Exhibit No.: _____
Issue(s): Prudence of the St. Joseph Water Treatment Plant; Used and Useful Capacity Adjustment
Witness/Type of Exhibit: Biddy/Direct
Sponsoring Party: Public Counsel
Case Nos.: WR-2000-281 and SR-2000-282

DIRECT TESTIMONY

OF

TED L. BIDDY

Submitted on Behalf of
the Office of the Public Counsel

MISSOURI-AMERICAN WATER COMPANY

Case Nos. WR-2000-281 and SR-2000-282

April 3, 2000

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Missouri American Water Company's Tariff Sheets Designed to Implement General Rate Increases for Water and Sewer Service Provided to Customers in the Missouri Service Area of the Company.	)))))	**Case No. WR-2000-281, et al.**

AFFIDAVIT OF TED L. BIDDY

STATE OF FLORIDA)
) **ss**
COUNTY OF LEON)

Ted L. Biddy, of lawful age and being first duly sworn, deposes and states:

1. My name is Ted L. Biddy. I am a consultant retained by the Missouri Office of the Public Counsel.

2. Attached hereto and made a part hereof for all purposes is my direct testimony consisting of pages 1 through 26 and Schedules TLB-1 through TLB-13.

3. I hereby swear and affirm that my statements contained in the attached testimony are true and correct to the best of my knowledge and belief.

Ted L. Biddy

Subscribed and sworn to me this 24 day of MARCH, 2000.

Notary Public

My commission expires 6-19-00.

Martin D. Jacobs
MY COMMISSION # CC564068 EXPIRES
June 19, 2000
BONDED THRU TROY FAIN INSURANCE, INC.

DIRECT TESTIMONY

OF

TED L. BIDDY

MISSOURI-AMERICAN WATER COMPANY

CASE NOS. WR-2000-281 AND SR-2000-282

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Ted L. Biddy. My business address is 2308 Clara Kee Boulevard, Tallahassee, Florida 32303.

Q. BY WHOM ARE YOU EMPLOYED, AND WHAT IS YOUR POSITION?

A. I am self-employed as a professional engineer and land surveyor.

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND WORK EXPERIENCE.

A. I graduated from the Georgia Institute of Technology with a B.S. degree in Civil Engineering in 1963. Prior to my graduation from Georgia Tech, I served in the U.S. Army where I studied Topographic Surveying at the Engineer's School at Ft. Belvoir, Virginia and then worked as a surveyor for the balance of my three-year enlistment. I am a registered professional engineer and land surveyor in Florida, Georgia, Mississippi and several other states.

After graduation from Georgia Tech, I was employed by the Southern Division of the national consulting engineering firm of Michael Baker, Jr., Inc. I started as a design engineer with the Baker firm, was promoted to project engineer after two years and was also

the Southern Division's Port & Harbor Engineer. During my employment with the Baker firm, my experience included major agricultural industrial complexes, airports, industrial parks, marinas, subdivisions, water and wastewater systems, warehouses, ship terminals and surveying.

In 1969, I entered private practice with my own firm. During the next 21 years, I operated my own consulting firm throughout the southeastern U.S. My experience during this period included commercial, industrial and governmental projects consisting of port and harbor development, subdivisions, industrial complexes, marinas, water supply, treatment and distribution systems, wastewater collection and treatment, studies, reports and forensic engineering, and expert court testimony.

In 1991, I joined the firm of Baskerville-Donovan, Inc. (BDI) as their Regional Manager and Vice-President for the firm's Tallahassee, Florida office. During the next seven years I managed BDI's Tallahassee office and served as Senior Project Manager for all projects. Major projects completed during this period included water and wastewater systems, roadway designs, dams, bridges, subdivisions and forensic studies. During this period I also did extensive work for the Florida Office of the Public Counsel, including studies, investigations and expert witness services for water and wastewater rate cases.

In October, 1998, after having had over 35 years experience in many areas of civil engineering, I left the BDI firm and returned to private practice as a sole practitioner

offering my services to the public in the field of civil engineering with a heavy emphasis in forensic work. The primary activities in which I engage in my current practice are studies, investigations, evaluations, reports and expert witness services for civil engineering projects, particularly water supply, treatment and distribution, and wastewater collection and treatment. I continue to perform projects involving water and wastewater rate cases before the Florida Public Service Commission on behalf of the Florida Office of the Public Counsel.

I have served as principal and chief designer for numerous water and wastewater projects. Among my many water and wastewater facilities designs have been a 2,000-acre development in Lake County, FL; a 1,200-acre development in Ocean Springs, MS; a four-mile water distribution system for Talquin Electric Cooperative, Inc. in Leon County, FL; a 320-lot subdivision in Leon County, FL; and completely refurbished water supply and treatment and wastewater collection and treatment systems for the city of Apalachicola, FL.

Q. HAVE YOU FURNISHED YOUR RESUME?

A. Yes. My detailed resume has been attached hereto as Schedule TLB-1.

Q. WHAT ARE YOUR PROFESSIONAL AFFILIATIONS?

A. I am a member of the Florida Engineering Society, the Florida Institute of Consulting Engineers, the National Society of Professional Engineers, the American Consulting

Engineers Council, the American College of Forensic Examiners, and the Florida Society of Professional Land Surveyors.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE A PUBLIC UTILITY COMMISSION AS AN EXPERT WITNESS?

A. Yes. I have testified before the Florida Public Service Commission on numerous water and wastewater rate cases since 1994. This testimony has covered various engineering issues including the prudence of constructed facilities and "used and useful" analyses. I have also furnished expert testimony concerning quality of service furnished by a utility.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS AN EXPERT WITNESS BEFORE STATE AND FEDERAL COURTS?

A. Yes. During my 37-year career, I have appeared in court as an expert witness on approximately 100 occasions. I have appeared before a number of state and federal courts for cases involving roadways, drainage, structural problems, and utilities, particularly water and wastewater facilities.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS CASE?

A. The purpose of my testimony in this case is to present direct testimony and schedules in connection with studies and investigations that I have completed, examining the prudence and reasonableness of Missouri American Water Company's ("MAWC") decision to construct a new ground water source and water treatment plant to replace its existing

surface water source and treatment facilities. My testimony will also report on the used and useful analyses that I have made of the new ground water source and treatment facilities, comparing its capacity with MAWC St. Joseph District's water demand.

Q. WHAT DOCUMENTS HAVE YOU REVIEWED IN PREPARATION FOR THE STUDIES AND INVESTIGATIONS THAT YOU HAVE COMPLETED?

A. I have studied the feasibility report, dated November, 1996, entitled "St. Joseph Ground Water Source of Supply and Water Treatment Plant Feasibility Study" ("1996 Study"), which MAWC prepared and which is attached hereto as Schedule TLB-3. I reviewed the direct testimony that Mr. John S. Young filed on behalf of MAWC. I reviewed all the original case materials filed in the case. I have reviewed all discovery request responses of MAWC to questions posed by the Missouri Office of the Public Counsel. I have reviewed all contracts, change orders and cost data for work which MAWC has caused to be performed for the new ground water supply and treatment plant.

Q. WHAT INVESTIGATIONS HAVE YOU PERFORMED AND WHAT ADDITIONAL DATA HAVE YOU DEVELOPED IN CONNECTION WITH THIS CASE?

A. I developed a series of data requests for MAWC to answer concerning important points related to cost comparisons and system data (Schedule TLB-12). I have studied MAWC's responses to these data requests and included these data in my analyses which I discuss below. I interviewed Missouri Public Service Commission ("Commission") Staff ("Staff")

engineer, Mr. Jim Merciel, concerning Commission policies and procedures in evaluating prudence and used and useful considerations.

I obtained a copy of two very important documents from Mr. Merciel's files, one being an MAWC 1991 report proposing necessary improvements to MAWC's existing surface water supply and treatment facilities to upgrade these facilities to current standards and to a capacity of 30 Million Gallons per Day (MGD). The 1991 Report includes cost estimates that turned out to be very important and will be discussed in detail below. The 1991 Report is attached hereto as Schedule TLB-6.

The second document I obtained from Mr. Merciel's files was a copy of the conditional approval by the Missouri Department of Natural Resources ("DNR"), dated February 11, 1991, of the alternative proposed by MAWC for improvements and upgrades to the existing surface water supply and treatment plant. The 1991 DNR letter is attached hereto as Schedule TLB-7.

I interviewed DNR officials concerning technical issues related to their permitting requirements for the new MAWC ground water supply and treatment plant, and a host of issues related to the existing surface water supply and treatment plant. In addition, I obtained from DNR copies of MAWC permits for the new facilities, a copy of DNR technical guidelines for these facilities and a copy of MAWC's engineering report submitted to DNR in support of its permit request. These data will be discussed in some

detail below in my analyses of various prudence and used and useful issues. (See Schedules TLB-10 and TLB-11, respectively.)

I interviewed my client, OPC's, legal and technical staff for information concerning the entire history of this matter and to obtain copies of prior Commission rulings in other cases concerning prudence and used and useful issues.

The most important part of my investigations consisted of inspections of the new ground water supply and treatment facilities, and of the existing surface water supply and treatment facilities. I photographed both the new and existing facilities during the inspections and have included these photographs as Schedule TLB-2 attached hereto. MAWC District Manager, Mr. Bob Amman, escorted me through these facilities and was responsive to some of my questions. I will refer to these inspections several times below in discussing the analyses which I performed in connection with this case.

Q. DID YOU FORM AN OPINION BASED ON YOUR STUDIES, INVESTIGATIONS AND ANALYSES MADE IN THIS CASE AS TO THE PRUDENCE OF MAWC'S DECISION TO CONSTRUCT NEW GROUND WATER SUPPLY AND TREATMENT FACILITIES TO REPLACE ITS EXISTING SURFACE WATER SUPPLY AND TREATMENT FACILITIES?

A. Yes. It is my professional opinion that the construction of a new ground water source and treatment facilities by MAWC to replace its existing surface water supply and treatment

facilities was not prudent at all, but was based on MAWC's decision to abandon an existing functioning water source and treatment plant without the benefit of detailed studies of the engineering and economic feasibility of expanding and upgrading the existing plant to meet functional requirements at a cost-effective price. To plunge headlong into the construction of the new facilities without benefit of such studies was imprudent and very ill-advised.

Q. PLEASE EXPLAIN.

A. In order to adequately explain, it is first necessary to discuss the potential flooding problem at the existing treatment plant site. MAWC stated as follows on page 4 of the 1996 Study that:

> The primary concerns with remaining at the existing site is (sic) the ability to reliably operate the treatment plant during flood conditions and low water conditions. Although the site can be improved to provide greater levels of flood protection, the reliability of the plant would remain suspect due to access issues associated with deliveries of the required chemicals, fuel and other utilities required to operate the plant and access for plant operations personnel. It is for these reasons that the Missouri Department of Natural Resources (DNR), citing MO DNR Rule 10 CSR 60-10 (see Exhibit A, Appendix D) has twice provided guidance on issues involving the siting of new or expanded treatment facilities. Attachment 1 to this feasibility study summary report provides two letters from the Missouri DNR dated January 5, 1996 and October 15, 1996 that indicate that a new or expanded treatment plant should not be located in the flood plain. As such, all of the alternatives associated with the existing site are not consistent with Missouri water works operations and design regulations and Missouri DNR recommendations and, as such, these alternatives are not feasible for implementation.

In the above-quoted statement by MAWC, the utility admits that the existing treatment plant site "can be improved to provide greater levels of flood protection."

However, the utility then cites "access issues" and Missouri DNR regulations and letters and concludes that all alternatives associated with the existing plant are not feasible for implementation. This admission by the utility is a classic understatement since my inspection of the existing plant site revealed that the existing facilities could be flood-proofed at a relatively small cost.

Q. HOW DID THE 1993 FLOOD AFFECT THE PLANT?

The 1993 flood which was rated as a 500-year frequency flood did not overtop the protecting levee located on the south, west and north sides of the plant site. Rather, the flood waters accumulated at the north side of the northern levee and then ran through the ballast (supporting rocks below rail and cross ties) of the railroad on the adjacent east side of the plant site with a "french drain" action and flooded the site from the east side. This explanation of the flooding mechanism was given to me by Mr. Amman during my inspection of the existing facilities.

Based on my observation of the east side of the plant, flood-proofing of the entire plant site could easily be accomplished by either extending the existing levee from the north end along the entire east side of the facility and connecting the new east side levee to the south side levee, or by constructing a short waterproof cutoff wall from the east end of the northern levee through the railroad to high ground east of the railroad.

Either construction would require dealing with and coordinating the work with the Burlington Northern Santa Fe Railroad ("Railroad Company"). When I asked Mr. Amman why MAWC did not attempt to coordinate with the Railroad Company to construct the flood-proofing facilities, his only answer to me was, "Have you ever tried dealing with a railroad?" This answer suggests that MAWC did not seriously pursue an obvious solution to the flooding problem at the site.

Q. IN YOUR PROFESSIONAL OPINION, HOW EXPENSIVE WOULD A LEVEE EXTENSION BE?

My calculations indicate that approximately 6,900 cubic yards of earthwork would be required to extend the levee along the approximate 1300 ft. long east side for an approximate construction cost of $103,111. Administrative costs in accomplishing even long and laborious negotiations and coordination with the Railroad Company might add another $25,000 to the cost but the total cost of $128,111 would be a very economical solution to the flooding problem at this site. See Schedule TLB-4 for the cost estimate I prepared for the levee extension.

Q. HAS MAWC OFFERED ANY RATIONALE FOR ITS DETERMINATION THAT NONE OF THE FOREGOING ALTERNATIVES AT THE EXISTING SITE WERE FEASIBLE?

MAWC, in its 1996 study, cites two letters from the Missouri DNR which the utility says provided guidance to MAWC for siting of new or expanded treatment facilities, to the effect

that new or expanded treatment plants should not be located in the flood plain. The utility seems to be saying that it was forbidden by DNR from expanding the existing plant on the Missouri River because the location is within the flood plain. Indeed, the utility states that any alternative at the existing site would not be feasible for implementation for this reason.

These statements by MAWC are apparently an attempt to justify the prudence of this utility's construction of a new ground water source and treatment plant to replace the existing plant which is located within the flood plain, without any clear indication that a more cost-effective alternative at the existing site would be prohibited.

The truth is that MAWC's representation in its feasibility study of the meaning of the two letters and of DNR Rule 10 CSR 60-10 is misleading and misstated in order to justify this utility's decision to abandon its existing plant and to construct a new very costly ground water source and treatment plant. A close reading of both letters and the Rule reveals that the relocation of an existing treatment plant is to be done only if such relocation outside the flood plain is practical and economical.

For example, the letter dated January 5, 1996 to MAWC from Jerry L. Lane, Director of DNR's Public Drinking Water Program, states in part: "Further, state regulations (10 CSR 60-10.020) stipulate that to the extent practicable, new or expanded water systems not be located in a floodplain. As such, any new or expanded WTP proposals will be required to

demonstrate to the Department that it is not practical to relocate outside the floodplain." (Schedule TLB-3, Summary Report, Attachment 1).

Furthermore, I obtained a copy of DNR's letter of July 25, 1996 to MAWC, authored by Rolando A. Bernabe, environmental engineer, which I attach hereto as Schedule TLB-5 which states as follows: "Existing water treatment plants that are already in the flood plain may be expanded if it is practical and economical. Structures that will protect the plant from flooding or prevent interruption of operation during flooding must be included with the expansion."

It is therefore clear from the letters from DNR officials and the DNR rule itself that an existing treatment plant within a flood plain can be expanded if no other more practical and economical alternative exists and provided further that flood-proofing features are installed around the plant.

To confirm that the foregoing statement is the correct interpretation of the DNR rule by DNR officials, I interviewed the following DNR officials by teleconference at 10:30 CST on March 1, 2000 with Mr. John Coffman, Deputy Public Counsel present in DNR's Jefferson City office:

Mr. Jerry Lane, Director, Public Drinking Water Program

Mr. Breck Summerford, Chief, Permit Section

Mr. Rolando Bernabe, Environmental Engineer, Permit Section

Mr. Bill Hills, Environmental Engineer, K.C. DNR Area Office

I asked each of these officials the following question: "If MAWC had flood-proofed their existing water treatment plant, is there anything that would have prevented MAWC from expanding the existing water treatment plant?' Each official acknowledged to me that there would have been nothing to prevent such an expansion under these conditions.

Q. PLEASE CONTINUE.

A. On another subject which I will discuss below, I also asked these officials what permit MAWC operated under for discharging the treatment plant residuals back to the Missouri River. I was told that the utility had an existing discharge permit and had applied for renewal of that permit on September 4, 1990 but that the EPA had objected to a renewal of the permit and that MAWC had been operating under their old permit for such discharge for the past ten years with DNR approval. The officials agreed that MAWC could have continued such discharge under their old permit for the foreseeable future.

Q. WHAT, IF ANY, DNR NOTICES OF VIOLATION HAS MAWC RECENTLY RECEIVED, TO THE BEST OF YOUR KNOWLEDGE?

A. I asked these officials whether MAWC had been under any DNR notice of violations, pending enforcement actions, or other mandate which would have forced the utility to relocate and construct a new water source and treatment plant. They said "no" and also

stated that the existing treatment plant had no history of violations and that MAWC was under no pressure from DNR to build a new treatment plant.

Q. PLEASE EXPLAIN THE ACCESS PROBLEM DURING FLOODING CONDITIONS AND WHAT CAN BE OR COULD HAVE BEEN DONE TO CURE THIS PROBLEM.

A. The two-mile paved access road from the south is occasionally flooded under severe flooding conditions and cannot be used. However, a graded roadway named County Line Road connects to the existing treatment plant from the north and can be used during the rare flood events. Please refer to photograph No. 8 of Schedule TLB-2 for a good view of this roadway running north around the high hills on the east side of the treatment plant. This roadway is higher than the 1993 flood crest and can adequately serve for access and materials delivery to the treatment plant with minor improvements. MAWC, in its 1996 Study, discusses this alternative access route as follows: "County Line Road allows access to the plant from the north, but is barely passable using four wheel drive trucks. For example, vehicles must ford one or two creeks. Much of the road lies in Andrew County, but Andrew County is unwilling to upgrade, or contribute to upgrading of the road" (Schedule TLB-3, Exhibit A, Appendix A, p. 26).

While the condition of this alternative access to the plant may well be as described by MAWC, it is obvious that one or two culverts constructed by MAWC at the two creek crossings would make this roadway more than "barely passable." A budget allowance of

$50,000 per culvert for a total of $100,000 should be more than adequate for this work, which would assure MAWC of an alternative access route to the plant site during the very rare flood events. Please also note from photograph No. 8 that a ramp at the level of the top of rails would need to be constructed across the proposed levee between the railroad and the plant site. The ramp would provide direct access to the flood-protected plant site and is estimated to cost about $25,000. Therefore, access to the treatment plant site is really a non-issue as far as expanding and upgrading the plant is concerned and this alternative access could be greatly improved for as little as $125,000.

Q. DOES YOUR RECOMMENDED REHABILITATION OF THE EXISTING PLANT IN ST. JOSEPH RESULT IN THE COMPLETE RETIREMENT OF THE EXISTING PLANT?

A. No.

Q. HAVE YOU INCLUDED IN YOUR RATE BASE RECOMMENDATION THE VALUE OF THE EXISTING PLANT THAT WOULD HAVE REMAINED IF THE COMPANY HAD REHABILITATED THE EXISTING PLANT?

A. No. I have not included this amount in my recommendation. OPC witness Kimberly Bolin addresses the value of the existing plant that should be included in rate base. The total water treatment plant necessary to serve the St. Joseph District would contain both the existing plant and the rehabilitation of the existing plant.

Q. WHAT ARE OTHER ISSUES THAT ARE IMPORTANT IN JUDGING THE PRUDENCE OF MAWC IN CONSTRUCTING A NEW WATER SOURCE AND TREATMENT PLANT AND ABANDONING THE EXISTING TREATMENT PLANT?

A. After determining that the flooding problem and access problem during rare flood events can be cured by flood-proofing the site and improving the alternative access road at minimal cost as well as being assured that expanding the plant at the existing location would not meet with any regulatory agency objections, the overriding consideration then, of course, becomes a matter of cost comparisons between expanding the existing plant versus the construction of a new facility, which MAWC has chosen to do.

Q. HAVE YOU MADE SUCH COST COMPARISONS?

A. Yes

Q. PLEASE EXPLAIN HOW YOU MADE THE COST COMPARISONS AND WHAT THE COMPARISONS REVEALED.

A. First of all, I need to explain how I made the cost comparisons. As consultant to the Missouri Office of Public Counsel, I had neither the time nor the budget to perform independent designs, quantity computations and cost estimates for the many features included in MAWC reported designs of the upgrade at the existing plant or the new groundwater source and treatment plant. My only option was to carefully examine all the

documents of record and other documents that I could obtain from MAWC, the Staff and DNR, for reasonableness of design, necessity, quantities and cost estimates.

Q. WERE YOU ABLE TO OBTAIN SUFFICIENT DOCUMENTS AND DID YOU MAKE THESE CAREFUL EXAMINATIONS OF THE REASONABLENESS OF DESIGN, NECESSITY, QUANTITIES AND COST ESTIMATES?

A. Yes, I was able to obtain all the documents of record, a report and approval letter from the Staff engineer, certain documents and reports from the DNR and some documents and data by data request discovery from MAWC.

Q. PLEASE EXPLAIN THE RESULTS OF YOUR EXAMINATIONS OF THESE DOCUMENTS.

A. I want to start with the documents I received from Staff engineer Jim Merciel. I received a copy of a 1991 report by MAWC which addressed six concepts for upgrading and increasing the capacity of the existing surface water source and treatment plant. I also received a copy of the tentative approval letter from DNR of MAWC's Concept III (b) after the utility had submitted the report to DNR for approval. I attach one copy of each of these documents hereto as Schedule TLB-6 and Schedule TLB-7, respectively.

The report was prepared in 1991 before the flood of 1993 and represented MAWC's best judgment for upgrading the existing plant and increasing the capacity to 30 MGD which is the same capacity as the new plant under construction. I believe this report to be the most

objective and truthful analysis of upgrades needed, since at that time the utility was not comparing the upgrade of the existing plant to a proposed new plant and had no "axe to grind" by artificially inflating the cost estimates for the various concepts studied in the report. I agree with the report's conclusion that Concept III (b) would be the most logical plan to adopt for upgrading the plant.

A brief description of each upgrade concept studied in the report and the estimated cost in 1991 dollars follows.

Concept I (a) provides for the renovation of all 24 filters to a high rate capacity to increase the total treatment capacity to 30MGD along with complete replacement of gallery piping, valves, etc.; waterproofing and humidity controlling the gallery; construction of a new transfer pumping station, 400,000 gallon clearwell, filter to waste sump, wash water tank, additions to the chemical building, new laboratory and support facilities. These improvements would be phased over a seven-year period and have a cost estimate of $16,200,000.

Concept I (b) provides for renovating filters 9-24 to high rate filtration, replacing filter bottoms on filters 9-18, installing air wash and filters to wash system, waterproof and dehumidifying gallery, valves, instrumentation and controls. This concept would provide 28-30 MGD capacity. Filters 1-8 would be retired and this area remodeled for new laboratory, offices, control room and support facilities. This concept also includes

replacement of all valves and construction of transfer pumping station, clearwell, filter to wash sump, wash water tank and chemical building addition. These improvements would be phased over a five-year period and have a cost estimate of $12,500,000.

Concept II (a) provides for the construction of four 3 MGD filters, a transfer pump station, clearwell, wash water storage tank and chemical building addition. This concept also includes air wash, filter to wash system, filter bottom replacements, new valves, instrumentation and controls, waterproofing and dehumidifying gallery, reworking filters 9-24 and remodeling filter area 1-8 into laboratory, offices, control room and support facilities. This concept would be phased over six years and has a cost estimate of $16,100,000.

Concept II (b) includes construction of ten 3 MGD filters, clearwell and pumping stations as well as renovations for lab, office and control room, adding wastewater tank and chemical building addition. This concept would be constructed over a four-year period and has a cost estimate of $13,500,000.

Concept III (a) provides for construction of nine 3.5 MGD filters, clearwell, pump stations, flocculation and settling in basin 1, Lab, office, control building, and chemical building addition. This concept would be phased over six years and has an estimated cost of $16,300,000.

Concept III (b) also provides for the construction of nine 3.5 MGD filters, clearwell, transfer pumping station, lab, office, control building, filter to waste sump and pump and the construction of superpulsator clarifiers and integral chemical facilities in basin No. 2. This concept would have a capacity of 30 MGD and has an estimated cost of $22,600,000 and would be phased over a six-year period.

These six concepts were thoroughly studied by MAWC with Concept III (b) being selected as the most logical program to adopt which would "provide the reliability needed, expand plant capacity and meet the new water quality regulations." The higher cost of Concept III (b) was said by MAWC to be "more than offset by the elimination of the problems and operating costs of the other concepts." MAWC then submitted the report to DNR for review and approval. Tentative approval was given by DNR by letter of February 11, 1991, subject only to pilot test of the superpulsator solids contact units. (See Schedules TLB-7 and TLB-10). Therefore, in 1991 MAWC could have upgraded their existing plant to a state-of-the-art 30 MGD Water Treatment Plant for a cost of only $22,600,000 and would have realized considerable savings in operating costs.

Q. HOW DOES THIS 1991 UPGRADE AND EXPANSION COST ESTIMATE COMPARE TO ESTIMATES BY MAWC IN ITS FEASIBILITY STUDY FOR UPGRADING AND EXPANDING THE EXISTING PLANT AND TO THE ESTIMATE FOR THE NEW WATER SOURCE AND TREATMENT PLANT CURRENTLY UNDER CONSTRUCTION?

A. Before I compare these costs, I want to first adjust the 1991 estimate to 1998 dollars and also add some additional items which were included in MAWC's 1996 Study. I will also add my estimates discussed above for flood-proofing the existing plant site and improving the alternative access road. The detail of increasing the 1991 estimate is included in my Schedule TLB-8 which I attach hereto. The rationale for construction cost increases from 1991 to 1998 is based on the construction industry's standard for history of construction cost increases as contained in the Engineering News-Record's cost indexes which I attach hereto as Schedule TLB-9.

I will summarize these additions to the 1991 cost estimate for upgrading and expanding the existing treatment plant as follows:

1991 Estimate by MAWC	=	$22,600,000
Addition for costs increase from 1991-1998 (21.48%)	=	4,854,480
Add Ozone Facilities	=	4,000,000
New Raw Water Intake and Low Service Pumping	=	4,600,000
Flood-proofing around plant	=	128,111
Access Road Improvements	=	125,000
TOTAL REVISED ESTIMATE	=	$36,307,591

The revised estimate includes everything MAWC proposed in Concept III (b) in its 1991 report, updated to 1998 costs, plus some items from MAWC's 1996 Study.

Q. DO YOU CONSIDER THIS A FAIR ESTIMATE TO MAWC FOR USE IN MAKING YOUR COST COMPARISONS?

A. Yes, I believe the estimate is very fair to MAWC. I have included the costs of adding ozone facilities and new raw water intake and low service pumping as contained in MAWC's 1996 feasibility study even though this $8,600,000 cost may not be required at this time. I have not included any residuals handling facilities or new pipeline to the Hill Reservoir because neither of these items are essential. I have also included the costs of flood-proofing the treatment plant site and the cost of alternative access improvements. I have included the estimate amounts by MAWC for ozone facilities and raw water intake and low service pumping without question even though both estimate amounts appear to be very high and possibly overestimated. If there is any error in the revised estimate, the error is on the side of MAWC. I also updated MAWC's 1991 estimate to 1998 dollars in order to compare the estimate to the cost of the new ground water source and treatment plant which was started by MAWC in 1998.

Q. CAN YOU NOW COMPARE THIS REVISED ESTIMATE OF UPGRADING AND EXPANDING THE EXISTING SURFACE WATER SOURCE AND TREATMENT PLANT TO THE COST OF THE NEW GROUND WATER SOURCE AND TREATMENT PLANT NOW UNDER CONSTRUCTION BY MAWC?

A. Yes. The cost of upgrading and increasing the capacity to 30 MGD for the existing surface water source and treatment plant would have been at most $36,307,591 for construction starting in 1998, giving MAWC every benefit of doubt, compared to MAWC's estimate of $75,445,000 for the cost of the new 30 MGD ground water source and treatment plant. This cost of upgrading and expanding the existing treatment plant amounts to approximately 48 percent of the amount that MAWC has spent and/or is now spending for the construction of the new ground water source and treatment plant. The $36,307,591 cost for upgrading and increasing the capacity of the existing plant, appropriately reduced or any lack of full used and useful percentage, should be the most that should be included in MAWC's rate base for source of supply and treatment plant expansion. The existing ratepayers should not be penalized and should not have to pay the higher rates which would result from applying the excessive cost of the new treatment facilities to the rate base, due to this utility's imprudent and ill-advised actions.

Q. EXPLAIN WHAT YOU MEAN WHEN YOU SAY THAT THE $36,307,591 SHOULD BE REDUCED BY ANY LACK OF FULL USED AND USEFUL PERCENTAGE?

A. There exists an incentive for all private utilities to overbuild their facilities in order to provide capacity for future customers, take advantage of lower construction costs now and to reap the cost savings associated with economy of scale. Invariably, utilities will try to claim all the cost of their overbuilt facilities in their rate base at the time these facilities are

put in use. However, it is certainly not fair for existing customers to pay higher rates to the utility based on a rate base that is the result of overbuilt capacity for future customers. Public utility commissions have recognized this inequity to existing ratepayers and have devised the concept of applying a "used and useful" percentage to the cost of a utility's overbuilt plant to reduce the cost of these facilities to an amount appropriate to the existing customers. Usually, a public utility commission will allow an overbuild such as a one to two-year additional capacity in recognition of the utility's need to be prepared to serve additional customers. Then, a commission will typically structure the utility's tariff to allow the utility to collect an amount from each future customer to pay the utility for the cost of the overbuild.

The amount of overbuild or sizing the plant for future capacity is a business decision which a utility must make at the time of design and construction. The savings in lower costs of larger facilities constructed now and the savings gained by the economy of scale in constructing larger capacity facilities must be weighed by the utility in relation to the fact that some portion of these costs (the overbuild) will not be included in the current rates.

Q. HOW HAVE YOU CALCULATED A USED AND USEFUL PERCENTAGE FOR MAWC'S NEW FACILITIES?

A. I have simply compared the maximum daily water usage for the year 2002, which includes a growth of two years to arrive at the numerator of the "used and useful" ratio for the new facilities. The denominator in the ratio is the plant capacity of 30 MGD. In this case, the

projected maximum day water usage at the year 2002 was found to be 24.135 MGD. Dividing this projected maximum day usage for the year 2002 by the capacity of 30 MGD gives a used and useful percentage of 80.45%. (See Schedule TLB-13 for rationale and calculation of used and useful percentage and TLB-11 and TLB-12 for water use analysis.)

