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 8N
Tape Number MISC
Inspection Date 8/4/99 (298 ft)

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other HOBAS
Installation Date
Upstream Manhole 8N012
Dnstream Manhole 8N004

Total Length of Survey 293

Survey Dir.(circle one) Upstream → Dnstream , Dnstream → Upstream

50 Foot Inspection Log Forget

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	?			20 % L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

scum build - up

foggy

Defect Report

Footage	Feature	Notes
293	MH	

NORTH LO

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 10 L
Tape Number MISC
Inspection Date 8/30/99 592 ft

Diameter 48
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 10L008
Dnstream Manhole 10L007

Total Length of Survey 5B1

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

No ribs

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	2			20 7c L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
580	MH	

LOWER SWAGGERTY 1-5 1

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 11K, 11L
Tape Number MISC
Inspection Date 8/5/99 297 ft

Diameter 24
Material(circle one) [✓ PVC], Clay , Concrete , Other VYLON
Installation Date
Upstream Manhole 11K168
Dnstream Manhole 11L041

(EGG SHAPE)

Total Length of Survey 270

Survey Dir.(circle one) [✓ Upstream → Dnstream], Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			15). L	~~YES~~
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

lined ? V4 cond

good quality tape

Defect Report

Footage	Feature	Notes
22	debris	
90	step	
120	dripping	11 : 00 ~~Stat~~ ? 8" connection
270	MH	th Cannon

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 11L
Tape Number MISC.
Inspection Date 8/5/99 251 ft

Diameter 24
Material(circle one) [✓ PVC], Clay , Concrete , Other VYLON
Installation Date
Upstream Manhole 11L023
Dnstream Manhole 11L042

Total Length of Survey 248

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			15 %. L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Minor slime & mineral buildups

Defect Report

Footage	Feature	Notes
248	STRUCTURE	END

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 11L
Tape Number MISC
Inspection Date 8/5/99 331 ft

Diameter 24
Material(circle one) [✓ PVC] , Clay , Concrete , Other NYLON
Installation Date
Upstream Manhole 11L024
Dnstream Manhole 11L023

Total Length of Survey 326

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			15 % L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
326	MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 11L
Tape Number MISC.
Inspection Date 8/5/99 175 ft

Diameter 24
Material(circle one) [✓ PVC], Clay , Concrete , Other VYLON
Installation Date
Upstream Manhole 11L040
Dnstream Manhole 11L024

Total Length of Survey 172

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			15 % L	~~YES~~
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

great condition

Defect Report

Footage	Feature	Notes
170	end MH	

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area

Grid Location 11L

Tape Number MISC

Inspection Date 8/5/99 408 ft

Diameter 24

Material(circle one) [✓ PVC], Clay , Concrete , Other NYLON

Installation Date

Upstream Manhole 11L041

Dnstream Manhole 11L040

Total Length of Survey 398

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	0			15 L	YES
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Defect Report

Footage	Feature	Notes
398	MH	

PORT

6

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area ______________________
Grid Location 22 M
Tape Number MISC.
Inspection Date 10/25/99 87 ft

Diameter 24
Material(circle one) PVC , Clay , Concrete , Other CPN
Installation Date ______________________
Upstream Manhole 22M002
Dnstream Manhole 22M001

Total Length of Survey 79

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

2 ?

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0	?			10? L	
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy & Smoky - steam

Defect Report

Footage	Feature	Notes
49	encrustation	at joint
79	MH	

NORTH LU 1-2

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6K
Tape Number 201
Inspection Date 7/10/00 (330 ft)

Diameter 30
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 6K 108
Dnstream Manhole 6K 109

Total Length of Survey 224

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50	/				
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Camera turned on side

Defect Report

Footage	Feature	Notes
224	MH	LIGHT Corrosion
		plugged lateral

Little Rock Wastewater Utility Plant
Sewer Video Evaluation Form

Area
Grid Location 6K , 7K
Tape Number 201
Inspection Date 7/10/02 (413 ft)

Diameter 42
Material(circle one) PVC , Clay , Concrete , Other CPR
Installation Date
Upstream Manhole 6K109
Dnstream Manhole 7K108

Total Length of Survey 517

Survey Dir.(circle one) [✓ Upstream → Dnstream] , Dnstream → Upstream

50 Foot Inspection Log

Foggy

Footage	Corrosion	Rebar	Debris	Flow Depth -Velocity	Lining
0					
50					
100					
150					
200					
250					
300					
350					
400					
450					
500					
550					
600					

See previous segment

Velocity: T – turbulent
L - laminar
Q – quiescent

General Notes:

Foggy lens

Defect Report

No Counter

Footage	Feature	Notes
419		plugged lateral
		light corrosion
	MH	Flowing lateral

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME LITT ROCK, CITY OF
ADDRESS ADAM FIELD WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LOCATION LITTLE ROCK, CITY OF-ADAMS FLD
LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. [illegible]0-0004

PERMIT NUMBER	DISCHARGE NUMBER
AR00218	001 A

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	00	11	01	TO	00	11	30

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE |__| ***
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUANTITY OR CONCENTRATION				NO. EX	*FREQUENCY OF ANALYSIS*	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	3999	******	(26)	******	20.3	18.3	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.29	******	7.01	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	3301	******	(26)	******	16.9	18.2	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	26.29	72.21	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.98	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	293	408	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	00	12	18
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

EPA Form 3320-1 (REV 3/99) Previous editions may be used.

THIS IS A 4-PART FORM PAGE 1 OF 1

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF
ADDRESS ADAMS FIELD WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-ADAMS FLD
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARG NITORING REPORT *(DMR)*

AR0021806
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	00	12	01	TO	00	12	31

Form Approved.
OMB No. -0004

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE ! ! ***

NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUANTITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	2624	******	(26)	******	12.8	16.3	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.73	******	7.18	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	2717	******	(26)	******	13.4	17.1	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	26.66	55.12	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALI
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.76	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	49	351	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	1	19
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

EPA Form 3320-1 (REV 3/99) Previous editions may be used.

THIS IS A 4 PART FORM PAGE 1 OF 1

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF
ADDRESS ADAMS FIELD WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-ADAMS FLD
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

Form Approved.
OMB No. [illegible]0-0004

AR00218	001 A
PERMIT NUMBER	DISCHARGE NUMBER

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	01	01	TO	01	01	31

*** NO DISCHARGE !__! ***
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUANTITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	2711	******	(26)	******	12.0	11.5	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.69	******	7.31	(12)	0	Daily	Gra.
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	2967	******	(26)	******	13.1	11.6	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	27.21	56.93	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.62	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	35	38	(13)	0	Daily	Gra
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903			
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

EPA Form 3320-1 (REV 3/99) Previous editions may be used.

THIS IS A 4-PART FORM PAGE 1 OF 1

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF
ADDRESS ADAMS FIELD WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-ADAMS FLD
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR ONITORING REPORT *(DMR)*

AR0021806
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	02	01	TO	01	02	28

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE |__| ***

NOTE: Read Instructions before completing this form.

Form Approved.
OMB No)-0004

PARAMETER		QUANTITY OR LOADING			QUANTITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C) 00310 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	4122	******	(26)	******	15.8	16.1	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH 00400 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		6.51	******	7.11	(12)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	*** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED 00530 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	5067	******	(26)	******	19.4	22.8	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	32.94	72.38	(03)	******	******	******		0	Cont.	TM
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL 50060 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	******	2.20	(19)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	*** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL 74055 1 1 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	87	1944	(13)	0	Daily	Gr
	PERMIT REQUIREMENT	******	******	*** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is , to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	3	10
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF
ADDRESS ADAMS FIELD WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-ADAMS FLD
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

AR0021806 PERMIT NUMBER
001 A DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	03	01	TO	01	03	31

Form Approved.
OMB No. 2 0004

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE !__! ***
NOTE: Read Instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUANTITY OR CONCENTRATION				NO. EX	*FREQUENCY OF ANALYSIS*	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	3928	******	(26)	******	17.1	23.3	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.53	******	7.10	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	3845	******	(26)	******	16.7	22.5	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	29.22	58.71	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.78	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	66	1243	(13)	0	Daily	Gra
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I Certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	4	20
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location (if Different)*
NAME LITT ~ ROCK WASTEWATER UTILITY
ADDRESS ADAM FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

PERMIT NUMBER: AR00218C
DISCHARGE NUMBER: 001 A

MONITORING PERIOD
FROM YEAR 01 MO 04 DAY 01 TO YEAR 01 MO 04 DAY 30

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1702	******	(26)	******	11.3	14.0	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.51	******	7.08	(12)	0	Daily	Gra
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	948	******	(26)	******	6.3	6.7	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	18.05	26.33	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	2.00	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	5	19	(13)	0	Daily	Gra'
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE: AREA CODE 501 NUMBER 376-2903

DATE: YEAR 01 MO 05 DAY [illegible]

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK WASTEWATER UTILITY
ADDRESS ADAMS FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARG ONITORING REPORT *(DMR)*

AR002180 PERMIT NUMBER

001 A DISCHARGE NUMBER

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	05	01	TO	01	05	31

*** NO DISCHARGE |__| ***

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1829	******	(26)	******	11.5	12.5	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.53	******	7.12	(12)	0	Daily	Gr
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	994	******	(26)	******	6.3	7.3	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	19.18	31.41	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.50	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	24	119	(13)	0	Daily	Gr'
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	7	2
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ RESS *(Include Facility Name/Location if Different)*

NAME LITT. ROCK WASTEWATER UTILITY
ADDRESS ADAMS FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTAN CHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARG NITORING REPORT *(DMR)*

AR0021806
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	06	01	**TO**	01	06	30

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C) 00310 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	1231	******	(26)	******	7.7	10.6	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH 00400 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		6.61	******	7.13	(12)	0	Daily	Grb
	PERMIT REQUIREMENT	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED 00530 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	895	******	(26)	******	5.6	9.0	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	19.19	24.26	(03)	******	******	******		0	Cont.	TM
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL 50060 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	******	2.56	(19)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL 74055 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	7	26	(13)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903			
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME LITTLE ROCK WASTEWATER UTILITY
ADDRESS ADAMS FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

AR0021806
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD							
	YEAR	**MO**	**DAY**		**YEAR**	**MO**	**DAY**
FROM	01	07	01	**TO**	01	07	31

*** NO DISCHARGE ! _ ! ***
NOTE: Read instructions before completing this form.

PARAMETER		**QUANTITY OR LOADING**			Quality or Concentration				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		AVERAGE	**MAXIMUM**	**UNITS**	**MINIMUM**	**AVERAGE**	**MAXIMUM**	**UNITS**			
BOD, 5-DAY (20 DEG. C)	**SAMPLE MEASUREMENT**	2717	******	(26)	******	17.3	38.6	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	**SAMPLE MEASUREMENT**	******	******		6.53	******	7.19	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	******	******	**** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	**SAMPLE MEASUREMENT**	2290	******	(26)	******	14.6	42.8	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	**SAMPLE MEASUREMENT**	19.08	24.47	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	**SAMPLE MEASUREMENT**	******	******		******	******	2.70	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	******	******	**** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	**SAMPLE MEASUREMENT**	******	******		******	32	35	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	**PERMIT REQUIREMENT**	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

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Rick L. Barger

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		**DATE**		
501	376-2903	01	08	14
AREA CODE	**NUMBER**	**YEAR**	**MO**	**DAY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ DRESS *(Include Facility Name/ Location (If Different)*
NAME LITT ROCK WASTEWATER UTILITY
ADDRESS ADAMS FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTAN CHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR ONITORING REPORT *(DMR)*

MAJOR

AR0021806
PERMIT NUMBER

001 A
DISCHARGE NUMBER

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW &

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	08	01	TO	01	08	31

*** NO DISCHARGE |__| ***

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1811	******	(26)	******	11.2	13.9	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.47	******	6.98	(12)	0	Daily	Gi
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	1413	******	(26)	******	8.7	9.5	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	/30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	19.45	30.16	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	******	******		******	******	1.52	(19)	0	Daily	Grab
50060 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	9	30	(13)	0	Daily	Gr
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	09	12
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITTLE ROCK WASTEWATER UTILITY
ADDRESS ADAMS FIELD WW TREATMENT PLANT
221 EAST CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK-ADAMS FILED WWTP
LOCATION LITTLE ROCK AR 72202
ATTN: RICK L BARGER/REGGIE A CORBITT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)* DISCHARGE MONITORING REPORT *(DMR)*

PERMIT NUMBER: AR0021806
DISCHARGE NUMBER: 001 A

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW.

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	09	01	TO	01	09	30

*** NO DISCHARGE !__! ***

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C) 00310 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	1448	******	(26)	******	9.6	13.0	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH 00400 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		6.56	******	6.98	(12)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	*** ****	6.0 MINIMUM	******	9.0 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED 00530 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	1057	******	(26)	******	7.0	8.0	(19)	0	Daily	24HFC
	PERMIT REQUIREMENT	9010 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	18.11	28.36	(03)	******	******	******		0	Cont.	TM
	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*** ****		DAILY	TOTALZ
CHLORINE, TOTAL RESIDUAL 50060 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	******	2.17	(19)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	*** ****	******	******	REPORT INST MAX	MG/L		DAILY	GRAB
COLIFORM, FECAL GENERAL 74055 1 0 0 EFFLUENT GROSS VALUE	SAMPLE MEASUREMENT	******	******		******	3	8	(13)	0	Daily	Grab
	PERMIT REQUIREMENT	******	******	*** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

R L Barger
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	10	16
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT TOTAL RESIDUAL CHLORINE (TRC) AS INSTANTANEOUS MAXIMUM.

ADEQ
RKANSAS
epartment of Environmental Quality

CERTIFIED MAIL RETURN RECEIPT REQUESTED (7000 0600 0023 8592 3410)

August 31, 2001

Mr. Rick Barger, P.E.,DEE
Director of Operations
Little Rock Wastewater Utility - Adams Field
221 East Capital
Little Rock, AR 72202-2412

RE: Application for Permit Number AR0021806

Dear Mr. Barger:

This letter constitutes notice of the Department's final permit decision and a copy of the final permit is enclosed. The response to comments describes any substantial changes from the draft permit.

The applicant, and any other person submitting written comments during the comments period, and any other person entitled to do so, may request an adjudicatory hearing and Commission review on whether the decision of the Department should he revised or modified. Such a request shall be in the form and manner required by Department Regulation No. 8.

CERTIFICATE OF SERVICE

I, Chuck Bennett, hereby certify that a copy of this permit has been mailed by first class mail to Mr. Rick Barger, P.E., DEE, Director of Operations, Little Rock Wastewater Utility - Adams Field, 221 East Capital, Little Rock, AR 72202-2412, on or before this 31st day of August, 2001.

Chuck Bennett
Chief, Water Division

CB:MB:mb

Enclosure

cc: Betty Buchanan
Mo Shafii
Shenel Sandidge

ADEQ
ARKANSAS
Department of Environmental Quality

RESPONSE TO COMMENTS
FINAL PERMIT DECISION

This is our response to comments received on the subject draft permit in accordance with regulations promulgated at 40 CFR Part 124.17.

Permit No. : AR0021806

Applicant : Little Rock Wastewater Utility-Adams Field

Prepared by : Morteza (Mo) Shafii

Permit Action : Final permit decision and response to comments received on the draft permit publicly noticed on June 16, 2001.

Date Prepared : July 27, 2001

The following comments have been received on the draft permit.

Letter from Rick Barger to Chuck Bennett dated July 12, 2001.

I. Response to issues raised

ISSUE #1

Permittee has requested that all the requirements and limits for cyanide be removed from the final permit.

RESPONSE #1

Staff agrees. permittee submitted additional analysis at below the acceptable Minimum Quantification Levels (MQL) for cyanide (20 $\mu g/l$). The analysis did not indicate that cyanide was present in the effluent. Based on the new data, all the requirements and limits for cyanide have been removed from the final permit.

ISSUE #2

See Issue #1.

ISSUE #3

Permittee has requested that based on 40 CFR 133.104(d) and previously issued permit the removal percentage for BOD5 and TSS be changed to 80% and 83%, respectively.

RESPONSE #3

Staff agrees.

ISSUE #4

Permittee has requested that condition of 8.c.a. of part III be revised to three(3) grab samples instead of four(4) grab samples.

RESPONSE #4

Staff does not agree. Requirements of four grab samples are based on 40 CFR 122.21(g)(7).

ISSUE #5

Page 13 of Part III, condition No. 9.1.d. the words "or below" be removed from the final permit.