The used and useful percentage of 80.45% should now be multiplied by the $36,307,591 to obtain the appropriately reduced value of $29,209,457 for cost of plant upgrade and expansion which should be in the rate base. The appropriate regulatory treatment, if any, of the remaining $7,098,134 will be addressed by OPC witness Russell W. Trippensee.

Q. WOULD YOU PLEASE SUMMARIZE YOUR FINDINGS BASED ON YOUR STUDY AND ANALYSIS OF THIS CASE REGARDING THE IMPLICATIONS OF EXPANDING A TREATMENT PLANT IN A FLOOD ZONE, THE FAIR COST OF EXPANDING THE EXISTING MAWC PLANT TO 30 MGD AND THE EQUITABLE ADJUSTMENT FOR USED AND USEFUL PERCENTAGE WHICH YOU RECOMMEND?

A. Yes, I will be glad to do so. First, the flood plain issue is easily solved by flood-proofing the plant site and improving the alternative access route at minimal costs. Secondly, I computed a fair cost for upgrading and increasing the existing plant's capacity to 30 MGD to be the amount of $36,307,591. Thirdly, I computed a used and useful percentage of 80.45% which should be applied to the cost of $36,307,591 to obtain the amount of

$29,209,457 which is the equitable amount which should be in the rate base for plant upgrade and expansion.

Q. DID YOU COMPARE YOUR REVISED ESTIMATE FOR UPGRADING THE EXISTING TREATMENT PLANT TO ESTIMATES MADE IN 1996 BY MAWC FOR THIS WORK?

A. Yes. The estimate given without detail by MAWC in the 1996 Study was $78,000,000 compared to my estimate of $36,307,591. This comparison is meaningless since we need to compare my estimate for this upgrade and expansion to the actual cost ($75,445,000) of the new facilities being constructed by MAWC. The $78,000,000 estimate in the 1996 Study was obviously an inflated estimate and an attempt by this utility to justify the cost of the new facilities it had chosen to construct. I consider the $78,000,000 estimate to be a ridiculous and meaningless number.

Q. DO YOU HAVE ANYTHING ELSE TO ADD TO YOUR TESTIMONY?

A. Not at this time.

LIST OF SCHEDULES

Schedule No.	Description
TLB - 1	Resume of Ted L. Biddy
TLB - 2	Photographs of Existing Treatment Plant and New Plant Under Construction Taken During Inspection of 2/15/00
TLB - 3	Missouri American Water Company's Feasibility Study of 1996
TLB - 4	Cost Estimate for Flood-Proofing Existing Plant by Levee Extension
TLB - 5	DNR Letter of 7/25/96 to MAWC
TLB - 6	MAWC Report of 1991 for Upgrading and Increasing Capacity of Existing Treatment Plant
TLB - 7	Tentative Approval Letter of 2/11/91 from DNR
TLB - 8	Detail of Additions to MAWC's 1991 Estimate
TLB - 9	Rationale for Construction Cost Increases from 1991 to 1998 as Determined from Cost Indexes Published by the *Engineering News-Record*
TLB - 10	Documents Received from Missouri DNR in Connection with MAWC's Pilot Plant Studies Of Superpulsator Contact Clarifier
TLB - 11	Section 3, Water Use Analysis Taken from MAWC's May, 1996 Engineer's Report, "Ground Water Source of Supply and Treatment Project for St. Joseph"
TLB - 12	MAWC's Response to OPC Data Request No. 4010 Regarding Average and Maximum Flows as of 9/30/99
TLB - 13	Rationale and Calculation of Used and Useful Percentage for Treatment Plant

TED L. BIDDY, P.E., P.L.S.
Civil Engineer
2308 Clara Kee Blvd.
Tallahassee, Fl 32303

Phone: (850)536-0928
Mobile: (850)508-2738
E-mail: TedBiddy@msn.com
Fax: (850)536-0938

CIVIL and FORENSIC ENGINEERING, INVESTIGATIONS, STUDIES, REPORTS

EDUCATION:

Topographic Surveying
The Engineer's School
Ft. Belvoir, Va, 1957

Bachelor of Science, Civil Engineering
Georgia Institute of Technology, 1963

Graduate Studies, Geodesy
Georgia Institute of Technology, 1963

REGISTRATIONS:

Professional Engineer, Florida No. 17656
Professional Engineer, Georgia No. 12609
Professional Engineer, Mississippi No. 3984
Professional Engineer, Louisiana No. 18431
Professional Engineer, South Dakota No. 4747
Professional Engineer, Nebraska No. E-6974
Professional Engineer, Missouri
Professional Land Surveyor, Florida No. 2658
Professional Land Surveyor, Georgia No. 1421
Professional Land Surveyor, Mississippi No. 1429

FIELDS OF COMPETENCE:

Project Management
Forensic Engineering
Civil Engineering
Structural Engineering
Sanitary Engineering
Soils & Foundations Engineering
Highway Engineering
Construction Contract Administration
Surveying
Coastal Mapping
Environmental Permitting

AFFILIATIONS:

Florida Engineering Society
American Consulting Engineers Council
Florida Society of Surveyors & Mappers
American College of Forensic Examiners

EXPERIENCE :

My 36 years career has been divided into three periods of professional experience as follows:

- 4/1//63 – 9/1/69 During the first 6.5 years following graduation from Georgia Tech, I worked for the Jackson, Mississippi Southern Division of the national consulting firm of Michael Baker, Jr., Inc. The work area included Georgia, North Carolina, Tennessee, Kentucky, Arkansas, Louisiana, Alabama, Florida and Mississippi. I began with the Baker firm as a design engineer and was a project engineer/manager when I left the firm in 1969. My experience with this firm included major agricultural industrial complexes; airports; industrial parks; marinas; subdivisions; water & wastewater systems; warehouses; ship terminals; and surveying. My final position with at the Baker firm was that of Port & Harbor Engineer for the firm's Southern Division.

- 9/1/69 – 4/1/91 During the next 21.5 years, I operated my own consulting firm throughout the Southeast U. S. from offices located in Jackson, Mississippi and Tallahassee, Florida. I served as chief operating officer with full responsibility for all engineering operations. During this period, the firm varied in size from 10 to 50 employees and performed over 1500 projects for a wide variety of clients. My experience during this period included the following areas:
    - Corps of Engineering Survey Contracts
    - National Ocean Survey Tidal Datum & Tidal Gage Contracts
    - Major River Barge Terminal
    - Large Warehouse Projects
    - Large & Small Subdivisions
    - Surveying & Platting
    - Bridges
    - Cofferdams, Bulkheads & Waterfront Structures
    - Water Supply & Distribution Systems
    - Wastewater Collection & Treatment
    - Roadways
    - Rail Spurs
    - Buildings
    - Marinas
    - Master Planning
    - Stormwater, Drainage & Flooding Studies
    - Industrial Parks
    - Feasibility Studies & Engineering Reports
    - Expert Court Testimony
    - Local, State & Federal Agencies Permitting
    - Forensic Engineering

- 4/1/91 – 10/1/98 During these 7 ½ years I worked in the Tallahassee Regional office of the consulting firm of Baskerville-Donovan, Inc.(BDI). I began with BDI as a Senior Civil Engineer, was promoted to Regional Manager in September, 1991 and held this position until February, 1998. During this period I was made a vice-president of BDI. During this period the Tallahassee Regional office of BDI grew from a 6-man office to a 30 man plus office and from annual revenues of $250,000 to in excess of $3,000,000. New clients obtained included the City of Tallahassee; Leon County; FSU; FDEP Parks & Recreation; FDOT; Fl. Office of Public Counsel; Fl Game & Fresh Water Fish Commission; and the cities of Apalachicola, Carrabelle and Sopchoppy. A relevant sample of the projects for which I served as Senior Project Manager/Director during this period is as follows:

CLIENTS	PROJECTS
City of Tallahassee	Four Lane Widening of East Park Ave., Appleyard Dr., Conner Blvd., Richview Rd., Mission Rd And Lipona Rd..
City of Tallahassee	New Animal Shelter
City of Tallahassee	Water & Wastewater System Expansions
City of Tallahassee	Stormwater Improvements at several Locations
Leon County	Rehabilitation of Lake Munson Dam
Leon County	Four Lane Widening of Buck Lake Rd..
Leon County	Design of County SAFE Roads Program including Old Magnolia Rd., Rococo Rd., Cypress Landing Rd., Proctor Rd., Nabb Rd., & Swatts Rd.
Leon County	Design of County Parks at Woodville, Fl., Ft. Braden & Chaires
Leon County	Miscellaneous ROW & Acquisition Surveys
Florida State University	Environmental Audits
Florida State University	Site Engineering & Permitting for Campus expansion areas
Florida State University	Acquisition Surveys for Campus Expansion
Florida State University	Design of Bridge & Roadway Repairs
FDEP Parks & Recreation	Surveys for Henderson Beach Park
FDOT	PD&E Studies of U. S. Hwy 98 and State Rd. No. 79
FDOT	Design of U. S. 98 improvements

FDOT	Design of 5.5 miles of State Road No. 79, a four lane divided roadway
Office of Public Counsel	Studies and Expert Testimony for Several water & sewer rate cases Before the Fl Public Service Comm.
Fl. Game & Fresh Water Fish Commission	Design of Water Control Structure & Dam at Lake Miccosukee
Fl Department of Corrections	Water & Wastewater Treatment Systems at several correctional Facilities
City of Apalachicola	Design & Permitting for new Wastewater Collection System, Treatment Plant, Water Supply and Distribution System
City of Carrabelle	Design of Water Distribution and Wastewater Collection System
St. George Is. Utilities	Design & permitting of new water Supply well and improvements to Treatment, Storage and Distribution Systems
Casa Del Mar Subdivision	Design of Major Subdivision on St. George Island
Tallahassee Developments	Design & permitting for numerous Residential & Commercial Developments in Leon County
Expert Witness Services	Studies and Expert Witness Services for various cases

After leaving the Baskerville-Donovan firm on September 30, 1998, I have again entered private practice offering my services to the public in the fields of Civil, Structural & Forensic Engineering. The primary focus of my practice is studies, investigations, evaluations, reports, engineering designs and the offering of expert witness services. The following is a listing of the clients I presently serve and the professional services that I furnish them.

CLIENTS	**PROJECTS**
Foley & Lardner Law Firm	Study, evaluation and expert testimony for structural engineering case
Alsobrook & Dove Law Firm	Studies, investigations, reports and Expert witness services for two cases
John Barley & Assocs. Law Firm	Studies, investigations, reports and

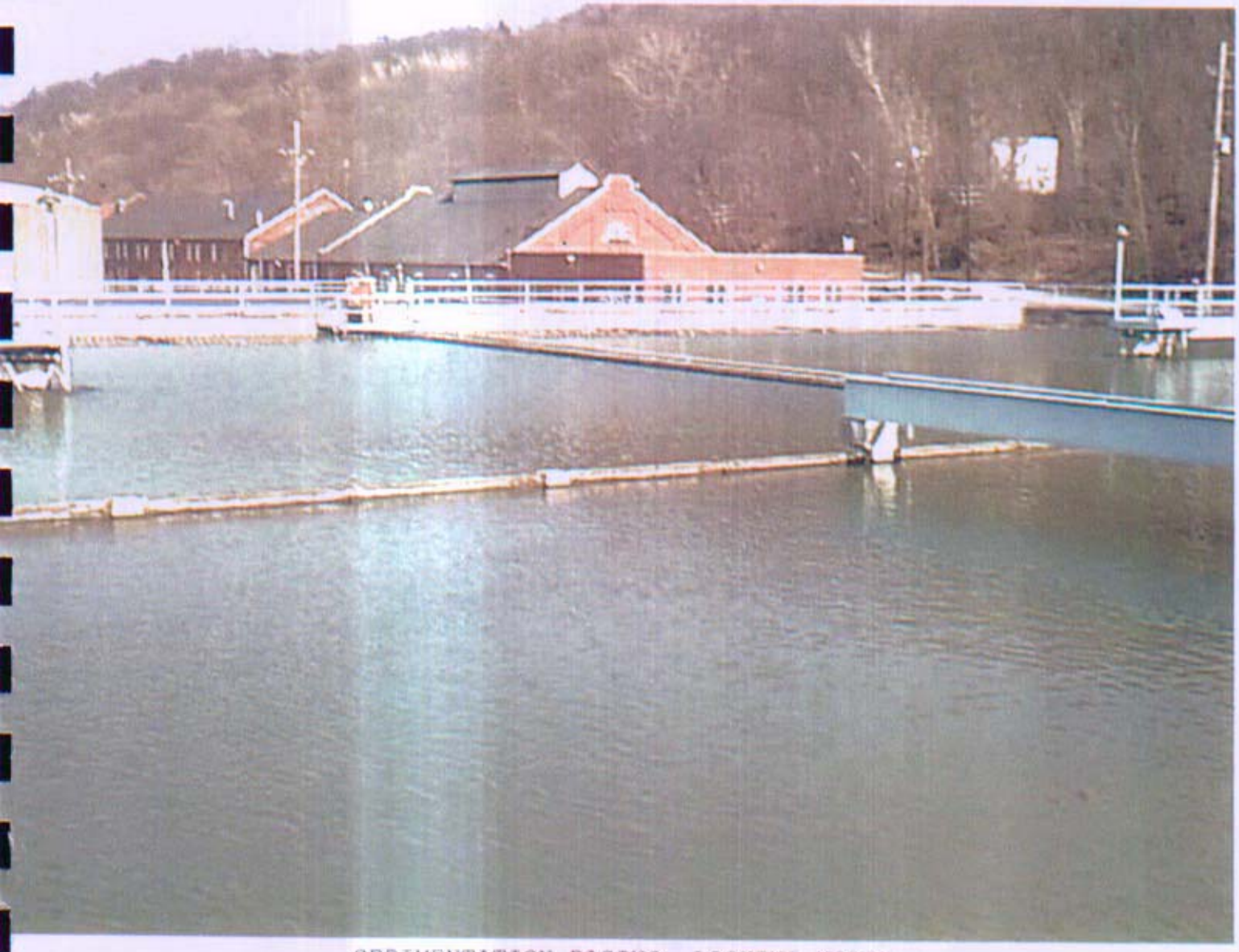
	Expert Witness services for one case
Fl. Office of Public Counsel	Studies, investigations and expert Witness services for 9 Utility rate cases
DiversiTech	Structural evaluation & retrofit designs for 3-story, 65 year old building in Quincy, Fl
Sweetbay Subdivision	Site Plan review, concurrency and Environmental Permitting
Meredith Lumber & Northstar	Design of retaining walls for Pensacola Street Realignment project
The Allen Morris Co.	Structural analysis of 10th floor roof Deck for inserts for new roof
Sawgrass Association	Studies & Forensic engineering for Wastewater Treatment Facilities & Environmental analysis of lake system.
Tarragon Realty Advisors	Structural analyses and retrofit designs for cure for wall movements for three story apartment building.
The Wetlands Company	Structural analysis & retrofit design to cure foundation problems at plant in Thomasville, Ga.
Mitch Covington	Structural analyses & retrofit designs to cure foundation & structural defects.
Miracle Hill Nursing Home	Studies, report and expert testimony of design and construction deficiencies at new Nursing Home Facility
Bouchelle Island	Design & Construction Administration for 2,800 ft. long breakwater

MISSOURI RIVER INTAKE STRUCTURE

MISSOURI RIVER INTAKE STRUCTURE

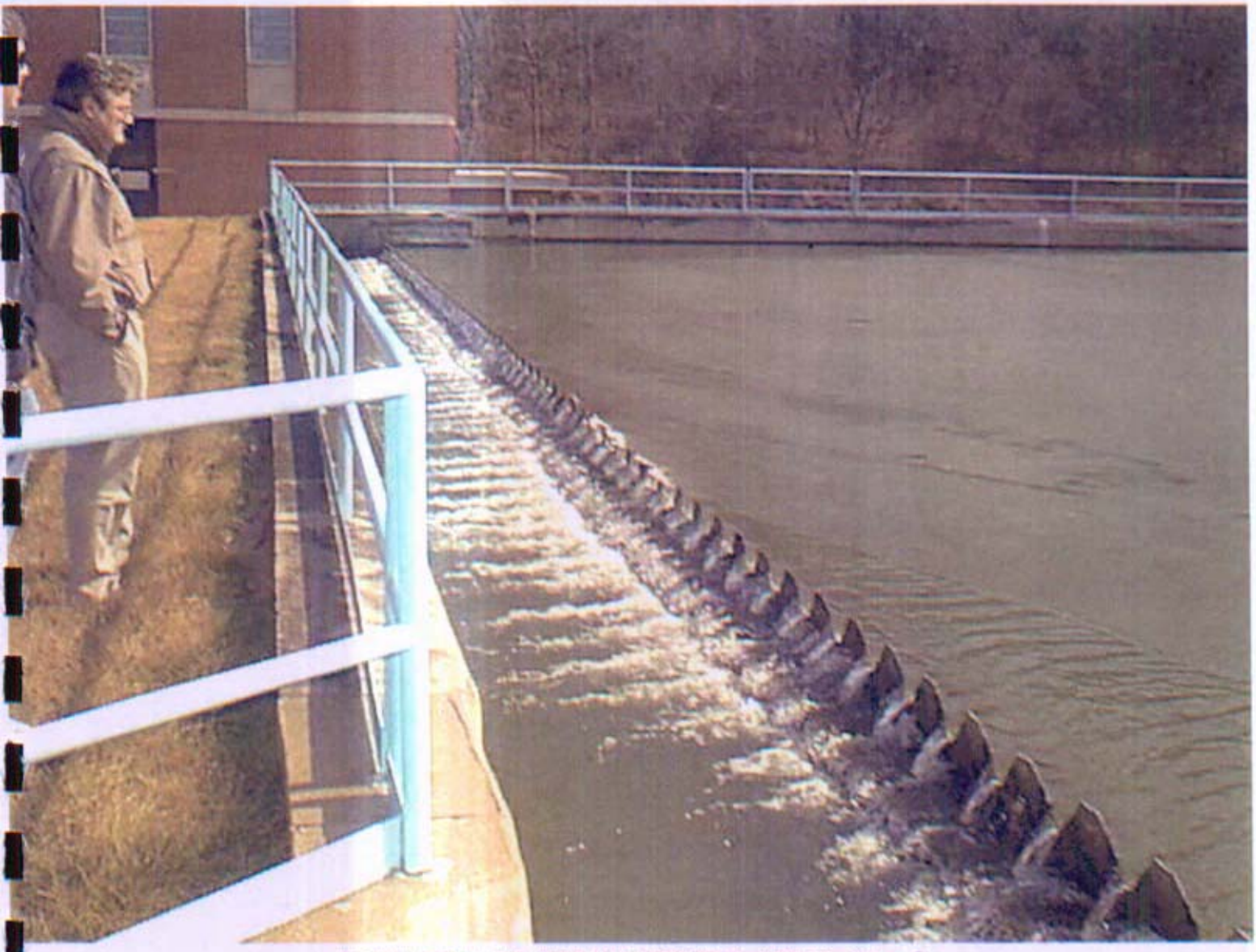
CLARIFIERS NO. 1 AND NO. 2, LOOKING SOUTH

SEDIMENTATION BASIN NO. 1, LOOKING SOUTH

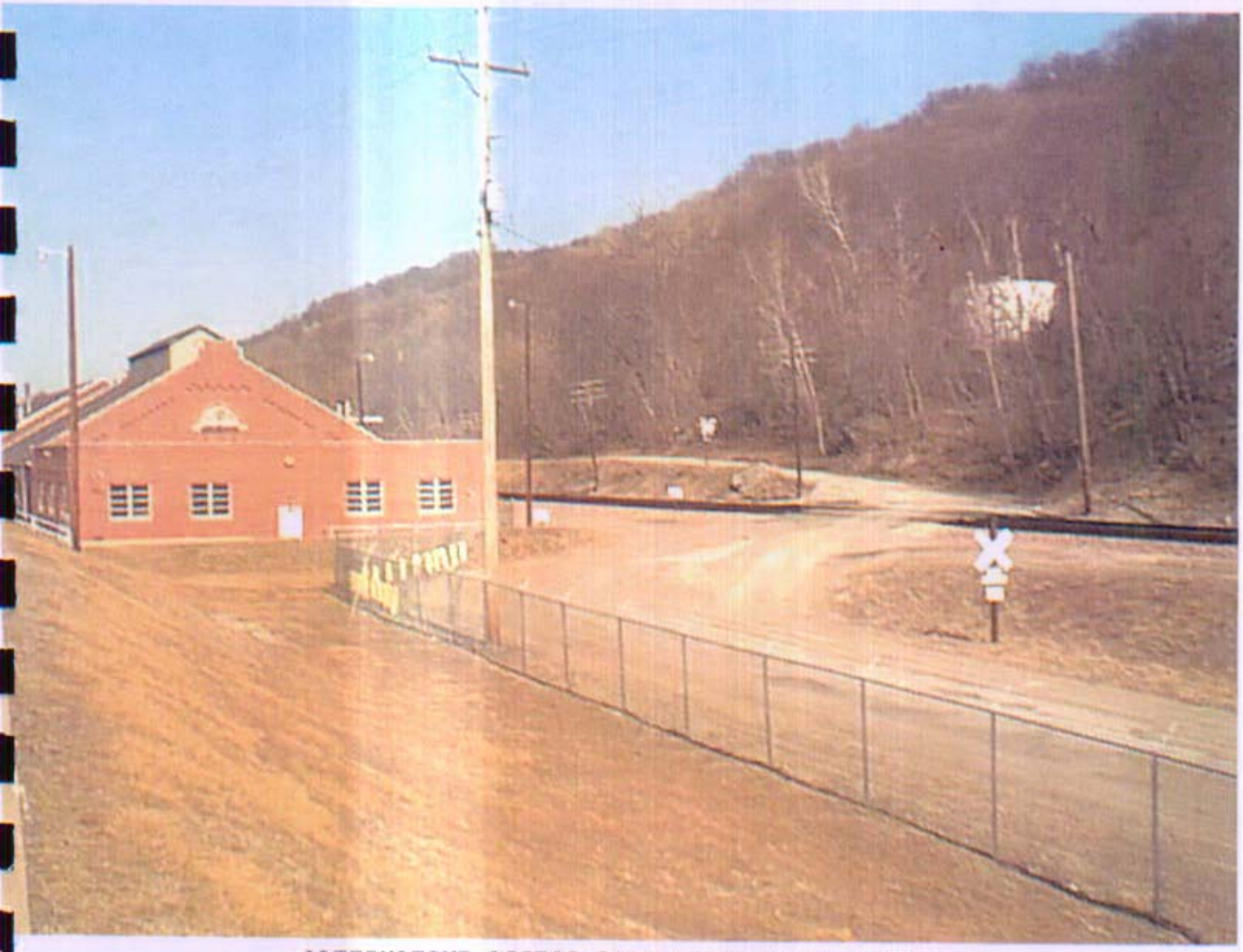


SEDIMENTATION BASINS, LOOKING NORTH

SEDIMENTATION BASINS, LOOKING NORTH



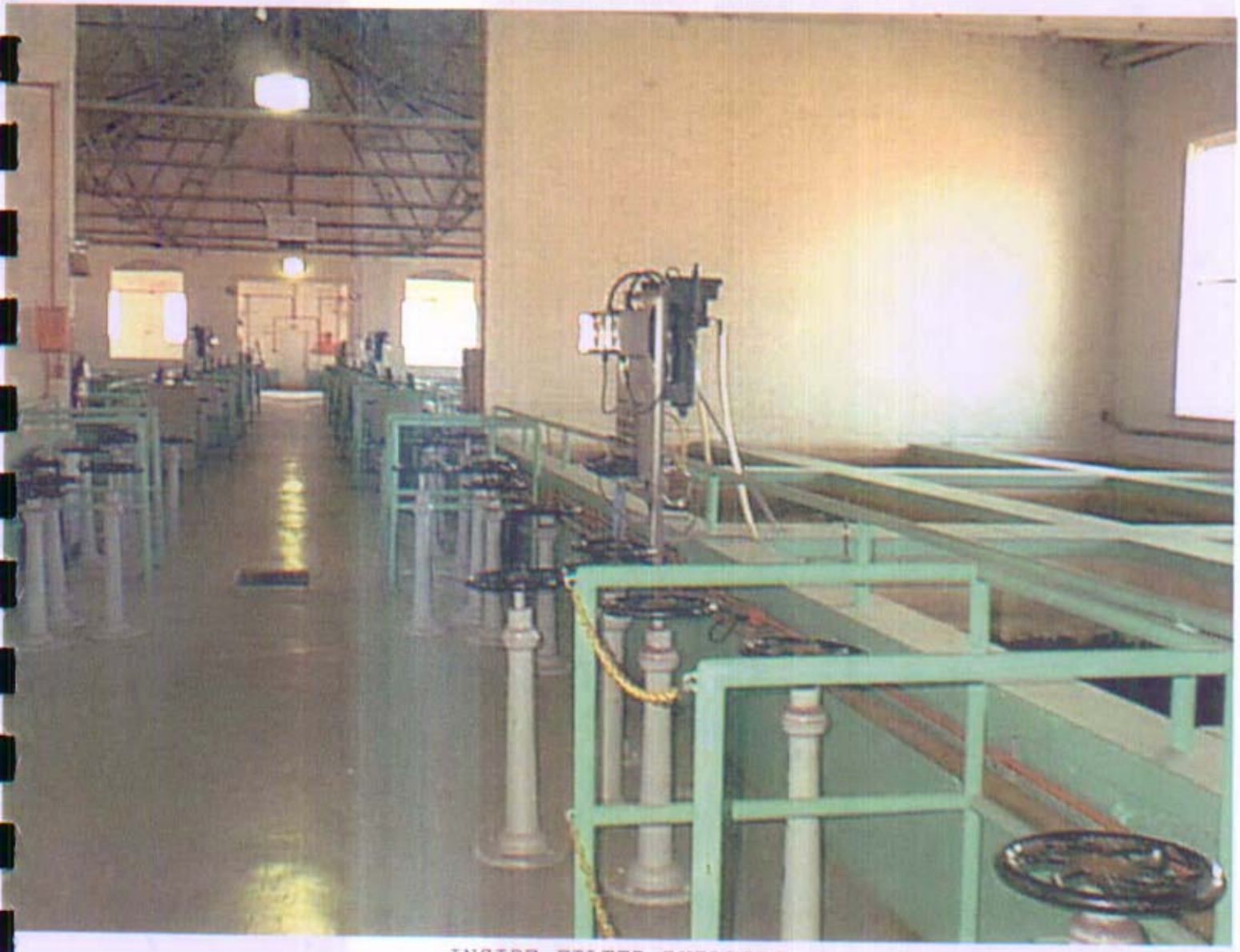
SOUTH END OF SEDIMENTATION BASIN NO. 3



ALTERNATIVE ACCESS ROAD ABOVE FLOOD LEVEL

1993 FLOOD LEVEL AT FILTER BLDG.

LOOKING NORTH INSIDE FILTER BUILDING



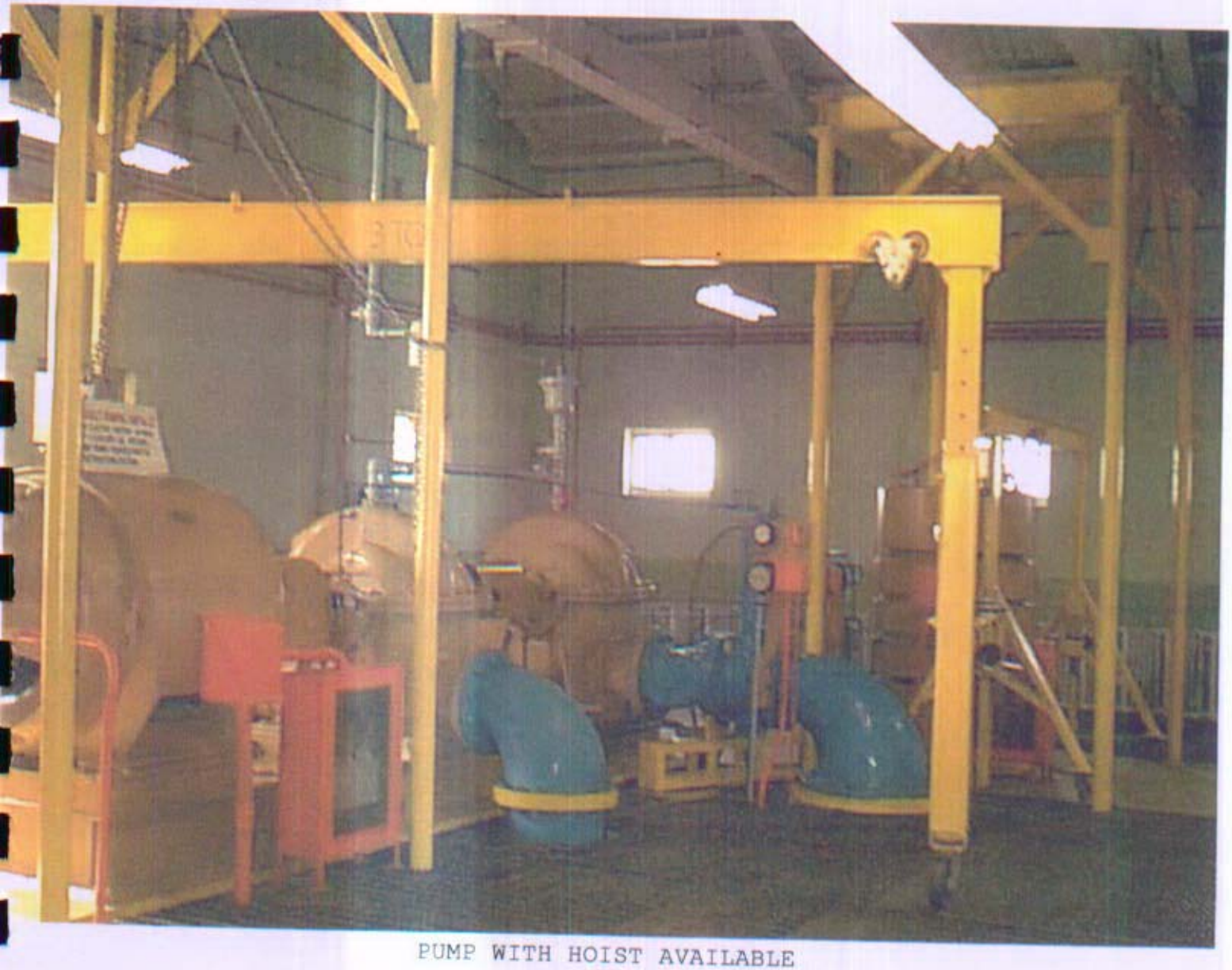
INSIDE FILTER BUILDING

1993 FLOOD LEVEL INSIDE FILTER BUILDING

CROWDED LAB AREA

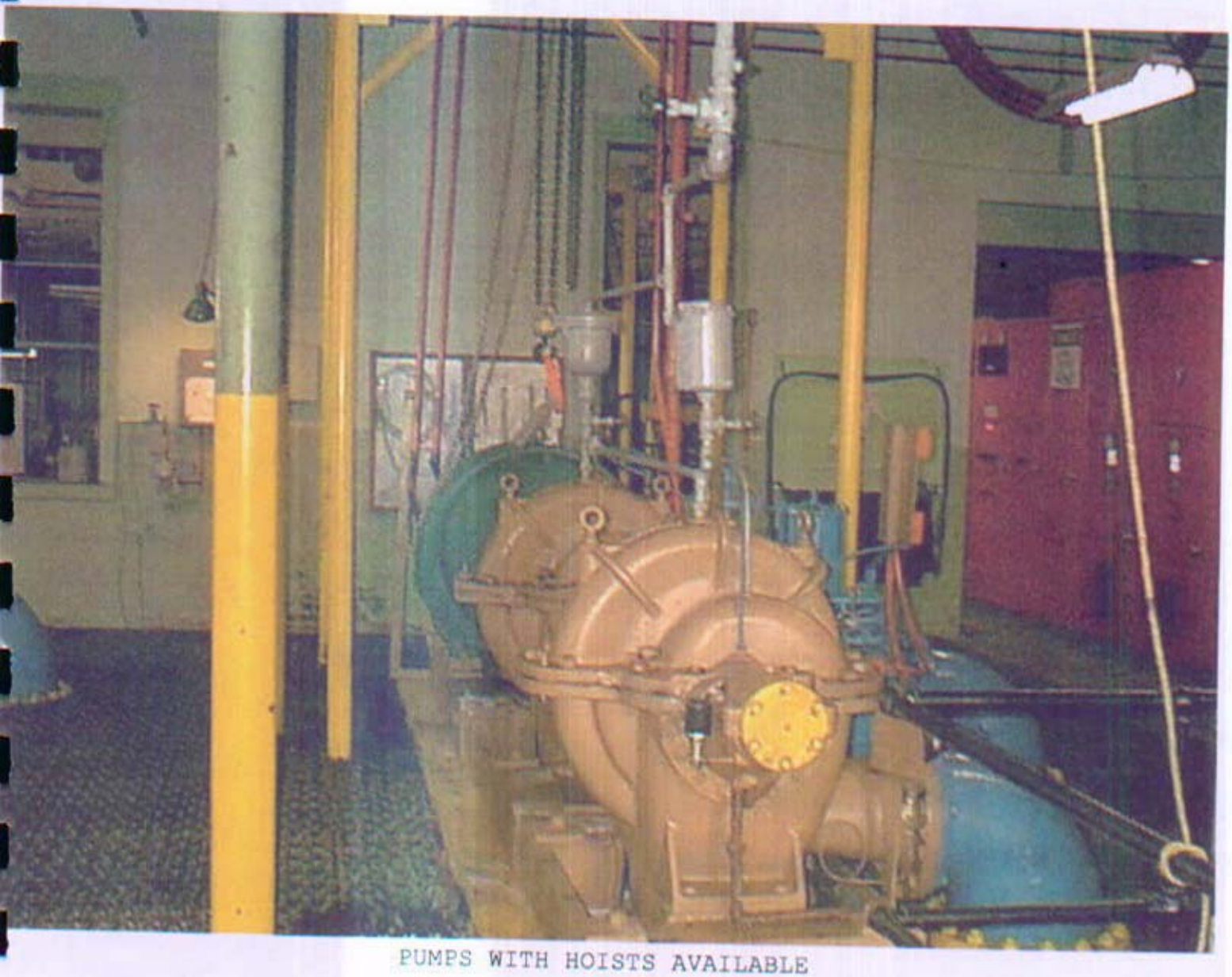
OPERATOR'S OFFICE

PUMP WITH HOIST AVAILABLE



PUMP WITH HOIST AVAILABLE

PUMP WITH HOIST AVAILABLE



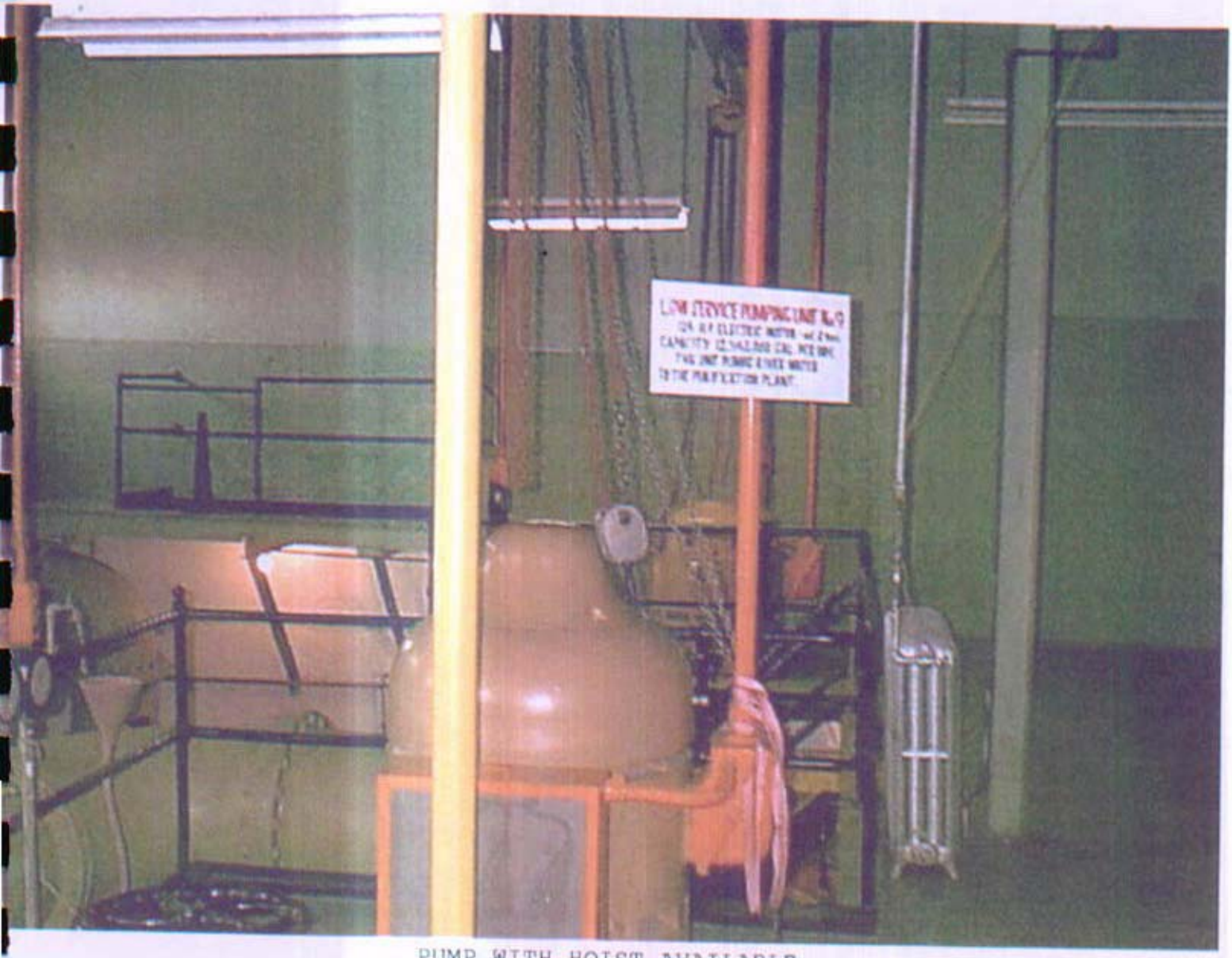
PUMPS WITH HOISTS AVAILABLE


LOW SERVICE PUMPING UNIT No.16
150 H.P. HYDRAULIC MOTOR
CAPACITY 15,120,000 GAL. PER DAY.
THIS UNIT PUMPS RIVER WATER
TO THE PURIFICATION PLANT.
M&W PUMP CORP.
HYDRAFLO
M&W

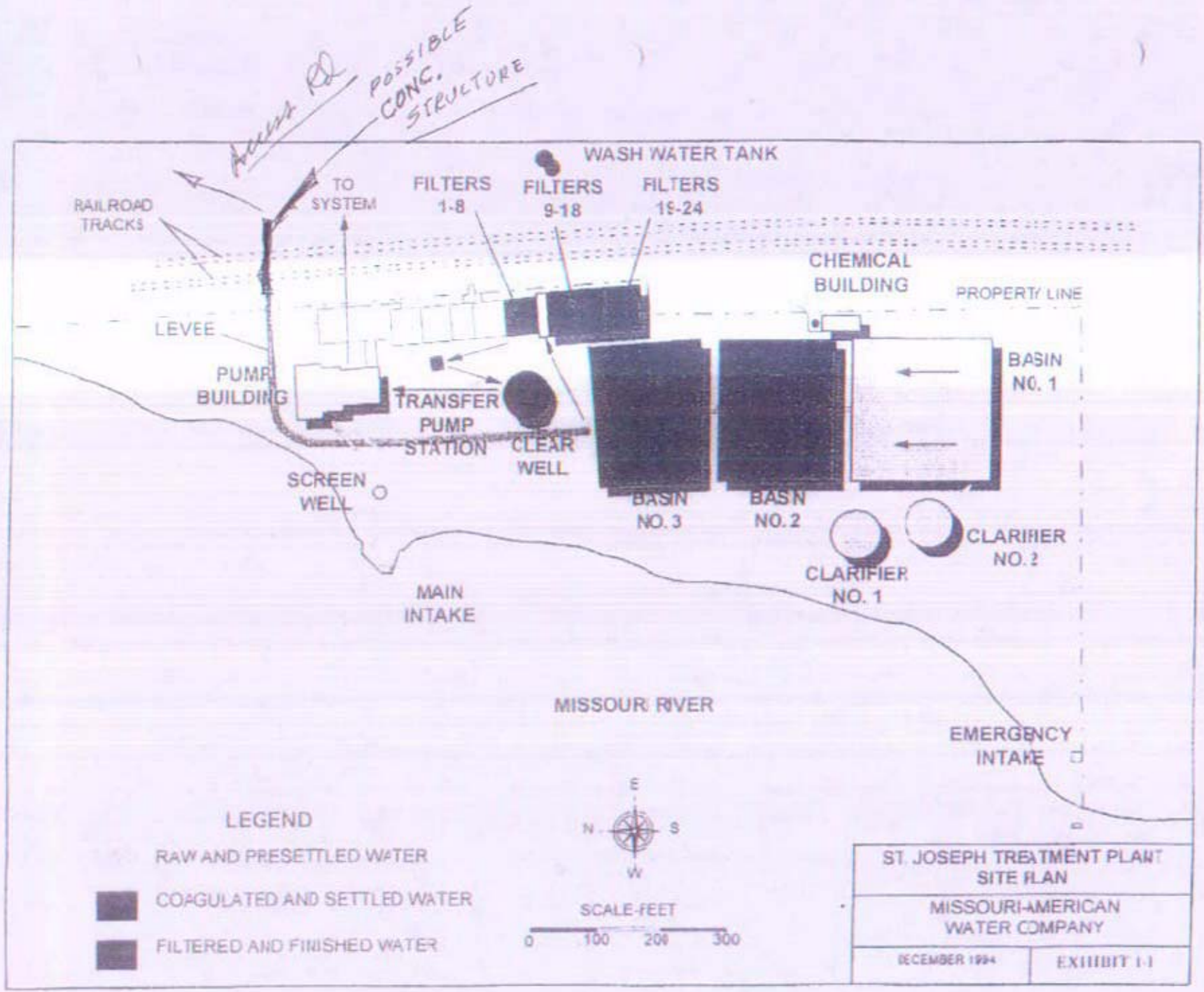
PUMP WITH HOIST AVAILABLE

PUMPS WITH HOISTS AVAILABLE


HIGH SERVICE PUMPING UNIT No. 14
600 H.P. ELECTRIC MOTOR - at 4% rpm
CAPACITY 1,500,000 GAL. PER DAY.
THIS UNIT PUMPS TREATED WATER
TO THE DISTRIBUTION SYSTEM.
14



PUMP WITH HOIST AVAILABLE


POSSIBLE CONC. STRUCTURE
WASH WATER TANK
TO SYSTEM
FILTERS 1-8
FILTERS 9-18
FILTERS 19-24
RAILROAD TRACKS
CHEMICAL BUILDING
PROPERTY LINE
LEVEE
PUMP BUILDING
TRANSFER PUMP STATION
CLEAR WELL
BASIN NO. 1
SCREEN WELL
BASIN NO. 3
BASIN NO. 2
CLARIFIER NO. 2
CLARIFIER NO. 1
MAIN INTAKE
MISSOUR RIVER
EMERGENCY INTAKE
LEGEND
RAW AND PRESETTLED WATER
COAGULATED AND SETTLED WATER
FILTERED AND FINISHED WATER
E
N
S
W
SCALE-FEET
0
100
200
300
ST. JOSEPH TREATMENT PLANT
SITE PLAN
MISSOURI-AMERICAN WATER COMPANY
DECEMBER 1994
EXHIBIT 1-1

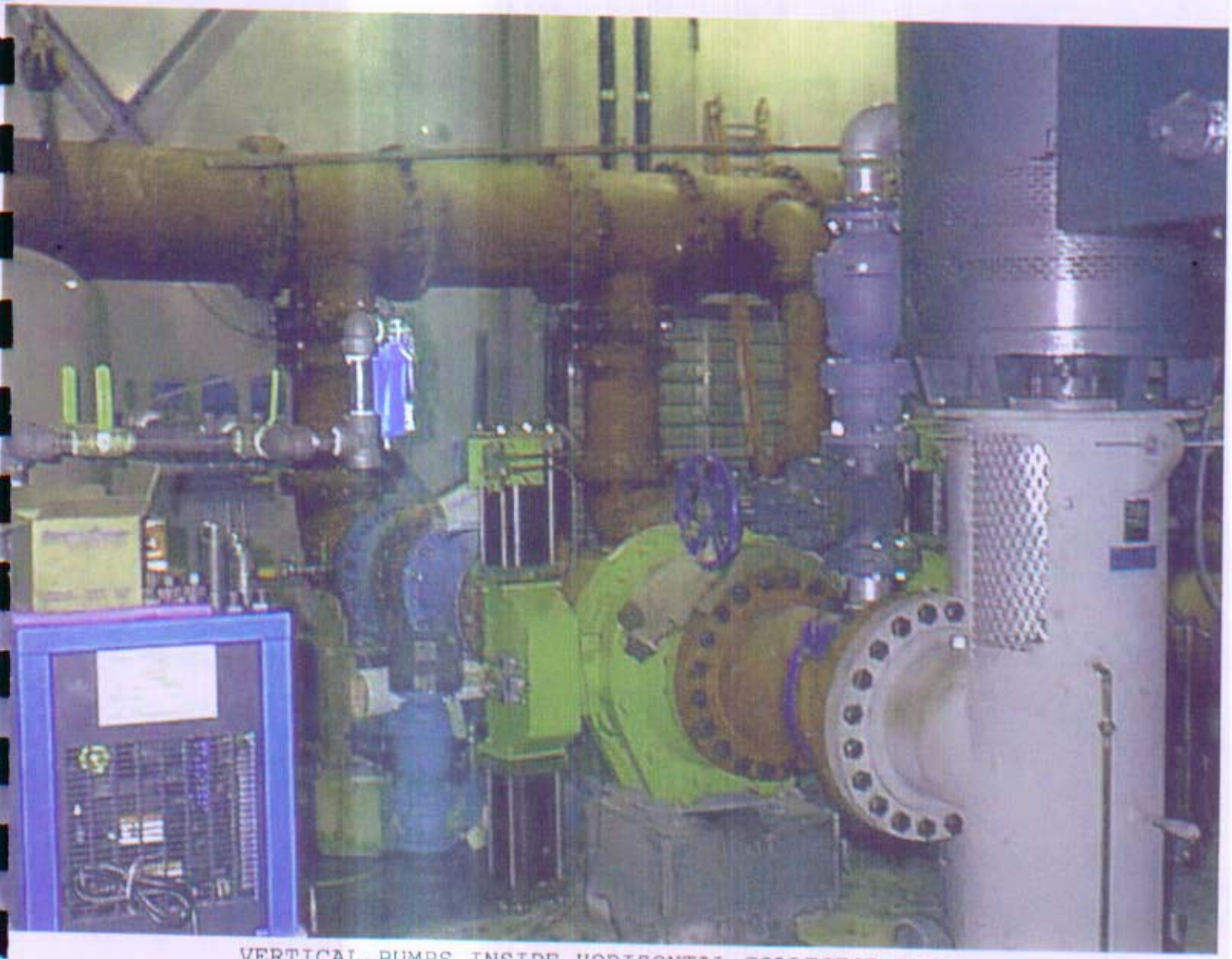
NEW 3 MGD WELL, ONE OF SEVEN, ALL IDENTICAL

LOOKING NORTH AT NEW 3 MGD WELLS

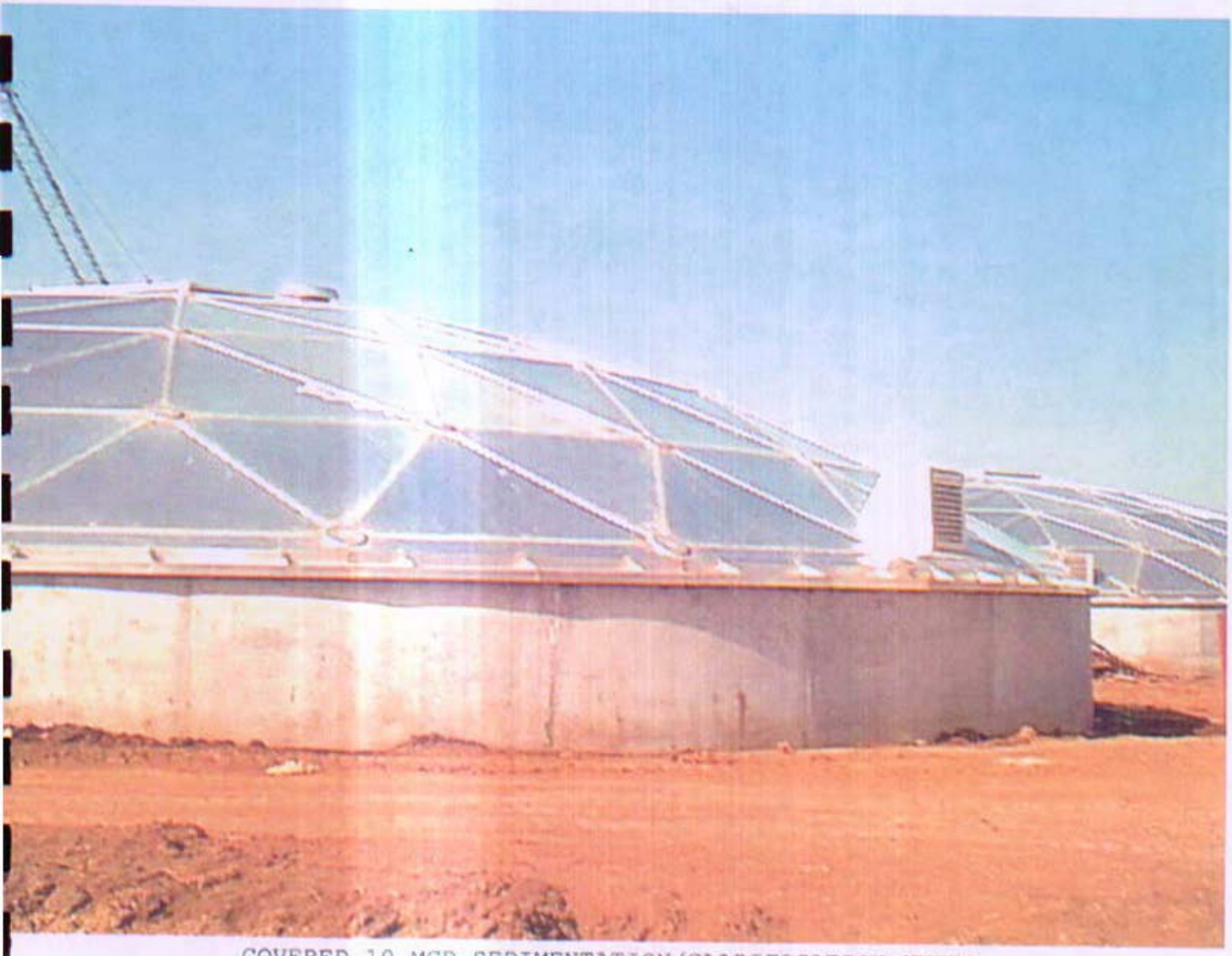
LOOKING SOUTH AT NEW 3 MGD WELLS

OUTSIDE VIEW OF HORIZONTAL COLLECTOR BLDG.

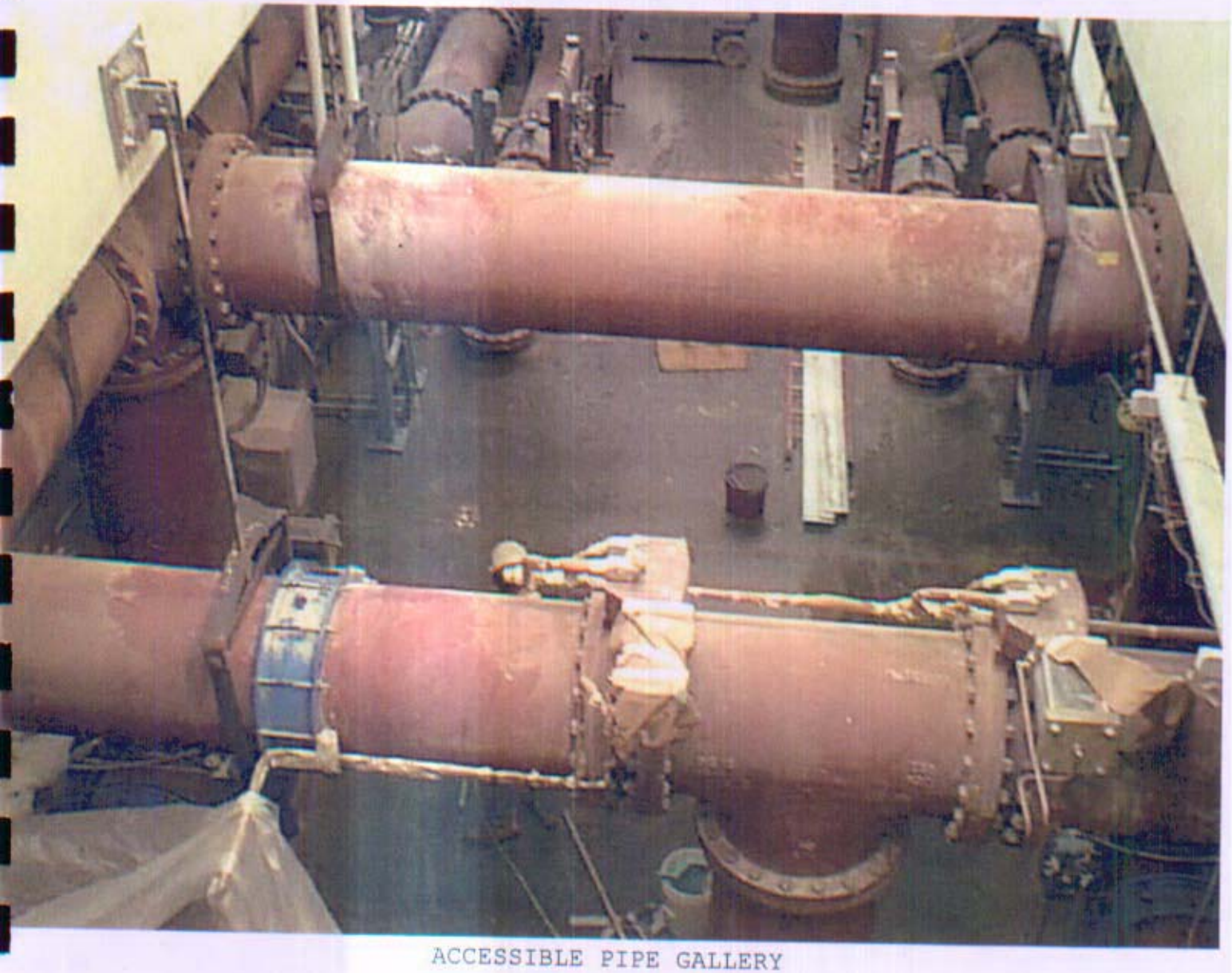
VERTICAL PUMPS INSIDE HORIZONTAL COLLECTOR BLDG.



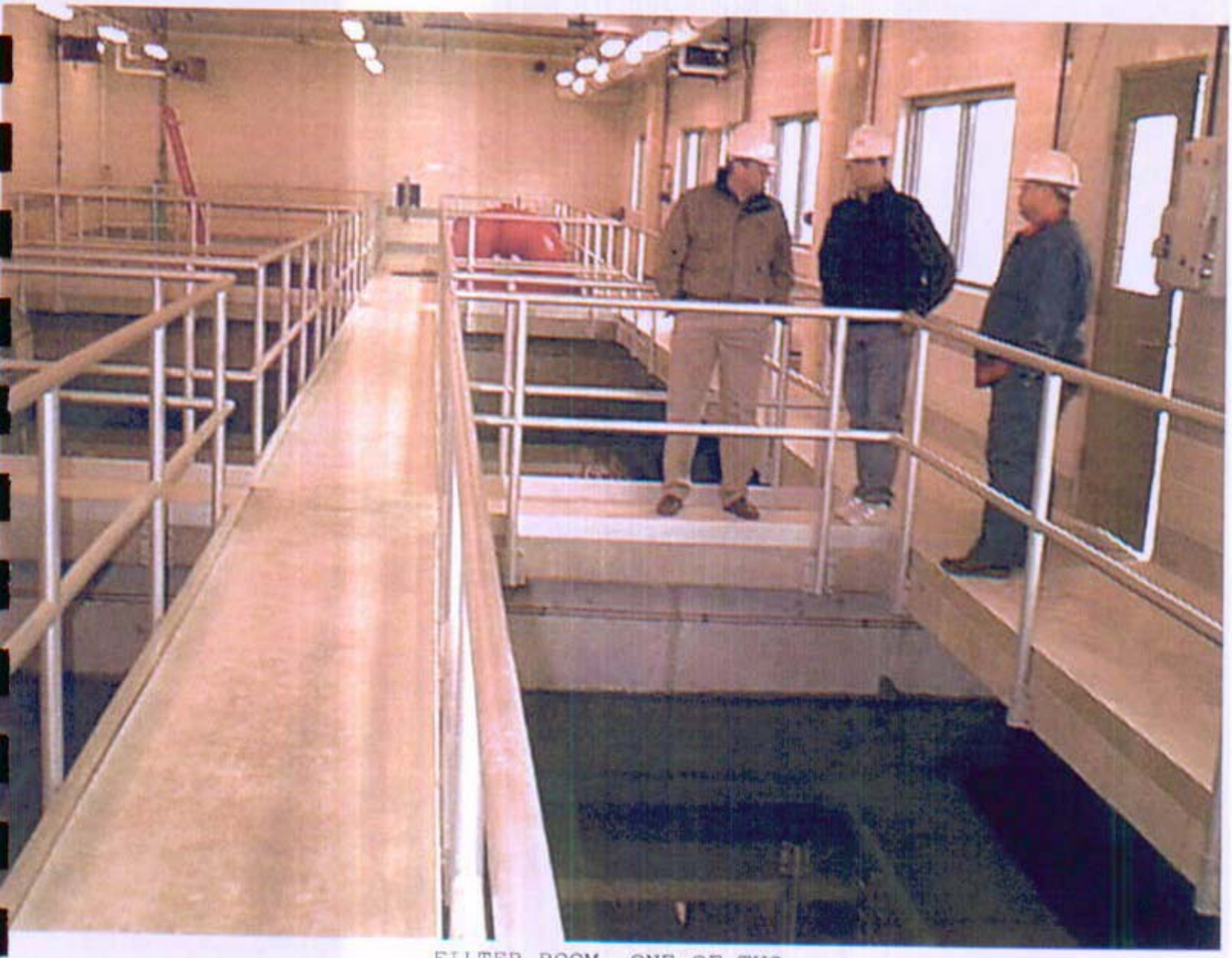
VERTICAL PUMPS INSIDE HORIZONTAL COLLECTOR BLDG.