RESPONSE #5

Staff does not agree. A dilution series is required to reveal a concentration-response relationship of a whole effluent. The effect of a toxicant to an organism is first seen in the highest concentration, in this case the critical dilution. If a response is determined in a lower concentration, it is typically revealed in the highest concentration as well. The language "or below" would also allow for possibility of a bimodal concentration-response relationship to an effluent.

ISSUE #6

Permittee has requested that synthetic dilution water of similar pH, hardness, and alkalinity to receiving stream (Arkansas River) to be used as the control and dilution water in lieu of the receiving water.

RESPONSE #6

The Department agrees.

ISSUE #7

Page 14 of Part III, condition No. 9.2.a.i, the words "or below" be removed from the final permit.

RESPONSE #7

See response #5 above.

ISSUE #8

Permittee has requested that condition No. 9.3.d.vi. of part III be deleted since facility discharge is not dechlorinated.

RESPONSE #9

Staff agrees.

ISSUE #9

Permittee has requested that condition 9.4.a. and c. of part III be corrected to read "Part II" instead of "Part III".

RESPONSE #9

Staff agrees.

ISSUE #10

Permittee has requested that biomonitoring in fact sheet be corrected to be consistent with biomonitoring in Part III in regard to reporting of pH, temperature, hardness, dissolved oxygen, and etc.

RESPONSE #10

Staff agrees.

ISSUE #11

Page 20 of Part III, condition No. 9.5.a. since it is unclear how the "more sensitive species" is determined, the reduction in the test frequency should be changed to not more than 1/year for each species.

RESPONSE #11

Staff does not agree.

ISSUE #12

See Issue #1

Permit number: AR0021806

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM AND THE ARKANSAS WATER AND AIR POLLUTION CONTROL ACT

In accordance with the provisions of the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended, Ark. Code Ann. 8-4-101 et seq.), and the Clean Water Act (33 U.S.C. 1251 et seq.),

Little Rock Wastewater Utility-Adams Field
221 East Capital
Little Rock, AR 72202-2412

is authorized to discharge from a facility located at

northeast of the Little Rock National Airport in Section 8, Township 1 North, Range 11 West in Pulaski County, Arkansas.

Latitude: 34° 44' 3.5"; Longitude: 92° 12' 50.3"

to receiving waters named:

Arkansas River in Segment 3C of the Arkansas River Basin.

The outfall is located at the following coordinates:

Outfall 001:Latitude : 34° 44' 34"; Longitude: 92° 12' 45"

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II (Version 2), III, and IV (Version 2) hereof.

This permit shall become effective on October 1, 2001

This permit and the authorization to discharge shall expire at midnight, September 30, 2006

Signed this 31st day of August, 2001

Chuck C. Bennett
Chief, Water Division
Arkansas Department of Environmental Quality

Part I
PERMIT REQUIREMENTS

SECTION A. FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS: OUTFALL 001- treated municipal wastewater

During the period beginning on effective date of the permit and lasting until date of expiration, the permittee is authorized to discharge from outfall serial number 001 - Treated municipal wastewater. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	**Discharge Limitations**			**Monitoring Requirements**	
	Mass (lbs/day)	Other Units (specify)		Measurement	Sample
	Monthly Avg	Monthly Avg	7-day Avg	Frequency	Type
Flow (MGD)+	N/A	N/A	N/A	Daily	Totalizing Meter
Biochemical Oxygen Demand (BOD5)	9010	30 mg/l	45 mg/l	Once/day	24-hr composite
Total Suspended Solids (TSS)	9010	30 mg/l	45 mg/l	Once/day	24-hr composite
Total Residual Chlorine (TRC)	N/A	Report mg/l (Instantaneous Max)		Once/day	Grab
Fecal Coliform Bacteria (FCB)**					
(April-September)	N/A	200	400	Once/day	Grab
(October-March)	N/A	1000	2000	Once/day	Grab
Chronic Biomonitoring[1]	N/A	N/A	N/A	Once/quarter	24-hr composite
<u>**Pimephales promelas (Chronic)**</u>		<u>7-day Average</u>			
Pass/Fail Growth (7-day NOEC) **TGP6C**		Report (Pass=0/Fail=1)		Once/quarter	24-hr composite
Pass/Fail Lethality (7-day NOEC) **TLP6C**		Report (Pass=0/Fail=1)		Once/quarter	24-hr composite
Survival (7-day NOEC) **TOP6C**		Report %		Once/quarter	24-hr composite
Coefficient of Variation **TQP6C**		Report %		Once/quarter	24-hr composite
Growth (7-day NOEC) **TPP6C**		Report %		Once/quarter	24-hr composite
<u>**Ceriodaphnia dubia (Chronic)**</u>		<u>7-day Average</u>			
Pass/Fail Reproduction (7-day NOEC) **TGP3B**		Report (Pass=0/Fail=1)		Once/quarter	24-hr composite
Pass/Fail Lethality (7-day NOEC) **TLP3B**		Report (Pass=0/Fail=1)		Once/quarter	24-hr composite
Survival (7-day NOEC) **TOP3B**		Report %		Once/quarter	24-hr composite
Coefficient of Variation **TQP3B**		Report %		Once/quarter	24-hr composite
Reproduction(7-day NOEC) **TPP3B**		Report %		Once/quarter	24-hr composite
		Minimum	Maximum		
pH	N/A	6 s.u.	9 s.u.	Once/day	Grab

\+ Report monthly average and daily maximum as MGD.

* See Part III, Condition No. 10.

** See Part III, Condition No. 2.

[1] See Part III, Condition No. 9.

There shall be no discharge of distinctly visible solids, scum or foam of a persistent nature, nor shall there be any formation of slime, bottom deposits or sludge banks.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):at Outfall 001, after the final treatment unit.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

1. Compliance with final limitations is required on the effective date of the permit.

RT II — STANDARD CONDITIONS

CTION A — GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the federal Clean Water Act and the Arkansas Water and Air Pollution Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. Any values reported in the required Discharge Monitoring Report which are in excess of an effluent limitation specified in Part 1.A. shall constitute evidence of violation of such effluent limitation and of this permit.

2. Penalties for Violations of Permit Conditions

The Arkansas Water and Air Pollution Control Act provides that any person who violates any provisions of a permit issued under the Act shall be guilty of a misdemeanor and upon conviction thereof shall be subject to imprisonment for not more than one (1) year, or a fine of not more than ten thousand dollars ($10,000) or by both such fine and imprisonment for each day of such violation. Any person who violates any provision of a permit issued under the Act may also be subject to civil penalty in such amount as the court shall find appropriate, not to exceed five thousand dollars ($5,000) for each day of such violation. The fact that any such violation may constitute a misdemeanor shall not be a bar to the maintenance of such civil action.

3. Permit Action

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit; or

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge; or

d. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination.

e. Failure of the permittee to comply with the provisions of ADPCE Regulation No. 9 (Permit fees) as required by condition II A. 10 herein.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

4. Toxic Pollutants

Notwithstanding Part II.A.3., if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Regulation No. 2, as amended (regulation establishing water quality standards for surface waters of the State of Arkansas) or Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standards or prohibition and the permittee so notified.

The permittee shall comply with effluent standards or prohibitions established under Regulation No. 2 (Arkansas Water Quality Standards), as amended, or Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" (Part II.B.4.a.), and "Upsets" (Part II.B.5.b.), nothing in this permit shall be construed to relieve the permittee from civil penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of this permit or applicable state and federal statutes or regulations which defeats the regulatory purposes of the permit may subject the permittee to criminal enforcement pursuant to the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended).

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

8. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or

9. Severability

The provisions of this permit are severable. If any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provisions to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Permit Fees

The permittee shall comply with all applicable permit fee requirements for wastewater discharge permits as described in ADPCE Regulation No. 9 (Regulation for the Fee System for Environmental Permits). Failure to promptly remit all required fees shall be grounds for the Director to initiate action to terminate this permit under the provisions of 40 CFR 122.64 and 124.5(d), as adopted in ADPCE Regulation No. 6, and the provisions of ADPCE Regulation No. 8.

SECTION B — OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

a. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

b. The permittee shall provide an adequate operating staff which is duly qualified to carry out operation, maintenance and testing functions required to insure compliance with the conditions of this permit.

2. Need to Halt or Reduce Not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or discharges or both until the facility is restored or alternative method of treatment is provided. This requirement applies, for example when the primary source of power for the treatment facility is reduced, is lost, or alternate power supply fails.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has reasonable likelihood of adversely affecting human health or the environment.

4. Bypass of Treatment Facilities

a. Bypass not exceeding limitation. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provision of Part II.B.4.b. and 4.c.

b. Notice

 (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible, at least ten days before the date of the bypass.

 (2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II.D.6(24-hour notice).

c. Prohibition of bypass.

 (1) Bypass is prohibited and the Director may take enforcement action against a permittee for bypass, unless:

  (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

  (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

  (c) The permittee submitted notices as required by Part II.B.4.b.

 (2) The Director may approve an anticipated bypass, after considering its adverse effects, if the director determines that it will meet the three conditions listed above in Part II.B.4.c.(1).

5. Upset Conditions

a. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Part II.B.5.b. of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review

b. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
   (1) An upset occurred and that the permittee can identify the cause(s) of the upset;
   (2) The permitted facility was at the time being properly operated;
   (3) The permittee submitted notice of the upset as required by Part II.D.6.; and
   (4) The permittee complied with any remedial measures required by Part II.B.3.

c. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. **Removed Substances**
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering the waters of the state. Written approval for such disposal must be obtained from the ADPCE.

7. **Power Failure**
The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failure either by means of alternate power sources, standby generators, or retention of inadequately treated effluent.

SECTION C — MONITORING AND RECORDS

1. **Representative Sampling**
Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge during the entire monitoring period. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director. Intermittent discharges shall be monitored.

2. **Flow Measurements**
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes and shall be installed at the monitoring point of the discharge.

3. **Monitoring Procedures**
Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals frequent enough to insure accuracy of measurements and shall insure that both calibration and maintenance activities will be conducted. An adequate analytical quality control program, including the analysis of sufficient standards, spikes, and duplicate samples to insure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory. At a minimum, spikes and duplicate samples are to be analyzed on 10% of the samples.

4. **Penalties for Tampering**
The Arkansas Water and Air Pollution Control Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under the Act shall be guilty of a misdemeanor and upon conviction thereof shall be subject to imprisonment for not more than one (1) year or a fine of not more than ten thousand dollars ($10,000) or by both such fine and imprisonment.

5. **Reporting of Monitoring Results**
Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1). Permittees are required to use preprinted DMR forms provided by ADPCE, unless specific written authorization to use other reporting forms is obtained from ADPCE. Monitoring results obtained during the previous calendar month shall be summarized and reported on a DMR form postmarked no later than the 25th day of the month following the completed reporting period to begin on the effective date of the permit. Duplicate copies of DMR's signed and certified as required by Part II.d.11 and all other reports required by Part II.D. (Reporting Requirements), shall be submitted to the Director at the following address:

Director
Arkansas Department of Pollution
Control and Ecology
8001 National Drive
P.O. Box 8913
Little Rock, AR 72219-8913

If permittee uses outside laboratory facilities for sampling and/or analysis, the name and address of the contract laboratory shall be included on the DMR.

6. **Additional Monitoring by the Permittee**
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated on the DMR.

7. **Retention of Records**
The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

8. **Record Contents**
Records and monitoring information shall include:
   a. The date, exact place, time and methods of sampling or measurements, and preservatives used, if any;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were formed;
   d. The individual(s) who performed the analyses;
   e. The analytical techniques or methods used; and
   f. The measurements and results of such analyses.

9. **Inspection and Entry**
The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:
   a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
   b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
   c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
   d. Sample, inspect or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D — REPORTING REQUIREMENTS

1. **Planned Changes**
The permittee shall give notice and provide plans and specification to the Director for review and approval prior to any planned physical alterations or additions to the permitted facility. Notice is required only when:

For Industrial Dischargers
   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b).
   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR Part 122.42(a)(1).

For POTW Dischargers:
   c. Any change in the facility discharge (including the introduction of any new source or significant discharge or significant changes in the quantity or quality of existing discharges of pollutants) must be reported to the permitting authority. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. **Anticipated Noncompliance**
The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. **Transfers**
The permit is nontransferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Act.

4. **Monitoring Reports**
Monitoring results shall be reported at the intervals and in the form specified in Part II.C.5. (Reporting). Discharge Monitoring Reports must be submitted even when no discharge occurs during the reporting period.

5. **Compliance Schedule**
Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

Twenty-four Hour Report

a. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain the following information:
   - (1) a description of the noncompliance and its cause;
   - (2) the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and
   - (3) steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance.

b. The following shall be included as information which must be reported within 24 hours:
   - (1) Any unanticipated bypass which exceeds any effluent limitation in the permit;
   - (2) Any upset which exceeds any effluent limitation in the permit; and
   - (3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.

c. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

7. **Other Noncompliance**
The permittee shall report all instances of noncompliance not reported under Part II.D.4, 5, and 6, at the time monitoring reports are submitted. The reports shall contain the information listed at Part II.D.6.

8. **Changes in Discharge of Toxic Substances for Industrial Dischargers**
The permittee shall notify the Director as soon as he/she knows or has reason to believe:
   a. That any activity has occurred or will occur which would result in the discharge, in a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2)[48 FR 14153, April 1983, as amended at 49 FR 38046, September 26, 1984].
   b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2)[48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984].

9. **Duty to Provide Information**
The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to detemine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit. Information shall be submitted in the form, manner, and time frame requested by the Director.

10. **Duty to Reapply**
If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The complete application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date. Continuation of expiring permits shall be governed by regulations promulgated in ADPCE Regulation No. 6.

11. **Signatory Requirements**
All applications, reports or information submitted to the Director shall be signed and certified.
   a. All permit applications shall be signed as follows:
      - (1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:
         - (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or
         - (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
      - (2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
      - (3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:
         - (i) the chief executive officer of the agency, or
         - (ii) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.
   b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
      - (1) The authorization is made in writing by a person described above.
      - (2) The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and
      - (3) The written authorization is submitted to the Director.
   c. Certification. Any person signing a document under this section shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. **Availability of Reports**
Except for data determined to be confidential under 40 CFR Part 2 and Regulation 6, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department of Pollution Control and Ecology. As required by the Regulations, the name and address of any permit applicant or permittee, permit applications, permits and effluent data shall not be considered confidential.

13. **Penalties for Falsification of Reports**
The Arkansas Air and Water Pollution Control Act provides that any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan or other document filed or required to be maintained under this permit shall be subject to civil penalties specified in Part II.A.2. and/or criminal penalties under the authority of the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended).

PART III
OTHER CONDITIONS

1. The operator of this wastewater treatment facility shall be licensed by the State of Arkansas in accordance with Act 211 of 1971, Act 1103 of 1991, Act 556 of 1993, and Regulation No. 3, as amended.

2. For Fecal Coliform Bacteria (FCB) report the monthly average as a 30-day geometric mean in colonies per 100 ml.

3. The permittee shall not cause or allow the permitted facility to emit odors which unreasonably interfere with enjoyment of life or use of property in the surrounding area.

4. For publicly owned treatment works, the 30-day average percent removal for Biochemical Oxygen Demand and Total Suspended Solids shall not be less than 80 and 83 percent unless otherwise authorized by the permitting authority in accordance with 40 CFR 133.102, as adopted by reference in ADEQ Regulation No. 6.

5. Produced sludge shall be disposed of by land application only when meeting the following criteria:

   a. Sewage sludge from treatment works treating domestic sewage (TWTDS) must meet the applicable provisions of 40 CFR Part 503;

   b. The sewage sludge has not been classified as a hazardous waste under state or federal regulations;

6. The permittee shall give at least 120 days prior notice to the Director of any change planned in the permittee's sludge disposal practice or land use applications, including types of crops grown (if applicable).

7. The permittee shall report all overflows with the Discharge Monitoring report (DMR) submittal. These reports shall be summarized and reported in tabular format. The summaries shall include: the date, time, duration, location, estimated volume, and cause of overflow; observed environmental impacts from the overflow; action taken to address the overflow; and ultimate discharge location if not contained (e.g., storm sewer system, ditch, tributary.) Overflows which endanger health or the environment shall be orally

reported to this department (Enforcement Section of Water Division), within 24 hours from the time the permittee becomes aware of the circumstance. A written report of overflows which endanger health or the environment, shall be provided within 5 days of the time the permittee becomes aware of the circumstance.