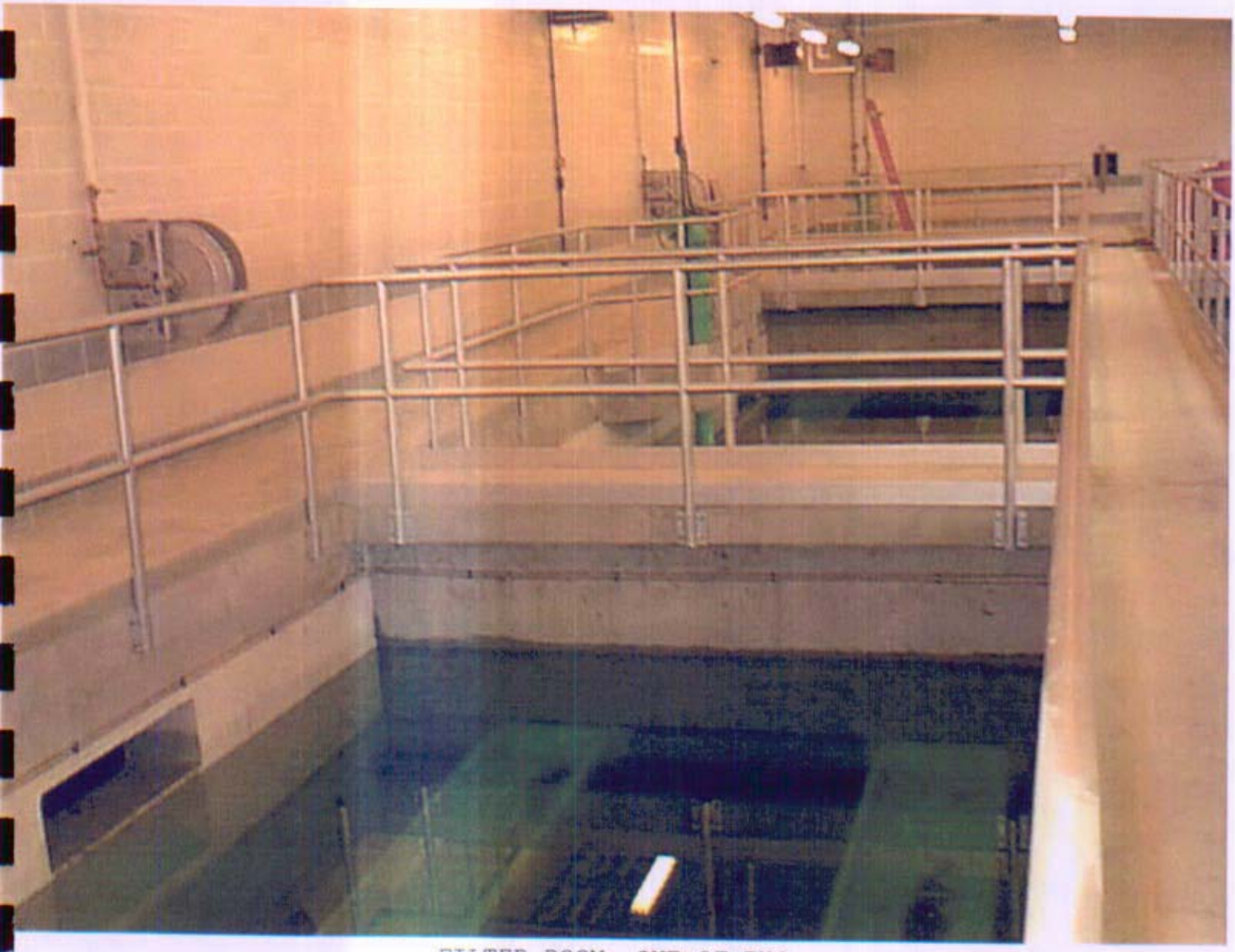
COVERED 10 MGD SEDIMENTATION/CLARIFICATION UNITS



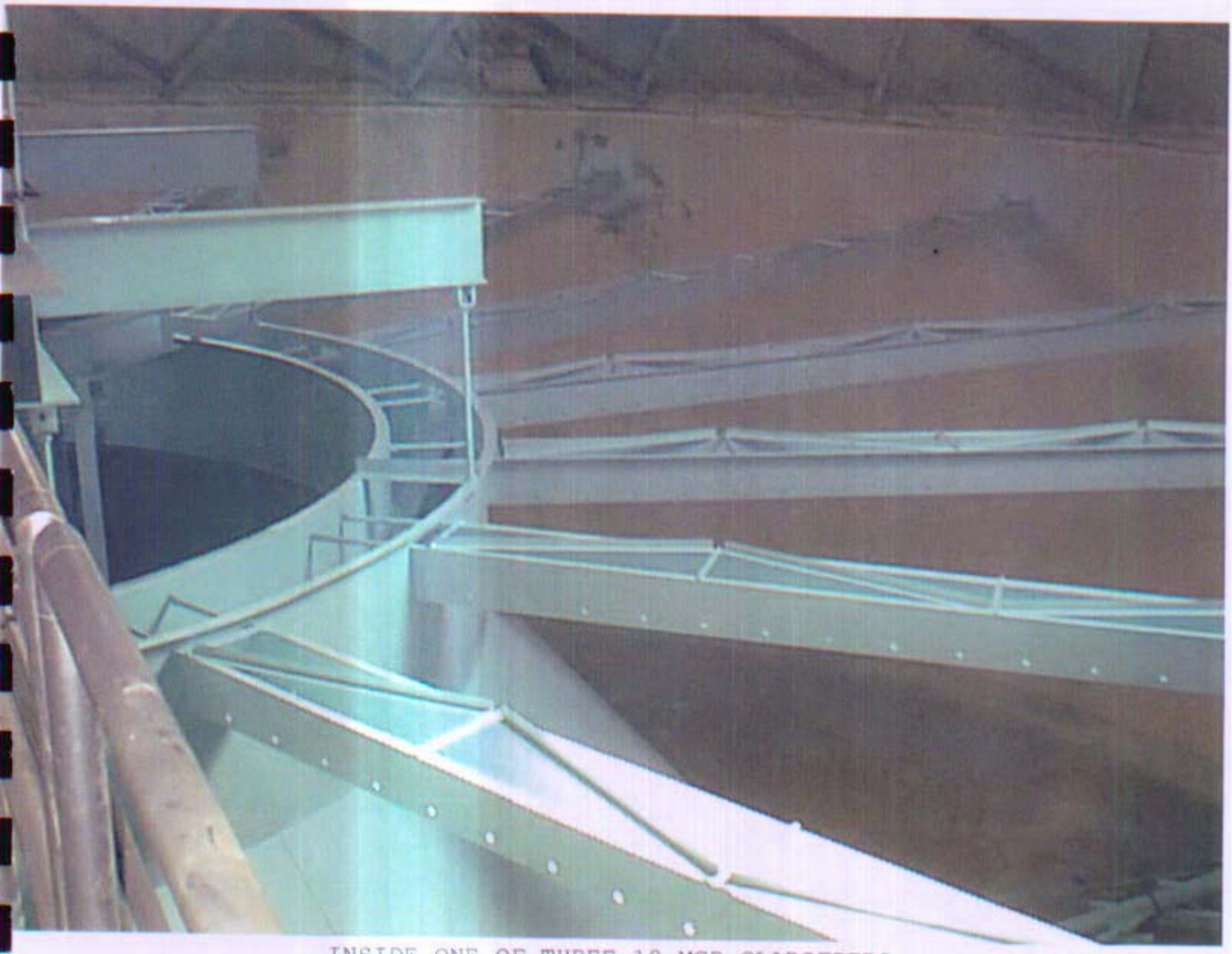
ACCESSIBLE PIPE GALLERY



FILTER ROOM, ONE OF TWO

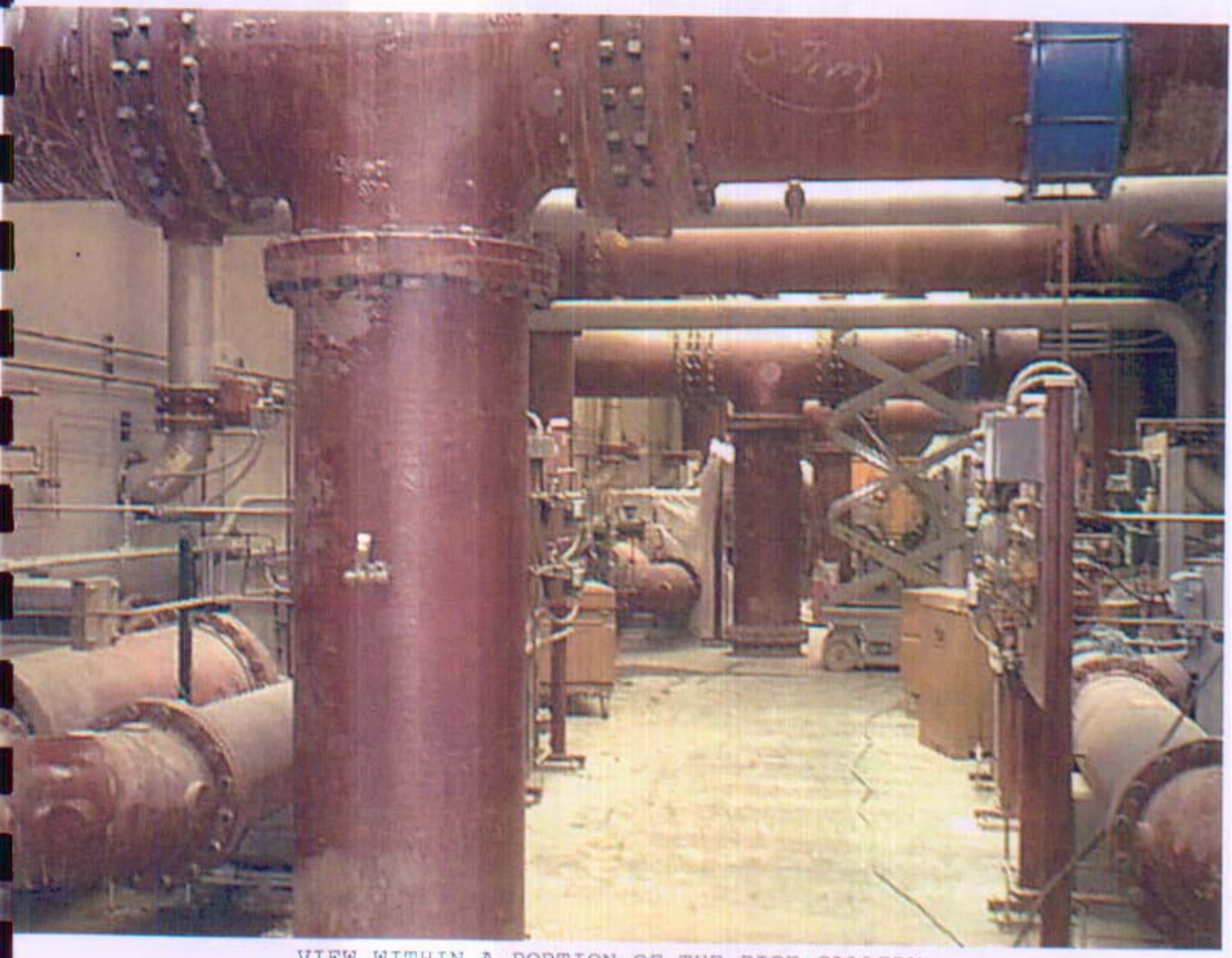


FILTER ROOM, ONE OF TWO



INSIDE ONE OF THREE 10 MGD CLARIFIERS

INSIDE ONE OF THREE 10 MGD CLARIFIERS



VIEW WITHIN A PORTION OF THE PIPE GALLERY

SCHEDULE TLB-3

IS BOUND

SEPARATELY.

Cost Estimate for Levee extension along East Side of existing MAWC treatment plant site

Length = 1280 ft.

Top Width = 10 ft.

Side Slopes = 2:1

Height = 5 ft. max. to record flood height

Section Area = 145 s.f.

Volume = 145 x 1280 = 185,600 c.f. = 6,874 c.y.

6874 c.y. @ $15.00	=	$103,111
Administrative (allow)	=	25,000
Total Estimate	=	$128,111

STATE OF MISSOURI
Mel Carnahan, Governor • David A. Shorr, Director
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

CI
Mo. American Water Company
St. Joseph, Missouri
Review Number 11610-96

July 25, 1996

Mr. Steven E. Creel, Design Engineer
American Water Works Service Company, Inc.
1025 Laurel Oak Road
P.O. Box 1770
Voorhees, New Jersey 08043

Dear Mr. Creel:

An engineering report for a groundwater supply source and treatment for St. Joseph, Missouri, has been reviewed. The report recommended developing wells into the Missouri River alluvium (vertical wells and/or horizontal collector wells at least 200 feet from the bank of the river) and constructing an iron and manganese removal treatment plant. The report was examined as to sanitary features which may affect the operation of the project, including size, capacities of units, and factors which may affect efficiency and ease of operation.

As you requested, we will respond to the items you presented in your letter of transmittal dated May 23, 1996, as numbered:

1. **Construction of New or Expanded Treatment Facilities in the Floodplain**
Because of our past flood experiences, we will not approve construction of a new water treatment plant in the flood plain. All parts of the water treatment plant shall be located at least four feet above the 100 year flood elevation or the highest flood in record. Groundwater supply wells and surface water source intake pumping stations and controls shall also be raised above the flood elevation and should be readily accessible during all weather conditions.

   Existing water treatment plants that are already in the flood plain may be expanded if it is practical and economical. Structures that will protect the plant from flooding or prevent interruption of operation during flooding must be included with the expansion.

2. **Ground Water Supply**
We concur with your assessment of the advantages of the groundwater source over

surface water source. The existence of the petroleum products pipeline near the selected well field site is a concern. Control measures that will protect contamination of the wells in case of a pipeline leak must be included in the design of the wells.

3. **Oxidation of Iron with Chlorine**
Aeration followed by chlorination is a common practice for the oxidation of iron and manganese in Missouri. Our experience using chlorine alone for oxidation of iron is limited to waters with very low concentration, less than 1 mg/l of iron.

Studies indicate that free chlorine may not be an effective oxidant when there is a significant amount of dissolved organic carbon, wherein the iron is complexed by organic matters. Even though the bench and pilot scale testing has demonstrated that the iron present in the alluvial water in Parkville and in the proposed well field is not organically bound, the raw water quality is expected to change in time. Also, a heavy dose of chlorine ahead of the plant and the anticipated induced infiltration from the river may increase the potential formation of regulated chlorination by-products. Because of our limited experience in this process and the uncertain changes in the raw water quality from the proposed wells, we recommend that provisions for future aerator be included in the design of the water treatment plant.

4. **Solids Contact Clarifications**
Our experience with the use of solids contact clarification for iron and manganese removal at a hydraulic loading rate of 1 gpm/sf at the sludge separation line is positive. The use of solids contact clarifiers will also be convenient should you decide, in the future, to add softening in the treatment process.

5 **Filtration**
In general, we require a maximum filtration rate of 4 gpm/sf with one filter out of service. Higher filtration rate may be acceptable if it can be shown through pilot testing that a filtration rate higher than 4 gpm/sf is adequate for the particular water to be treated and the pretreatment that will be provided.

Although the Ground Water Characterization and Pilot treatment Study included in the report shows very good finished water quality at a higher filtration rate of 6 gpm/sf, the source water in the study has lower concentration of iron and manganese than what is initially anticipated from the proposed wells. Even if the raw water quality is predicted to improve after a period of pumping, in effect of induced river water infiltration, the design must incorporate treatment contingencies during the transition period and in a situation where the levels of iron and manganese does not come down as low as predicted and/or the dissolved organic carbon significantly increases to adversely impact the oxidation process.

Initially, we may approve the proposed water treatment plant at a lower capacity, enough to meet the demand within the next five years, at a filtration rate not to exceed 4 gpm/sf. Studies may be conducted during the five year interim period to demonstrate effectiveness

of high rate filtration on the stabilized raw water quality. The approval will be upgraded to 30 mgd when it can be demonstrated that higher filtration rate is justified. The plant design must include provisions for adding more filters in case the pretreatment will produce less desirable quality of effluent due to inferior raw water quality than is presently predicted..

6. **Interior Access to Chlorine and Ammonia Feed Rooms**
Interior access to the chlorine and ammonia rooms is not encouraged. Even if the intra-plant gas piping will operate under a vacuum, the possibility of gas escaping into the work area still exist.

7. **Residuals Handling**
The supernatant of the settled filter washwater may be recycled at a maximum rate of 10 percent the plant's capacity if it is not going to cause adverse effect on the finish water. Alternative disposal of the supernatant by some other means must be included in the design.

8. **Unattended Operation**
The proposed unattended operation of the wells, treatment facilities, and pumping equipment will be considered after a report covering the results and experiences of at least one year demonstration period is completed and submitted to this office. The report must prove with confidence the reliability of the of the procedure, equipment, monitors, and surveillance system. A certified operator must be on-duty during the demonstration period. Problems and/or alarms that occurred during the demonstration period and the actions taken during those incidents must be included in the report. The report must also cover all aspects of the automation system including the following:

- Identification of critical features in each pumping and treatment step that will be electronically monitored, have alarms, and can be operated automatically or off-site via a control system.
- A plant control flow diagram which shows the location of all critical features and automated controls.
- Description of off-site control station/s that allow observation of plant operations, receiving alarms and the ability to adjust and control operation of equipment and the treatment process.
- A chain of certified operators on a "standby duty" status with remote operational capability at all times and located within a reasonable driving time to the facilities.
- A certified operator doing an onsite check at least once per day to verify proper operation.
- Automated monitoring of critical functions with alarm features.

Missouri-American Water Company

MEMORANDUM

August 14, 1991

Missouri-American Water Company - St. Joseph District
Filter Plan Improvements - Evaluation of Alternatives

Pursuant to the terms and conditions of Budget Project 91-12, System Engineering is undertaking development of designing treatment plant improvements for the St. Joseph District. Because of the magnitude of this project, the Company requested that System Engineering investigate a number of alternatives before beginning the formal design process. This would give the company the latitude of resolving the treatment problems at the St. Joseph District.

Basic need for the treatment plant improvements is centered around two primary areas:

1. The recent amendments to the Safe Drinking Water Act provide that water treatment requirements will become much more restrictive in the near future. For example, effluent turbidities may not exceed 0.5 NTU 95% of the time. Failure to meet this standard will require the plant to issue public notice indicating that the company cannot provide properly treated water. Efforts by the plant to produce a finished water that will meet these standards has not been successful. The treatment process has on several occasions attempted to control and reduce the level of turbidity in the finished water. These efforts have resulted in lower levels of turbidity over short periods of time that would meet these standards, however, it was not successful over a constant or long term basis. To achieve the treatment requirements provided under the terms of the Safe Drinking Water Amendments, the treatment plant will require major reconstruction.

2. The present treatment plant was last up-graded over thirty-five years ago. The first filters were installed in 1913. These consisted of eight 600,000 gallon a day units. Leopold bottoms were added to these units in 1954 and 1955. In 1925, 10, 1 million gallon a day filters were added, and in 1956 6 additional 1 million gallon filters were constructed. Since 1956 no major improvements have been completed. Maintaining these facilities is becoming increasingly more difficult. The majority of the repair parts required need to be manufactured by local machine shops. This is both costly and inefficient.

The 1988 Comprehensive Planning Study indicated the need to provide additional treatment capacity in order to meet expected peak demands of 25 million gallons a day by the year 2002. The peak of 25 million gallons a day has already been reached. The report also addressed the age and condition of the existing filters and pointing out the need for major renovations to the controls and instrumentations to meet the present day standards. The Comprehensive Planning Study report also addresses the treatment concern outlined in Item #1 above. In addition to the treatment requirements needed, the report also indicated that improved chemical feeding facilities, new laboratory equipment and facilities, general plant support facilities, including offices, rest rooms, transfer pumping stations, additional clearwell storage will be required.

In order to provide the best possible solution to these problems, the Company investigated a series of proposals that would provide the treatment improvements needed. Six alternatives were developed that would provide the improvements needed. These alternatives have been developed that would include preliminary site drawings and estimated construction costs. Three of these concepts include the renovation of some or all of the existing filters. The final three proposals include the construction of new filters. Because of the extremely high construction costs associated with this project, and in an effort to minimize the rate impact on customers, the construction plans were developed to phase the projects over an extended period of time.

CONCEPT I (a)

Renovate Filters Nos. 1-24

This proposal provides for the renovation of all 24 filters to high rate capacity that will increase treatment capacity to 30 million gallons a day. Complete replacement of gallery piping, valves, ceiling, ladders will be necessary. This proposal also provides for the installation of drains, air wash, filter to waste systems and electrically activated valves. The gallery will have to be waterproofed and humidity controlled equipment will also be included. Filter operation instrumentation and controls, including semi-automatic backwash equipment is also provided.

The plant will have to remain in service during the construction period and renovation of the filters can only be completed during low demand periods. In addition, only two filter units can be removed from service at any one time. Therefore, renovation of the filter units will be limited four per calendar year.

In addition to the renovation of the 24 filters, the project provides for the construction of a transfer pumping station, 400,000 gallon clearwell, filter to waste sump, wash water tank, additions to the chemical building, new laboratory and support facilities. The pipe gallery, which is extremely crowded at this time, will become even more crowded with the addition of the filter to waste piping and valves. Many plant shut downs can be expected during the construction period. Some improvements will have to be made to the existing filters during the extended construction period. Construction is forecast to be completed in three phases.

Phase I (Including Engineering Design)

Start July 1991 - Complete March 1994

Engineering Design	$ 740,000
High Rate Filters (8)	$ 2,140,000
Transfer Pump Station	$ 1,500,000
Clearwell	$ 1,100,000
Engineering Supervision	$ 200,000
Carry-over Improvements to Existing Filters	$ 500,000
Sub-Total	**$ 6,180,000**
O & C	$ 618,000
	$ 6,798,000
Interest	$ 421,000
TOTAL PHASE I	**$ 7,219,000**
Say	$ 7,200,000

Phase II

Start May 1994 - Complete April 1996

High Rate Filters (8)	$ 2,260,000
Filter to Waste Sump	$ 242,000
Wash water Sludge Tank	$ 175,000
Chemical Building Additions	$ 1,320,000
Laboratory/Office Facility	$ 770,000
Engineering Supervision	$ 220,000
Sub-Total	**$ 4,987,000**
O & C	$ 499,000
	$ 5,486,000
Interest	$ 340,000
TOTAL PHASE II	**$ 5,826,000**
Say	$ 5,800,000

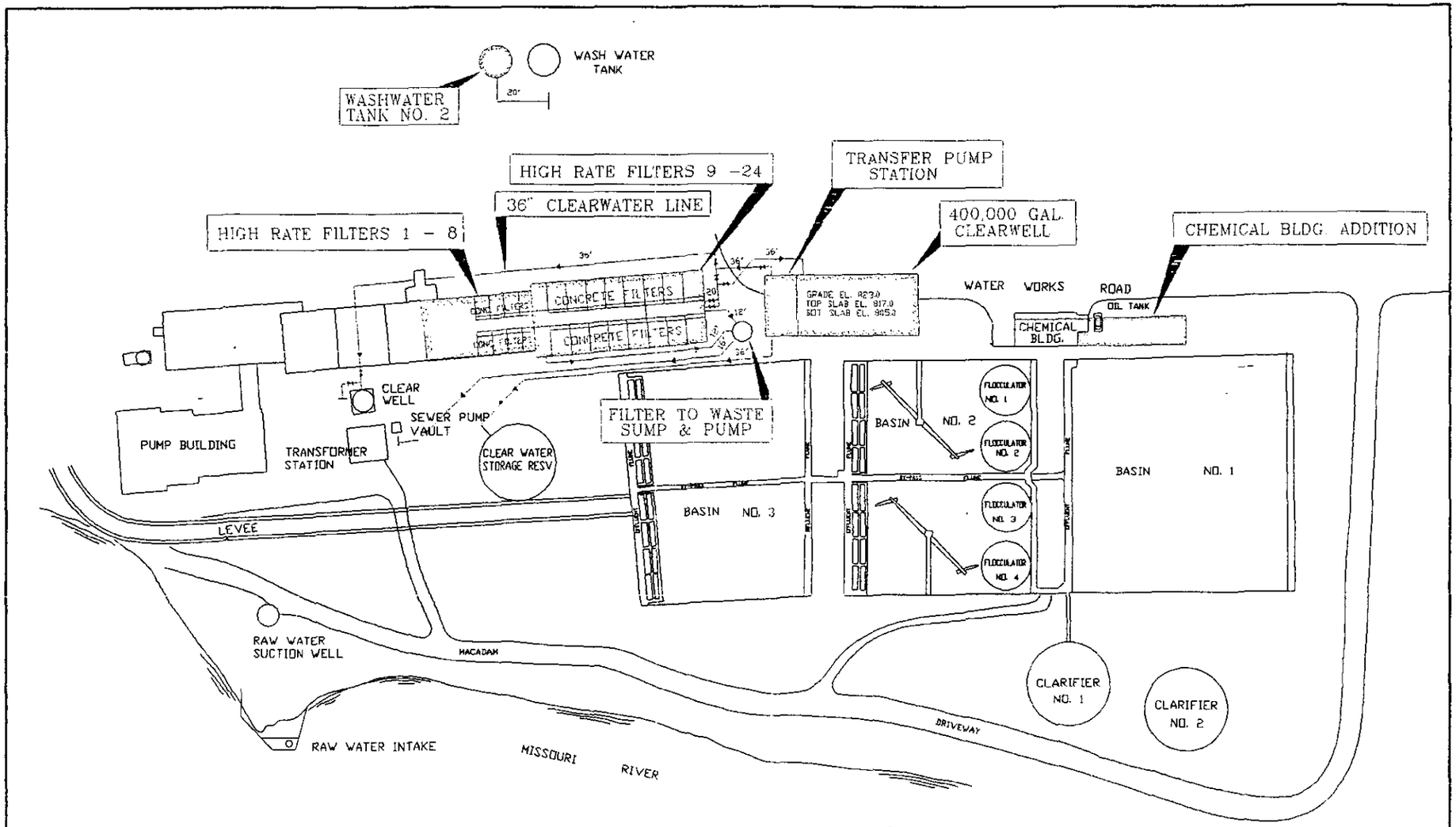
Phase III

Start October 1996 - Complete March 1998

High Rate Filters	$ 2,480,000
Engineering Supervision	$ 242,000
Sub-Total	**$ 2,722,000**
O & C	$ 272,000
	$ 2,994,000
Interest	$ 186,000
TOTAL PHASE III	**$ 3,180,000**
Say	$ 3,200,000

RE-CAP CONCEPT 1(a)

Phase I	$ 7,200,000
Phase II	$ 5,800,000
Phase III	$ 3,200,000
TOTAL	$16,200,000



MISSOURI-AMERICAN WATER COMPANY

ST. JOSEPH DISTRICT

CONCEPT 1A
SITE PLAN

7-91 K
RP91-12
NTS

CONCEPT I (b)

High Rate Filters Nos. 9-24

This concept provides for renovating filters numbered 9-24 to high rate filtration that will provide an estimated treatment capacity of 28-30 million gallons a day. The proposal will also include the installation of air wash and filter to wash system, replace filter bottoms on filters 9-18. Waterproof and dehumidify gallery, installation of electrically operated valves are also included. The proposal provides filter operation instrumentation and controls including semi-automatic back wash operations. The gullet walls will be raised and wash troughs will also be replaced, together with the replacement of the filter media.

Filters number 1-8 will be retired and the area remodeled to accommodate the new laboratory, offices, control room and other support facilities. Proposed construction will also include the replacement of all valves and pipe supports, the construction of a transfer pump station, 400,000 gallon clearwell, filter to waste sump, wash water storage tank and chemical building additions.

The same situation will exist under Concept I(b) with regard to the crowded pipe gallery situation and required plant shut-downs during the construction period. The state may not approve filter rates above three gallons a minute per square foot under this concept. Some improvements will be required to the existing filters during the extended construction.

Construction under Concept I(b) will be completed in two phases.

Phase I (Including Engineering Design)

Start July 1991 - Complete March 1994

Engineering Design	$ 660,000
High Rate Filters (8)	$ 1,900,000
Transfer Pump Station	$ 1,500,000
Clearwell	$ 1,100,000
Engineering Supervision	$ 300,000
Carry-over Improvements to Existing Filters	$ 500,000
Sub Total	**$ 5,960,000**
O & C	$ 596,000
	$ 6,556,000
Interest	$ 406,000
TOTAL PHASE I	**$ 6,962,000**
Say	$ 7,000,000

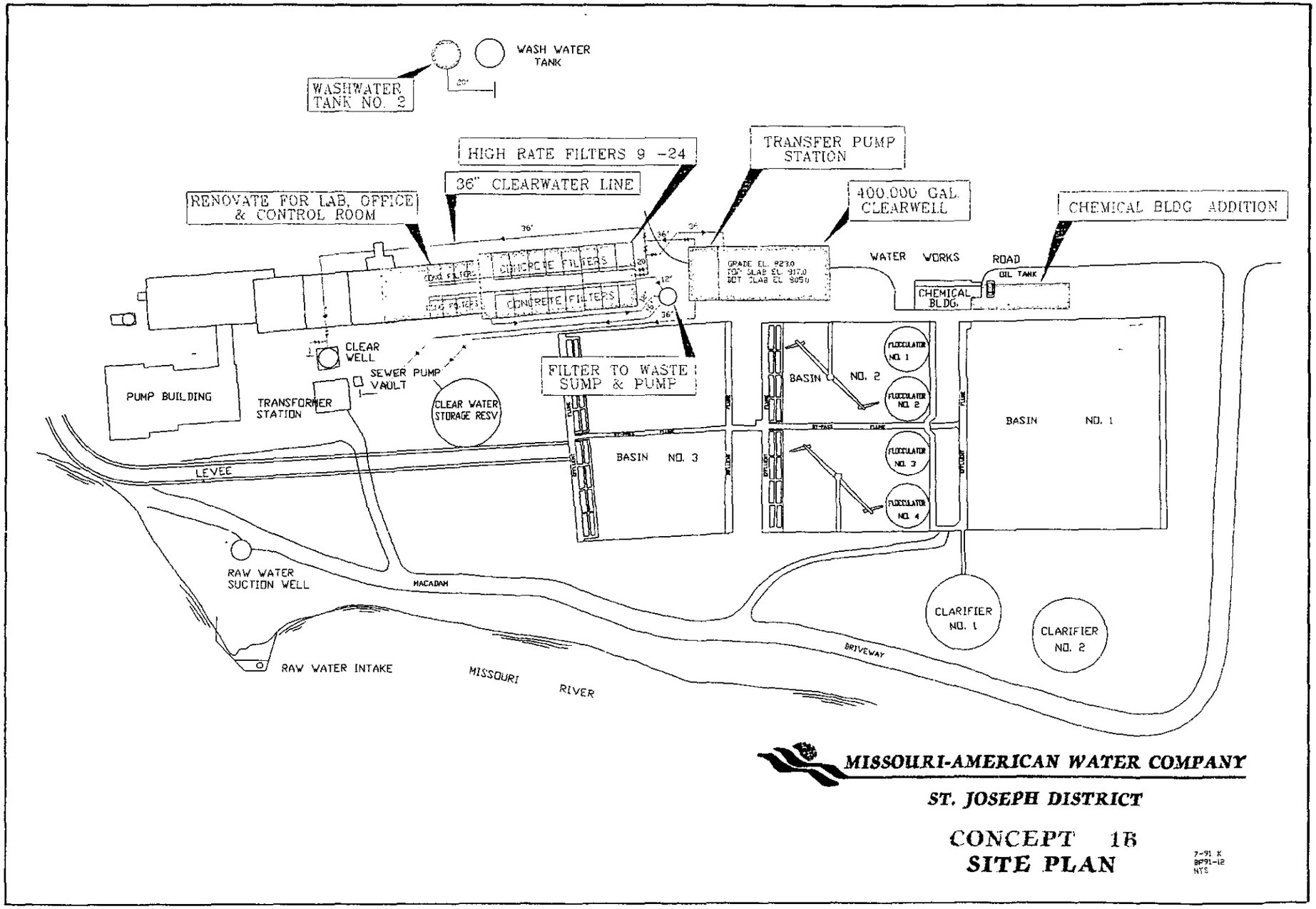
Phase II

Start May 1994 - Complete April 1996

High Rate Filters (8)	$ 2,090,000
Filter to Wash Sump	$ 242,000
Wash Water Tank	$ 175,000
Chemical Building Addition	$ 1,320,000
Laboratory/Office Facilities	$ 550,000
Engineering Supervision	$ 330,000
Sub-Total	**$ 4,707,000**
O & C	$ 471,000
	$ 5,178,000
Interest	$ 321,000
TOTAL PHASE II	**$ 5,499,000**
Say	$ 5,500,000

RE-CAP CONCEPT 1(b)

Phase I	$ 7,000,000
Phase II	$ 5,500,000
TOTAL	**$12,500,000**



MISSOURI-AMERICAN WATER COMPANY

ST. JOSEPH DISTRICT

CONCEPT 1B
SITE PLAN

7-91 K
BP91-12
NTS

CONCEPT II (a)

Construct Four New Filters and Renovate Filters 9-24

This proposal includes the construction of 4, 3 million gallon a day filters, a transfer pump station, clearwell, wash water storage tank, and chemical building additions. Filters 9-24 will be renovated to include the installation of air wash and filter to waste systems. The replacement of filter bottoms on Filters 9-18 is also included. Water proofing and dehumidifying the gallery, install electrically operated valves, new instrumentation and controls is also provided for under this concept. The gullet walls will be raised and replacement of wash troughs and filter media is included. Total capacity of the filters 9-24 will be 16 million gallons a day.

The area that was occupied by filters 1-8 will be renovated and remodeled to accommodate the laboratory, offices, control room and general support facilities.

Constructing the facilities as described for Concept II (a) will not relieve the over crowded pipe gallery situation described under Concept I (a) and I (b). The Company will not be relieved from the operating costs associated with cold weather operation and ice removal along the open flumes. The project will be completed in three phases. This proposal would also require the expenditure of funds to improve existing filters during the construction phasing process.

Phase I (Including Engineering Design)

Start July 1991 - Complete June 1993

Engineering Design	$ 770,000
Transfer Pump Station, Clearwell and Filters	$ 4,700,000
Settled Water Flumes and Piping	$ 210,000
Filter to Waste Pump and Piping	$ 390,000
Carry-over Improvements	$ 500,000
Engineering Supervision	$ 200,000
Sub Total	**$ 6,770,000**
O & C	$ 677,000
	$ 7,447,000
Interest	$ 462,000
TOTAL PHASE I	**$ 7,909,000**
Say	$ 7,900,000

Phase II

Start August 1993 - Complete July 1995

Up-Grade Filters 9-18	$ 2,530,000
Waste Water Storage Tank	$ 175,000
Chemical Building Additions	$ 1,320,000
Engineering Supervision	$ 220,000
Sub Total	**$ 4,245,000**
O & C	$ 425,000
	$ 4,670,000
Interest	$ 290,000
TOTAL PHASE II	**$ 4,960,000**
Say	$ 5,000,000

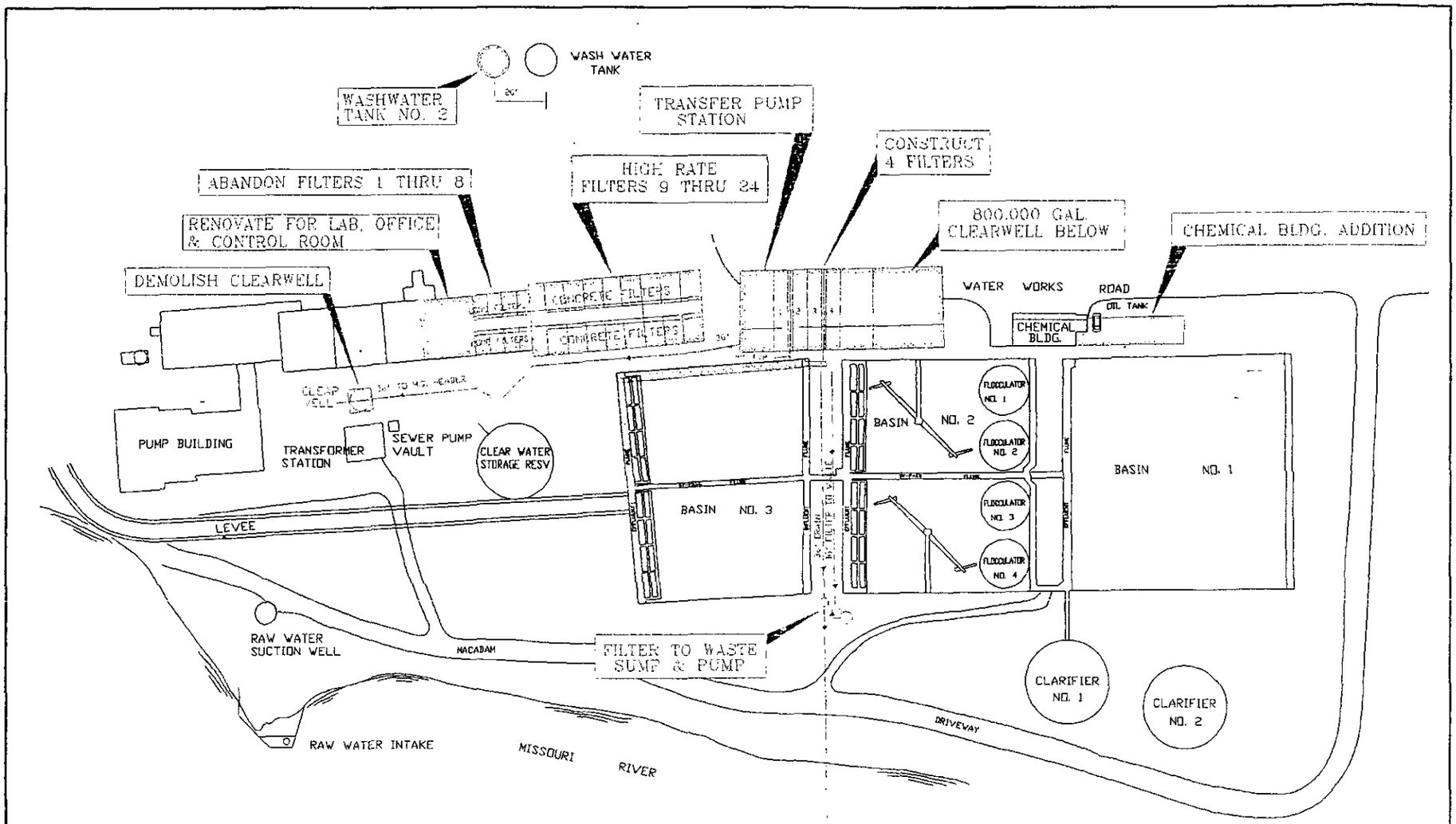
Phase III

Start September 1995 - Complete August 1997

Up-Grade Filters 19-24	$ 1,815,000
Construct Laboratory/Office Facilities	$ 695,000
Engineering Supervision	$ 242,000
Sub Total	**$ 2,752,000**
O & C	$ 266,000
	$ 3,018,000
Interest	$ 182,000
TOTAL PHASE ~~II~~ III	**$ 3,200,000**
Say	$ 3,200,000

RE-CAP CONCEPT II (a)

Phase I	$ 7,900,000
Phase II	$ 5,000,000
Phase III	$ 3,200,000
TOTAL	$16,100,000



MISSOURI-AMERICAN WATER COMPANY

ST. JOSEPH DISTRICT

CONCEPT 2A

SITE PLAN

7-91 K
8P91-12
NTS

CONCEPT II (b)

Construct Ten Filters

This proposal provides for the construction of ten 3 million gallon a day filters, clearwell and pumping stations in the area bounded by the existing filter building, railroad tracks, basin and chemical building. This site is very restrictive due to the surrounding structures and the railroad property. Because of the restriction, the only way to get the settled water to the filters is through large flumes constructed within basins 2 and 3. This situation raises the potential of damage to the flumes from icing. The control of ice damage in the basins of St. Joseph has been a problem for many years. Once complete, the demolition of the existing filters and structures will be extremely expensive and time consuming.

This project will be completed in two phases and would require the expenditure of funds to improve existing filters during the construction period.

Phase I (Including Engineering Design)

Start July 1991 - Complete June 1993

Engineering Design	$ 650,000
Construct 4 Filters, Transfer Pumping Station and Clearwell	$ 4,700,000
Settled Water Flumes and Piping	$ 210,000
Filter to Waste Sump Piping	$ 170,000
Carry-over Improvements	$ 500,000
Engineering Supervision	$ 300,000
Sub Total	**$ 6,530,000**
O & C	$ 653,000
	$ 7,183,000
Interest	$ 445,000
TOTAL PHASE I	**$ 7,628,000**
Say	$ 7,600,000

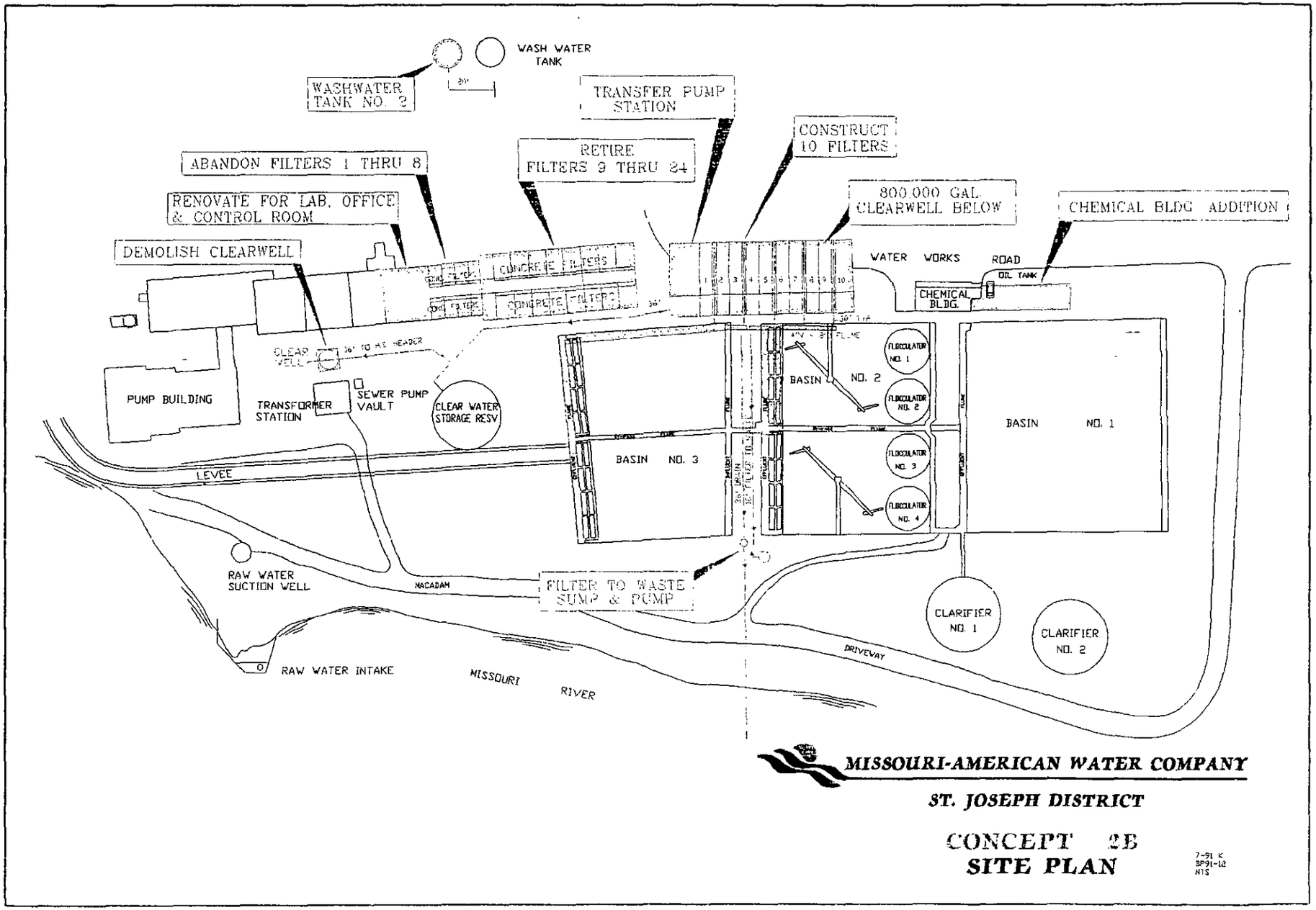
Phase II

Start September 1993 - Complete August 1995

Construct 6 Filters	$ 2,880,000
Chemical Building Additions	$ 1,320,000
Laboratory Support Facilities	$ 550,000
Engineering Supervision	$ 330,000
Sub Total	**$ 5,080,000**
O & C	$ 508,000
	$ 5,588,000
Interest	$ 346,000
TOTAL PHASE II	**$ 5,934,000**
Say	$ 5,900,000

RE-CAP CONCEPT II (b)

Phase I	$ 7,600,000
Phase II	$ 5,900,000
TOTAL	$13,500,000



MISSOURI-AMERICAN WATER COMPANY

ST. JOSEPH DISTRICT

CONCEPT 2B
SITE PLAN

7-91 K
BP91-12
NTS

CONCEPT III (a)

Construct Nine Filters and Improvements to Basin Number 1

Concept III (a) provides for the construction of 9, 3.5 million gallon a day filters, clearwell and pump stations in basin number 3. To replace the lost settling and flocculation and sludge removal facilities these units will be installed in Basin Number 1. This proposal provides ample room for further expansion of the plant, including additional clearwell capacity and added filters. The proposed treatment improvements in Basin Number 1 will be designed to improve reliability and better pretreatment performance.

This proposal would be completed in three phases and would also require the expenditure of funds for improvements to the existing filters during the construction period.

Phase I (Including Engineering Design)

Start July 1991 - Complete January 1993

Engineering Design	$ 760,000
Construct Flocculation - Basin No. 1	$ 730,000
Construct Sludge Removal Basin No. 1	$ 1,200,000
Carry-over Improvements	$ 500,000
Engineering Supervision	$ 200,000
Sub Total	**$ 3,390,000**
O & C	$ 339,000
	$ 3,729,000
Interest	$ 231,000
TOTAL PHASE I	**$ 3,960,000**
Say	$ 4,000,000

Phase II

Start March 1993 - Complete 1995

Construct 4 (3.5) MGD Filters, Transfer Pump Station and Clearwell	$ 5,390,000
Engineering Supervision	$ 230,000
Sub Total	**$ 5,620,000**
O & C	$ 562,000
	$ 6,182,000
Interest	$ 383,000
TOTAL PHASE II	**$ 6,565,000**
Say	$ 6,600,000

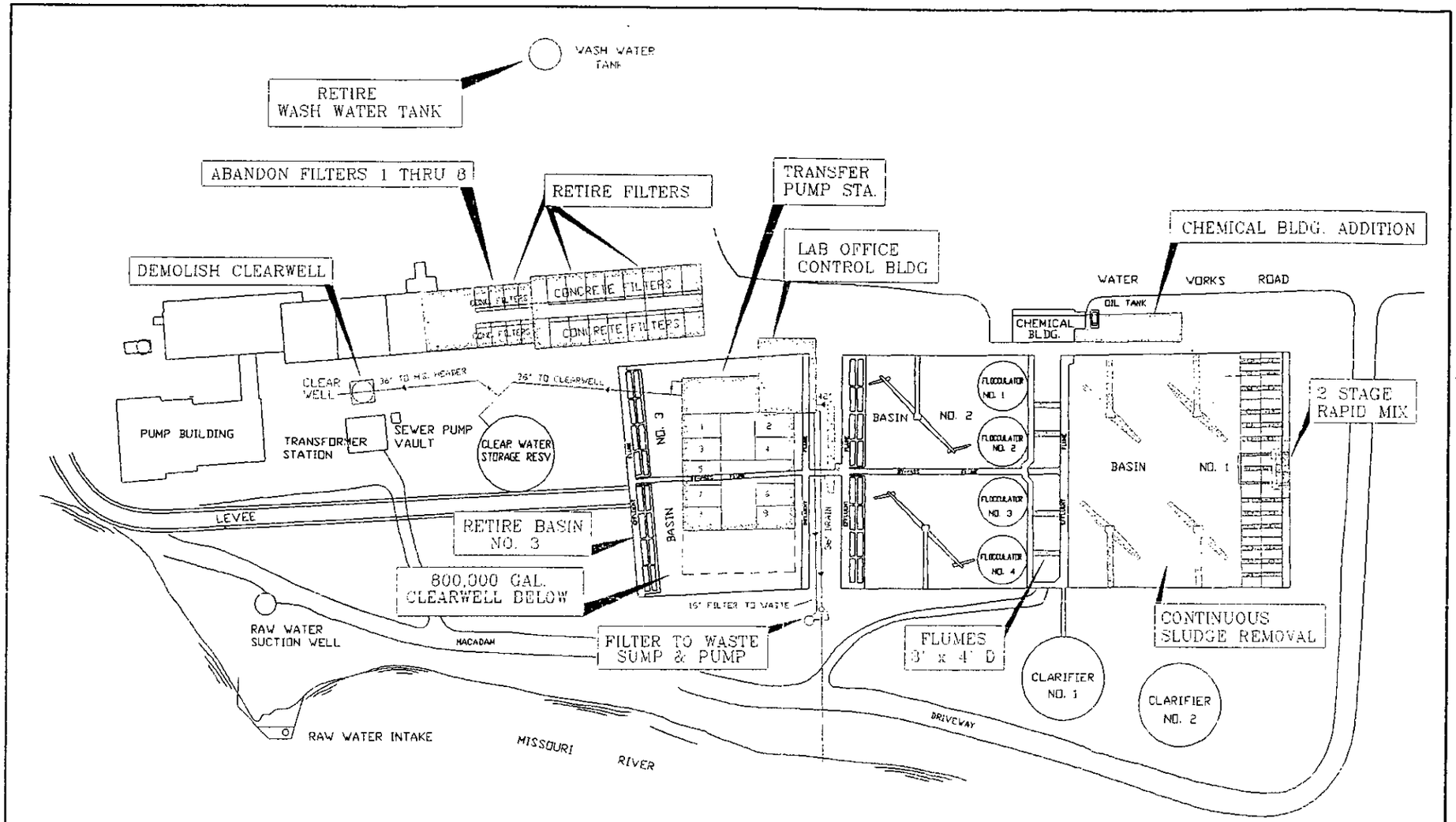
Phase III

Start May 1995 - Complete

Construct 5 (3.5) MGD Filters	$ 2,415,000
Chemical Building Additions	$ 1,380,000
Laboratory/Office Facilities	$ 805,000
Engineering Supervision	$ 265,000
Sub Total	**$ 4,865,000**
O & C	$ 487,000
	$ 5,352,000
Interest	$ 332,000
TOTAL PHASE III	**$ 5,684,000**
Say	$ 5,700,000

RE-CAP CONCEPT III(a)

Phase I	$ 4,000,000
Phase II	$ 6,600,000
Phase III	$ 5,700,000
TOTAL	$16,300,000



MISSOURI-AMERICAN WATER COMPANY

ST. JOSEPH DISTRICT

CONCEPT 3A
SITE PLAN

7-91 R
BP93-12
NTS

CONCEPT III (b)

Construct Nine Filters and Superpulsators

Concept III (b) is similar to the previous concept, except that construction of superpulsator clarifiers and integral chemical facilities is proposed in Basin No. 2. The superpulsator clarifiers would completely replace the 3 existing settling basins. Pretreatment capacity would be 30 million gallons per day. In addition to improving process control, all pretreatment facilities would be under roof, eliminating the maintenance and operating problems associated with the ice cover on the existing basins.

Filtration capacity of 30 million gallons per day would be constructed along with a baffled clearwell, transfer pumping station, and laboratory/support facility in two phases. After completion of filter construction, the existing 24 filters would be retired. Some immediate improvements must be made to the existing filters, such as media replacement and turbidimeter installation to perm, it the existing filters to remain in service until the new filters are completed.

This concept would be completed over a 6 year period and 4 phases to provide initial treatment capacity of 30 million gallons per day. The use of superpulsator clarifiers frees up a significant amount of space that will facilitate potential future construction such as waste handling facilities or plant expansion.

Phase I

Start August 1991 - Complete April 1992

Carry-over Improvements to existing filters (media replacement and turbidimeter, etc.	$ 450,000
Engineering Design	$ 10,000
Sub Total	**$ 460,000**
O & C	$ 23,000
	$ 483,000
Interest	$ 8,000
TOTAL PHASE I	**$ 491,000**
Say	$ 500,000

Phase II

Start July 1991 - Complete June 1994

Engineering Design	$ 750,000
Four Superpulsators, including building and chemical building	$ 8,300,000
Engineering Supervision	$ 500,000
Community Relations	$ 100,000
Sub Total	**$ 9,650,000**
O & C	$ 965,000
	$10,615,000
Interest	$ 658,000
TOTAL PHASE II	**$11,273,000**
Say	$11,300,000

Phase III

Start March 1994 - Complete July 1996

Engineering Design	$ 400,000
Construct 12 mgd filtration, clearwell, transfer pump station	$ 4,900,000
Laboratory, Support Facility	$ 700,000
Engineering Supervision	$ 400,000
Community Relations	$ 50,000
Sub Total	**$ 6,450,000**
O & C	$ 645,000
	$ 7,095,000
Interest	$ 440,000
TOTAL PHASE III	**$ 7,535,000**
Say	$ 7,600,000

Phase IV

Start March 1996 - Complete July 1998

Engineering Design	$ 200,000
Construct 18 mgd filtration	$ 2,100,000
Engineering Supervision	$ 400,000
Community Relations	$ 50,000
Sub Total	**$ 2,750,000**
O & C	$ 275,000
	$ 3,025,000
Interest	$ 185,000
TOTAL PHASE IV	**$ 3,210,000**
Say	$ 3,200,000

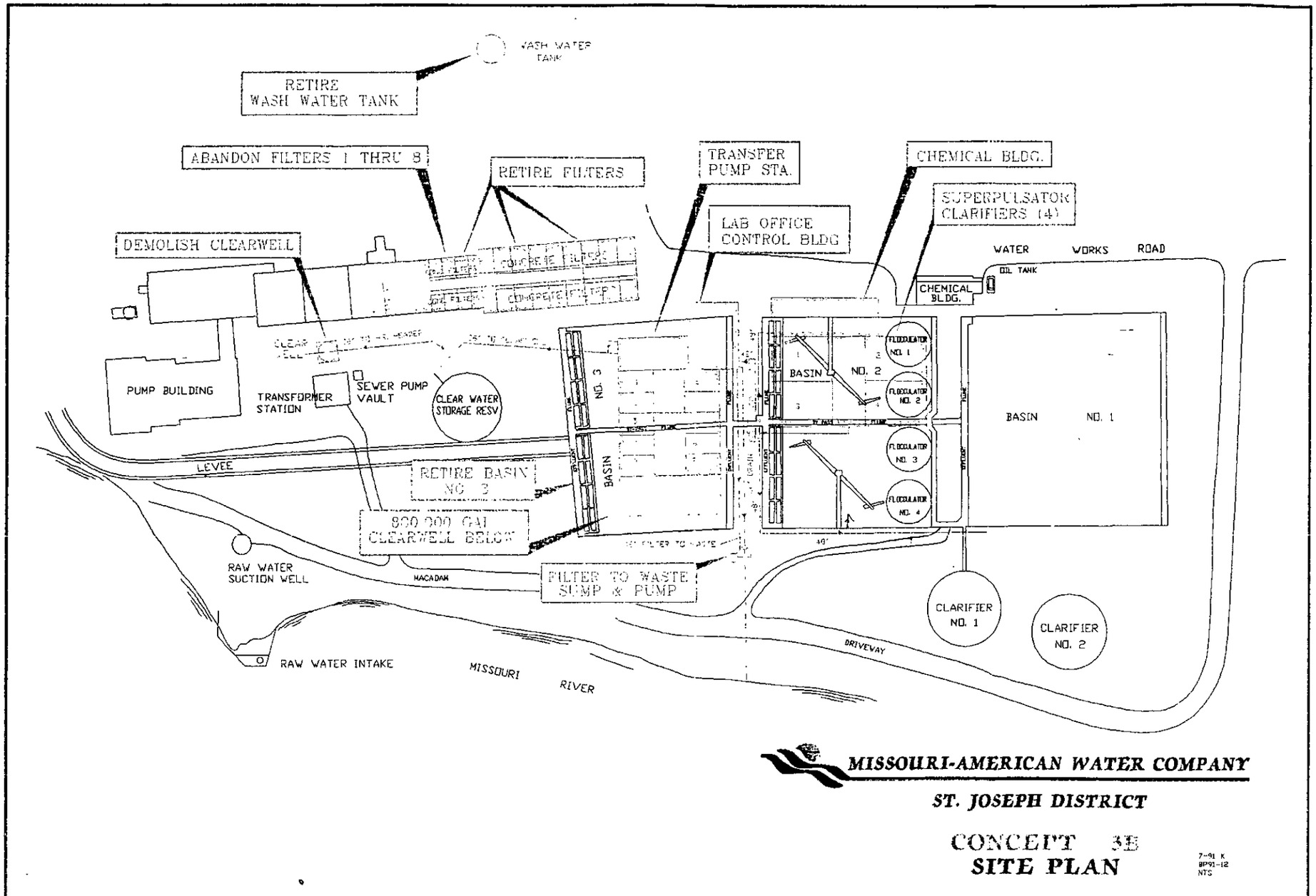
RE-CAP CONCEPT III (b)

	(1991 $)	(Future $)
Phase I	$ 500,000	$ 500,000
Phase II	$11,300,000	$12,500,000
Phase III	$ 7,600,000	$ 9,300,000
Phase IV	$ 3,200,000	$ 4,300,000
TOTAL	$22,600,000	$26,600,000

5% inflation factor

MISSOURI-AMERICAN WATER COMPANY
St. Joseph District - Plant Improvements
Revenue Requirement
Construction of Filters and Superpulsators

	Filters Phase II Nov 93	Phase III June 4, 1994	Phase IV Dec 195 Dec '97
Investment	$12,500,000	$ 9,300,000	$ 4,300,000
Rate of Return	9.74%	9.74%	9.74%
Utility Operating Income	$ 1,217,500	$ 905,820	$ 418,820
Property Taxe Expense @ 0.75%	$ 93,750	$ 69,750	$ 32,250
Depreciation Expense @ 2.28%	$ 285,000	$ 157,170	$ 141,040
Income Taxes (see below)	$ 335,707	$ 249,766	$ 115,483
Total Revenue Requirement	$ 1,931,957	$ 1,382,506	$ 707,593
	rate Percentage increase →		
Tax Calculation	27.71%	15.52%	7.36%
Utility Operating Income	$ 1,217,500	$ 905,820	$ 418,820
Less Interest:			
$12,500,000 x 5.01%	$ 626,250		
$ 9,300,000 x 5.01%		$ 465,930	
$ 4,300,000 x 5.01%			$ 215,430
Net Income	$ 591,250	$ 439,890	$ 203,390
Divided by 100% - 36.216%	63.784%	63.784%	63.784%
Conversion	$ 926,957	$ 689,656	$ 318,873
Less Net Income	$ (591,250)	$ (439,890)	$ (203,390)
Net Tax Increase	$ 335,707	$ 249,766	$ 115,483
Assumptions:			
Effective Federal Tax Rate	32.859%	32.859%	32.859%
Effective State Tax Rate	3.357%	3.357%	3.357%
Total Effective Tax Rate	36.216%	36.216%	36.216%
Property Tax Rate - Allowed last case	0.75%	0.75%	0.75%
Effective Depreciation Rates			
Acct. 332.5 (Phase II)	2.28%		
Acct. 332.3 (Phase III)		1.69%	
Acct. 332.4 (Phase IV)			3.28%
Rate of Return			
Ratio / Cost			
Long Term Debt 58.60% / 8.55%	5.01%	5.01%	5.01%
Preferred Equity 9.05% / 9.39%	0.85%	0.85%	0.85%
Common Equity 32.35% / 12.00%	3.88%	3.88%	3.88%
Rate of Return	9.74%	9.74%	9.74%


WASH WATER TANK
RETIRE WASH WATER TANK
ABANDON FILTERS 1 THRU 8
RETIRE FILTERS
TRANSFER PUMP STA.
CHEMICAL BLDG.
SUPERPULSATOR CLARIFIERS (4)
LAB OFFICE CONTROL BLDG
DEMOLISH CLEARWELL
WATER WORKS ROAD
OIL TANK
CHEMICAL BLDG.
PUMP BUILDING
TRANSFORMER STATION
SEWER PUMP VAULT
CLEAR WATER STORAGE RESV
CLEAR WELL
NO. 3
BASIN
NO. 2
FLOCCULATOR NO. 1
FLOCCULATOR NO. 2
FLOCCULATOR NO. 3
FLOCCULATOR NO. 4
BASIN NO. 1
LEVEE
RETIRE BASIN NO. 3
800,000 GAL CLEARWELL BELOW
RAW WATER SUCTION WELL
MACADAM
FILTER TO WASTE SUMP & PUMP
CLARIFIER NO. 1
CLARIFIER NO. 2
DRIVEWAY
RAW WATER INTAKE
MISSOURI RIVER
MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
CONCEPT 3B
SITE PLAN
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Recommendations

The proposals and concepts outlined here have all been reviewed by System Engineering, Regional Engineering, Regional Water Quality, St. Joseph District Management and the undersigned. It was the opinion of this group that all six concepts had merit and would accomplish the project goal. It was, however, the consensus of the group that:

1. Concepts I (a), I (b), and II (a) were not considered for further study due primarily to the construction problems associated with the required continued operation of the treatment plant and the fact that the reconstruction would not eliminate the operational problems associated with congestion in the pipe gallery and icing situation.

2. Concept II (b) was eliminated due to the restrictive situation relating to the railroad and the icing problem.

3. Concept III (a) would meet the requirements of the Company regarding water quality capacity, reliability and expansion. The problem areas would be the icing and the eventual need for the reconstruction of Basin 2.

4. Concept III (b) was considered the most logical program to adopt. It would provide the reliability needed, expand plant capacity and meet the new water quality regulations. Considering the estimated costs of proposal III (a), and the four phases of III (b), the additional cost would be more than offset by the elimination of the problems and operating costs associated with Concept III (a).

The undersigned therefore recommends the following:

1. That the Company endorse Concept III (b) for the plant expansion project of the St. Joseph District.

2. To present this proposal to the Board of Directors.

3. To present budget project memorandum for Phase I and design of Phase II to the Board of Directors at the October meeting.

Following the approval of the Board of Directors, the plan will be presented to the Missouri DNR and the Missouri Public Service Commission for their input and endorsement. After receiving the input and endorsement of these agencies, the company would then move forward with an aggressive public information program aimed at showing primarily the need for the plant, the development of the plan, and the eventual cost of water to the customer. This program would have to be active for the entire period of the project and would include media coverage, press conferences, service and community organization presentations, including development of video programs and plant visits. Professional assistance would be required in this area.

It is further proposed that a schedule be developed for presenting rate proposals on a timely basis to coincide with the completion of each phase of the project in an effort to minimize rate shock and also to recognize the Company's investments on a more timely basis.

In order to insure continued operation of the existing plant during the extended construction period and also to insure that the production from these existing facilities meets required quality standards, it will be necessary to complete certain interim or carry-over improvements. These improvements will be designed as Phase I of the project. This will include the replacement of filter media, reinforcing filter and pipe gallery structure and such other work that maybe necessary to insure the continued operation of the plant that will meet Federal and State standards during this period.