8. **Contributing Industries and Pretreatment Requirements**

a. The permittee shall operate an industrial pretreatment program in accordance with Section 402(b)(8) of the Clean Water Act, the General Pretreatment Regulations (40 CFR Part 403) and the approved POTW pretreatment program submitted by the permittee. The pretreatment program was approved on **November 1, 1982** and modified on **April 6, 1999.** The POTW pretreatment program is hereby incorporated by reference and shall be implemented in a manner consistent with the following requirements:

i. Industrial user information shall be updated at a frequency adequate to ensure that all IUs are properly characterized at all times.

ii. The frequency and nature of industrial user compliance monitoring activities by the permittee shall be commensurate with the character, consistency and volume of waste. However, in keeping with the requirements of 40 CFR 403.8(f)(2)(v), the permittee must inspect and sample the effluent from each Significant Industrial User at least once a year. This is in addition to any industrial self-monitoring activities;

iii. The permittee shall enforce and obtain remedies for noncompliance by any industrial users with applicable pretreatment standards and requirements.

iv. The permittee shall control through permit, order, or similar means, the contribution to the POTW by each Industrial User to ensure compliance with applicable Pretreatment Standards and Requirements. In the case of Industrial Users identified as significant under 40 CFR 403.3(t), this control shall be achieved through permits or equivalent individual control mechanisms issued to each such user. Such control mechanisms must be enforceable and contain, at a minimum, the following conditions:

(1) Statement of duration (in no case more than five years;

(2) Statement of non-transferability without, at a minimum, prior notification to the POTW and provision of a copy of the existing control mechanism to the new owner or operator;

(3) Effluent limits based on applicable general pretreatment standards, categorical pretreatment standards, local limits, and State and local law;

(4) Self-monitoring, sampling, reporting, notification and recordkeeping requirements, including an identification of the pollutants to be monitored, sampling location, sampling frequency, and sample type, based on the applicable general pretreatment standards in 40 CFR 403, categorical pretreatment standards, local limits, and State and local law;

(5) Statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements, and any applicable compliance schedule. Such schedules may not extend the compliance date beyond federal deadlines.

v. The permittee shall evaluate, at least once every two years, whether each Significant Industrial User needs a plan to control slug discharges. If the POTW decides that a slug control plan is needed, the plan shall contain at least the minimum elements required in 40 CFR 403.8 (f)(2)(v).

vi. The permittee shall provide adequate staff, equipment, and support capabilities to carry out all elements of the pretreatment program; and,

vii. The approved program shall not be modified by the permittee without the prior approval of the Department.

b. The permittee shall establish and enforce specific limits to implement the provisions of 40 CFR Parts 403.5(a) and (b), as required by 40 CFR Part 403.5(c). Each POTW with an approved pretreatment program shall continue to develop these limits as necessary and effectively enforce such limits.

The permittee shall, within sixty(60) days of the effective date of this permit,(1) submit a **written certification** that a technical evaluation has demonstrated that the existing technically based local limits (TBLL) are based on current state water quality standards and are adequate to prevent pass through of pollutants, inhibition of or interference with the treatment facility, **or** (2) submit a **written notification** that a technical evaluation revising the current TBLL and a draft sewer use ordinance which incorporates such revisions will be submitted within 12 months of the effective date of this permit.

All specific prohibitions or limits developed under this requirement are deemed to be conditions of this permit. The specific prohibitions set out in 40 CFR Part 403.5(b) shall be enforced by the permittee unless modified under this provision.

c. The permittee shall analyze the treatment facility influent and effluent for the presence of the toxic pollutants listed in 40 CFR 122 Appendix D (NPDES Application Testing Requirements) Table II at least **once/six months** and the toxic pollutants in Table III at least **once/quarter**. If, based upon information available to the permittee, there is reason to suspect the presence of any toxic or hazardous pollutant listed in Table V, or any other pollutant, known or suspected to adversely affect treatment plant operation, receiving water quality, or solids disposal procedures, analysis for those pollutants shall be performed at least **once/quarter** on both the influent and effluent.

i. The influent and effluent samples collected shall be composite samples consisting of at least 12 aliquots collected at approximately equal intervals over a representative 24 hour period and composited according to flow. Sampling and analytical procedures shall be in accordance with guidelines established in 40

CFR 136. Where composite samples are inappropriate, due to sampling, holding time, or analytical constraints, at least four (4) grab samples, taken at equal intervals over a representative 24 hour period, shall be taken.

d. The permittee shall prepare annually a list of Industrial Users which during the preceding twelve months were in significant noncompliance with applicable pretreatment requirements. For the purposes of this Part, significant noncompliance shall be determined based upon the more stringent of either criteria established at 40 CFR Part 403.8(f)(2)(vii) [rev. 7/24/90] or criteria established in the approved POTW pretreatment program. This list is to be published annually in the largest daily newspaper in the municipality during the month of **March**.

In addition, during the month of **March** the permittee shall submit an updated pretreatment program status report to ADEQ containing the following information:

i. An updated list of all significant industrial users. For each industrial user listed, the following information shall be included:

(1) Standard Industrial Classification (SIC) code and categorical determination.

(2) Control document status. Whether the user has an effective control document, and the date such document was last issued, reissued, or modified, (indicate which industrial users were added to the system (or newly identified) within the previous 12 months).

(3) A summary of all monitoring activities performed within the previous 12 months. The following information shall be reported:

(a) total number of inspections performed;
(b) total number of sampling visits made;

(4) Status of compliance with both effluent limitations and reporting requirements.

Compliance status shall be defined as follows:

(a) Compliant (C) - no violations during the previous 12 month period;

(b) Non-compliant (NC) - one or more violations during the previous 12 months but does not meet the criteria for significant noncompliant industrial users.

(c) Significant Noncompliance (SN) - in accordance with requirements described in d. above.

(5) For significantly noncompliant industrial users, indicate the nature of the violations, the type and number of actions taken (notice of violation, administrative order, criminal or civil suit, fines or penalties collected, etc.) and current compliance status. If ANY industrial user was on a schedule to attain compliance with effluent limits, indicate the date the schedule was issued and the date compliance is to be attained.

ii. A list of all significant industrial users whose authorization to discharge was terminated or revoked during the preceding 12 month period and the reason for termination.

iii. A report on any interference, pass through, upset or POTW permit violations known or suspected to be caused by industrial contributors and actions taken by the permittee in response.

iv. The results of all influent, effluent analyses performed pursuant to paragraph (c) above;

v. A copy of the newspaper publication of the significantly noncompliant industrial users giving the name of the newspaper and the date published; and

vi. The information requested may be submitted in tabular form as per the example tables provided for your convenience (See Attachments

A, B and C); and

vii. The monthly average water quality based effluent concentration necessary to meet the state water quality standards as developed in the approved technically based local limits.

e. The permittee shall provide adequate notice to the Department of the following:

i. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Section 301 and 306 of the Act if it were directly discharging those pollutants; and

ii. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

Adequate notice shall include information on (i) the quality and quantity of effluent to be introduced into the treatment works, and (ii) any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.

MONITORING RESULTS (1) FOR THE ANNUAL PRETREATMENT REPORT
REPORTING YEAR: __________, 2001 TO __________, _____
TREATMENT PLANT : City of ______________________ NPDES PERMIT #AR00__________
AVERAGE POTW FLOW: __________ MGD % IU FLOW: _____ %

METALS, CYANIDE and PHENOLS (Total)	MAHL mg/l	Influent Dates Sampled (mg/l) Once/quarter				WQ level/ limit mg/l	Effluent Dates Sampled (mg/l) Once/quarter				Laboratory Analysis (See Attachment PPS)	
											E P A Method Used	Detection Level Achieved (ug/l)
Antimony	N/A					N/A						
Cadmium												
Copper												
Lead												
Mercury												
Nickel												
Selenium												
Silver												
Z												
Chromium												
Cyanide												
Arsenic						N/A						
Molybdenum						N/A						
Phenols	N/A					N/A						
Beryllium	N/A					N/A						
Thallium	N/A					N/A						
Flow, MGD	N/A					N/A						
(2)												

(1) It is advised that the influent and effluent samples are collected considering flow detention time through each plant. **Analytical MQLs should be used so that the data can also be used for Local Limits assessment and NPDES application purpose.**

(2) Record the name of any pollutants [40 CFR 122, Appendix D, Table II and/or Table V] detected and the quantity in which they were detected.

MAI Maximum Allowable Headworks Level.

WQ Water Quality.

ATTACHMENT A

PRETREATMENT PROGRAM STATUS REPORT
UPDATED SIGNIFICANT INDUSTRIAL USERS LIST

Industrial User	SIC Code	Categorical Determination	Control Document		New User	Times Inspected	Times Sampled	Compliance Status				Effluent Limits
								Reports				
			Y/N	Last Action				BMR	90-day Compliance	Semi Annual	Self Monitoring	

ATTACHMENT B

SIGNIFICANT VIOLATIONS - ENFORCEMENT ACTIONS TAKEN

Industrial User	Nature of Violation		Number of Action Taken					Penalties Collected	Compliance Schedule		Current Status	Comments
	Reports	Limits	N.O.V.	A.O.	Civil	Criminal	Other		Date Issued	Date Due		

ATTACHMENT C

PRETREATMENT PERFORMANCE SUMMARY (PPS)

NOTE: ALL QUESTIONS REFER TO THE INDUSTRIAL PRETREATMENT PROGRAM AS APPROVED BY THE EPA. THE PERMITTEE SHOULD NOT ANSWER THE QUESTIONS BASED ON CHANGES MADE TO THE APPROVED PROGRAM WITHOUT DEPARTMENT AUTHORIZATION.

I. General Information

Control Authority Name ______________________________

Address ______________________________

City ______________ State/Zip ______________

Contact Person ______________________________
(Position)

Contact Telephone ( ) ______________________________

NPDES Permit Nos. ______________________________

Reporting Period ______________________________
(Beginning Month and Year) (Ending Month and Year)

Total Number of Categorical IUs ______________________________

Total Number of Significant Noncategorical IUs ______________

II. Significant Industrial User Compliance

	SIGNIFICANT INDUSTRIAL USERS	
	Categorical	NonCategorical
1) No. of SIUs Submitting BMRs/Total No. Required.	___/___	N/A*
2) No. of SIUs Submitting 90-Day Compliance Reports/No. Required.	___/___	N/A*
3) No. of SIUs Submitting Semiannual Reports/ Total No. Required.	___/___	______
4) No. of SIUs Meeting Compliance Schedule/ Total No. Required to Meet Schedule	___/___	______
5) No. of SIUs in Significant Noncompliance/ Total No. of SIUs	___/___	______
6) Rate of Significant Noncompliance for all SIUs (categorical and noncategorical) . . .	___/___	

III. Compliance Monitoring Program

	SIGNIFICANT INDUSTRIAL USERS	
	Categorical	NonCategorical
1) No. of Control Documents Issued/Total No. Required.	/	/
2) No. of Nonsampling Inspections Conducted. .		
3) No. of Sampling Visits Conducted.		
4) No. of Facilities Inspected (nonsampling) .		
5) No. of Facilities Sampled		

IV. Enforcement Actions

	SIGNIFICANT INDUSTRIAL USERS	
	Categorical	NonCategorical
1) No. of Compliance Schedules Issued/No. of Schedules Required	/	/
2) No. of Notices of Violations Issued to SIUs		
3) No. of Administrative Orders Issued to SIUs		
4) No. of Civil Suits Filed.		
5) No. of Criminal Suits Filed		
6) No. of Significant Violators (attach newspaper publication).		
7) Amount of Penalties Collected (total dollars/IUs assessed)	/	/
8) Other Actions (sewer bans, etc.).		

The following certification must be signed in order for this form to be considered complete:

I certify that the information contained herein is completeand accurate to the best of my knowledge.

Authorized Representative Date

9. WHOLE EFFLUENT TOXICITY TESTING (7-DAY CHRONIC NOEC FRESHWATER)

1. SCOPE AND METHODOLOGY

a. The permittee shall test the effluent for toxicity in accordance with the provisions in this section.

APPLICABLE TO FINAL OUTFALL(S): **001**

CRITICAL DILUTION (%): **20**

EFFLUENT DILUTION SERIES (%): **8, 11, 15, 20, 27**

COMPOSITE SAMPLE TYPE: **Defined at PART I**

TEST SPECIES/METHODS: **40 CFR Part 136**

Ceriodaphnia dubia chronic static renewal survival and reproduction test, Method 1002.0, EPA/600/4-91/002 or the most recent update thereof. This test should be terminated when 60% of the surviving females in the control produce three broods or at the end of eight days, whichever comes first.

Pimephales promelas (fathead minnow) chronic static renewal 7-day larval survival and growth test, Method 1000.0, EPA/600/4-91/002, or the most recent update thereof. A minimum of five (5) replicates with eight (8) organisms per replicate must be used in the control and in each effluent dilution of this test.

b. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution above which lethality that is statistically different from the control (0% effluent) at the 95% confidence level does not occur.

c. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

iv. Test failure is defined as a demonstration of statistically significant sub-lethal or lethal effects to a test species at or below the effluent critical dilution.

2. PERSISTENT LETHALITY

The requirements of this subsection apply only when a toxicity test demonstrates significant lethal effects at or below the critical dilution. Significant lethal effects are herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

a. Part I Testing Frequency Other Than Monthly

i. The permittee shall conduct a total of two (2) additional tests for any species that demonstrates significant lethal effects at or below the critical dilution. The two additional tests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two additional tests in lieu of routine toxicity testing. The full report shall be prepared for each test required by this section in accordance with procedures outlined in Item 4 of this section and submitted with the period discharge monitoring report (DMR) to the permitting authority for review.

ii. If one or both of the two additional tests demonstrates significant lethal effects at or below the critical dilution, the permittee shall initiate Toxicity Reduction Evaluation (TRE) requirements as specified in Item 5 of this section. The permittee shall notify ADEQ in writing within 5 days of the failure of any retest, and the TRE initiation date will be the test completion date of the first failed retest. A TRE may be also be required due to a demonstration of persistent significant sub-lethal effects or intermittent lethal effects at or below the critical dilution, or for failure to perform the required retests.

iii. If one or both of the two additional tests demonstrates significant lethal effects at or below the critical dilution, the permittee shall henceforth increase the frequency of testing for this species to once per quarter for the life of the permit.

iv. The provisions of Item 2.a are suspended upon submittal of the TRE Action Plan.

b. Part I Testing Frequency of Monthly

The permittee shall initiate the Toxicity Reduction Evaluation (TRE) requirements as specified in Item 5 of this section when any two of three consecutive monthly toxicity tests exhibit significant lethal effects at or below the critical dilution. A TRE may be also be required due to a demonstration of persistent significant sub-lethal effects or intermittent lethal effects at or below the critical dilution, or for failure to perform the required retests.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. Test Acceptance

The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied, including the following additional criteria:

i. The toxicity test control (0% effluent) must have survival equal to or greater than 80%.

ii. The mean number of Ceriodaphnia dubia neonates produced per surviving female in the control (0% effluent) must be 15 or more.

iii. 60% of the surviving control females must produce three broods.

iv. The mean dry weight of surviving fathead minnow larvae at the end of the 7 days in the control (0% effluent) must be 0.25 mg per larva or greater.

v. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: the young of surviving females in the Ceriodaphnia dubia reproduction test; the growth and survival endpoints of the fathead minnow test.

vi. The percent coefficient of variation between replicates shall be 40% or less in the critical dilution, unless significant lethal or nonlethal effects are exhibited for: the young of surviving females in the Ceriodaphnia dubia reproduction test; the growth and survival endpoints of the fathead minnow test.