History on the installation dates of the existing filter media is incomplete. Filters 1 thru 8 were constructed in 1913 and the bottoms replaced in 1954. Plant records do not indicate what occurred regarding the media, if it was replaced or some additional media added. It is our feeling that some additional media was installed in 1954 to Filters 1 thru 8.

Phase I of this project is scheduled to begin during the last quarter of 1991 and be completed by April 1992. Projected expenditures for the first phase of the project will total $500,000. A total of $200,000 will be spent during 1991 and the balance during the first quarter of 1992.

Phase II of the project will include the construction of the 4 super-pulsators, the superpulsator structure, chemical building and related facilities. The superpulsator and chemical building structure will be located at the present site of Basin No. 2.

The design portion of Phase II, which will include, in addition to the engineering design and specifications of the facilities, the acquisition of required Missouri DNR approvals, the construction bidding process, awarding of contracts and securing necessary permits will be completed in 1992. The actual construction will begin in early 1993 and be completed and placed in service by June 1994.

One of the major factors considered in the proposal to phase this project was the overall cost, estimated to be in excess of $26 million. In order to lessen the overall impact of securing appropriate rates in a timely fashion the project was so designed that the various components could be constructed and placed in service independently of the other Phases.

The various components that go to make up Phase II will be completed and placed in service in June 1994. The company plans to file with the Missouri Public Service Commission a proposal to increase water rates.

It is projected that this phase of the plant improvement project, reflecting the investment of $12,500,000 and will require an increase in rates amounting to $1,648,620 or about 0.24% based on the current revenue level. This projected increase does not consider any increased plant operating costs relating to the new plant operation. Nor does the increase indicated reflect any other plant investments or other operating costs than need to be considered.

It is projected that the company would file a case with the Missouri Public Service Commission in November 1993 based on a September 1993 test year to be updated for in service facilities. The statutory order date on this petition would be October 1994. A schedule showing the calculation of revenue requirements is shown on page 19.

Beginning in March 1994, and prior to the completion of Phase II, Engineering design work, including the drafting of specification, bidding of the construction work, and awarding of contracts will be underway on Phase III.

It is projected that construction for Phase III will begin in January 1995 and be completed and in service in July 1996. Phase III will include the construction of an 800,000 gallon clearwell, 12 MGD filter capacity, transfer

pumping station, laboratory and office facilities, and related equipment. This phase of the project will require the expenditure of approximately $9,300,000.

Based on the investment of $9,300,000 in new treatment plant facilities will require increased revenues of $1,226,573. This would increase rates for the St. Joseph District by about 15%. This increase does not consider any increased plant operating expenses relating to the new plant or any other operating expense increases or any other plant improvements.

It is projected that the company would file for increased rates relating to this investment and any other cost adjustments in December, 1995, based on an October, 1995, test year. The statutory order date on this petition would be November, 1996.

Design of the final phase of this project will begin in March, 1996, with the start of construction scheduled for the early 1997. It is forecast that this phase of the project will be completed and in service by July, 1998. Phase IV of the project will include the construction of 18 MGD filter capacity, and require the estimated expenditure of $4,300,000.

Based on the expenditure, estimated at $4,300,000 in total filter capacity, the St. Joseph District will require a rate increase amounting to $567,125 or about 6%. As previously stated, this rate adjustment forecast does not reflect any increased plant operating cost this addition or any other factors that could cause increased operating expenses.

It is anticipated that the Company would file for increased rates relating to this investment in December, 1997, based on a test year ending October, 1997. The statutory order date on this petition would be November, 1998.

The total project will require the investment of $26.6 million over a 6 1/2 year period. The rated treatment plant capacity will be increased from 20.8 MGD to 30 MGD and the water quality will meet current and projected standards.

By phasing the project in the manner described, "rate shock" will be minimized without jeopardizing the concept of the project.

R. H. Moon
Regional Manager - Operating Services

RHM:djk

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Divisionof Parks, Recreation,
and Historic Preservation

P.O. Box 176
Jefferson City, MO 65102

MO-American Water Co.
St. Joseph, MO
Review No. 1897-91

February 11, 1991

Mr. H. W. Cole
American Water Works Service Company
St. Joseph Water Company
2707 Pembroke Lane
St. Joseph, MO 64506

Dear Mr. Cole:

An engineering report for a multi-phase water treatment plant improvements for the American Water Company in St. Joseph, Missouri, has been reviewed. The proposed phases of improvements are: Phase-1, replacing filter media of the existing filters, installing filter effluent turbidimeters, and using a streaming monitor to assist in coagulation control; Phase-2, replacing the existing secondary stage sedimentation basins with superpulsator solids contact clarifiers and improving pretreatment chemical applications; Phase-3, adding four filters with combined capacity of 12 MGD (million gallons per day), a clearwell, transfer pump station, and laboratory/support building and; Phase-4, adding six more filters with a combined capacity of 18 MGD to improve the reliability and performance of the treatment plant. The report was examined as to sanitary features which may affect the operation of the project, including size, capacities of units, and factors which may affect efficiency and ease of operation.

Our experience with solids contact units used as secondary stage treatment has not been favorable. Tentative approval of the engineering report is hereby given pending completion of the proposed pilot test using superpulsator solids contact units as second stage treatment to the existing primary clarifiers.

Should results of the pilot test are favorable, you may proceed to arrange for financing of the proposed improvements and have your engineer prepare detailed plans and specifications for our review and approval. An addendum to this engineering report evaluating the data gathered from the pilot test must be submitted with the detailed plans and specifications.

Schedule TLB-7

Regulations require written approval of detailed plans and specifications prior to initiating construction of the proposed improvements. Upon receipt of the detailed plans and specifications, we will proceed with our review and advise you by written report of our approval. An updated engineering report must be submitted before final plans and specifications will be reviewed if the original report is more than two years old.

Sincerely,

PUBLIC DRINKING WATER PROGRAM

Rolando A. Bernabe

Rolando A. Bernabe
Environmental Engineer

RAB:be

cc: Mr. Steven E. Creel
Kansas City Regional Office
Public Service Commission
Water Pollution Control Program

DETAIL OF ADDITIONS TO MAWC's 1991 ESTIMATE

1991 Estimate by MAWC	=	$22,600,000
Additions for cost increases from 1991 to 1998		
$22,600,000 x 21.48%	=	4,854,480
Add Ozone Facilities		
MAWC's estimate	=	4,000,000
Add new raw water intake & low service pumping		
MAWC's	=	4,600,000
Flood proofing around plant (see TLB-4)	=	128,111
Access Road Improvements		
Creek Culverts: 2 @ $50,000	=	100,000
Ramp Across Levee (allow)	=	25,000
Total Revised Estimate	=	$36,307,591

RATIONALE FOR CONSTRUCTION COST INCREAS FROM 1991 ESTIMATE TO 1998 DOLLARS

The attached articles from the Engineering News-Record gives the Construction Cost Index History from 1908 to 1999. Another attached article explains how this construction cost index is computed. This record of cost increases over the years is an industry standard and is widely recognized throughout the profession.

I computed the cost increase from 1991 to 1998 as follows:

February, !998 Index	=	5873.50	
Less 1991 Index	=	4835	
Increase	=	1038.5	
Percentage Increase	=	1038.5/4835 =	21.48% (3.07%/yr.)

To the estimates prepared in 1991, I added 21.48% to give equivalent dollars at February, 1998 which was the time the new facilities were started.

Source: **ENR: Engineering News-Record**
Date: 02/02/1998
Document ID: DG19980910050000322
Subject(s): Construction industry
Citation Information: Vol. 240, No. 5, Pg. 23, Section: CONSTRUCTION ECONOMICS: COST INDEXES

CONSTRUCTION COST INDEX

After holding steady the previous month, labor costs rose 0.5%, helping to drive the CCI 1.8% above a year ago.

20-CITY: 1913=100	FEB. 1998 INDEX VALUE	% CHG. MONTH	% CHG. YEAR
CONSTRUCTION COST	5873.50	+0.4	+1.8
COMMON LABOR	11889.21	+0.5	+2.7
WAGE $/HR.	22.59	+0.5	+2.7

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Project Bids and Legal Notices

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Top Contractors
Top Specialty Contractors
Top International Contractors
Top International Design Firms
Top Environmental Firms
Top Design Build Firms
Top CM Firms (fee)
Top CM Firms (at risk)

Construction Cost Index History (1908-1999)

HOW ENR BUILDS THE INDEX: 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVG
1977	2494	2505	2513	2514	2515	2541	2579	2611	2644	2675	2659	2660	2576
1978	2672	2681	2693	2698	2733	2753	2821	2829	2851	2851	2861	2869	2776
1979	2872	2877	2886	2886	2889	2984	3052	3071	3120	3122	3131	3140	3003
1980	3132	3134	3159	3143	3139	3198	3260	3304	3319	3327	3355	3376	3237
1981	3372	3373	3384	3450	3471	3496	3548	3616	3657	3660	3697	3695	3535
1982	3704	3728	3721	3731	3734	3815	3899	3899	3902	3901	3917	3950	3825
1983	3960	4001	4006	4001	4003	4073	4108	4132	4142	4127	4133	4110	4066
1984	4109	4113	4118	4132	4142	4161	4166	4169	4176	4161	4158	4144	4146
1985	4145	4153	4151	4150	4171	4201	4220	4230	4229	4228	4231	4228	4195
1986	4218	4230	4231	4242	4275	4303	4332	4334	4335	4344	4342	4351	4295
1987	4354	4352	4359	4363	4369	4387	4404	4443	4456	4459	4453	4478	4406
1988	4470	4473	4484	4489	4493	4525	4532	4542	4535	4555	4567	4568	4519
1989	4580	4573	4574	4577	4578	4599	4608	4618	4658	4658	4668	4685	4615
1990	4680	4685	4691	4693	4707	4732	4734	4752	4774	4771	4787	4777	4732
1991	4777	4773	4772	4766	4801	4818	4854	4892	4891	4892	4896	4889	4835
1992	4888	4884	4927	4946	4965	4973	4992	5032	5042	5052	5058	5059	4985
1993	5071	5070	5106	5167	5262	5260	5252	5230	5255	5264	5278	5310	5210
1994	5336	5371	5381	5405	5405	5408	5409	5424	5437	5437	5439	5439	5408
1995	5443	5444	5435	5432	5433	5432	5484	5506	5491	5511	5519	5524	5471
1996	5523	5532	5537	5550	5572	5597	5617	5652	5683	5719	5740	5744	5620
1997	5765	5769	5759	5799	5837	5860	5863	5854	5851	5848	5838	5858	5825
1998	5852	5874	5875	5883	5881	5895	5921	5929	5963	5986	5995	5991	5920
1999	6000	5992	5986	6008	6006	6039	6076						

Base: 1913=100. Indexes revised from September 1996 through January 1998

ANNUAL AVERAGE

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1908	97	**1931**	181	**1954**	628
1909	91	**1932**	157	**1955**	660
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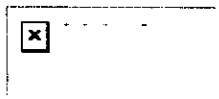
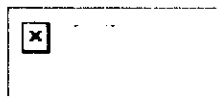
1911	93	**1934**	198	**1957**	724
1912	91	**1935**	196	**1958**	759
1913	100	**1936**	206	**1959**	797
1914	89	**1937**	235	**1960**	824
1915	93	**1938**	236	**1961**	847
1916	130	**1939**	236	**1962**	872
1917	181	**1940**	242	**1963**	901
1918	189	**1941**	258	**1964**	936
1919	198	**1942**	276	**1965**	971
1920	251	**1943**	290	**1966**	1019
1921	202	**1944**	299	**1967**	1074
1922	174	**1945**	308	**1968**	1155
1923	214	**1946**	346	**1969**	1269
1924	215	**1947**	413	**1970**	1381
1925	207	**1948**	461	**1971**	1581
1926	208	**1949**	477	**1972**	1753
1927	206	**1950**	510	**1973**	1895
1928	207	**1951**	543	**1974**	2020
1929	207	**1952**	569	**1975**	2212
1930	203	**1953**	600	**1976**	2401


Title: Using ENR's Indexes

Summary: *Readers of ENR direct a steady stream of questions* concerning its indexes and how to apply them. To help clarify the nature and uses of the **cost** indexes, here are answers to some *frequently asked questions.Q*: What is the difference between ENR's **Construction Cost Index** and its Building **Cost Index**?A: The difference is in their labor component.

Source: **ENR: *Engineering News-Record***
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Price: $1.50
Document Size: Short (1 or 2 pages)
Document ID: DS19980911340000355
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Author(s): Tim Grogan
Document Type: *Articles & General info*

Using ENR's Indexes

Readers of ENR direct a steady stream of questions concerning its indexes and how to apply them. To help clarify the nature and uses of the **cost** indexes, here are answers to some frequently asked questions. Q: What is the difference between ENR's **Construction Cost Index** and its Building **Cost Index**? A: The difference is in their labor component. The CCI uses 200 hours of common labor, multiplied by the 20-city average rate for wages and fringe benefits. The BCI uses 68.38 hours of skilled labor, multiplied by the 20-city wage fringe average for three trades--bricklayers, carpenters and structural ironworkers. For their materials component, both indexes use 25 cwt of standard

structural steel at the mill price, 1.128 tons of bulk portland cement priced locally and 1,088 board-ft of 2x4 lumber priced locally. The ENR indexes measure how much it **cost** to purchase this hypothetical package of goods and services compared to what is was in the base year. Q: What kinds of **construction** do the ENR indexes represent? A: They both apply to general **construction costs**. The CCI can be used where labor **costs** are a high proportion of total **costs**. The BCI is more applicable for structures. Q: Where does ENR get its data? A: ENR has price reporters covering 20 U.S. cities and two Canadian cities (Montreal and Toronto) who check prices locally. The prices are quoted from the same suppliers each month. ENR computes its latest indexes from these figures and local wage rates. Q: Are the material prices averaged? A: No. ENR reporters collect spot prices for all of the materials tracked, including those in the **index**. The reporters survey the same suppliers each month for materials that affect the **index**. Actual prices within a city may vary depending on the competitiveness of the market and local discounting practices. This method allows for a quick indicator of price movement, which is its primary objective. Q: Do the city indexes have different weightings? A: No. Each city uses the same weight for the labor and materials components as the U.S. average **index**. Q: Do the indexes measure **cost** differentials between cities? A: No. This is one of the more common errors in the application of ENR's indexes, which only measure the trend in an individual city and in the U.S. as a whole. Differentials between cities may reflect differences in labor productivity and building codes. Moreover, quoting bases for lumber and cement vary from one city to another. Q: Are indexes seasonally adjusted? A: No. This is an important point for users to keep in mind. Wages, the most important component, usually affect the **index** once or twice a year. Steel pricing, the second most influential component, comes into play similarly. Lumber prices, more dependent on local pricing and production conditions, are the most volatile and can change appreciably from month to month. Studying an **index** movement for a period of less than 12 months can sometimes miss these important developments. The users of the indexes for individual cities should keep a eye open for the timing and nature of wage settlements. For example, stalled labor negotiations may keep the old wage rate in effect longer than a 12 month period, giving the appearance of a low inflation rate. Q: Are the annual average weighted: A: No. They are straight mathematical averages. Q: Are the indexes verifiable? A: Yes. ENR's indexes are available to the entire industry. U.S. average wages and prices are published the first week of each month on the Market Trends page of the magazine. Indexes for individual cities appear in the second issue of each month. A calendar reference can be found on any Materials Price page listing the issues where readers can find various prices. Q: Does ENR have **cost** indexes for cities outside the U.S.? A: ENR publishes indexes for two Canadian cities each month. Quarterly **cost** reports often include parameter **costs** for various types of building in specific foreign cities. Q: Does ENR forecast its indexes? A: ENR publishes indexes for two Canadian cities each month. ENR's December quarterly **cost** report includes the most comprehensive listing of international **costs**. Q: Does ENR forecast its indexes? A: Yes. ENR projects its BCI and CCI for the next 12 months once a year in the December quarterly **cost** report. To reach its forecast, ENR incorporates the new wage rates called for in multiyear collective-bargaining agreements and estimates for areas where new contract terms will be negotiated. ENR estimates the materials component by studying consumption forecasts and historical trends. Q: Does ENR ever revise the indexes? A: Yes. On rare occasions ENR must revise the indexes. Any revision affecting the 20-city average indexes in the latest 14-month period can be found in the first issue of each month on the Markets Trends page of the magazine. All revisions for individual cities are published in the tables below that appear in each First Quarterly **Cost** Report. times miss these important developments. The users of the indexes for individual cities should keep an eye open for the timing and nature of wage settlements. For example, stalled labor negotiations may keep the old wage rate in effect longer than a 12 month period, giving the appearance of a low inflation rate. Q: Are annual average weighted? A: No. They are straight mathematical averages. Q: Are the indexes verifiable? A: Yes. ENR's indexes are available to the entire industry. U.S. average wages and prices

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American Water Works Service Company, Inc.
1025 Laurel Oak Road • P.O. Box 1770 • Voorhees, New Jersey 08043 • (609) 346-8201

October 16, 1992

BP 91-12

Mr. Rolando A. Bernabe
Department of Natural Resources
Public Drinking Water Program
Post Office Box 176
Jefferson City, Missouri 65102

Re: Missouri-American Water Company
Design of Plant Improvements
Pilot Study Results

Dear Mr. Bernabe:

A report of the Superpulsator pilot plant study at St. Joseph is enclosed for your review.

I am looking forward to our meeting scheduled for October 27. Please feel free to call me if you have any questions prior to the meeting.

Very truly yours,

Steven Creel

Steven E. Creel

SEC:smo
Enclosure

cc: B. Summerford - DNR
W. F. L'Ecuyer - MAWC/St.Joseph
H. W. Cole - MAWC/St. Joseph
J. J. Buhman - MAWC/St. Joseph
R. H. Moon - Mid-America Region
C. A. Blanck - Mid-America Region
J. W. Wilner - Mid-America Region

92MIDCOR

Schedule TLB-10

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT

SUPERPULSATOR PILOT STUDY RESULTS

Prepared by :
AMERICAN WATER WORKS SERVICE COMPANY
SYSTEM ENGINEERING
VOORHEES, NEW JERSEY

OCTOBER 1992

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
SUPERPULSATOR PILOT STUDY RESULTS

INTRODUCTION

The Missouri-American Water Company is planning improvements to their St. Joseph surface water treatment facilities. A proprietary high rate upflow solids contact clarifier, marketed as the Superpulsator, has been proposed as secondary clarifiers to replace existing sedimentation basins. Superpulsator clarifiers have been successfully used at numerous other locations in the American Water System. The Missouri Department of Natural Resources has conditionally approved a comprehensive preliminary design concept, but has required pilot testing of the Superpulsator clarifier. A pilot study was performed in fulfillment of this requirement. from May 27, 1992 through August 21, 1992 at the St. Joseph treatment plant.

TYPICAL WATER QUALITY

The St. Joseph plant withdraws all of it's supply from the Missouri River. The river water is typical of midwestern surface waters with relatively high pH, alkalinity, and hardness. The Missouri River is notable for periodic high concentrations of solids (turbidity).

The St. Joseph plant typically removes at least 90 percent of the river water turbidity in two presedimentation clarifiers, using cationic polymer as coagulant. Occasionally, high turbidities have passed through the presedimentation clarifiers and been removed in secondary clarification (three sedimentation basins). Superpulsator clarifiers have been proposed for secondary clarification, as replacement for the existing sedimentation basins.

The DNR expressed concerns about the Superpulsator clarifier's solids contact process being employed as a second stage clarifier. American Water Works Service Company desired to see the performance of the Superpulsator under elevated turbidity conditions. The testing period has allowed treatment to be evaluated under both conditions.

A typical annual average turbidity for the effluent of the presedimentation clarifiers is 14 NTU. The Superpulsator clarifier was tested over a range of turbidities from 13.9 to 119 NTU, with an average of 21.9 NTU. In addition, a two day test of extremely high turbidities (521 and 735 NTU) was performed.

PILOT PLANT FACILITIES

The pilot Superpulsator clarifier is of painted steel construction with a depth of 16 feet, with a surface area of 16 square feet. The unit has a rapid mix tank and

vacuum chamber external of the main body of the clarifier. Inside the clarifier are distribution laterals at the bottom of the unit, and collection laterals at the top of the clarifier. Within the clarifier are angled plates which serve to stabilize the solids blanket by preventing shortcircuiting.

A sludge hopper is attached to the side of the unit to collect the excess solids from the top of the solids blanket. Blowdown from the sludge hopper is accomplished through an automatic valve and timer. A vacuum blower operates continuously to provide the pulsing action of the Superpulsator. A raw water pump was provided with the pilot unit along with a digital flowmeter to continuously measure and totalize the flow.

Two pilot filters were set up in a trailer to filter a portion of the Superpulsator effluent. The filters were of PVC construction with an inside diameter of 6.375 inches. Filter No. 1 contained 32 inch depth of filter sand with an effective size of 0.55 mm. Filter No. 2 was of dual media construction with 24-inches of granular activated carbon (GAC) above a ten inch deep layer of filter sand. The GAC had an effective size of 0.8 to 1.0 mm. The sand in Filter No. 2 was identical to the sand in Filter No. 1. The configuration of the sand filter was identical to the existing plant filters, while the GAC dual media filter design has been proposed for the plant improvements. A constant flow device was used on each filter to maintain a constant flow throughout the filter run.

The source water for the Superpulsator clarifier came from the effluent of the plant's existing presedimentation clarifiers. The water had been treated with cationic polymer to remove the bulk of the river water solids within the presedimentation clarifiers.

Operation and data collection was performed by Mr. Albin Krupa of Technical Services Group. Technical direction was provided by American Water Works Service Company-System Engineering. The pilot plant was manned eight hours per day, five days per week. The Superpulsator clarifier and the filters ran continuously five days per week. Plant personnel performed some filter data collection through the evening hours.

A continuous turbidimeter was used to monitor Superpulsator effluent. A continuous turbidimeter was also used to monitor the effluent of the dual media filter. Influent turbidity, clarified turbidity, clarified pH, and filter effluent turbidity were monitored hourly with grab samples throughout the eight hour manned operating period. A streaming current monitor was used to monitor the mixed water from the Superpulsator clarifier rapid mix tank for coagulation control. An electronic controller was used for a portion of the study to automatically adjust the output of the alum feed pump.

SUMMARY OF RESULTS

Water quality and chemical feed data from daily log sheets have been summarized and are presented in Appendix A. The data are again summarized in Table 1, presented below. The Superpulsator performed well over a range of turbidity and chemical treatment schemes. Overall, the Superpulsator effluent averaged 1.6 NTU, while daily averages ranged from 0.8 to 2.9 NTU.

River turbidities ranged from 95 JTU to 3,402 JTU and averaged 675 JTU during the test period. The plant typically uses cationic polymer to maximize turbidity removal in the presedimentation clarifiers. Turbidity removal averaged 97 percent through the presedimentation clarifiers. Daily average turbidity entering the Superpulsator ranged from 14.7 to 119 NTU, and averaged 22 NTU.

In Trial No. 3, turbid river water (525 and 735 NTU) was pumped directly into the Superpulsator for two days to simulate a peak turbidity event. One hourly sample showed influent turbidity greater than 1000 NTU, and a 3500 JTU jackson candle turbidity value. This level of solids reflects a historical peak in turbidity passing through the presedimentation clarifiers.

Excellent results were obtained in each of seven distinct chemical treatment schemes. The objectives of maintaining average turbidities below 2 NTU and peak turbidities below 5 NTU were met.

The solids contact process appears to buffer influent turbidity spikes. The Superpulsator clarifier achieved good results when faced with an influent turbidity spike from 14.8 NTU on June 18 to turbidities of 61 to 154 NTU on the following day. Superpulsator effluent turbidities remained below 4 NTU throughout the episode, with an average of 2.9 NTU. Superpulsator effluent also remained below 4 NTU during the river water testing.

A high molecular weight polymer is required to stabilize the solids blanket in the Superpulsator. In each trial, Betz 1100, an anionic polymer was used.

Primary Coagulant

Alum and ferric chloride were both effective primary coagulants. Performance of these two coagulants, in the absence of chlorine, was equivalent with average clarified turbidities of 1.6 NTU and 1.5 NTU respectively with the same range of coagulant dose. Low doses of ferric chloride produced good results over seven days of testing with an average effluent turbidity of 1.8 NTU at an average dose of 8 mg/L.

A proprietary aluminum based coagulant, containing a blend of alum and

polymer produced excellent results in terms of a low clarified turbidity (1.3 NTU) and solids blanket characteristics in a 24 hour testing period.

Effect of Hydraulic Rate

Most of the testing was conducted at a surface overflow rate of 4 gpm/sf. The rate was reduced to as low as 3.1 gpm/sf during Trial No. 5 to better control floc carryover. Otherwise the Superpulsator was operated at 4 gpm/sf.

TABLE 1
SUPERPULSATOR AND FILTER RESULTS

Trial No.	Chemical	Dose mg/L	Days of Oper.	Rise Rate gpm/sf	Superpulsator Effluent Turbidity NTU		Dual Media Filter Effluent Turbidity NTU	
					Range	Average	Range	Average
1	Aluminum Sulfate Betz 1100	6-35 0.10- 0.33	24	3.6-4.0	0.8 to 2.2	1.6	0.26 - 0.32	0.29 (1)
2	Aluminum Sulfate Betz 1100 Powdered Act. Carbon	11 - 30 0.13 - 0.28 5 - 33	6	4.0 - 4.1	0.9 to 1.3	1.2	(2)	(2)
3	Aluminum Sulfate Betz 1100	115-137	2	3.8 - 4.0	1.6 to 2.5	1.9	0.26 - 0.31	0.29
4	Ferric Chloride Betz 1100	6 to 28	3	3.1 - 3.7	1.2 to 2.4	1.7	0.19 - 0.24	0.21
5	Ferric Chloride Betz 1100 Lime	6.5 to 41 0.12 - 0.22 4 - 35	10	3.1 - 4.0	1.0 to 2.1	1.5	0.14 - 0.32	0.22
6	Ferric Chloride Betz 1100 Lime Chlorine (calcium hypochlorite)	6 to 23 0.1 to 0.13 4 to 18 4 to 6	11	4.0 - 4.1	1.5 to 2.5	1.8	0.11 - 0.28	0.16
7	Clar-Ion A-410-P Chlorine (calcium hypochlorite)	6	1	4.0		1.6		0.16

NOTES:

1. Filters were online for three days during Trial 1.
2. Filters were not online for Trial 2.
3. Trial 3 was with river water as influent to the Superpulsator.

Start-up

At initial startup, the Superpulsator was operating at 3 gpm/sf with an effluent turbidity of less than 2 NTU within 12 hours of startup. Clarified turbidity did not exceed 3 NTU during the initial startup. The Superpulsator, and the solids blanket, was easily restarted after being shutdown over weekends. The unit was started at a reduced rate for approximately 15 to 30 minutes before going to full rate.

The only time difficulty was experienced in startup was following the July 9 and 10 high turbidity trials after the unit was shut down over the weekend. A restart with ferric chloride was aborted due to the destabilization of the alum blanket with floc carryover.

FILTER RESULTS

The two pilot filters were brought on-line July 6, 1992 providing 32 days of filtration data. The sand filter was operated at 2 gpm/sf while the dual media filter was run at 4 gpm/sf.

The sand filter and dual media GAC filter produced nearly identical turbidity results with the average effluent turbidities for the entire program averaging 0.20 NTU and 0.21 NTU respectively. It has been concluded that filter rates within the range tested do not have a significant impact on turbidity removal.

Filter effluent turbidities improved when chlorine was introduced. For example, with the dual media filter, effluent turbidities averaged 0.16 NTU with chlorination, compared to 0.23 NTU without chlorine. The improvement was slightly more pronounced with prechlorination than for intermediate chlorination (Superpulsator effluent). A brief test with potassium permanganate showed similar results. Typical practice will be to apply chlorine as prechlorination (inlet to Superpulsators) or intermediate chlorination.

Filter headloss was reduced when chlorine was applied. The average rate of increase in filter headloss in the dual media filter was 1.1 inch/hour when chlorine was applied. Assuming 72-inches of available headloss, 65 hour runs are expected at 4 gpm/sf. Note that the dual media filter was operating at 4 gpm/sf. Filter headloss data for the dual media filter is presented in Appendix A for each day of filter operation. Turbidity breakthrough was not experienced in any of the filter runs.

Overall, the average rate of headloss over the pilot program was 1.9 inches/hour (38 hour run). The highest rate of filter headloss increase was 4.7 inches/hour (15 hour run) during the first day of high turbidity testing. This shortened run was caused by an excessive dose of blanket control polymer (0.66 mg/L). Note

that a lower dose of polymer on the second day of high turbidity testing produced a 1.7 inches/hour rate (42 hour run).

The organic chemical capability of the GAC dual media filter was demonstrated through removal of Atrazine from the raw water. Samples taken August 11, 1992 showed the following atrazine concentrations:

Superpulsator Effluent	0.000416 mg/L
Sand Filter Effluent	0.000423 mg/L
GAC Filter Effluent	<0.00007 mg/L

As expected the GAC dual media filter removed the atrazine, while little or no removal was seen through the sand filter.

CONCLUSIONS

1. The Superpulsator was able to produce clarified turbidities from 0.8 to 2.9 NTU under a wide range of influent (presettled) turbidity conditions (14 - 119 NTU).

2. Excellent turbidity removal was achieved though the Superpulsator operating at hydraulic rates of 3.1 to 4.2 gpm/sf.

3. Filtration studies using existing and proposed media configurations demonstrated that effluent turbidities of 0.20 NTU were consistently achievable when processing Superpulsator effluent.

4. The dual media filter operating at 4 gpm/sf produced the same turbidity removal as the sand filter operating at 2 gpm/sf.

5. Filter runs of 65 hours or more are consistently achievable with the dual media filter operating at 4 gpm/sf when processing Superpulsator effluent.

6. An effective solids blanket was formed in the Superpulsator at startup in less than 12 hours with influent turbidities averaging 15 NTU.

7. Ferric chloride, alum, and a proprietary coagulant each were effective primary coagulants in the Superpulsator.

8. The capability of GAC in a filter adsorber to remove atrazine was demonstrated.

MISSOURI – AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
SUPERPULSATOR PILOT STUDY
APPENDIX A – DAILY RESULTS SUMMARY

DATE	River Turbidity /TU	Cationic Polymer mg/L	Superpuls. Rate gpm/sf	Alum mg/L	Ferric Chloride mg/L	Blanket Polymer mg/L	Lime mg/L	Chlorine mg/L	Powdered Carbon mg/L	Freeod. Eff Turbidity NTU	Superpuls. Eff. Turb NTU	Superpuls. Eff pH	Sand Filt Eff Turb NTU	Dual Media Filter Eff Turb NTU	Dual Media Filter Headloss in/hr	COMMENTS
27-May-92	218	0.8	1.8	21		0.11				14.5	2.1	7.4				STARTED UP SUPERPULSATOR
28-May-92	185	0.7	3.0	27		0.13				15.4	1.8	7.8				
29-May-92	158	0.7	3.0	24		0.14				15.3	1.8	7.7				SHUT DOWN FOR WEEKEND
01-Jun-92	128	0.7														RAN JAR TESTS
02-Jun-92	110	0.8	3.7	18		0.10				15.8	1.2	7.7				RESTART SUPERPULSATOR AT 3 GPM/SF
03-Jun-92	115	0.8	4.0	24		0.10				15.8	1.5	7.8				INCREASED PULSE
04-Jun-92	120	0.8	4.0	28		0.13				16.5	1.5	7.8				SIMULATE ALUM FAILURE
05-Jun-92	85	0.4	4.0	28		0.15				16.8	1.2	7.8				SHUT DOWN FOR WEEKEND
08-Jun-92	252	0.8	4.0	28		0.15				15.8	1.8	7.8				START UP SUPERPULSATOR
09-Jun-92	152	0.7	4.0	27		0.15				15.3	1.2	7.7				MANUAL BLOWDOWN
10-Jun-92	200	0.7	3.8	24		0.15				13.9	1.7	7.8				
11-Jun-92	375	0.8	3.8	18		0.14				16.9	1.4	7.7				PREPARATION FOR RIVER PUMP
12-Jun-92	243	0.7	4.2	18		0.14				18.0	1.1	7.8				CLEANED SCD
13-Jun-92	178	0.4	4.1	16		0.16				14.8	1.0	7.8				STARTUP SUPERPULSATOR
16-Jun-92	177	0.8	4.0	11		0.13				15.3	1.1	7.8				
17-Jun-92	1,095	1.0	4.0	24		0.12				30.8	2.2	7.4				REMOVED FISH FROM PUMP
18-Jun-92	543	1.7	4.0	10		0.14				14.8	0.8	7.8				REMOVED FISH FROM PUMP
19-Jun-92	3,402	1.8	4.0	35		0.16				119.0	2.8	7.2				
21-Jun-92	2050	2.2	4.0	27		0.29				31.0	1.7					REDUCED PULSE, SHUTDOWN
22-Jun-92	1,261	1.7	3.8	24		0.23				17.1	1.3	7.4				FULL FLOW
23-Jun-92	412	1.1	4.0	17		0.21				16.8	1.2	7.8				START PAC FEED
24-Jun-92																PUMP BROKEN, UNIT OFF
25-Jun-92	193	0.8	4.0	14		0.15			5	15.7	0.8	7.8				REPAIR PUMP, BACK ONLINE
26-Jun-92	142	0.8	4.0	17		0.18			5	16.8	1.2	7.8				CLEANED SCD, SHUTDOWN
29-Jun-92	122	0.4	4.1	17		0.15			22	17.1	1.0	7.8				STARTUP, POLYMER FACED TO ALUM
30-Jun-92	128	0.8	4.0	20		0.16			18	16.8	1.3	7.7				
01-Jul-92	122	0.8	4.0	17		0.13			13	16.1	1.2	7.8				
02-Jul-92	117	0.8	4.0	20		0.29			33	14.3	1.3	7.7				PULSE: 17" @ 40 SCD
03-Jul-92	118	0.4	4.0	35		0.33				15.8	0.8	7.5	0.81	0.22	2	CARBON OVERFEED, REPAIR PIPE
06-Jul-92	203	0.6	4.1	31		0.13				19.3	0.8	7.5	0.25	0.29	1.7	CARBON OVERFEED, FILTERS ONLINE
07-Jul-92	337	0.7	4.0	33		0.28				17.5	0.8	7.4	0.28	0.26	2.5	VARY ALUM DOSE
08-Jul-92	302	0.7	3.8	33		0.29				28.4	0.8	7.5	nil	nil		VARY POLYMER FEED LOCATION
09-Jul-92	558	0.7	4.0	137		0.66				(1) 92.1	1.8	7	0.34	0.31	4.7	START DIRECT RIVER FEED
10-Jul-92	1,350	1.4	3.8	115		0.46				(1) 735	2.8	6.7	0.24	0.26	1.7	DIRECT RIVER FEED, INSTALLED STATIC MIXER
13-Jul-92													nil	nil		CLOGGED RAW WATER PUMP
14-Jul-92	2,467	2.1	4.0										nil	nil		RESTART w FERRIC–OLD BLANKET UNSTABLE
15-Jul-92	1,850	2.3	2.4		36	0.36					1.4		nil	nil		REBUILD BLANKET w FERRIC CHLORIDE
16-Jul-92	1,260	1.8	3.1		36	0.10				20.0	1.2	6.8	0.23	0.24	3	
17-Jul-92	992	1.8	3.1		28	0.10				16.3	1.5	7.4	0.19	0.19	2.9	
20-Jul-92	332	0.9	3.7		6	0.07				14.8	2.4	7.5	0.16	0.21	3.4	CLOGGED FERRIC INJECTOR
21-Jul-92	297	1.1	3.5		25	0.14	17			17.5	2.1	7.8	0.17	0.26	1.7	
22-Jul-92	270	0.9	3.2		28	0.14	12			15.7	1.3	7.8	0.20	0.19	1.9	
23-Jul-92	440	1.0	3.1		28	0.16	23			15.5	1.3	7.5	0.28	0.24	3.3	LIME FEED FAILURE
24-Jul-92	328	0.7	3.2		6.5	0.13	8			15.8	1.0	8.1	0.29	0.22	2.6	
25-Jul-92	1,400	1.9	3.1		6.5	0.12	4			21.9	1.4	7.4	0.28	0.26	2	
27-Jul-92	1,803	2.4	3.3		41	0.14	35			51.8	1.9	7.8	0.20	0.17	1.2	SLUDGE CONCENTRATOR FULL
28-Jul-92	800	1.3	3.2		41	0.12	32			19.5	1.0	7.9	0.17	0.14	2.1	
29-Jul-92	1,167	1.7	3.6		36	0.14	17			28.0	1.3	8.1	0.22	0.22		INCREASE FLOW TO 4 GPM/SF
30-Jul-92	2,200	2.1	4.0		18	0.22	25			69.0	1.4	8.1	0.18	0.20	4.6	8PM POWER FAILURE – RESET SCD, 8P OFF
31-Jul-92													nil	nil		LIME OVERFEED, RESTART 8P
03-Aug-92	540	0.8	4.0		28	0.17	20			21.0	2.1	8.1	0.21	0.22	2.1	MONDAY RESTART OF 8P
04-Aug-92	360	0.7	4.0		23	0.12	18	5		23.2	2.2	8.2	0.30	0.21	0.9	START CHLORINE FEED
05-Aug-92	282	0.7	4.0		23	0.12	17	5		15.3	1.8	8.2	0.11	0.11	1	
06-Aug-92	270	0.8	4.0		22	0.13	10	4		15.4	1.8	8.2	0.11	0.11	2.9	0.8% SOLIDS IN BLOWDOWN
07-Aug-92	210	0.7	4.0		14	0.10	12	5		14.7	1.7	8.2	0.12	0.12	0.9	POLYMER PUMP FAILED– 8P EFF=2
10-Aug-92	327	0.5	4.1		10	0.13	10	5		19.7	1.8	7.9	0.13	0.15	1.2	MONDAY RESTART, VARY CHLORINE LOC.
11-Aug-92	305	0.4	4.0		10	0.13	9	5		17.9	1.8	8.1	0.11	0.12	0.8	DNR VISIT
12-Aug-92	472	0.8	4.1		11	0.13	5.8	6		20.4	2.1	8.1	0.14	0.13	1	MOVE CL2 TO 8P EFF
13-Aug-92	360	0.4	4.0		6	0.13	5.1	4		23.0	1.5	8.1	0.17	0.17	0.8	BRIEF KMNO4 TRIAL – REDUCED FILTER EFF
14-Aug-92	392	0.4	4.0		8	0.13	8	4		23.3	2.0	8	0.14	0.15	0.8	RESUME PRECHLORINATION
17-Aug-92	212	0.5	4.1		9.3	0.12	5	4		16.4	2.5	7.9	0.18	0.20	1.3	LIME FEED FAILED, REPAIRED
18-Aug-92	170	0.3	4.1		8	0.13	4	5		16.9	1.8	8	0.14	0.15	0.8	
19-Aug-92	150	0.4	4.0	12		0.12	4	3		23.5	1.8	8	0.20	0.28	1.3	USE ALUM
20-Aug-92	177	0.4	4.0	12		0.13	0	7		19.2	1.9	7.9	0.19	0.21	0.9	NO ALUM FEED PREVIOUS NIGHT
21-Aug-92	167	0.3	4.0	(2) 6		0.13	0	7		18.0	1.3	8.1	0.14	0.16	0.5	CLARION A 410 P = PRIMARY COAGULANT
				(2) Clar – ion A–410 P – alum/polymer blend						(1) River water supplied directly to Superpulsator						
AVERAGE	675	1.0	3.9							21.9	1.8	7.79	0.20	0.21	1.8	
MAXIMUM	3,402	2.4	4.2	137	41	0.66	35	7	33	119	2.8	8.2	0.34	0.32	4.7	
MINIMUM	85	0.3	1.8	0	6	0.07	0	3	5	13.9	0.8	6.7	0.11	0.11	0.5	

American Water Works Service Company, Inc.
1025 Laurel Oak Road • P.O. Box 1770 • Voorhees, New Jersey 08043 • (609) 346-8201

November 16, 1992

BP 91-12

Mr. Jerry L. Lane, P. E.
Missouri Department of Natural Resources
205 Jefferson Street
Jefferson City, Missouri 65102

Re: Missouri-American Water Company
St. Joseph District
Treatment Plant Improvements
Approval of Superpulsator Pilot Results

Dear Mr. Lane:

Thank you for taking time October 27 to discuss the Superpulsator pilot results and the other planned improvements at St. Joseph. Some additional information was requested in the meeting and this material is enclosed. Also, I am taking the opportunity to make some minor revisions in the report of pilot results, and to address the issues raised at the meeting.

Three additional copies of the original Preliminary Design Concept and Engineering Report are enclosed. Additional information is presented to reinforce the reasons for the process selection.

SUMMARY

The proposed process improvements at St. Joseph were presented in the Preliminary Design Concept and Engineer's Report dated December 10, 1991. Tentative approval was given to the project by the Department of Natural Resources (DNR) in a letter dated February 10, 1992. The approval was conditional upon favorable Superpulsator pilot test results.

The Superpulsator pilot testing program was conducted in June, July, and August of 1992, with results being summarized in the report presented at our October meeting. The results of the pilot testing program were excellent.

A Superpulsator hydraulic loading rate of 3 gpm/sf is sought as stated in the December, 1991 submittal. This loading rate includes a significant safety factor since successful pilot testing was done at 4 gpm/sf. Full scale results from two American System plants have been presented to verify the excellent treatment results consistently achievable with the Superpulsator clarifier.

Approval of a 4 gpm/sf filtration rate with a dual media filter is requested. The pilot results showed no discernable difference in filter effluent turbidity between the sand filter operating at 2 gpm/sf and the dual media filter operated at 4 gpm/sf. This result is consistent with the principle that filter effluent quality is much more dependent upon effective coagulation than filtration rate. Data from another pilot testing program that evaluated Superpulsator and high rate filtration demonstrates the minor effect of filtration rate on particle removal at rates up to 10 gpm/sf.

The proposed process incorporates the requirement of two stage treatment using the existing first stage clarifiers. The proposed process is comprehensive, yet flexible to comply with the requirements of the Surface Water Treatment Rule, remove synthetic organic chemicals, and be in a position to comply with future water quality regulations. Lastly, the proposed process is highly effective, but demonstrates fiscal responsibility in selection of rates and sizing.

SUPERPULSATOR PILOT TEST REPORT REVISIONS

A revised report of Superpulsator results is enclosed. The following revisions were made:

1. Depth of granular activated carbon in the dual media filter was 32 inches, rather than 24 inches.

2. Average influent turbidity during the high turbidity testing using river water on July 9 was 935 NTU, rather than 735 NTU due to an averaging error. Average surface loading rate was 3 gpm/sf for the river water testing due to raw water pump limitations, not treatment limitations. The 3500 JTU turbidity value mentioned in the original report was for a river water sample the following day and not related to the high turbidity testing program.

   A table of the historical maximum turbidity values over the last 19 years for river water, and in the effluent of the primary clarifiers is enclosed as Appendix A. The highest daily average turbidity from the clarifiers was 1084 JTU on June 17, 1982, with the remainder of the annual maximum turbidity data below 700 JTU. Note that historical turbidity records use JTU, and NTU were used in the pilot plant data. While the turbidity units cannot be compared in a strict analytical sense, the influent turbidities in the testing

were similar to the maximum turbidities seen passing through the primary clarifiers.

SUPERPULSATOR OPERATING DATA

Operating reports for the American Water Works Superpulsator installations at Pittsburgh, Pennsylvania and Davenport, Iowa were presented in the meeting. Pertinent facility information is listed in Table 1.

Table 1
PENNSYLVANIA-AMERICAN WATER COMPANY
PITTSBURGH DIVISION
HAYS MINE PLANT

Source	Monongahela River
Plant Capacity	60 MGD
Treatment Process	Presedimentation, Superpulsator Clarifiers, Dual media Filters (GAC/sand)
Superpulsator Rate	State Permit: 3 gpm/sf

12 Month Performance

	AVERAGE ntu	RANGE ntu
River Turbidity	13	1.3 - 210
Superpulsator Effluent	0.8	0.3 - 3.3

IOWA-AMERICAN WATER COMPANY
QUAD CITIES DISTRICT
DAVENPORT (EAST RIVER) PLANT

Source	Mississippi River
Plant Capacity	30 MGD (15 MGD Superpulsators, 15 MGD Sedimentation Basins)
Treatment Process	Superpulsator Clarifiers in parallel with Conventional Basins, Dual media Filters (GAC/sand)
Superpulsator Rate	State Permit: 3 gpm/sf

12 Month Performance

	AVERAGE ntu	RANGE ntu
River Turbidity	19	4 - 77
Superpulsator No. 1 Effluent	1.9	0.6 - 5.4
Superpulsator No. 2 Effluent	2.2	0.6 - 9.5
Conventional Basins	2.4	0.9 - 5.1

Copies of the monthly reports for these plants were handed out at the meeting, and also are attached.

The results from the Hays Mine plant are excellent in every area. The Superpulsators have produced consistently high quality water despite varying raw water quality conditions in the Monongahela River. Filtered effluent turbidities of 0.05 to 0.27 NTU are being achieved with long filter runs.

At the Davenport plant, the Superpulsators are run in parallel with two conventional sedimentation basins. The Superpulsator performance is somewhat better than the basins even though the Superpulsator clarifiers are operated at 80 percent of design capacity year round, while the basins are operated at approximately 40 percent capacity.

The only anomaly in the Davenport Superpulsator results occurred in January 1992, when Superpulsator No. 2 turbidities peaked at 9.5 NTU. The high turbidities were caused by floc carryover, resulting from a malfunctioning polymer feed system. Note that despite the floc carryover, the filtered effluent turbidities remained less than or equal to 0.10 NTU. This episode demonstrates that even with floc carryover, effective coagulation was performed in the clarifier and treatment was not jeopardized.

SUPERPULSATOR SURFACE LOADING RATE

Approval of a Superpulsator clarifier surface loading rate of 3 gpm/sf has been requested. The requested 3 gpm/sf rating provides a significant performance safety factor since successful piloting was demonstrated at 4 gpm/sf.

Construction of the Superpulsators at a reduced loading rate would result in a significant increase in construction costs over the requested 3 gpm/sf rating. The increase in construction cost is estimated to be $1,500,000 for Superpulsators rated at 2 gpm/sf.

American's other Superpulsator installations have been approved at 3 gpm/sf in Iowa (1) and Pennsylvania (2).

These surface loading rates are calculated on the surface area above the plates only and do not include sludge concentrators, distributors, and vacuum chambers. The loading rate based on the basin dimensions would be approximately 2 gpm/sf. Preliminary dimensioned Superpulsator layouts are enclosed as Appendix B.

FILTRATION RATE

A filtration rate of 3 gpm/sf (all filters in service) and 3.3 gpm/sf (one filter out of service) was requested in the preliminary design concept. An Empty Bed Contact Time (EBCT) of 6 minutes was proposed at the 3.3 gpm/sf rate, resulting in a 32 inch depth of GAC.

A higher filtration rate would have been requested initially except for a concern about the construction cost related to the increased filter depth necessary to maintain an empty bed contact time of six minutes. Subsequent to submittal of the preliminary report , a consultant has estimated construction cost savings of approximately $450,000 can be realized if a rate of 4 gpm/sf (one filter out of service) is allowed.

The GAC/sand dual media pilot filter operating at 4 gpm/sf demonstrated excellent turbidity removal in the Superpulsator pilot study, averaging 0.21 NTU. With use of a preoxidant (chlorine), filter effluent turbidities averaged 0.16 NTU. Filter effluent

turbidities always remained below the Surface Water Filtration Rule limit of 0.5 NTU. Filter aids were not used.

A sand filter operating at 2 gpm/sf was run in parallel with the GAC/sand dual media pilot filter in the study. Effluent turbidity averaged 0.20 NTU, as compared to the dual media filter results of 0.21. The 0.01 NTU difference is not considered to be significant.

This comparison demonstrates that filter rate is not a predominant factor in determining effluent quality. Particle destabilization through coagulation is the single most important factor in providing the best filter effluent quality[1]. Another demonstration of this principle is a pilot study in which filtration rates of 5-10 gpm/sf were evaluated in terms of turbidity and particle removal[2]. Particle and turbidity removal was excellent, regardless of filtration rate. A portion of a table of results is enclosed as Appendix C showing only a slight decrease in particle removal as filtration rate increased. Note that the log removals indicated are for the filter only and do not include particle removal through the clarifier.

In an overview of the major factors affecting filtered water qualilty, Amirtharajah listed the following areas where filtered quality could be improved[3]:

1. Pretreatment (coagulation)
2. Initial Degradation and Filter Ripening
3. Minimizing Rate Changes
4. Use of Polymers
5. Effectiveness of Backwashing

The proposed improvements address each of these factors to the maximum extent possible. There is no known better pretreatment scheme than the proposed Superpulsator, except possibly with the use of ozone for particle destabilization. A streaming current monitor will be used to monitor the charge on the particles to optimize coagulation and filtration results. To minimize the impact of the filter ripening period, full flow filter to waste capability will be provided in the new filters. Additionally, chemical feed such as alum or polymer treatment of the washwater will be considered to shorten the ripening period and improve effluent quality at the beginning of the filter run.

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[1]. Amirtharajah, et al. "Some Theoretical and Conceptual Views of Filtration",JAWWA 80:12

[2]. James M. Montgomery Consulting Engineers Inc. and Havens and Emerson Inc. Tri-County Water Treatment Plant Pilot Study Results. Final report to New Jersey-American Water Company (1991)

[3]. Amirtharajah, Ibid.

Filtration rate changes will be minimized, but when necessary will be accomplished gradually through the use of state of the art control techniques. Filter aid polymer feed capability will be provided for use as necessary to improve effluent quality when coagulation is not optimized. The backwash procedure will include an air scour step to improve filter cleaning beyond the cleaning achievable by water wash alone.

Filtration rates in new plants are commonly 4 - 6 gpm/sf. One of the reasons for the acceptance of these rates is because filtration rate has little or no impact on effluent quality, while substantial capital cost savings are associated with higher filtration rates.

Because of the significant cost savings and based on our pilot filtration results, a filtration rate of 4 gpm/sf with one filter out of service is requested. The sand depth will remain at 10 inches, while the GAC depth would increase from 32 to 38 inches to maintain a six (6) minute EBCT. The 4 gpm/sf maximum filtration rate requested at St. Joseph will not compromise filter effluent quality in any way, and will significantly reduce construction costs that must be passed on to the consumer.

ADDITIONAL CLARIFICATION

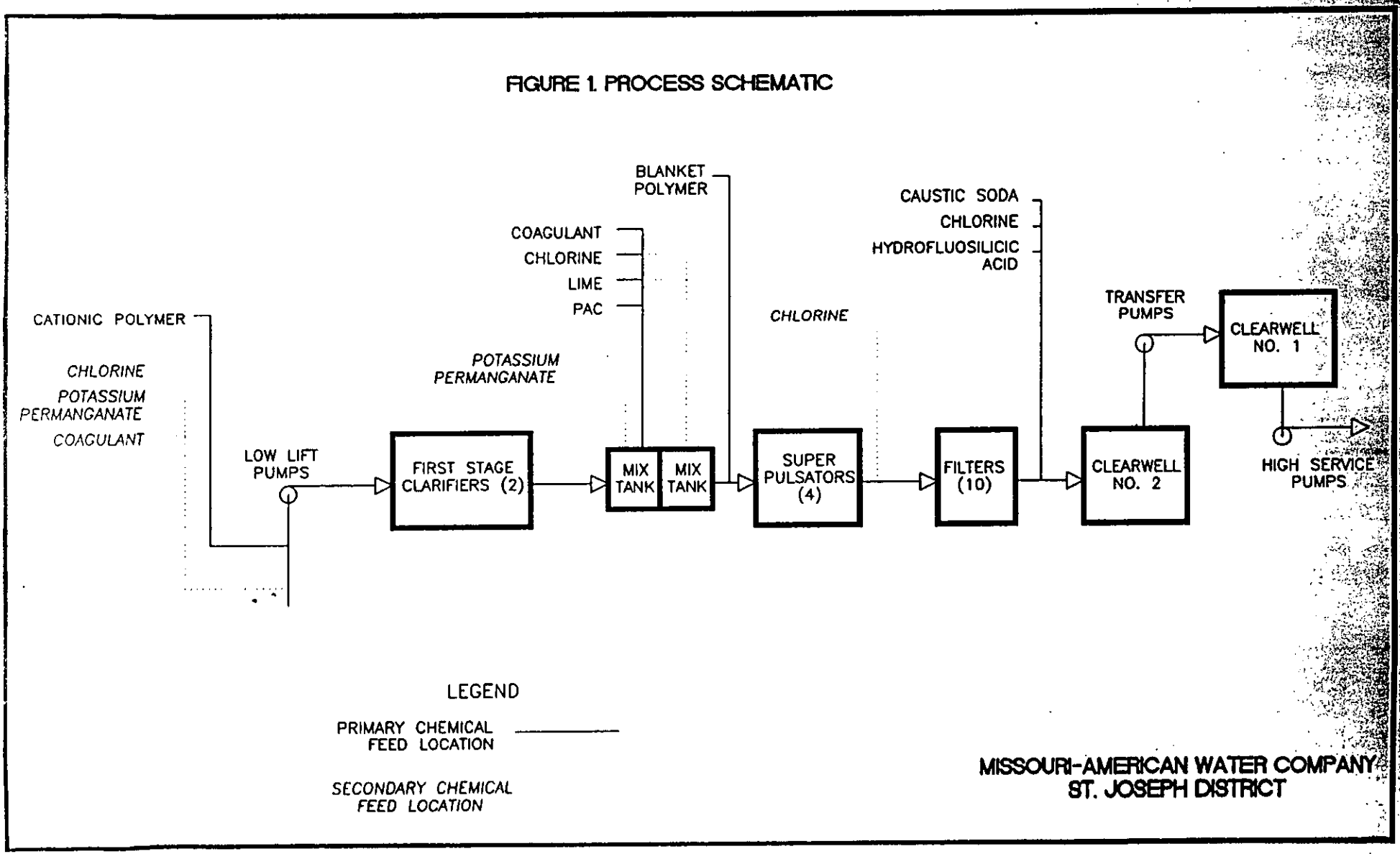
The Superpulsators are proposed as the second stage clarification at St. Joseph as shown in Figure 1. A possible requirement for a third stage of clarification was discussed at the meeting.

The solids contact process of the Superpulsator has been shown to be effective and reliable through pilot testing and through many months of operation at full scale installations. A downstream basin will not provide any significant additional turbidity removal. The installation of a basin downstream of the Superpulsators would not improve water quality and could have detrimental effects on water quality in terms of disinfection byproducts, biological growth, etc. There are substantial capital and operating costs associated with installation of a basin.

A basin downstream of the Superpulsators would provide another chemical feed location for disinfection or corrosion control chemicals. However, disinfection and corrosion control chemicals can be added elsewhere to provide equivalent, or better results. As called out in the preliminary concept, disinfection contact time will be provided in clearwells, after filtration to meet and exceed the minimum requirements of the Surface Water Treatment Rule. Disinfection with chlorine in post-treatment is preferred to minimize trihalomethane generation.

Corrosion results have been good at St. Joseph. The plant uses the Langelier Index to provide a slightly scale forming water. Lime is added in pretreatment when necessary to maintain effluent pH in the 7.4 to 7.7 range. As pointed out, the Water Company must demonstrate that optimum corrosion control is being provided. The methodology of

FIGURE 1. PROCESS SCHEMATIC



demonstrating optimum corrosion control has not been established. However, the proposed process is amenable to several possible alternative corrosion control techniques.

For example, the use of zinc orthophosphate has been very effective and is being used successfully at many locations in the American System. Zinc orthophosphate, or other phosphate type corrosion inhibitors would be fed at the inlet to the clearwell. Caustic soda is proposed to fine tune the pH of the plant effluent. Should additional alkalinity or calcium be necessary, or a substantial increase in pH be required, chemical additions could be made in pretreatment, prior to the Superpulsators. Coagulants such as ferric chloride or ferric sulfate rather than alum, would be used if an elevated pH in pretreatment was necessary.

In summary, approval is sought for the two stage clarification process, with the second stage Superpulsator at a 3 gpm/sf loading rate, and a dual media filtration rate of 4 gpm/sf. I would be happy to discuss this project with you, either by phone or in person. My phone number is (609) 346-8208. A response to the requested process, clarification, and filtration rates is requested by December 10 in order that we may proceed with design of these facilities.

Very truly yours,

Steven E. Creel

SEC/d
encl.
cc: B. Summerford - DNR
R. Bernabe - DNR
G. W. Thornburg - Mid-America Region
W. F. L'Ecuyer - MAWC - St. Joseph

(92Midcor)

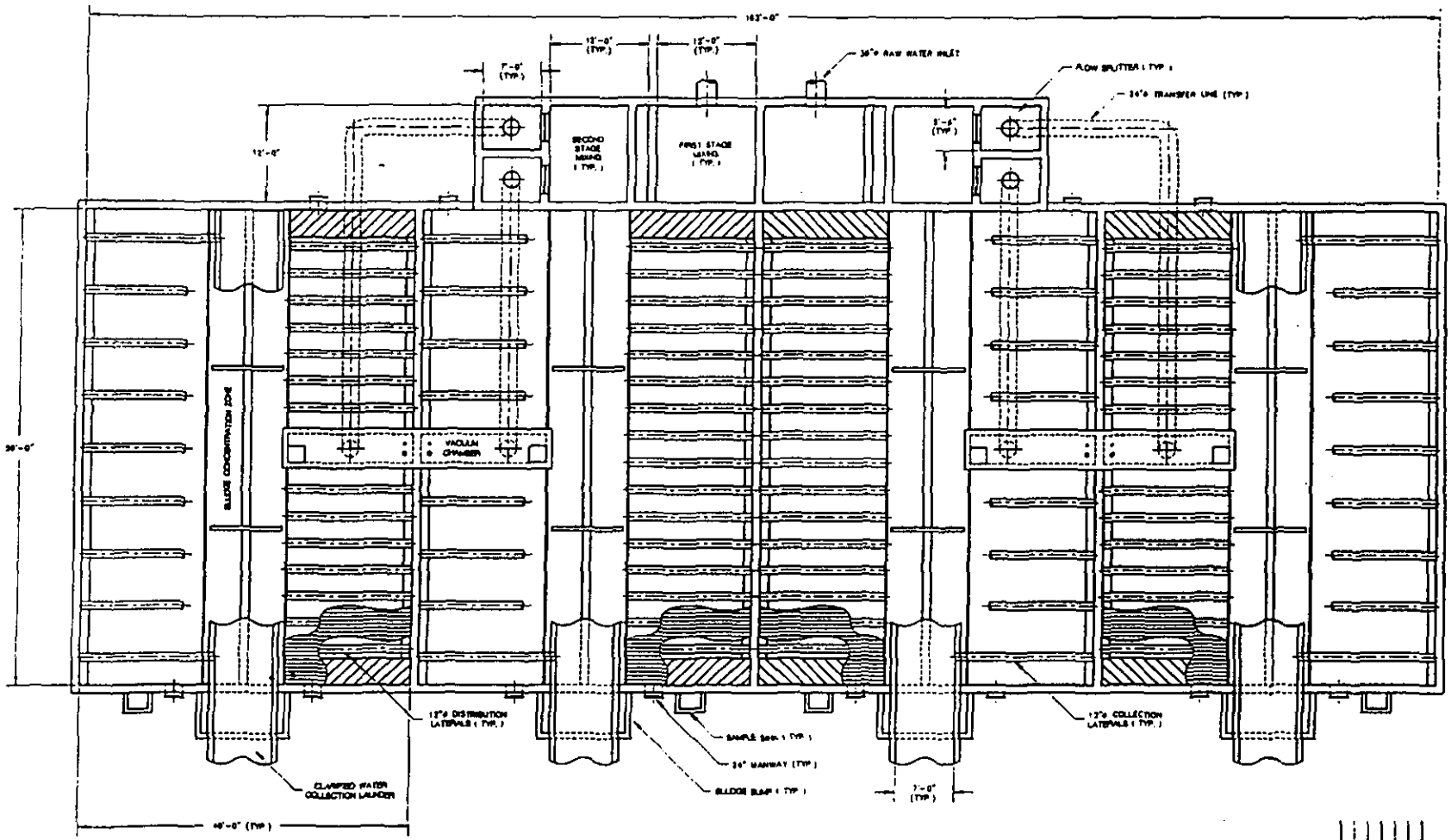
APPENDIX A - HISTORICAL TURBIDITY DATA

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT

YEAR	MISSOURI RIVER JTU	PRIMARY CLARIFIER EFFLUENT JTU
1991	6,167 (6/16)	193 (6/16)
1990	6,783 (6/18)	642 (6/19)
1989	3,358 (6/26)	127 (6/19)
1988	1,992 (5/25)	37 (5/25)
1987	3,633 (7/09)	88 (7/09)
1986	4,583 (5/17)	130 (5/17)
1985	6,567 (4/26)	130 (4/26)
1984	6,200 (6/08)	252 (6/08)
1983	2,650 (6/19)	82 (6/19)
1982	8,033 (6/16)	1,084 (6/17)
1981	2,190 (6/19)	41 (6/19)
1980	7,600 (6/17)	515 (6/17)
1979	3,417 (3/19)	350 (3/19)
1978	5,133 (4/18)	671 (4/18)
1977	3,050 (8/29)	105 (8/29)
1976	5,133 (6/16)	210 (6/16)
1975	4,833 (4/30)	108 (4/30)
1974	8,750 (5/21)	517 (5/21)
1973	3,917 (7/04)	184 (7/04)

APPENDIX B

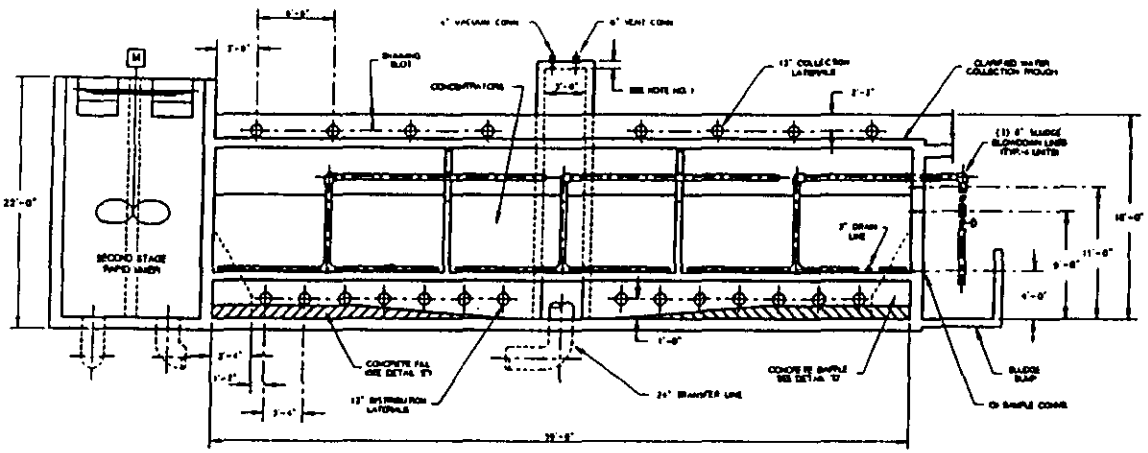
PRELIMINARY SUPERPULSATOR LAYOUT



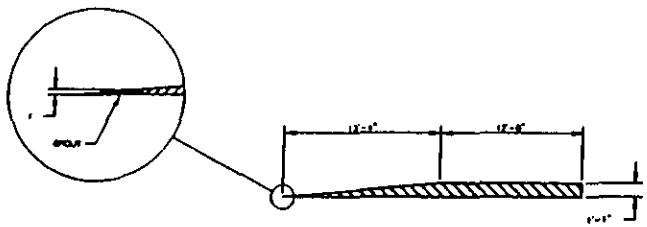
PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

Infilco Degremont Inc.