Test failure may not be construed or reported as invalid due to a coefficient of variation value of greater than

40%. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

b. Statistical Interpretation

i. For the Ceriodaphnia dubia survival test, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be Fisher's Exact Test as described in EPA/600/4-91/002 or the most recent update thereof.

ii. For the Ceriodaphnia dubia reproduction test and the fathead minnow larval survival and growth test, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in EPA/600/4-91/002 or the most recent update thereof.

iii. If the conditions of Test Acceptability are met in Item 3.a above and the percent survival of the test organism is equal to or greater than 80% in the critical dilution concentration and all lower dilution concentrations, the test shall be considered to be a passing test, and the permittee shall report an NOEC of not less than the critical dilution for the DMR reporting requirements found in Item 4 below.

c. Dilution Water

i. Dilution water used in the toxicity tests will be receiving water collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness, and alkalinity to the closest downstream perennial water for;

(A) toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

(B) toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of instream toxicity (fails to fulfill the test acceptance criteria of Item 3.a), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

(A) a synthetic dilution water control which fulfills the test acceptance requirements of Item 3.a was run concurrently with the receiving water control;

(B) the test indicating receiving water toxicity has been carried out to completion (i.e., 7 days);

(C) the permittee includes all test results indicating receiving water toxicity with the full report and information required by Item 4 below; and

(D) the synthetic dilution water shall have a pH, hardness, and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. Samples and Composites

i. The permittee shall collect a minimum of three flow-weighted composite samples from the outfall(s) listed at Item 1.a above.

ii. The permittee shall collect second and third composite samples for use during 24-hour renewals of each dilution concentration for each test. The permittee must collect the composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis.

iii. The permittee must collect the composite samples so that the maximum holding time for any effluent sample shall not exceed 72 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first composite sample. Samples shall be chilled to 4 degrees Centigrade during collection, shipping, and/or storage.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Item 4 of this section.

v. MULTIPLE OUTFALLS: If the provisions of this section are applicable to multiple outfalls, the permittee shall combine the composite effluent samples in proportion to the average flow from the outfalls listed in Item 1.a above for the day the sample was collected. The permittee shall perform the toxicity test on the flow-weighted composite of the outfall samples.

4. REPORTING

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this section in accordance with the Report Preparation Section of EPA/600/4-91/002, or the most current publication, for every valid or invalid toxicity test initiated whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of PART II.C.3 of this permit. The permittee shall submit full reports upon the specific request of the Department. For any test which fails, is considered invalid or which is terminated early for any reason, the full report must be submitted for review.

b. A valid test for each species must be reported on the DMR during each reporting period specified in PART I of this permit unless the permittee is performing a TRE which may increase the frequency of testing and reporting. Only ONE set of biomonitoring data for each species is to be recorded on the DMR for each reporting period. The data submitted should reflect the LOWEST survival results for each species during the reporting period. All invalid tests, repeat tests (for invalid tests), and retests (for tests previously failed) performed during the reporting period must be attached to the DMR for ADEQ review.

c. The permittee shall submit the results of each valid toxicity test on the DMR for that reporting period in accordance with PART II.D.4 of this permit, as follows below. Submit retest information clearly marked as such with the following month's DMR. Only results of valid tests are to be reported on the DMR.

i. <u>Pimephales promelas</u> (fathead minnow)

(A) If the No Observed Effect Concentration (NOEC) for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TLP6C.

(B) Report the NOEC value for survival, Parameter No. TOP6C.

(C) Report the NOEC value for growth, Parameter No. TPP6C.

(D) If the No Observed Effect Concentration (NOEC) for growth is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TGP6C.

(E) Report the highest (critical dilution or control) Coefficient of Variation, Parameter No. TQP6C.

ii. <u>Ceriodaphnia dubia</u>

(A) If the NOEC for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TLP3B.

(B) Report the NOEC value for survival, Parameter No. TOP3B.

(C) Report the NOEC value for reproduction, Parameter No. TPP3B.

(D) If the No Observed Effect Concentration (NOEC) for reproduction is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TGP3B.

(E) Report the higher (critical dilution or control) Coefficient of Variation, Parameter No. TQP3B.

5. Monitoring Frequency Reduction

a. The permittee may apply for a testing frequency reduction upon the successful completion of the first four consecutive quarters of testing for one or both test species, with no lethal or sub-lethal effects demonstrated at or below the critical dilution. If granted, the monitoring frequency for that test species may be reduced to not less than once per year for the less sensitive species (usually the fathead minnow) and not less than twice per year for the more sensitive test species (usually the Ceriodaphnia dubia).

b. CERTIFICATION - The permittee must certify in writing that no test failures have occurred and that all tests meet all test acceptability criteria in item 3.a. above. In addition the permittee must provide a list with each test performed including test initiation date, species, NOECs for lethal and sub-lethal effects and the maximum coefficient of variation for the controls. Upon review and acceptance of this information the Department will issue a letter of confirmation of the monitoring frequency reduction. A copy of the letter will be forwarded to the Permit Compliance System section to update the permit reporting requirements.

c. SUB-LETHAL FAILURES - If, during the first four quarters of testing, sub-lethal effects are demonstrated to a test species, two monthly retests are required. In addition, quarterly testing is required for that species until the effluent passes both the lethal and sub-lethal test endpoints for the affected species for four consecutive quarters. Monthly retesting is not required if the permittee is performing a TRE.

d. SURVIVAL FAILURES - If any test fails the survival endpoint at any time during the life of this permit, two monthly retests are required and the monitoring frequency for the affected test species shall be increased to once per quarter until the permit is re-issued. Monthly retesting is not required if the permittee is performing a TRE.

e. This monitoring frequency reduction applies only until the expiration date of this permit, at which time the monitoring frequency for both test species reverts to once per quarter until the permit is re-issued.

6. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction

Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the critical dilution and include the following:

i. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) and "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA-600/6-91/005F), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081), as appropriate.

The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

ii. Sampling Plan (e.g., locations, methods, holdin times, chain of custody, preservation, etc.). effluent sample volume collected for all tests be adequate to perform the toxicity test, toxic characterization, identification and confirmati procedures, and conduct chemical specific analy when a probable toxicant has been identified;

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of efflu toxicity, the permittee shall conduct, concurre with toxicity testing, chemical specific analys the identified and/or suspected pollutant(s) an source(s) of effluent toxicity. Where lethality demonstrated within 48 hours of test initiation, composite sample shall be analyzed independently Otherwise the permittee may substitute a composi sample, comprised of equal portions of the indiv composite samples, for the chemical specific ana sis;

iii. Quality Assurance Plan (e.g., QA/QC implementati corrective actions, etc.); and

iv. Project Organization (e.g., project staff, proje manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan with thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achie the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities port, with the Discharge Monitoring Report in the mon of January, April, July and October, containing information on toxicity reduction evaluation activiti including:

i. any data and/or substantiating documentation whi identifies the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity

iii. any data which identifies effluent toxicity cont mechanisms that will reduce effluent toxicity to level necessary to meet no significant lethality the critical dilution.

d. The permittee shall submit a Final Report on Toxicity

Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

f. Quarterly testing during the TRE is a minimum monitoring requirement. EPA recommends that permittees required to perform a TRE not rely on quarterly testing alone to ensure success in the TRE, and that additional screening tests be performed to capture toxic samples for identification of toxicants. Failure to identify the specific chemical compound causing toxicity test failure will normally result in a permit limit for whole effluent toxicity limits per federal regulations at 40 CFR 122.44(d)(1)(v).

PART IV —

SECTION A — DEFINITIONS

All definitions contained in Section 502 of the Clean Water Act shall apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. "Act" means the Clean Water Act, Public Law 95-217(33. U.S.C. 1251 et seq.) as amended.
2. "Administrator" means the Administrator of the U.S. Environmental Protection Agency.
3. "Applicable effluent standards and limitations" means all State and Federal effluent standards and limitations to which a discharge is subject under the Act, including, but not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, and pretreatment standards.
4. "Applicable water quality standards" means all water quality standards to which a discharge is subject under the federal Clean Water Act and which have been (a) approved or permitted to remain in effect by the Administrator following submission to the Administrator pursuant to Section 303(a) of the Act, or (b) promulgated by the Director pursuant to Section 303(b) or 303(c) of the Act, and standards promulgated under regulation No. 2, as amended, (regulation establishing water quality standards for surface waters of the State of Arkansas).
5. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.
6. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during that sampling day.
7. "Daily Average" (also known as monthly average) discharge limitations means the highest allowable average of "daily discharge(s)" over a calendar month, calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes daily average concentration effluent limitations or conditions, the daily average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily concentration, F = daily flow and n = number of daily samples; daily average discharge =

$$\frac{C1F1 + C2F2 + \dots CnFn}{F1 + F2 + \dots + Fn}$$

8. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.
9. "Department" means the Arkansas Department of Pollution Control and Ecology (ADPCE).
10. "Director" means the Administrator of the U.S. Environmental Protection Agency and/or the Director of the Arkansas Department of Pollution Control and Ecology.
11. "Grab sample" means an individual sample collected in less than 15 minutes in conjunction with an instantaneous flow measurement.
12. "Industrial User" means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly-owned treatment works.
13. "National Pollutant Discharge Elimination System" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.
14. "POTW" means a Publicly Owned Treatment Works.
15. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in productions.
16. "ADPCE" means the Arkansas Department of Pollution Control and Ecology.
17. "Sewage sludge" means the solids, residues, and precipitate separated from o created in sewage by the unit processes of a publicly-owned treatment works Sewage as used in this definition means any wastes, including wastes from humans, households, commercial establishments, industries, and storm water runoff, that are discharged to or otherwise enter a publicly-owned treatment works.
18. "7-day average" discharge limitation, other than for fecal coliform bacteria, is the highest allowable arithmetic means of the values for all effluent samples collected during the calendar week. The 7-day average for fecal coliform bacteria is the geometric mean of the values of all effluent samples collected during the calendar week. The DMR should report the highest 7-day average obtained during the calendar month. For reporting purposes, the 7-day average values should be reported as occurring in the month in which the Saturday of the calendar week falls in.
19. "30-day average", other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month. The 30-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.
20. "24-hour composite sample" consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample collected at frequent intervals porportional to flow over the 24-hour period.
21. "12-hour composite sample" consists of 12 effluent portions collected no closer together than one hour and composited according to flow. The daily sampling intervals shall include the highest flow periods.
22. "6-hour composite sample" consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.
23. "3-hour composite sample" consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.
24. "Treatment works" means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage and industrial wastes, of a liquid nature to implement section 201 of the Act, or necessary to recycle reuse water at the most economic cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities, and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment.
25. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. Any upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventive maintenance, or careless or improper operations.
26. For "fecal coliform bacteria", a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.
27. "Dissolved oxygen", shall be defined as follows:
    a. When limited in the permit as a monthly minimum, shall mean the lowest acceptable monthly average value, determined by averaging all samples taken during the calendar month;
    b. When limited in the permit as an instantaneous minimum value, shall mean that no value measured during the reporting period may fall below the stated value.
28. The term "MGD" shall mean million gallons per day.
29. The term "mg/l" shall mean milligrams per liter or parts per million (ppm).
30. The term "µg/l" shall mean micrograms per liter or parts per billion (ppb).

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LIT ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR ONITORING REPORT *(DMR)*

(2-16) AR0040177 PERMIT NUMBER

(17-19) 001 A DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	00	11	01	TO	00	11	30
	(20-21)	(22-23)	(24-25)		(26-27)	(28-29)	(30-31)

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW
--
*** NO DISCHARGE !__! ***

Form Ap ved.
OMB N 0-0004
Approva expires 05-31-98

NOTE: Read Instructions before completing this form.

PARAMETER (32-37)		(3 Card Only) QUANTITY OR LOADING AVERAGE (46-53)	MAXIMUM (54-61)	UNITS	(4 Card Only) QUANTITY OR CONCENTRATION MINIMUM (38-45)	AVERAGE (46-53)	MAXIMUM (54-61)	UNITS	NO. EX (62-63)	FREQUENCY OF ANALYSIS (64-68)	SAMPLE TYPE (69-70)
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	2756	******	(26)	******	17.3	22.2	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.75	******	7.36	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	2704	******	(26)	******	16.7	20.8	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	19.80	38.62	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	95	260	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

I CERTIFY UNDER PENALTY OF LAW THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED HEREIN; AND BASED ON MY INQUIRY OF THOSE INDIVIDUALS IMMEDIATELY RESPONSIBLE FOR OBTAINING THE INFORMATION, I BELIEVE THE SUBMITTED INFORMATION IS TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT. SEE 18 U.S.C. § 1001 AND 33 U.S.C. § 1319. *(Penalties under these statutes may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)*

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	00	12	1
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LIT ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR ONITORING REPORT *(DMR)*

(2-16)	(17-19)
AR0040177	001 A
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	00	12	01	TO	00	12	31
	(20-21)	(22-23)	(24-25)		(26-27)	(28-29)	(30-31)

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW
--
*** NO DISCHARGE ☐ ***

Form Approved.
OMB N 40-0004
Approva. xpires 05-31-98

NOTE: Read Instructions before completing this form.

PARAMETER (32-37)		(3 Card Only) QUANTITY OR LOADING (46-53) AVERAGE	(54-61) MAXIMUM	UNITS	(4 Card Only) QUANTITY OR CONCENTRATION (38-45) MINIMUM	(46-53) AVERAGE	(54-61) MAXIMUM	UNITS	NO. EX (62-63)	*FREQUENCY OF ANALYSIS* (64-68)	SAMPLE TYPE (69-70)
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	2265	******	(26)	******	15.3	17.4	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.63	******	7.25	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	2162	******	(26)	******	14.7	19.5	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	17.97	36.41	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	165	884	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	1	19
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

EPA Form 3320-1 (08-95) Previous editions may not be used. (REPLACES EPA FORM T-40 WHICH MAY NOT BE USED.)

00376/991210-1926

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

PERMIT NUMBER	DISCHARGE NUMBER
AR0040177	001 A

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	01	01	TO	01	01	31

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE ! _ ! ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	2378	******	(26)	******	14.6	14.9	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.82	******	7.12	(12)	0	Daily	Gra
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	2344	******	(26)	******	14.4	14.9	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	19.32	32.66	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	61	166	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
AREA CODE	NUMBER	YEAR	MO	DAY
501	376-2903	01	2	16

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

EPA Form 3320-1 (Rev 3/99) Previous editions may be used. 00419/010110-1917 This is a 4-part form.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT *(DMR)*

PERMITTEE NAME/ADDRESS *(Include Facility Name/ Location if Different)*

NAME LITTLE ROCK, CITY OF (LRWU)
ADDRESS FOUR [illegible] CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

AR00401[illegible]
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	02	01	TO	01	02	28

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1893	******	(26)	******	12.2	12.3	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.66	******	7.14	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	1819	******	(26)	******	11.8	14.6	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	19.65	34.91	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	75	72	(13)	0	Daily	Grab
74055 1 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Rick Barger

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	3	19
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED [illegible] REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

EPA Form 3320-1 (Rev 3/99) Previous editions may be used. This is a 4-part form.

00420/010110-1917

PERMITTEE NAME/ADDRESS *(Include Facility Name/ Location if Different)*
NAME LIT E ROCK, CITY OF (LRWU)
ADDRESS FOU HE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTA DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR MONITORING REPORT *(DMR)*

AR0040177
PERMIT NUMBER

001 A
DISCHARGE NUMBER

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	03	01	**TO**	01	03	31

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C) 00310 1 0 0	SAMPLE MEASUREMENT	1732	******	(26)	******	11.9	22.9	(19)	0	Daily	24HFC
EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH 00400 1 0 0	SAMPLE MEASUREMENT	******	******		6.74	******	7.19	(12)	0	Daily	Gra
EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED 00530 1 0 0	SAMPLE MEASUREMENT	1510	******	(26)	******	10.4	12.2	(19)	0	Daily	24HFC
EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 0	SAMPLE MEASUREMENT	16.80	33.78	(03)	******	******	******		0	Cont.	TM
EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL 74055 1 1 0	SAMPLE MEASUREMENT	******	******		******	59	500	(13)	0	Daily	Grab
EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	1000 30DA GEO	2000 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	4	20
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

EPA Form 3320-1 (Rev 3/99) Previous editions may be used.

00421/[illegible] This is a 4-part form. **PAGE** **OF**

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location If Different)*

NAME LITT ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

PERMIT NUMBER AR0040177
DISCHARGE NUMBER 001 A

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	04	01	**TO**	01	04	30

*** NO DISCHARGE !__! ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1121	******	(26)	******	11.3	14.6	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.79	******	7.21	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	990	******	(26)	******	9.9	12.4	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	11.99	14.53	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	28	67	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Bruce A. Bennett
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE 501 376-2903
AREA CODE / NUMBER

DATE YEAR [illegible] MO [illegible] DAY [illegible]

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME LITT ROCK, CITY OF (LRWU)
ADDRESS FOUR E CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARGE MONITORING REPORT *(DMR)*

PERMIT NUMBER	DISCHARGE NUMBER
AR00401	001 A

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	05	01	TO	01	05	31

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1602	******	(26)	******	18.8	36.1	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.89	******	7.22	(12)	0	Daily	Gra
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*******	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	1265	******	(26)	******	14.9	36.1	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	10.12	17.45	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	*******		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	63	126	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	*******	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	7	02
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED [illegible] REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

PERMITTEE NAME RESS *(Include Facility Name/Location if Different)*

NAME LITT. . ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTAN' CHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHARC ONITORING REPORT *(DMR)*

PERMIT NUMBER	AR0040177
DISCHARGE NUMBER	001 A

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	06	01	TO	01	06	30

*** NO DISCHARGE ! __ ! ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1091	******	(26)	******	10.9	14.7	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.85	******	7.27	(12)	0	Daily	Gra
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	1083	******	(26)	******	10.8	11.3	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	12.03	13.65	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	12	71	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operarions

TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903			
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/99 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)
NAME LITTLE ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

PERMIT NUMBER: AR0040177
DISCHARGE NUMBER: 001 A

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

MONITORING PERIOD	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	07	01	TO	01	07	31

*** NO DISCHARGE |__| ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1307	******	(26)	******	13.2	15.9	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.78	******	7.07	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	1102	******	(26)	******	11.1	18.7	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	11.90	20.83	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	11	15	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Rick L. Barger
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	08	14
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/98 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

PERMITTEE NAM ORESS *(Include Facility Name/ Location if Different)*
NAME LIT _ ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTA SCHARGE ELIMINATION SYSTEM *(NPDES)*
DISCHAR ONITORING REPORT *(DMR)*

PERMIT NUMBER	DISCHARGE NUMBER
AR0040177	001 A

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	08	01	TO	01	08	31

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW
--
*** NO DISCHARGE !__! ***
NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1157	******	(26)	******	11.5	13.5	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.64	******	7.01	(12)	0	Daily	Gr
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	955	******	(26)	******	9.5	11.4	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	12.20	19.88	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	15	37	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Rick L. Barger, P.E., DEE
Director of Operations
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	09	12
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/96 REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

EPA Form 3320-1 (Rev 3/99) Previous editions may be used. 00426/C[illegible] This is a 4-part form. **PAGE** 1 **OF**

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

NAME LIT[illegible] ROCK, CITY OF (LRWU)
ADDRESS FOURCHE CREEK WWTP
221 E. CAPITOL
LITTLE ROCK AR 72202
FACILITY LITTLE ROCK, CITY OF-FOURCHE
LOCATION LITTLE ROCK AR 72206
ATTN: RICK L. BARGER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

AR0040177	001 A
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM	01	09	01	TO	01	09	30

MAJOR

F - FINAL
001-MONTHLY-TRTD MUNICIPAL WW

*** NO DISCHARGE !__! ***

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			Quality or Concentration				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
BOD, 5-DAY (20 DEG. C)	SAMPLE MEASUREMENT	1375	******	(26)	******	13.7	20.8	(19)	0	Daily	24HFC
00310 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
PH	SAMPLE MEASUREMENT	******	******		6.49	******	7.00	(12)	0	Daily	Grab
00400 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	6 MINIMUM	******	9 MAXIMUM	SU		DAILY	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	763	******	(26)	******	7.6	13.0	(19)	0	Daily	24HFC
00530 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	4003 MO AVG	******	LBS/DY	******	30 MO AVG	45 7 DA AVG	MG/L		DAILY	COMP24
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	11.98	14.11	(03)	******	******	******		0	Cont.	TM
50050 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	REPORT MO AVG	REPORT DAILY MX	MGD	******	******	******	**** ****		DAILY	TOTALZ
COLIFORM, FECAL GENERAL	SAMPLE MEASUREMENT	******	******		******	16	70	(13)	0	Daily	Grab
74055 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	******	******	**** ****	******	200 30DA GEO	400 7 DA GEO	#/ 100ML		DAILY	GRAB
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

Rick L. Barger, P.E., DEE
Director of Operations

TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
501	376-2903	01	10	26
AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

FLOW MUST BE MONITORED AND REPORTED (AS MONTHLY AVERAGE AND DAILY MAXIMUM UNDER QUANTITY IN MILLION GALLONS PER DAY). REPORT INSTANTANEOUS MAXIMUM TOTAL RESIDUAL CHLORINE. CHUCK BENNETT'S LETTER DATED 05/01/[illegible] REMOVES TOTAL RESIDUAL CHLORINE MONITORING FROM THE PERMIT.

Permit number: AR0040177

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM AND THE ARKANSAS WATER AND AIR POLLUTION CONTROL ACT

In accordance with the provisions of the Air Pollution Control Act (Act 472 of 1949, as amended, Ark. Code Ann. 8-4-101 et seq.), and the Clean Water Act (33 U.S.C. 1251 et seq.),

Little Rock Wastewater Utility (LRWU)
Fourche Creek Wastewater Treatment Plant (WWTP)
221 E. Capitol
Little Rock, AR 72202-2412

is authorized to discharge from a facility located at

Latitude: 34° 41' 50.03": Longitude: 92° 09' 47.49"

9500 Birdwood Road, in the Northwest 1/4 of the Southwest 1/4 of Section 23, Township 1 North, Range 11 West, in Pulaski County, Arkansas

to receiving waters named:

Arkansas River in Segment 3C of the Arkansas River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II (Version 2), III, and IV (Version 2) hereof.

This permit shall become effective on May 1, 1997.

This permit and the authorization to discharge shall expire at midnight, April 30, 2002.

Signed this 31st day of March 1997

Chuck C. Bennett
Chief, Water Division

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS: OUTFALL 001- treated municipal wastewater

During the period beginning on effective date and lasting until date of expiration, the permittee is authorized to discharge from outfall serial number 001 - Treated municipal wastewater. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	**Discharge Limitations**			**Monitoring Requirements**	
	Mass (lbs/day)	Other Units (specify)			
	Monthly Avg	Monthly Avg	7-day Avg	Measurement Frequency	Sample Type
Flow (MGD)+	N/A	N/A	N/A	Daily	Totalizing Meter
Biochemical Oxygen Demand (5-day)	4003	30 mg/l	45 mg/l	Once/day	24-hr. Composite
Total Suspended Solids	4003	30 mg/l	45 mg/l	Once/day	24-hr. Composite
Fecal Coliform Bacteria					
April 1 - September 30	N/A	200/100 ml	400/100 ml	Once/day	Grab
October 1 - March 31	N/A	1000/100 ml	2000/100 ml	Once/day	Grab
Total Residual Chlorine	N/A	N/A	Report, mg/l	Once/~~week~~ DAY	Grab
Chronic Biomonitoring *	N/A	N/A	N/A	Quarterly	24-hr Composite
Silver, Total Recoverable **	N/A	Report, µg/l	Report, µg/l	Quarterly	24-hr Composite
pH	N/A	Minimum 6 s. u.	Maximum 9 s. u.	Once/day	Grab

\+ Report monthly average and daily maximum as MGD.
* See Part III, Condition No. 10.
** Monitor and report for one year. See Part III, Condition 11.

There shall be no discharge of distinctly visible solids, scum or foam of a persistent nature, nor shall there be any formation of slime, bottom deposits or sludge banks.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: at outfall 001, after the final treatment unit for all samples except biomonitoring. For biomonitoring sample at the sluice gate immediately prior to entering the receiving stream.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

> Compliance with final effluent limits is required on the effective date of the permit.

PART II — STANDARD CONDITIONS

SECTION A — GENERAL CONDITIONS

1. **Duty to Comply**

   The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the federal Clean Water Act and the Arkansas Water and Air Pollution Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. Any values reported in the required Discharge Monitoring Report which are in excess of an effluent limitation specified in Part I.A. shall constitute evidence of violation of such effluent limitation and of this permit.

2. **Penalties for Violations of Permit Conditions**

   The Arkansas Water and Air Pollution Control Act provides that any person who violates any provisions of a permit issued under the Act shall be guilty of a misdemeanor and upon conviction thereof shall be subject to imprisonment for not more than one (1) year, or a fine of not more than ten thousand dollars ($10,000) or by both such fine and imprisonment for each day of such violation. Any person who violates any provision of a permit issued under the Act may also be subject to civil penalty in such amount as the court shall find appropriate, not to exceed five thousand dollars ($5,000) for each day of such violation. The fact that any such violation may constitute a misdemeanor shall not be a bar to the maintenance of such civil action.

3. **Permit Action**

   This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

   a. Violation of any terms or conditions of this permit; or
   b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
   c. A change in any conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge; or
   d. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination.
   e. Failure of the permittee to comply with the provisions of ADPCE Regulation No. 9 (Permit fees) as required by condition II.A. 10 herein.

   The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

4. **Toxic Pollutants**

   Notwithstanding Part II.A.3., if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Regulation No. 2, as amended (regulation establishing water quality standards for surface waters of the State of Arkansas) or Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standards or prohibition and the permittee so notified.

   The permittee shall comply with effluent standards or prohibitions established under Regulation No. 2 (Arkansas Water Quality Standards), as amended, or Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. **Civil and Criminal Liability**

   Except as provided in permit conditions on "Bypassing" (Part II.B.4.a.), and "Upsets" (Part II.B.5.b.), nothing in this permit shall be construed to relieve the permittee from civil penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of this permit or applicable state and federal statutes or regulations which defeats the regulatory purposes of the permit may subject the permittee to criminal enforcement pursuant to the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended).

6. **Oil and Hazardous Substance Liability**

   Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

7. **State Laws**

   Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

8. **Property Rights**

   The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

9. **Severability**

   The provisions of this permit are severable. If any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provisions to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. **Permit Fees**

    The permittee shall comply with all applicable permit fee requirements for wastewater discharge permits as described in ADPCE Regulation No. 9 (Regulation for the Fee System for Environmental Permits). Failure to promptly remit all required fees shall be grounds for the Director to initiate action to terminate this permit under the provisions of 40 CFR 122.64 and 124.5(d), as adopted in ADPCE Regulation No. 6, and the provisions of ADPCE Regulation No. 8.

SECTION B — OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. **Proper Operation and Maintenance**

   a. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.
   b. The permittee shall provide an adequate operating staff which is duly qualified to carry out operation, maintenance and testing functions required to insure compliance with the conditions of this permit.

2. **Need to Halt or Reduce Not a Defense**

   It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or discharges or both until the facility is restored or alternative method of treatment is provided. This requirement applies, for example when the primary source of power for the treatment facility is reduced, is lost, or alternate power supply fails.

3. **Duty to Mitigate**

   The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has reasonable likelihood of adversely affecting human health or the environment.

4. **Bypass of Treatment Facilities**

   a. Bypass not exceeding limitation. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provision of Part II.B.4.b. and 4.c.
   b. Notice
      (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible, at least ten days before the date of the bypass.
      (2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II.D.6(24-hour notice).
   c. Prohibition of bypass.
      (1) Bypass is prohibited and the Director may take enforcement action against a permittee for bypass, unless:
         (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
         (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
         (c) The permittee submitted notices as required by Part II.B.4.b.
      (2) The Director may approve an anticipated bypass, after considering its adverse effects, if the director determines that it will meet the three conditions listed above in Part II.B.4.c.(1).

5. **Upset Conditions**

   a. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Part II.B.5.b. of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

b. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
   (1) An upset occurred and that the permittee can identify the cause(s) of the upset;
   (2) The permitted facility was at the time being properly operated;
   (3) The permittee submitted notice of the upset as required by Part II.D.6.; and
   (4) The permittee complied with any remedial measures required by Part II.B.3.

c. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. **Removed Substances**
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering the waters of the state. Written approval for such disposal must be obtained from the ADPCE.

7. **Power Failure**
The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failure either by means of alternate power sources, standby generators, or retention of inadequately treated effluent.

SECTION C — MONITORING AND RECORDS

1. **Representative Sampling**
Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge during the entire monitoring period. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director. Intermittent discharges shall be monitored.

2. **Flow Measurements**
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes and shall be installed at the monitoring point of the discharge.

3. **Monitoring Procedures**
Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals frequent enough to insure accuracy of measurements and shall insure that both calibration and maintenance activities will be conducted. An adequate analytical quality control program, including the analysis of sufficient standards, spikes, and duplicate samples to insure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory. At a minimum, spikes and duplicate samples are to be analyzed on 10% of the samples.

4. **Penalties for Tampering**
The Arkansas Water and Air Pollution Control Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under the Act shall be guilty of a misdemeanor and upon conviction thereof shall be subject to imprisonment for not more than one (1) year or a fine of not more than ten thousand dollars ($10,000) or by both such fine and imprisonment.

5. **Reporting of Monitoring Results**
Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1). Permittees are required to use preprinted DMR forms provided by ADPCE, unless specific written authorization to use other reporting forms is obtained from ADPCE. Monitoring results obtained during the previous calendar month shall be summarized and reported on a DMR form postmarked no later than the 25th day of the month following the completed reporting period to begin on the effective date of the permit. Duplicate copies of DMR's signed and certified as required by Part II.d.11 and all other reports required by Part II.D. (Reporting Requirements), shall be submitted to the Director at the following address:

Director
Arkansas Department of Pollution
Control and Ecology
8001 National Drive
P.O. Box 8913
Little Rock, AR 72219-8913

If permittee uses outside laboratory facilities for sampling and/or analysis, the name and address of the contract laboratory shall be included on the DMR.

6. **Additional Monitoring by the Permittee**
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated on the DMR.

7. **Retention of Records**
The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time

8. **Record Contents**
Records and monitoring information shall include:
   a. The date, exact place, time and methods of sampling or measurements, and preservatives used, if any;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were formed;
   d. The individual(s) who performed the analyses;
   e. The analytical techniques or methods used; and
   f. The measurements and results of such analyses.

9. **Inspection and Entry**
The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:
   a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
   b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
   c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
   d. Sample, inspect or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D — REPORTING REQUIREMENTS

1. **Planned Changes**
The permittee shall give notice and provide plans and specification to the Director for review and approval prior to any planned physical alterations or additions to the permitted facility. Notice is required only when:

For Industrial Dischargers
   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b).
   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR Part 122.42(a)(1).

For POTW Dischargers:
   c. Any change in the facility discharge (including the introduction of any new source or significant discharge or significant changes in the quantity or quality of existing discharges of pollutants) must be reported to the permitting authority. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. **Anticipated Noncompliance**
The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. **Transfers**
The permit is nontransferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Act.

4. **Monitoring Reports**
Monitoring results shall be reported at the intervals and in the form specified in Part II.C.5. (Reporting). Discharge Monitoring Reports must be submitted even when no discharge occurs during the reporting period.

5. **Compliance Schedule**
Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. **Twenty-four Hour Report**
   a. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain the following information:
      (1) a description of the noncompliance and its cause;
      (2) the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and
      (3) steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance.
   b. The following shall be included as information which must be reported within 24 hours:
      (1) Any unanticipated bypass which exceeds any effluent limitation in the permit;
      (2) Any upset which exceeds any effluent limitation in the permit; and
      (3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.
   c. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

7. **Other Noncompliance**
   The permittee shall report all instances of noncompliance not reported under Part II.D.4, 5, and 6, at the time monitoring reports are submitted. The reports shall contain the information listed at Part II.D.6.

8. **Changes in Discharge of Toxic Substances for Industrial Dischargers**
   The permittee shall notify the Director as soon as he/she knows or has reason to believe:
   a. That any activity has occurred or will occur which would result in the discharge, in a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2)[48 FR 14153, April 1983, as amended at 49 FR 38046, September 26, 1984].
   b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2)[48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984].

9. **Duty to Provide Information**
   The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to detemine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit. Information shall be submitted in the form, manner, and time frame requested by the Director.

10. **Duty to Reapply**
    If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The complete application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date. Continuation of expiring permits shall be governed by regulations promulgated in ADPCE Regulation No. 6.

11. **Signatory Requirements**
    All applications, reports or information submitted to the Director shall be signed and certified.
    a. All permit applications shall be signed as follows:
       (1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:
          (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or
          (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
       (2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
       (3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:
          (i) the chief executive officer of the agency, or
          (ii) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.
    b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
       (1) The authorization is made in writing by a person described above.
       (2) The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and
       (3) The written authorization is submitted to the Director.
    c. Certification. Any person signing a document under this section shall make the following certification:

       "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. **Availability of Reports**
    Except for data determined to be confidential under 40 CFR Part 2 and Regulation 6, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department of Pollution Control and Ecology. As required by the Regulations, the name and address of any permit applicant or permittee, permit applications, permits and effluent data shall not be considered confidential.

13. **Penalties for Falsification of Reports**
    The Arkansas Air and Water Pollution Control Act provides that any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan or other document filed or required to be maintained under this permit shall be subject to civil penalties specified in Part II.A.2. and/or criminal penalties under the authority of the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended).

PART III
OTHER CONDITIONS

1. Contributing Industries and Pretreatment Requirements

   a. The permittee shall operate an industrial pretreatment program in accordance with Section 402(b)(8) of the Clean Water Act, the General Pretreatment Regulations (40 CFR Part 403) and the approved POTW pretreatment program submitted by the permittee. The pretreatment program was approved on November 1, 1982. The permittee shall submit all necessary proposed modifications to the ADPC&E per provisions set forth in the program's NPDES Tracking Permit AR0021806. The POTW pretreatment program is hereby incorporated by reference and shall be implemented in a manner consistent with the following requirements:

      i. Industrial user information shall be updated at a frequency adequate to ensure that all IUs are properly characterized at all times.

      ii. The frequency and nature of industrial user compliance monitoring activities by the permittee shall be commensurate with the character, consistency and volume of waste. However, in keeping with the requirements of 40 CFR 403.8(f)(2)(v), the permittee must inspect and sample the effluent from each Significant Industrial User at least once a year. This is in addition to any industrial self-monitoring activities;

      iii. The permittee shall enforce and obtain remedies for noncompliance by any industrial users with applicable pretreatment standards and requirements.

      iv. The permittee shall control through permit, order, or similar means, the contribution to the POTW by each Industrial User to ensure compliance with applicable Pretreatment Standards and Requirements. In the case of Industrial Users identified as significant under 40 CFR 403.3(t), this control shall be achieved through permits or equivalent individual control mechanisms issued to each such user. Such control mechanisms must be enforceable and contain, at a minimum, the following conditions:

(1) Statement of duration (in no case more than five years;

(2) Statement of non-transferability without, at a minimum, prior notification to the POTW and provision of a copy of the existing control mechanism to the new owner or operator;

(3) Effluent limits based on applicable general pretreatment standards, categorical pretreatment standards, local limits, and State and local law;

(4) Self-monitoring, sampling, reporting, notification and recordkeeping requirements, including an identification of the pollutants to be monitored, sampling location, sampling frequency, and sample type, based on the applicable general pretreatment standards in 40 CFR 403, categorical pretreatment standards, local limits, and State and local law;

(5) Statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements, and any applicable compliance schedule. Such schedules may not extend the compliance date beyond federal deadlines.

v. The permittee shall evaluate, at least once every two years, whether each Significant Industrial User needs a plan to control slug discharges. If the POTW decides that a slug control plan is needed, the plan shall contain at least the minimum elements required in 40 CFR 403.8 (f)(2)(v).

vi. The permittee shall provide adequate staff, equipment, and support capabilities to carry out all elements of the pretreatment program; and,

vii. The approved program shall not be modified by the permittee without the prior approval of the Department.

b. The permittee shall establish and enforce specific limits to implement the provisions of 40 CFR Parts 403.5(a) and (b), as required by 40 CFR Part 403.5(c). Each POTW with an approved pretreatment program shall continue to develop these limits as necessary and effectively enforce such limits.

In accordance with EPA policy and with the requirements of 40 CFR Part 403.8(f)(4) and 40 CFR Part 403.5(c), the permittee shall conduct a headworks analysis to determine if technically based local limits are necessary to implement the general and specific prohibitions of 40 CFR Parts 403.5(a) and (b). This evaluation should be conducted in accordance with the latest revision of the EPA "Region 6 Technically Based Local Limits Development Guidance", and after review of the "Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program" December, 1987. Local limits must be revised and submitted to ADPC&E in approvable form based upon the findings of the technical evaluation per the provisions set forth in the Program's NPDES Tracking Permit AR0021806. At the same time, a draft Sewer Use Ordinance including the proposed, modified local limits and any necessary portions updated to come into compliance with current General Pretreatment Regulations (40 CFR 403) must be submitted. Additional modifications to the Pretreatment Program, including an Enforcement Response Plan, must also be submitted at this time.

All specific prohibitions or limits developed under this requirement are deemed to be conditions of this permit. The specific prohibitions set out in 40 CFR Part 403.5(b) shall be enforced by the permittee unless modified under this provision.

c. The permittee shall analyze the treatment facility influent and effluent for the presence of the toxic pollutants listed in 40 CFR 122 Appendix D (NPDES Application Testing Requirements) Table II at least twice per year and the toxic pollutants in Table III at least four times per year. If, based upon information available to the permittee, there is reason to suspect the presence of any toxic or hazardous pollutant listed in Table V, or any other pollutant, known or suspected to adversely affect treatment plant operation, receiving water quality, or solids disposal procedures, analysis for those pollutants shall be performed at least four times per year on both the influent and effluent.

i. The influent and effluent samples collected shall be composite samples consisting of at least 12 aliquots collected at approximately equal intervals over a representative 24 hour period and composited according to flow. Sampling and analytical procedures shall be in accordance with guidelines established in 40 CFR 136. Where composite samples are inappropriate, due to sampling, holding time, or analytical constraints, at least 3 grab samples, taken at equal intervals over a representative 24 hour period, shall be taken.

d. The permittee shall prepare annually a list of Industrial Users which during the preceding twelve months were in significant noncompliance with applicable pretreatment requirements. For the purposes of this Part, significant noncompliance shall be determined based upon the more stringent of either criteria established at 40 CFR Part 403.8(f)(2)(vii) [rev. 7/24/90] or criteria established in the approved POTW pretreatment program. This list is to be published annually in the largest daily newspaper in the municipality during the month of March.

In addition, during the month of March the permittee shall submit an updated pretreatment program status report to ADPC&E containing the following information:

i. An updated list of all significant industrial users. For each industrial user listed, the following information shall be included:

(1) Standard Industrial Classification (SIC) code and categorical determination.

(2) Control document status. Whether the user has an effective control document, and the date such document was last issued, reissued, or modified, (indicate which industrial users were added to the system (or newly identified) within the previous 12 months).

(3) A summary of all monitoring activities performed within the previous 12 months. The following information shall be reported:

(a) total number of inspections performed;

(b) total number of sampling visits made;

(4) Status of compliance with both effluent limitations and reporting requirements. Compliance status shall be defined as follows:

(a) Compliant (C) - no violations during the previous 12 month period;

(b) Non-compliant (NC) - one or more violations during the previous 12 months but does not meet the criteria for significant noncompliant industrial users.

(c) Significant Noncompliance (SN) - in accordance with requirements described in d. above.

(5) For significantly noncompliant industrial users, indicate the nature of the violations, the type and number of actions taken (notice of violation, administrative order, criminal or civil suit, fines or penalties collected, etc.) and current compliance status. If ANY industrial user was on a schedule to attain compliance with effluent limits, indicate the date the schedule was issued and the date compliance is to be attained.

ii. A list of all significant industrial users whose authorization to discharge was terminated or revoked during the preceding 12 month period and the reason for termination.

iii. A report on any interference, pass through, upset or POTW permit violations known or suspected to be caused by industrial contributors and actions taken by the permittee in response.

iv. The results of all influent, effluent analyses performed pursuant to paragraph (1)(c) above;

v. A copy of the newspaper publication of the significantly noncompliant industrial users giving the name of the newspaper and the date published; and

vi. The information requested may be submitted in tabular form as per the example tables provided for your convenience (See Attachments A, B and C); and

vii. The monthly average water quality based effluent concentration necessary to meet the state water quality standards as developed in the approved technically based local limits.

e. The permittee shall provide adequate notice to the Department of the following:

i. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Section 301 and 306 of the Act if it were directly discharging those pollutants; and

ii. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

Adequate notice shall include information on (i) the quality and quantity of effluent to be introduced into the treatment works, and (ii) any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.

MONITORING RESULTS [1] FOR THE ANNUAL PRETREATMENT REPORT
REPORTING YEAR: ____________, 199__ TO ____________, 199__

TREATMENT PLANT : ______________________________ NPDES PERMIT #AR00__________
AVERAGE POTW FLOW: __________MGD % IU FLOW: ______%

METALS, CYANIDE & PHENOLS	[illegible] Average Effluent [illegible]	Influent Dates Sampled				Effluent Dates Sampled			
Antimony (Total)									
Arsenic (Total)									
Beryllium (Total)									
Cadmium (Total)									
Chromium (Total)									
Copper (Total)									
Lead (Total)									
Mercury (Total)									
Molybdenum (Total)									
Nickel (Total)									
Selenium (Total)									
Silver (Total)									
Thallium (Total)									
Zinc (Total									
Cyanide (Total)									
Phenols (Total)									
[4]									

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[1] It is advised that the influent and effluent samples are collected considering flow detention time through each plant. Analytical MQLs should be used so that the data can also be used for Local Limits assessment and NPDES application purposes.

[2] Monthly average effluent level is based on State Water Quality Standards and implementation procedures.

[3] Indicate reported units of measurement

[4] Record the names of any pollutants [40 CFR 122, Appendix D, Table II and/or Table V] detected and the quantity in which they were detected.

2. The operator of this wastewater treatment facility shall be licensed by the State of Arkansas in accordance with Act 211 of 1971, Act 1103 of 1991, Act 556 of 1993, and Regulation No. 3, as amended.

3. Any sludge generated from the treatment process shall be stored and/or disposed of in a manner approved by this Department, and in accordance with Part II B6 herein. Written authorization from the facility or facilities where sludge is to be disposed must accompany each request for Department approval.

4. The permittee, at all times, shall handle and dispose of sewage sludge in such a manner so as to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants which may be present.

5. If an applicable "acceptable management practice" or numerical limitations for pollutants in sewage sludge promulgated under Section 405(d)(2) of the Act is more stringent than the sludge pollutant limits or acceptable management practice in this permit, or controls a pollutant not listed in this permit, this permit shall be promptly modified or revoked and reissued to conform to the requirements promulgated under Section 405(d)(2). The permittee shall comply with the limitations by no later than the compliance deadline specified in the applicable regulation as required in Section 405(d)(2)(D) of the Act.

6. Produced sledges shall be disposed of by land application only when meeting the following criteria:

    a. Sewage sludge from treatment works treating domestic sewage (TWTDS) must meet the applicable provisions of 40 CFR Part 503 on the respective compliance date of the federal regulation;

    b. The sewage sludge which has not been classified as a hazardous waste under state or federal regulations;

    c. Under the terms and conditions of a NPDES permit, if issued by EPA; and

    d. A separate state "no discharge" permit authorizing land application of sewage sludge and containing additional state requirements. (If ADPCE receives authorization to issue NPDES permits containing Part 503 requirements, the

NPDES permit issued by ADPCE will contain the additional state requirements and a separate state "no discharge" permit will no longer be necessary).

7. The permittee shall give at least 120 days prior notice to the Director of any change planned in the permittee's sludge disposal practice or land use applications, including types of crops grown (if applicable).

8. For publicly owned treatment works, the 30-day average percent removal for Biochemical Oxygen Demand and Total Suspended Solids shall not be less than 85 percent unless otherwise authorized by the permitting authority in accordance with 40 CFR 133.102, as adopted by reference in ADPC&E Regulation No. 6.

9. The permittee shall not cause or allow the permitted facility to emit odors which unreasonably interfere with enjoyment of life or use of property in the surrounding area.

10. Chronic Biomonitoring Requirements

a. Scope

The permittee shall test Outfall 001 for toxicity in accordance with the provisions in this section. Such testing will determine if an effluent sample dilution affects the survival and/or reproduction or growth of the appropriate test organism.

The first toxicity test must be initiated within 60 days from the effective date of the permit and the results of the test submitted with the first Discharge Monitoring Report (DMR) following completion of the toxicity test. However, if lethality is demonstrated for either test organism in any toxicity test required by this permit, the test results must be submitted to the Department within 15 days of receipt of results.

The toxicity tests specified herein shall be conducted once per **quarter**.

b. Definitions

Toxicity is herein defined as a statistically significant difference at the 95% confidence level between the survival, reproduction or growth of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

Lethality, a component of toxicity, is herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

Significant nonlethal effect, a component of toxicity, is herein defined as a statistically significant difference at the 95% confidence level between the reproduction or growth of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

Toxicity Reduction Evaluation (TRE) is an evaluation intended to determine those actions necessary to achieve compliance with water quality-based effluent limitations by reducing an effluent's toxicity or chemical concentration(s) to acceptable levels. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or determine the treatment methods which will reduce the effluent toxicity.

c. Test Methods

All test organisms, procedures, and quality assurance requirements used shall be in accordance with the latest revision of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof, unless specified otherwise in the permit. The following tests shall be used:

i. Chronic static renewal survival and reproduction test using *Ceriodaphnia dubia* (Method 1002.0). This test should be terminated when 60% of the surviving females in the control produce three broods.

ii. Chronic static renewal 7-day larval survival and growth test using fathead minnow (*Pimephales promelas*) (Method 1000.0). A minimum of five (5) replicates with eight (8) organisms per replicate must be used for this test.

d. Test Acceptance

i. The toxicity test control (0% effluent) must have a survival equal to or greater than 80%. Should the control survival be less than 80%, the toxicity test, including control and all effluent dilutions, shall be repeated.

ii. The mean number of *Ceriodaphnia dubia* neonates produced per surviving female in the control (0% effluent) must be 15 or more. Should the control neonate production be less than 15, the toxicity test, including control and all effluent dilutions, shall be repeated.

iii. The average weight of surviving fathead minnow larvae at the end of the 7 days in the control (0% effluent) must be 0.25 mg or greater. Should the average larval weight be less than 0.25 mg, the toxicity test, including control and all effluent dilutions, shall be repeated.

iv. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for:

(1) the young of surviving females in the *Ceriodaphnia dubia* reproduction test;
(2) fathead minnow growth test; and
(3) fathead minnow survival test.

v. The percent coefficient of variation between replicates shall be 40% or less for the low flow dilution (critical dilution) for ADPC&E to agree with a finding of no toxicity for these dilutions.

vi. If the permittee has conducted toxicity testing prior to the effective date of the permit in accordance with the provisions of this section, the test results may be submitted to ADPCE for approval. If approved, the test(s) will constitute partial fulfillment of the toxicity testing requirements of the permit.

e. Statistical Interpretation

i. For the *Ceriodaphnia dubia* survival test, the statistical analyses used to determine if there is a significant difference between the control and the low flow dilution shall be Fisher's Exact Test as described in the "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

ii. For the *Ceriodaphnia dubia* reproduction test and the fathead minnow larval survival and growth test, the statistical analyses used to determine if there is a significant difference between the control and the low flow (critical dilution) effluent concentration shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

f. Dilution Series

Five dilutions in addition to a control (0% effluent) composed of the same water as the dilution water, shall be used in the toxicity tests. These additional effluent dilutions shall be 4%, 5%, 8%, 10%, and 13%. The low-flow effluent concentration (critical dilution) is defined as 10% effluent.

g. Dilution Water

Dilution water used in the toxicity tests will be receiving water from the Arkansas River collected as close to the point of discharge as possible but unaffected by the discharge. If there is no receiving water due to zero flow conditions, the permittee may substitute synthetic dilution water.

If the receiving water is unsatisfactory as a result of preexisting instream toxicity (fails to fulfill the criteria of 10.d above, or for other reasons substantiated by the permittee) synthetic dilution water may be substituted for the receiving water, provided the following stipulations are met:

i. a synthetic dilution water control is run;

ii. the synthetic dilution water fulfills the requirements of 10.d;

iii. A receiving water control is run concurrently with the test (provided sufficient receiving water is available), until receiving water toxicity is adequately documented to the Department.

iv. the permittee submits all test results indicating receiving water toxicity with the report and information required by item 10.m and the Discharge Monitoring Report (DMR); and

v. the synthetic dilution water shall have a pH, hardness and alkalinity similar to that of the receiving water and shall be prepared in accordance with the procedures in EPA/600/4-89/001 using ecoregion water characteristics as follows:

For discharges located in the Gulf Coastal, Arkansas River Valley, Boston Mountains, or Ouachita Mountains Ecoregions, and discharges to the Ouachita River, use **SOFT** water:

For discharges located in the Delta or Ozark Highlands Ecoregions, and discharges to the White, Arkansas, Mississippi, and St. Francis Rivers, use **MODERATELY HARD** water:

For discharges to the Red River, use **HARD** water.

Synthetic dilution water may be used in all subsequent tests for both test species provided all of the above stipulations are met.

h. Samples and Composites

A minimum of three flow-weighted 24-hour composite samples representative of the dry weather flows during normal operation will be collected from Outfall 001. A 24-hour composite sample consists of a minimum of twelve (12) effluent portions collected at equal time intervals and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

The 24-hour composite samples must be collected such that the samples include any periodic episode of chlorination, use of a biocide or other potentially toxic substance discharged on an intermittent basis.

i. When collecting composite samples for toxicity testing, the permittee shall also analyze effluent for all parameters as specified in Part 1, Section A of this permit. These analyses may be utilized as those required in Part 1, Section A for the monitoring period encompassing the toxicity test or may be in addition to the requirements of Part 1, Section A, at the permittee's discretion. The results of these analyses shall be included in the reports required in item 10.m below.

The 24-hour composite samples must be collected so that the maximum holding time for any effluent sample shall not exceed 72 hours. The toxicity test must be initiated within 36 hours after the collection of the last portion of the first 24-hour composite sample. Samples shall be chilled to 4 degrees Centigrade during collection, shipping and/or storage.

If the flow from the outfall 001 being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume that is sufficient to complete the required toxicity tests with daily renewal of effluent.

j. Low Flow Lethality Testing - Special Conditions

The requirements of this subsection (10.j) apply only when a toxicity test at the 10 % effluent concentration demonstrates lethality.

i. The permittee shall conduct a total of two additional tests (retests) for any species that demonstrates significant lethal effects at the 10% effluent concentration. The retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute a retest in lieu of routine toxicity testing, unless the specified testing frequency for the species demonstrating significant lethal effects is monthly. All retest data shall be submitted within 15 days of each test completion.

ii. If the results of the increased testing indicate lethality in the effluent at low flow dilution, the permittee shall submit a plan for a Toxicity Reduction Evaluation (TRE) and shall continue toxicity testing at a frequency of once per month for the species showing lethality, using the sample protocols as specified above until notified otherwise by the Department. The TRE plan, including a proposed implementation schedule, shall be submitted to the Department within 60 days of receipt of the results of the verification testing showing a lethal effluent. The plan will be reviewed by the Department. If deemed acceptable, the permittee shall be notified and the TRE plan shall become a requirement of this permit. Incomplete or unsatisfactory TRE plans and/or schedules will be returned to the permittee for correction of deficiencies. Failure to correct identified deficiencies within 30 days shall be considered a violation of this permit.

iii. The permittee shall conduct the TRE in accordance with the approved schedule and, upon completion, the permittee shall prepare a report which contains, at a minimum:

(1) the source of the toxicity (e.g. constituents; class of toxicants, suspected industrial contributors, etc.);

(2) results of any treatability studies conducted;

(3) discussion of alternative treatment or management techniques to reduce or eliminate toxicity;

(4) selection of the appropriate course of action to be followed by the permittee;

(5) an implementation schedule for making any required changes to reduce/eliminate toxicity.

iv. Upon completion of the TRE, the permittee shall select an appropriate course of action to reduce or eliminate the toxicity, and shall submit an application for modification of this permit, if applicable, including a proposed schedule for accomplishment. Additionally, if recommended solutions include construction or modification of the treatment system, an application for a construction permit shall also be submitted. The above applications shall be submitted within 90 days of completion of the TRE.

v. If none of the retests demonstrate significant lethality, the permittee shall return to the testing frequency specified in item 10.a.

k. Low Flow Nonlethal Effects Testing - Special Conditions

The requirements of this subsection (10.k) apply only when a toxicity test demonstrates a significant nonlethal effect at the 10% effluent concentration, **and** the test does not demonstrate a significant lethal effect as described in item 10.j. above.

i. Quarterly or Semi-Annual Testing: If the frequency of testing specified in this permit is quarterly or semi-annual, the permittee shall conduct a total of two (2) additional tests (retests) **for the species that demonstrated the significant nonlethal effects.** The retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute a retest in lieu of routine toxicity testing. If one of the retests shows significant non-lethal effects at the 10% effluent concentration, the permittee may suspend the retesting for this reporting period and shall notify ADPCE in writing. All retest results shall be submitted to ADPCE within fifteen (15) days of test completion. After submitting the results which demonstrate significant non-lethal effects in one of the retests, and at the discretion of ADPCE, the permittee may be required to biomonitor for both species at an increased frequency of once per month for twelve (12) consecutive months; however, as a minimum, the permittee shall be required to biomonitor at least once per six (6) months for the remainder of the permit duration. The duration and frequency of biomonitoring will be stated in writing to the permittee.

If none of the retests demonstrate significant toxicity (lethal and nonlethal effects), the permittee shall return to the original testing frequency until fulfillment of the first year testing requirements. After the completion of the first year requirements, the permittee shall continue testing at a frequency of once per six (6) months.

ii. Monthly Testing: If the frequency of testing specified in item 10.a. is monthly, the permittee will continue testing monthly until the completion of the first year requirement and then test at a frequency of once per six (6) months for the duration of the permit.

l. No Toxicity Certification

If the toxicity tests for specific test organism(s) do not indicate toxicity at the 10 % effluent concentration during the first year or four consecutive test (whichever occurs later), the permittee shall certify this information in writing to ADPCE, and the biomonitoring requirements for that organism(s) may be reduced upon written authorization by the Department.

m. Reporting

i. The permittee shall prepare a full report of the results according to the Report Preparation Section of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms". The full report must be submitted with the first DMR containing these biomonitoring results. Subsequent reports accompanying DMRs need include only sections 9.4 (Test Methods) and 9.7 (Results) of the full report prepared for the appropriate toxicity test, unless the full report is specifically requested by ADPCE. However, the full report shall be retained pursuant to the provisions of Part II.C.7 of this permit.

ii. The permittee shall submit the toxicity testing information contained in the summary sheet provided by ADPCE along with the DMR submitted for the end of the reporting period following each toxicity test.

n. Permit Reopener Conditions

This permit may be reopened to require effluent limits, additional testing, and/or other appropriate actions to address toxicity. Accelerated or intensified toxicity testing and/or a TRE may be required in accordance with Section 308 of the Clean Water Act, and the Arkansas Water and Air Pollution Control Act (Act 472 of 1949, as amended).

o. Total Residual Chlorine

Total residual chlorine (TRC) in the effluent composite sample shall be measured and reported both at the time of sample termination and at the time of toxicity test initiation. The permittee shall ensure that the effluent composite used in toxicity testing is representative of normal facility residual chlorine discharge concentration.

11. **Metals Monitoring Requirements**

This permit may be reopened to include numeric limitations for Silver, additional testing, and/or other appropriate actions.

If any individual analytical test result is less than the minimum quantification level listed below, a value of zero (0) may be used for that individual result for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

Pollutant	EPA Method	MQL (μg/l)
Silver, Total Recoverable	272.2	2

The permittee may develop a matrix specific method detection limit (MDL) in accordance with Appendix B of CFR Part 136. For any pollutant for which the permittee determines a site specific MDL, the permittee shall send to ADPC&E, NPDES

Permits Branch, a report containing QA/QC documentation, analytical results, and calculations necessary to demonstrate that a site specific MDL was correctly calculated. A site specific minimum quantification level (MQL) shall be determined in accordance with the following calculation:

MQL = 3.3 x MDL

Upon written approval by the NPDES Permits Branch, the site specific MQL may be utilized by the permittee for all future Discharge Monitoring Report (DMR) calculations and reporting requirements.

12. **CONDITIONS FOR LAND APPLICATION OF SLUDGE**

A. Land Application of Municipal Sewage Sludge

In addition to applicable requirements of 40 CFR Part 503 as promulgated by the U.S. Environmental Protection Agency, permittee desiring to land apply municipal sewage sludge will comply with the following additional state requirements.

B. General Requirements:

1. Only sludge which is not classified as a hazardous waste under state or federal regulations may be land applied as fertilizer.

2. Plant Available Nitrogen (PAN) shall not be applied at a rate exceeding the annual nitrogen uptake of the crop. At no time shall the nitrogen application rate (PAN/acre-year) be allowed to exceed the site specific rate approved by the Department.

3. Sludge with Polychlorinated Biphenyls (PCB) concentration greater than or equal to 50 mg/kg dry weight shall not be land applied at any time.

C. Monitoring and Reporting Requirements for all Sludge Application Facilities:

1. The permittee shall be responsible for a sludge analysis, soil analysis, and reporting program which includes the following:

a. Sludge Analysis

(1) Sludge samples collected must be representative of the treated sludge to be land applied. The samples are to be stored in appropriate glass or plastic containers and kept refrigerated or frozen to prevent any change in nutritional value.

(2) Quarterly grab samples of the land applied sludge shall be analyzed and reported in dry weight (mg/kg) for:

% Volatile Solids
% Total Solids
Total Phosphorus
Total Potassium
Nickel
Cadmium
Copper
Lead
Arsenic
Total Kjeldahl Nitrogen
Nitrate Nitrogen
Nitrite Nitrogen
Ammonia Nitrogen
Mercury
Selenium
Zinc
pH

(3) Annual grab samples of the land applied sludge shall be analyzed for Polychlorinated Biphenyls (PCB).

(4) Soils Analysis

Each land application site shall be soil tested in the Spring prior to application for the following parameters:

Nitrate-Nitrogen
Phosphorus
Magnesium
pH
Copper
Arsenic
Mercury
Potassium
Nickel
Cadmium
Lead
Zinc
Selenium

b. Reporting

(1) Annual reports shall be sent to the Department and to the owner of the land receiving sludge **prior to May 1**, which must include the following:

The sludge and soil analyses conducted under section B.1.a. above (including a statement that the analyses were performed in accordance with EPA Document SW-846, "Test Methods for Evaluation of Solid Waste," or other procedures approved by the Director), application dates and locations, volumes of sludge applied (in dry tons/acre-year and gallons/acre-year of sludge), methods of disposal, identity of hauler, and type of crop grown, amounts of nitrogen applied, total metals added that year (lbs/acre), total metals applied to date, and copies of soil analyses for each site.

(2) The permittee shall also maintain copies of the above records for Department personnel review at the sludge production facility.

(3) Permittee shall forward a copy of all reports required by 40 CFR Part 503 or required by a NPDES permit issued by EPA to the Director, ADPCE, when such reports are submitted to EPA.

D. Additional Requirements For The Land Application of Sludge on Any Land:

1. The permittee shall be responsible for assuring that the land owner of any land application site not owned by the permittee and the waste applicator if different from the permittee abides by the conditions of this permit.

2. Storage facilities (at production facility or disposal site) are required to store sludge during periods of inclement weather, equipment breakdown, frozen or snow-covered ground, during periods of inactive plant growth, or when access would damage the field or crop. Disposal site storage must be limited to less than ten (10) days unless the sludge is covered and a seepage barrier provided.

3. In the event that storage is exceeded and sludge cannot be land applied, sludge shall be disposed of by an alternative method approved by the Director.

4. Sludge shall be spread evenly over the application area and in no way shall sludge be allowed to enter the waters of the State.

5. Sludge shall not be applied to slopes with a gradient greater than 15%; or to soils that are saturated, frozen or covered with snow, and during rain or when precipitation is imminent.

6. The permittee shall not cause any underground drinking water source to exceed the limitations in 40 CFR 257 Appendix I.

7. The permittee shall not cause or contribute to the taking of life or the destruction or adverse modification of the critical habitat of any endangered or threatened species of plant, fish or wildlife.

8. The permittee shall take all necessary measures to reduce obnoxious and offensive odors. Equipment shall be maintained and operated to prevent spillage and leakage.

9. Disposal of sewage sludge in a floodplain shall not restrict the flow of the base flood, reduce the temporary storage capacity of the floodplain, or result in a washout of solid waste, so as to pose a hazard to human life, wildlife or land and water uses.

10. The permittee shall give at least 120 days prior notice to the Director of any change planned in the sewage sludge disposal practice.

11. All new land application sites must have a management plan approved by the Department prior to land application of sewage sludge.

Form Approved.
OMB No. 2040-0004.
Approval expires 6-30

PERMIT NUMB	DISCHARGE NUMBER

	MONITORING PERIOD						
FROM	YEAR	MO	DAY	TO	YEAR	MO	DAY
	(20-21)	(22-23)	(24-25)		(26-27)	(28-29)	(30-31)

NOTE: Read Instructions before completing this form.

PARAMETER (32-37)		(3 Card Only) QUANTITY OR LOADING (46-53) (54-61)			(4 Card Only) QUALITY OR CONCENTRATION (38-45) (46-53) (54-61)				NO. EX (62-63)	FREQUENCY OF ANALYSIS (64-68)	SAMPLE TYPE (69-70)
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
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ITLE PRINCIPAL EXECUTIVE OFFICER

TYPED OR PRINTED

I CERTIFY UNDER PENALTY OF LAW THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED HEREIN, AND BASED ON MY INQUIRY OF THOSE INDIVIDUALS IMMEDIATELY RESPONSIBLE FOR OBTAINING THE INFORMATION, I BELIEVE THE SUBMITTED INFORMATION IS TRUE, ACCURATE AND COMPLETE I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT SEE 18 USC § 1001 AND 33 USC § 1319 *(Penalties under these statutes may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)*

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
AREA CODE	NUMBER	YEAR	MO	DAY

T AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

Form Approved.
OMB No. 2040-0004.
Approval expires 6-3C

PERMIT NUMB	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			
	(20-21)	(22-23)	(24-25)		(26-27)	(28-29)	(30-31)

NOTE: Read Instructions before completing this form.

PARAMETER (32-37)		(3 Card Only) QUANTITY OR LOADING			(4 Card Only) QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		(46-53) AVERAGE	(54-61) MAXIMUM	UNITS	(38-45) MINIMUM	(46-53) AVERAGE	(54-61) MAXIMUM	UNITS	(62-63)	(64-68)	(69-70)
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
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	PERMIT REQUIREMENT										

ITLE PRINCIPAL EXECUTIVE OFFICER

TYPED OR PRINTED

I CERTIFY UNDER PENALTY OF LAW THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED HEREIN, AND BASED ON MY INQUIRY OF THOSE INDIVIDUALS IMMEDIATELY RESPONSIBLE FOR OBTAINING THE INFORMATION, I BELIEVE THE SUBMITTED INFORMATION IS TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT. SEE 18 USC § 1001 AND 33 USC § 1319. *(Penalties under these statutes may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)*

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
AREA CODE	NUMBER	YEAR	MO	DAY

T AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

Form Approved.
OMB No. 2040-0004.
Approval expires 6-3

PERMIT NUM

(17-19)
DISCHARGE NUMBER

	MONITORING PERIOD						
	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			
	(20-21)	(22-23)	(24-25)		(26-27)	(28-29)	(30-31)

NOTE: Read instructions before completing this form.

PARAMETER (32-37)		(3 Card Only) QUANTITY OR LOADING (46-53) (54-61)			(4 Card Only) QUALITY OR CONCENTRATION (38-45) (46-53) (54-61)				NO. EX (62-63)	FREQUENCY OF ANALYSIS (64-68)	SAMPLE TYPE (69-70)
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
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ITLE PRINCIPAL EXECUTIVE OFFICER

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SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE		
AREA CODE	NUMBER	YEAR	MO	DAY

T AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*

PART IV —
SECTION A — DEFINITIONS

All definitions contained in Section 502 of the Clean Water Act shall apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. "Act" means the Clean Water Act, Public Law 95-217(33. U.S.C. 1251 et seq.) as amended.
2. "Administrator" means the Administrator of the U.S. Environmental Protection Agency.
3. "Applicable effluent standards and limitations" means all State and Federal effluent standards and limitations to which a discharge is subject under the Act, including, but not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, and pretreatment standards.
4. "Applicable water quality standards" means all water quality standards to which a discharge is subject under the federal Clean Water Act and which have been (a) approved or permitted to remain in effect by the Administrator following submission to the Administrator pursuant to Section 303(a) of the Act, or (b) promulgated by the Director pursuant to Section 303(b) or 303(c) of the Act, and standards promulgated under regulation No. 2, as amended, (regulation establishing water quality standards for surface waters of the State of Arkansas).
5. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.
6. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during that sampling day.
7. "Daily Average" (also known as monthly average) discharge limitations means the highest allowable average of "daily discharge(s)" over a calendar month, calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes daily average concentration effluent limitations or conditions, the daily average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily concentration, F = daily flow and n = number of daily samples; daily average discharge =

$$\frac{C1F1 + C2F2 + \ldots CnFn}{F1 + F2 + \ldots + Fn}$$

8. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.
9. "Department" means the Arkansas Department of Pollution Control and Ecology (ADPCE).
10. "Director" means the Administrator of the U.S. Environmental Protection Agency and/or the Director of the Arkansas Department of Pollution Control and Ecology.
11. "Grab sample" means an individual sample collected in less than 15 minutes in conjunction with an instantaneous flow measurement.
12. "Industrial User" means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly-owned treatment works.
13. "National Pollutant Discharge Elimination System" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.
14. "POTW" means a Publicly Owned Treatment Works.
15. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in productions.
16. "ADPCE" means the Arkansas Department of Pollution Control and Ecology.
17. "Sewage sludge" means the solids, residues, and precipitate separated from or created in sewage by the unit processes of a publicly-owned treatment works. Sewage as used in this definition means any wastes, including wastes from humans, households, commercial establishments, industries, and storm water runoff, that are discharged to or otherwise enter a publicly-owned treatment works.
18. "7-day average" discharge limitation, other than for fecal coliform bacteria, is the highest allowable arithmetic means of the values for all effluent samples collected during the calendar week. The 7-day average for fecal coliform bacteria is the geometric mean of the values of all effluent samples collected during the calendar week. The DMR should report the highest 7-day average obtained during the calendar month. For reporting purposes, the 7-day average values should be reported as occurring in the month in which the Saturday of the calendar week falls in.
19. "30-day average", other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month. The 30-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.
20. "24-hour composite sample" consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample collected at frequent intervals porportional to flow over the 24-hour period.
21. "12-hour composite sample" consists of 12 effluent portions collected no closer together than one hour and composited according to flow. The daily sampling intervals shall include the highest flow periods.
22. "6-hour composite sample" consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.
23. "3-hour composite sample" consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.
24. "Treatment works" means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage and industrial wastes, of a liquid nature to implement section 201 of the Act, or necessary to recycle reuse water at the most economic cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities, and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment.
25. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. Any upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventive maintenance, or careless or improper operations.
26. For "fecal coliform bacteria", a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.
27. "Dissolved oxygen", shall be defined as follows:
    a. When limited in the permit as a monthly minimum, shall mean the lowest acceptable monthly average value, determined by averaging all samples taken during the calendar month;
    b. When limited in the permit as an instantaneous minimum value, shall mean that no value measured during the reporting period may fall below the stated value.
28. The term "MGD" shall mean million gallons per day.
29. The term "mg/l" shall mean milligrams per liter or parts per million (ppm).
30. The term "μg/l" shall mean micrograms per liter or parts per billion (ppb).

ORDINANCE NO. 18,232

AN ORDINANCE ESTABLISHING A SCHEDULE OF SEWER RATES FOR THE LITTLE ROCK WASTEWATER UTILITY WITH THE EFFECTIVE DATE OF APRIL 1, 2000, REPEALING ORDINANCE NO. 16,456 (APPROVED JULY 6, 1993), EFFECTIVE APRIL 1, 2000, DECLARING AN EMERGENCY, AND FOR OTHER PURPOSES

WHEREAS, the authority to operate and maintain the Little Rock Wastewater Utility is vested in the Little Rock Sanitary Sewer Committee (the "Sewer Committee"), but the authority to establish sewer rates is vested in the Board of Directors of the City, and the Sewer Committee has determined and recommended to the City Board of Directors that the rates herein set forth should be duly adopted by ordinance pursuant to law because the current sewer rates need to be adjusted; and,

WHEREAS, the Board of Directors finds that the rates proposed by the Sewer Committee and established herein are adequate to pay the principal of and the interest on sewer revenue bonds, to make payments into the sewer revenue bonds sinking fund, to provide an adequate depreciation fund and to provide the Little Rock Wastewater Utility's estimated cost of operating and maintaining the sewer system, including the cost of improvements; and, WHEREAS, as a result of the comprehensive rate study performed in 1999, the need for an adjustment of rates was determined and the Sewer Committee has requested the adoption of rates reflected herein and has stated that the adjustments are necessary to cover the cost of the foregoing items herein.

NOW, THEREFORE, BE IT ORDAINED BY THE BOARD OF DIRECTORS OF THE CITY:

Section 1. That the following monthly rates are hereby established as rates to be charged for services furnished by the Utility, which rates the Board of Directors hereby find and declare to be reasonable and necessary minimum rates to be charged;

(a) The Sewer Committee shall compute separately for each customer (customer being hereby defined as any landowner whose buildings or premises are connected with and use the sewer system or otherwise discharge sanitary sewage, industrial waste, water or other liquids, either directly or indirectly into the sewer system) the monthly water consumption of each customer.

(b) In case of customers obtaining water exclusively from the Little Rock Municipal Water Works, the computation shall be based upon the water consumption records of the Little Rock Municipal Water Works.

(c) In the case of customers obtaining water from sources other than the Little Rock Municipal Water Works, the Sewer Committee shall determine the amount of water obtained by such customers from other sources and the amount so determined shall be used (together with the amount reflected by the Little Rock Municipal Water Works' records, if any said customer also obtained water from the Little Rock Municipal Water Works) in making the computation.

(d) In the case of customers whose water use is such that an appreciable quantity does not reach the sewer system, then the customer may be permitted by the Utility, upon written request to the Utility, to have a meter installed for the purpose of determining the amount of such quantity not reaching the sewer system, provided, however, the meter shall be inspected and approved by the Utility. Upon written application to the Sewer Committee, if a customer can show by such an approved and inspected meter that an appreciable quantity of the water used by the customer did not reach the sewer system, then the computation upon which that customer's sewage charge is based shall be adjusted and determined in accordance with the measurement as indicated by the meter, but the burden of showing that an appreciable quantity of water usage does not reach the sewer system shall be upon the customer, and in no event shall the customer be entitled to any adjustment for such water usage beyond twelve months from the date of the written application to the Sewer Committee.

In the case of water used for irrigation or lawn sprinkling purposes, the customer shall have an additional service meter installed by the Little Rock Municipal Water Works to deliver the water in such a way that the water is billed separately without a sewer charge being computed.

(e) The following rates shall be effective April 1, 2000 and shall be applied to the monthly water consumption of each customer, as above determined, to arrive at the monthly charge for each customer:

(1) <u>Service Availability Charge</u>

	Rates	
	Effective April 1, 2000	
Size Water Meter Furnishing Water	Inside City Limits	Outside City Limits
5/8"	$ 3.00	$ 4.50
3/4"	$ 4.45	$ 6.70
1"	$ 7.40	$ 11.10
1 1/2"	$ 14.85	$ 22.30
2"	$ 23.75	$ 35.60
3"	$ 44.50	$ 66.75
4"	$ 74.20	$111.30
6" or larger	$148.40	$222.60

(2) Volumetric Charge (for all water consumed)

	Effective April 1, 2000	
Volume of Water Consumed	Inside City Limits	Outside City Limits
Per 100 cu. ft	$ 1.50	$ 2.25

(3) Billing Charge Customers whose usage requires rendering a bill by means other than the Municipal Water Works' Data Processing Facilities shall pay a service charge of $5.00 per bill in addition to all other charges.

(4) Delinquent Accounts All accounts for sewer service not paid within thirty (30) days of the billing date shall bear interest at the maximum rate permitted by law until paid in full.

Section 2. The following rates for extra strength charges and Liquid Waste Haulers are also established as rates which the Board of Directors further find and declare to be reasonable and minimum rates to be charged:

(a) The discharge of wastewaters having an excessive Biochemical Oxygen Demand (BOD) or Total Suspended Solids Content (TSS) or Oil and Grease Content (O&G) constitute an added expense in the operation and maintenance of the Utility's treatment facilities and should be accompanied by payment of an

Extra Strength Surcharge to compensate for this added expense. Excessive BOD and/or TSS is hereby defined as in excess of 250 mg/1, for either parameter, and excessive O&G is hereby defined as in excess of 50 mg/1, as determined in accordance with test methods approved under 40 CFR Part 136. The Extra Strength Surcharge shall be 10 cents per pound of BOD in excess of 250 mg/1, 9 cents per pound of TSS in excess of 250 mg/1, and 10 cents per pound of O&G in excess of 50 mg/1. The Extra Strength Surcharge shall be computed separately for BOD, TSS and O&G on the total discharge (consumption).

(b) There shall be a charge paid on domestic liquid waste (septage) delivered to Adams Field Treatment Plant which is discharged into the sewer system at the Plant, as follows:

Cost Base	<1000 Gal.	1000+ Gal.
Charge	$30.00	$60.00

(c) There shall be a charge paid on all approved sources of landfill leachate delivered to the Adams Field or pumped into the collection system of 10 cents per gallon.

(d) There shall be a charge paid on all approved sources of other liquid waste delivered to the Adams Field or pumped into the collection system of 20 cents per gallon.

(e) The following parameters are limited in concentration by the Sanitary Sewer Committee through regulation and/or Significant Industrial Users Discharge Permits: arsenic, cadmium, chromium, copper, cyanide, lead, pH, mercury, nickel, selenium, silver, TTO, zinc, and any other parameter limited by a discharge permit issued to the user.

Section 3. All bills for sewer service shall be rendered monthly. Under the provisions of A.C.A. §14-235-223, if any sewer charge is not paid within thirty (30) days after same is due, suit may be brought to collect the amount due, together with a 10% penalty and a reasonable attorney's fee.

Section 4. Each user of the sewer system shall be notified, at least annually by publication in a newspaper having wide circulation in Pulaski County, Arkansas, in conjunction with a regular bill, of the rate and the portion of the user charges which are attributable to waste water treatment services, in compliance with 40 C.F.R. §35.929-2(f).

Section 5. That the provisions of this Ordinance are separable and, if a section, provision, or phrase shall be declared invalid, it shall not affect the validity of the remainder of this Ordinance.

Section 6. That all resolutions and ordinances and parts thereof in conflict with this ordinance including Ordinance No. 16, 456 (approved July 6, 1993) are repealed at the effective date of this Ordinance which is April 1, 2000.

Section 7. That it is hereby ascertained and declared that inadequate sewer rates will endanger the proper operation, maintenance, and continued improvement of the wastewater collection and treatment facilities of the City which are necessary in order to prevent a hazard to the public health, safety and welfare of the inhabitants of the City; and, therefore, an emergency is declared to exist and this Ordinance shall take effect on April 1, 2000; and, until that date, Ordinance No. 16,456, adopted July 6, 1993, shall remain in full force and effect.

PASSED: **March 21, 2000**

APPROVED:

Jim Dailey

MAYOR Jim Dailey

ATTEST:

Nancy Wood

CITY CLERK **Nancy Wood**

CONSOLIDATED STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

	1999 ACTUAL	2000 FORECAST	2001 BUDGET	2002 PROJECTED	2003 PROJECTED	2004 PROJECTED	2005 PROJECTED
BEGINNING FUND BALANCE	10,331,496	8,337,878	8,892,058	8,616,355	6,742,362	7,158,610	(387,790)
CASH RECEIPTS FROM:							
OPERATIONS	17,850,104	20,178,897	20,432,086	20,568,981	20,706,793	20,845,528	20,985,193
CONTRIBUTIONS	442,136	270,000	318,702	318,702	318,702	318,702	318,702
INTEREST INCOME	422,429	460,000	425,000	375,000	350,000	350,000	350,000
OTHER INCOME	-	-	-	-	-	-	-
CO-GENERATION	1,006	1,500	1,000	1,000	1,000	1,000	1,000
BOND ISSUES/EPA LOAN	434,113	5,001,797	4,745,900	1,818,190	2,500,000	7,000,000	7,000,000
EXTRAORDINARY GAINS	-	-	-	-	-	-	-
TOTAL SOURCES OF FUNDS	19,149,788	25,912,194	25,922,688	23,081,873	23,876,495	28,515,230	28,654,895
CASH DISBURSEMENTS FROM:							
OPERATIONS	13,665,250	13,690,071	15,317,524	15,777,047	16,250,360	16,737,872	17,240,006
PURCH. OF PROP., PLANT & EQUIP.	3,627,468	8,055,657	7,032,652	5,247,411	2,342,143	14,915,817	13,458,402
REDEMPTION OF BONDS/LOANS	1,638,422	1,781,853	1,855,200	1,935,787	2,435,616	2,533,241	2,648,742
INTEREST PAID ON BONDS/LOANS	1,834,274	1,830,433	1,993,015	1,995,621	1,937,128	1,874,700	1,938,296
BOND ISSUE EXPENSE	377,992	-	-	-	495,000	-	
EXTRAORDINARY LOSSES	-	-	-	-	-	-	-
TOTAL ALLOCATION OF FUNDS	21,143,406	25,358,014	26,198,391	24,955,866	23,460,247	36,061,630	35,285,446
INCREASE/DECREASE IN FUNDS	(1,993,618)	554,180	(275,703)	(1,873,993)	416,248	(7,546,400)	(6,630,551)
ENDING FUNDS BALANCE	8,337,878	8,892,058	8,616,355	6,742,362	7,158,610	(387,790)	(7,018,341)
RESTRICTED BALANCE	3,810,432	3,825,000	3,825,000	3,825,000	3,825,000	3,825,000	3,825,000
APPROPRIATED BALANCE	1,300,000	1,400,000	1,428,000	1,456,560	1,485,691	1,515,405	1,545,713
UNRESTRICTED BALANCE	3,227,446	3,667,058	3,363,355	1,460,802	1,847,919	(5,728,195)	(12,389,054)
TOTAL	8,337,878	8,892,058	8,616,355	6,742,362	7,158,610	(387,790)	(7,018,341)

INCOME STATEMENT

	1999 ACTUAL	2000 BUDGET	2001 BUDGET	2002 PROJECTED	2003 PROJECTED	2004 PROJECTED	2005 PROJECTED
OPERATING REVENUE:							
ASSESSMENTS LEVIED	16,979,065	19,035,250	19,637,989	19,769,564	19,902,020	20,035,364	20,169,601
INDUSTRIAL SURCHARGE	485,075	500,625	545,131	548,783	552,460	556,161	559,887
OTHER FEES AND INCOME	231,943	278,125	248,966	250,634	252,313	254,003	255,705
TOTAL OPERATING INCOME	17,696,083	19,814,000	20,432,086	20,568,981	20,706,793	20,845,528	20,985,193
OPERATING EXPENSE:							
SUPPORT SERVICES	4,910,554	4,759,227	5,385,710	5,547,281	5,713,701	5,885,114	6,061,666
OPERATIONS	3,647,799	3,616,414	4,109,205	4,232,481	4,359,456	4,490,240	4,624,947
MAINTENANCE	4,732,852	4,795,803	5,822,609	5,997,285	6,177,203	6,362,518	6,553,393
C.W.I.P.	(1,124,997)	(1,152,740)	(1,141,348)	(1,175,589)	(1,210,857)	(1,247,183)	(1,284,598)
TOTAL OPERATING EXPENSE	12,166,208	12,018,704	14,176,176	14,601,458	15,039,503	15,490,689	15,955,408
NET INCOME BEFORE DEPRECIATION	5,529,875	7,795,296	6,255,910	5,967,523	5,667,290	5,354,839	5,029,785
FUNDED DEPRECIATION	9,348	30,000	75,000	65,000	50,000	30,000	10,000
NON-FUNDED DEPRECIATION	4,105,289	4,169,413	4,688,153	4,801,488	4,903,496	4,904,799	5,083,883
NET INCOME AFTER DEPRECIATION	1,415,238	3,595,883	1,492,757	1,101,035	713,794	420,040	(64,098)
NON-OPERATING REVENUE:							
INTEREST INCOME	442,976	307,000	425,000	375,000	350,000	350,000	350,000
GAIN ON DISPOSAL OF PROPERTY	46,084	5,000	5,000	5,000	5,000	5,000	5,000
MISCELLANEOUS	33,388	6,000	6,000	6,000	6,000	6,000	6,000
INCOME BEFORE NON-OPERATING EXPENSES	1,937,686	3,913,883	1,928,757	1,487,035	1,074,794	781,040	296,902
NON-OPERATING EXPENSES:							
AMORTIZATION - BOND DISC & EXP	66,085	109,489	93,353	88,873	84,216	95,020	95,183
INTEREST ON LONG-TERM DEBT	1,737,906	1,744,616	1,972,507	1,973,688	1,913,829	1,849,434	1,911,420
LOSS ON DISPOSAL OF PROPERTY	16,177	-	-	-	-	-	-
EXTRAORDINARY LOSS - LITIGATION	-	-	-	-	-	-	-
NET INCOME	117,518	2,059,778	(153,239)	(575,525)	(923,251)	(1,163,414)	(1,709,701)