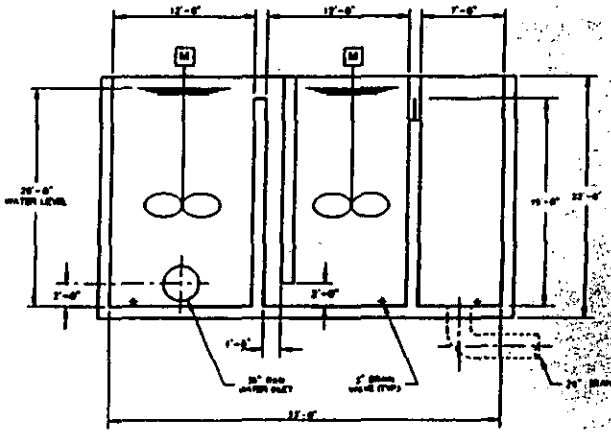
SUPERPULSATOR® LAYOUT
PLAN VIEW



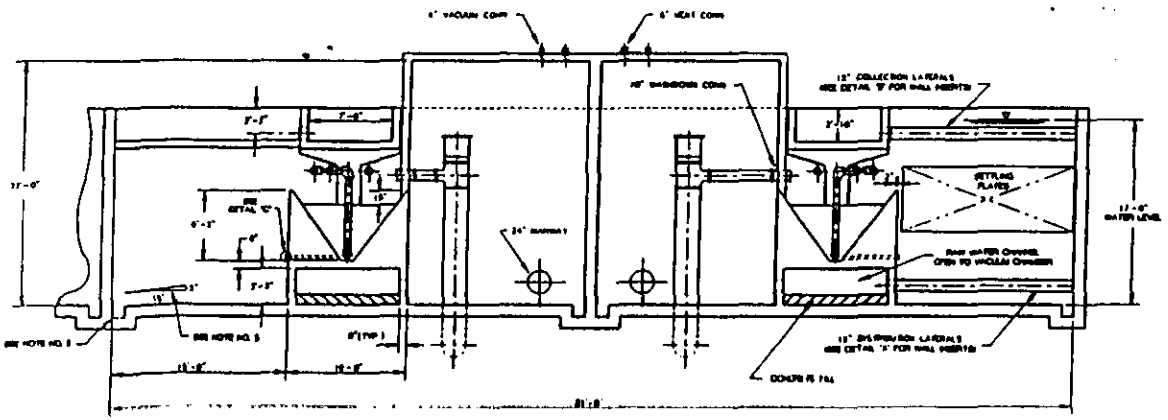
SECTION "B-B"



DETAIL "E"



SECTION "C-C"



NOTES

1. ENGINEER TO VERIFY VACUUM CHAMBER TOP THICKNESS
2. DRAIN CHANNEL TO BE NOMINAL 12" x 12".
3. FLOOR SLOPE TO BE NOMINAL 2 INCH PER 15 FT
4. SEE DWG. 042091-1715 FOR DETAILS NOT SHOWN
5. CONCRETE BASINS ARE DESIGNED FOR FUTURE CONVERSION TO SUPERPULSATOR "V" STYLE

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

FOR:
ST. JOSEPH W.T.P.
ST. JOSEPH Minnesota

Infilco Degremont Inc.

SUPERPULSATOR® LAYOUT
SECTION VIEWS

APPENDIX C

EFFECT OF MEDIA TYPE AND FILTRATION RATE ON PARTICLE REMOVAL

FROM:

JAMES M. MONTGOMERY CONSULTING ENGINEERS INC. AND HAVENS AN EMERSON INC. TRI-COUNTY WATER TREATMENT PLANT PILOT STUDY RESULTS. FINAL REPORT TO NEW JERSEY-AMERICAN WATER COMPANY (1991)

TABLE 5-12
EFFECT OF MEDIA TYPE AND FILTRATION RATE
ON PARTICLE REMOVAL ACROSS THE FILTERS (CONTINUED)
4000 Series Tests Without Ozone

Statistic	Filtration Rate	Log Removal of Particles: Anthracite/Sand Filter (AS1 + AS2)	Mono-Media GAC Filter	GAC/Sand Filter
Cumulative Number of Particles (1 - 120 µm)				
Average	5	1.08	1.00	1.09
Maximum		1.19	1.08	1.19
Minimum		0.98	0.91	0.96
Number of Tests		4	3	4
Average	6	1.02	0.96	1.03
Maximum		1.13	1.02	1.14
Minimum		0.96	0.92	0.96
Number of Tests		5	5	5
Average	8	0.91	0.88	0.95
Maximum		0.98	0.94	1.01
Minimum		0.82	0.82	0.89
Number of Tests		5	5	4
Average	10	0.92	0.92	0.94
Maximum		1.08	0.98	1.09
Minimum		0.77	0.84	0.78
Number of Tests		5	3	4
Particles in Giardia Size Range (5 - 12 µm)				
Average	5	1.55	1.43	1.58
Maximum		1.74	1.53	1.75
Minimum		1.43	1.35	1.40
Number of Tests		4	3	4
Average	6	1.49	1.38	1.50
Maximum		1.57	1.51	1.62
Minimum		1.43	1.27	1.41
Number of Tests		5	5	5
Average	8	1.32	1.29	1.41
Maximum		1.54	1.47	1.59
Minimum		1.15	1.08	1.23
Number of Tests		4	4	3
Average	10	1.34	1.15	1.41
Maximum		1.59	1.55	1.55
Minimum		1.10	0.84	1.23
Number of Tests		5	4	3

JOHN ASHCROFT
Governor

RON KUCERA
Acting Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102

St. Joseph, MO
Review No. 1897-91R

November 19, 1992

Mr. Steven E. Creel
American Water Works Service Company, Inc.
P.O. Box 1770
Voorhees, New Jersey 08043

Dear Mr. Creel:

It was a pleasure meeting with your group last October 27, 1992. We hope our meeting was as worthwhile to you as it was to us.

We have reviewed the pilot test data and information on similar installations that you and your group presented to us. The pilot test results were impressive, indicating the proposed technology may be effective to satisfy the requirements of the Missouri Safe Drinking Water Act and the Missouri Public Drinking Water Regulations. Before we accept your proposal, however, we request that the following evaluations be conducted and the results submitted to us to supplement the report:

1. "CT" evaluation of the total treatment process showing that a minimum of 3.0 log and 4.0 log removal and/or inactivation of Giardia Lamblia cysts and viruses respectively is achieved.

2. Stabilization of the finished water. The treatment must provide flexibility to adjust pH and alkalinity at levels that will be compatible with the lead and copper rule.

3. Cost evaluation (principal cost and operational cost) justifying using GAC filter in lieu of separate GAC contactor units.

We are also concerned about the extremely high rates of clarification and filtration that is being proposed. As we stated, we generally do not allow solids contact units for secondary stage treatment. Because of the impressive pilot test results, we may allow the use of super-pulsator units as secondary stage treatment if the design loading rate is lowered to not more than 2 gpm per square foot. For a dual filter media (filter sand and anthracite), you may raise the filtration rate up to 4 gpm per square foot of the filter surface area with at least one of the biggest filters out of service.

We appreciate your coming and discussing with us the proposed improvements for the water treatment plant in St. Joseph, Missouri. If you have any questions feel free to call us.

Sincerely,

PUBLIC DRINKING WATER PROGRAM

Rolando A. Bernabe

Rolando A. Bernabe
Environmental Engineer

RAB:dp

c: Mr. William F. L'Ecuyer
Kansas City Regional Office
Mr. Breck Summerford

MEL CARNAHAN
Governor

DAVID SHORR
Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102

CI
St. Joseph, MO
Review No. 1897-91R

January 27, 1993

Mr. William F. L'Ecuyer
Vice President and Manager
Missouri-American Water Co.
P.O. Box 6276
St. Joseph, MO 64506

Dear Mr. L'Ecuyer:

After reviewing the additional information and discussing the project with Mr. Steven Creel, of your Company, we decided to approve the engineering report for the proposed water treatment plant improvements as a full scale demonstration plant for a period of at least one year. This decision was reached because of our inexperience in the physical setup of the proposed facilities, higher rates of clarification for the superpulsators, and concerns that the proposed treatment scheme may not have the flexibility to provide optimum corrosion control for the finished water.

You may proceed to prepare detailed plans and specifications for the proposed improvements. We will review and approve the project on an interim basis while we become familiar with the operation and the effective performance of the plant. During the interim period, after the improvements are completed, we will periodically evaluate the operational data of the plant to determine the plant's performance in meeting the drinking water standards. We will issue the final construction approval for the treatment plant improvements after one year of operation should operational data show the treatment plant is adequate.

If you have any questions, or if we can be of assistance to you, please feel free to call us.

Sincerely,

PUBLIC DRINKING WATER PROGRAM

Rolando A. Bernabe
Environmental Engineer

RAB:be

c: Kansas City Regional Office
Mr. Steven E. Creel
American Water Works Service Company, Inc.

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Division of Parks, Recreation, and Historic Preservation

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176
Jefferson City, MO 65102

AR
MO-American Water Co.
St. Joseph, MO
Review No. 1897-91

December 24, 191 1992

Mr. H. W. Cole, MAWC
American Water Works Service Company
St. Joseph Water Company
2707 Pembroke Lane
St. Joseph, Missouri 64506

Dear Mr. Cole:

This is to advise that an engineering report for treatment plant improvements for Missouri-American Water Company, St. Joseph, Missouri was submitted for review and approval by American Water Works Service Company, Inc., consulting engineers, Voorhees, New Jersey on December 16, 1991. Please make reference to Review Number 1897-91 when submitting documents pertinent to this proposal.

A field survey and review of the documents will be made as rapidly as possible. Approximately forty-five to sixty days are required by our staff to review the preliminary plans and discuss possible changes with your engineers. You will be advised in writing of our approval of the proposals set forth in the documents.

A copy of the regulations regarding submission of plans and approval of water works is enclosed. Please note that it is necessary to obtain written approval of detailed plans before construction is started.

In addition, your facility may be required to obtain other permits from the Water Pollution Control Program. We have notified this program of your application for our permit, however you should apply directly to this program for any necessary permits.

Sincerely,

PUBLIC DRINKING WATER PROGRAM

Breck E. Summerford, P.E., Chief
Engineering & Compliance

BES:be

Enclosure

cc: American Water Works Service Company, Inc.
Kansas City Regional Office
Water Pollution Control Program

STATE OF MISSOURI Mel Carnahan, Governor • David A. Shorr, Director
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF THE DIRECTOR
P.O. Box 176 Jefferson City, MO 65102-0176 (314)751-4422
FAX (314)751-7627

AI
MO-American Water Company
St. Joseph District
Review No. 11209-94

March 30, 1994

Mr. Steven E. Creel, P.E.
Design Engineer
1025 Laurel Oak Road
P.O. Box 1770
Vorhees, New Jersey 08043

Dear Mr. Creel:

We are advising that additional information is needed to complete the proposal which included an engineering report for an evaluation and pilot testing of the adsorption clarifier for Missouri-American Water Company, St. Joseph District, Missouri, submitted by Ramon G. Lee, P.E., consulting engineer, Vorhees, New Jersey on March 28, 1994. In order for us to review the proposed waterworks, please advise your engineer to complete his submittal by sending to us the following:

1. We require two sets of the engineering report with the Missouri-registered professional engineer's seal properly affixed to each set. Please provide the second set with the engineer's seal.

In an effort to further expedite our permit review process, these documents will be carefully reviewed as soon as possible by our contracted PRIVATE CONSULTANT, if the above-requested documents are received in this office. If the proposal is not completed, the original submittals will not be reviewed. Our consultant will process the documents and discuss possible changes or necessary additions to the submittal with your engineers. Please make reference to Review Number 11209-94 when submitting the above requested documents or other documents pertinent to the proposal.

Regulations provide that our approval of the project must be secured in writing before construction work is started. This approval is your assurance that the proposed work complies with requirements of this Division.

When the proposal is reviewed, you will receive copies of our report and approval of the submittal for the proposed work, and this report will serve as your authorization to award contracts and begin construction.

Enclosed is the policy of this department to expedite review of permit applications. If it is not possible for you to respond with the requested information within 30 calendar days, an extension of time for response may be requested by letter. The request for extension must identify the reasons why the applicant cannot respond within the established time frame and must include a proposed timetable or deadline for response. Extension will only be granted when the request is received within 30 calendar days from your receipt of this letter.

Further action on your application for a construction permit awaits your satisfactory response to the above comments. Should you have any questions, please feel free to call Bev Elya at (314) 751-5924.

Sincerely,

PUBLIC DRINKING WATER PROGRAM

Ronald C. Moeller

for Breck E. Summerford, P.E., Chief
Permits Section

BES:be

Enclosure

Certified Mail # P 206 489 066

c: Ramon G. Lee, P.E.
H. W. Cole, St. Joseph District
John J. Buhman, St. Joseph District
Kansas City Regional Office

SECTION 3
WATER USE ANALYSIS

3.1 OVERVIEW

The St. Joseph service area is located in northwestern Missouri along the Missouri River which forms the state border between Missouri and Kansas. The St. Joseph area serves approximately 30,000 customers. As of 1990, St. Joseph was Missouri's fifth largest city.

Of the customers in the St. Joseph service area, 87.6% are residential accounts, 10.5% are commercial accounts, 0.4% are industrial accounts, 0.6% are "Other" accounts, and 0.9% are fire services. Based on the 1990 Census figures, MAWC-St. Joseph directly serves a population of approximately 77,000, and including the customers in the re-sale areas, the population served increases to 99,800.

The fifteen year projections for the total number of customers and their associated demands are presented in this Section. Table 3-1 and Exhibit 3-1 summarize the projected levels of consumption by customer category for the target years 1999, 2004 and 2009 for the St. Joseph District. These projections were developed based on a review of population trends, local Planning Commission forecasts, customer data and discussions with area representatives.

Where applicable, statistical analyses of customer data from 1977 through 1993 was incorporated into the demand projections. In 1993, St. Joseph was impacted by the extremely wet summer weather and the flood-related outage of the water plant. The 1993 consumption figures generally were not used in the statistical analysis of water demand trends. Data for 1992, as well as 1993, are shown throughout this chapter for illustrative purposes. Water usage in the St. Joseph system in 1993 was impacted by the wet weather conditions, and by the flooding conditions which rendered the plant inoperable for approximately five days. Since 1993 represented a highly unusual weather and water demand situation, long-term demand projections have been based primarily on statistical analysis of trends from prior years. The demand projections have been modified to account for the loss of two major industrial customers in 1993.

Non-revenue usage and unaccounted-for water were projected based on Water Company usage data and from anticipated effects of water management programs. Non-revenue use generally includes water used in fire fighting, water main flushing, sewer flushing, and identifiable leakage where quantifiable. Unaccounted-for water represents the difference between metered production and the sum of all metered sales and non-revenue usage. This category includes water lost due to meter inaccuracy, undetected leakage, illegally opened fire hydrants and theft.

The projected average day demand was developed from the summation of the residential, commercial, industrial, other, non-revenue and unaccounted-for-water projections.

Future maximum day to average day demand ratios were estimated using a statistical analysis of similar data gathered since 1977. Both a point estimate and an interval estimate of this ratio were determined. The point estimate is the mean value of the ratio. This ratio reflects a value for which the past ratios were higher 50 percent of the time and lower 50 percent of the time. While this value may be adequate to estimate annual operational parameters, the level is not adequate to base long term capital planning decisions on.

To define the ratio that will not be exceeded in a given number of years, an interval estimate around the mean value of this ratio is determined. The interval estimate defines the interval of values that the maximum to average day ratio will fall within for a certain degree of confidence. The upper boundary defined by the confidence level of 95% is chosen for maximum day demand projections. This value is applied to the maximum to average demand ratio to develop the upper boundary for the maximum day projection. In this way, the maximum day projection represents a level that is not expected to be exceeded more than once in twenty years. The following subsections present the detailed analysis.

3.1.1 St. Joseph Residential Customer Classification

The residential customer base in the St. Joseph service area makes up approximately 88% of the total customer base and uses approximately 34% of the total water sales. The acquisition of Buchanan County Public Water Service District (PWSD) No. 2 was the major reason for the increase in residential customers from 24,273 in 1991 to 26,118 in 1992, an increase of 1,845 new customers. Approximately 1,750 new residential customers were the result of the acquisition. Aside from the increase due to the acquisition, the residential customer base grew on average 100 customers per year

from 1980 to 1993. During 1990, 58 new customers were added, and during 1991, 84 customers were added to the customer base. Aside from the increase due to the acquisition, approximately 95 residential customers were added in 1992. In 1993, 244 new residential customers were added; however, this was largely due to a change in classification from commercial to residential. There appears to have been a trend of slow but stable growth in the number of MAWC residential customers since 1980.

From the information provided by the St. Joseph Area Chamber of Commerce, Sales and Marketing Management (S&MM) estimates were given for the St. Joseph metropolitan area in Buchanan County. Their projection is for the population to decrease by 2.8% from a total of 82,700 in 1991 to 80,400 in 1996. Also, the total number of households is projected to decrease by 1.6% from 1991 to 1996. These projections follow the recent population trends in the area, as shown in Table 3-1, with a decrease in population since 1980 and a more noticeable decrease since 1985. This follows a decade of moderate growth in the 1970's.

This declining trend can also be seen by examination of the construction permits and money spent in new housing construction as well as industrial and commercial development projects. This declined from a high of $38.7 million in 1989 to $25.6 million in 1991.

Table 3-1
Population of Key Areas: St. Joseph Service Area

Area	1970*	1980*	1985	1990*
City of St. Joseph	72,748	76,691	75,000	71,852
Buchanan County	86,915	87,888	86,700	83,083
Andrew County	11,913	13,980	15,200	14,632
Two-County Metro Area	98,828	101,868	101,900	97,715

*actual census data

The only major residential development now occurring is located in the northeast portion of the city, directly east of the Karnes Road tank, along Twelve Oaks Drive and Lakewood Drive and the surrounding area. The construction is expected to be completed in two or three phases, with 144 lots projected to be built in the next four to five years. These are mainly luxury single family homes. Most of the limited amount of residential growth that is expected to occur will most likely take place in the

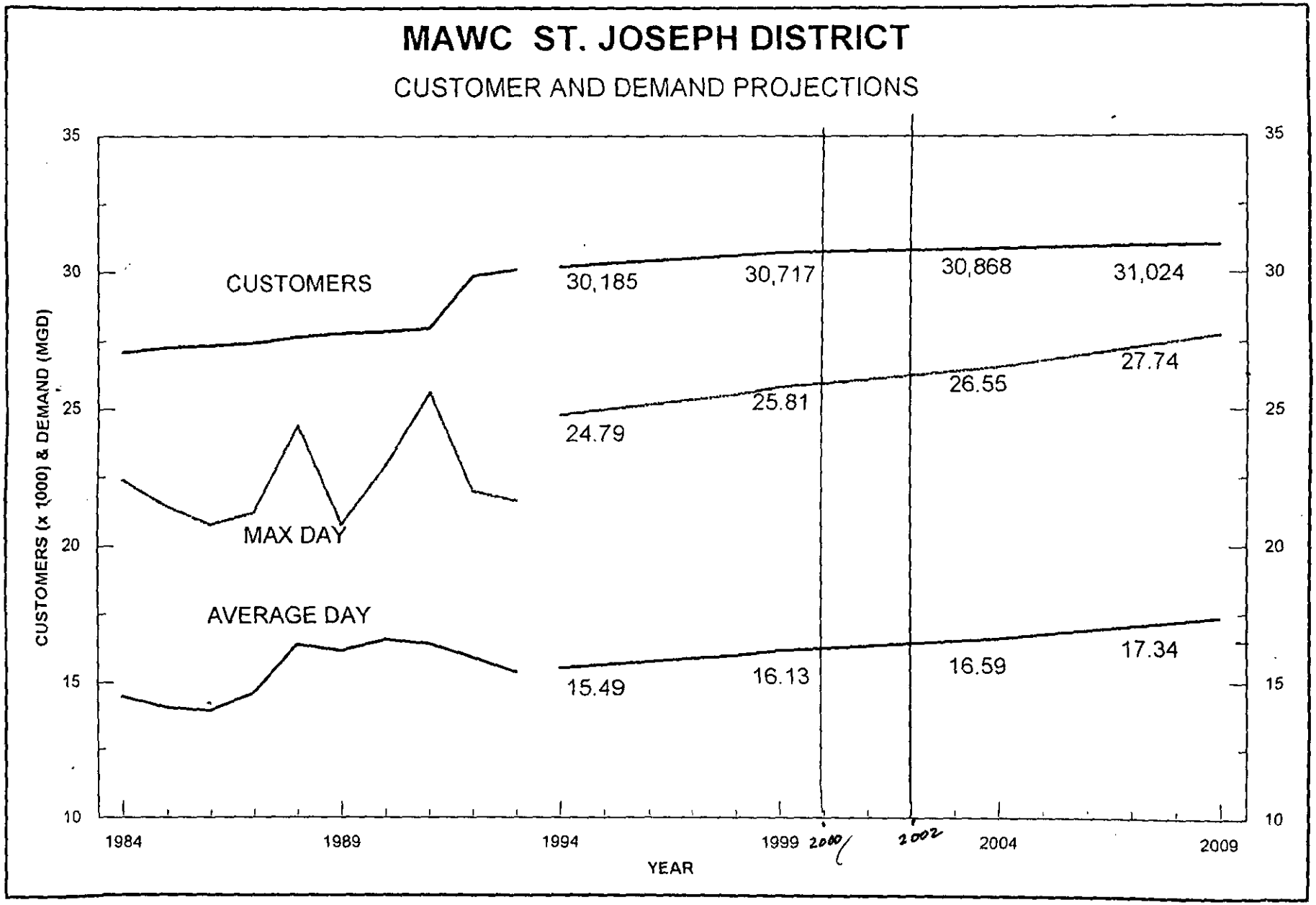

MAWC ST. JOSEPH DISTRICT
CUSTOMER AND DEMAND PROJECTIONS
CUSTOMERS (x 1000) & DEMAND (MGD)
YEAR
CUSTOMERS
MAX DAY
AVERAGE DAY
30,185
30,717
30,868
31,024
24.79
25.81
26.55
27.74
15.49
16.13
16.59
17.34
35
30
25
20
15
10
1984
1989
1994
1999
2000
2002
2004
2009

EXHIBIT 3-1

Karnes Road high service area. In addition, approximately 15 to 20 homes were built within the last two years around South 22nd Street below Commercial Avenue, which is in the southern portion of main service. A few more lots are available in this area for additional homes.

In the Southern Buchanan County service area, not much residential growth is expected to occur over the length of the planning period. It is a very rural area consisting of rolling hills, with homes scattered throughout the area. There are a few clusters of homes throughout the area which make up small towns. The only growth that is expected to occur would be the construction of a couple of homes at a time. Also, a few more customers may be added as they convert from private wells to the MAWC system. Neither of these increases is expected to provide for any substantial growth in the rural water district.

Since 1980, as the population has slowly declined in the St. Joseph area, MAWC's residential customer base has shown a slight increase, averaging 100 new customers a year from 1980-1993. This has mainly been due to new home construction in the area, although this activity is also slowing. There have not been many new businesses coming into the area to increase employment opportunities and attract new growth. The fact that MAWC's residential customer base continued to increase during an overall population decline is attributed to a slight decrease in the number of people per household, which is a common trend. From 1980 to 1990, the number of people per household decreased from approximately 2.6 to 2.5. Also, certain customers that have previously been classified under the commercial category are sometimes transferred to residential status, thus increasing the recorded number of residential customers. This can occur when multi-family dwellings or apartments with one meter, which are classified commercial, are modified to include a separate meter for each family unit, thus transferring them to residential classification.

The trend of slow growth is expected to continue over the next five years. However, as new construction continues to decline, the residential customer base is expected to stabilize. Therefore, the residential customer base is projected to continue to grow at a moderate rate of 75 per year through 1999. Growth is projected to decrease to 25 per year through 2008. This will increase the residential customer base to 26,737 by 1999; 26,862 by 2004; and 26,987 by 2009.

The per customer usage has averaged 186 gpcd over the past ten years and also over the past five years. The usage has decreased over the last 5 years from a high of 204 gpcd in 1988 to the 1992 and 1993 levels of 176 gpcd, with the exception of an increase in 1991 to 195 gpcd. This was most likely due to 1991 being an exceptionally hot and dry year. Also, the low per customer usage in 1992 and 1993 was related to these years being exceptionally cool and/or wet. The higher water rates which will be in effect as a result of the new water treatment plant may have the effect of slightly reducing residential usage; however, the level of price elasticity that will occur in response to projected water rate increases is difficult to predict. Based on past trends and using a conservative approach, the per customer usage is projected at 185 gpcd for existing customers for the planning scenario. A low demand scenario considering reduced per customer consumption figures due to price elasticity is presented in Section 3.1.8.

For new construction, the law will mandate that water efficient fixtures be installed in new homes. With these new fixtures in place, 70 gallons per person per day is considered reasonable usage. According to the 1990 census information, the average number of persons per household was 2.5. This will reduce the per customer usage to a projected level of 175 gpcd. Some remodeling of existing homes will also occur, with the old fixtures being replaced with low flow models. Therefore, a slight reduction in per customer usage from existing customers will occur. It is projected that 1/2 percent of the existing customers will convert to low flow fixtures each year, bringing their usage down to 175 gpcd.

Therefore, residential sector demand is projected to increase to 4.94 mgd by 1999, 4.95 mgd by 2004, and 4.97 mgd by 2009 based on a per customer usage of 185 gpcd for existing customers, 175 gpcd for existing homes with new low flow fixtures, and 175 gpcd for new customers.

3.1.2 St. Joseph Commercial Customer Classification

In 1993, the commercial customer base comprised 11% of the total customer base and accounted for 19% of the total sales. This sector includes commercial businesses and apartment buildings. Apartment buildings are estimated to comprise from 20 to 30 percent of the total commercial demand.

Since 1977, the commercial customer base decreased by an average of 16 per year to a level of 3,156 in 1993. The acquisition of Buchanan County PWSD No. 2, now referred to as the Southern Buchanan

County Service, was the main reason for an increase of 48 commercial customers in 1992. 39 of the 48 new commercial customers in 1992 were a part of this acquisition.

There is no substantial commercial development occurring in the St. Joseph area. At this point, there is preliminary talk of constructing a highway bypass loop which would extend completely around the city. If this would happen, it would open up the opportunity for additional growth, especially in the commercial sector. However, if this project were to move forward, construction would most likely not occur within the time frame of this planning study.

The largest commercial customer, Heartland Health System, is also the largest employer in St. Joseph, with over 2,000 employees. They have two locations. Heartland Hospital West is located at 8th and Faraon Streets, and Heartland Hospital East is located at Riverside and Faraon. The overall usage for Heartland was 0.237 mgd in 1992, which was 9.5 percent of the overall commercial demand. Their usage is projected to increase through 1998 and remain stable from 1999 through 2008. Heartland East will be experiencing most of the growth due to the relocation of all of their acute care to this facility, which includes a centralized laundry for both hospitals. Also, a 43 million dollar expansion is to be completed sometime in 1995. Heartland West is projected to have a slight decrease in usage due to this relocation. In addition, several water conservation measures have been initiated within the last year.

The commercial per customer usage has averaged 785 gpcd over the past ten years and 800 gpcd over the past five years. From 1989-1993, the low was 773 gpcd in 1993, and the high was 858 in 1991, with a decrease to 788 gpcd in 1992. The average of 800 gpcd over the past five years will be used for future projections. The commercial demand as a percentage of residential demand has averaged 55 percent over the past ten years and has remained relatively stable, fluctuating between 52 percent and 56 percent. Since this ratio has shown little fluctuation and has proven to be a reliable method for projecting commercial usage, 55 percent will be used as the ratio of commercial demand to residential demand. The commercial customer base is projected to increase to 3,400 by 1999, 3,405 by 2004, and 3,415 by 2009 with demands of 2.71 mgd by 1999, 2.72 mgd by 2004, and 2.73 mgd by 2009.

3.1.3 St. Joseph Industrial Customer Classification

The industrial customer base has remained fairly constant since 1977, showing only slight variations from year to year. The number of industrial customers was at 118 in 1977 and 114 in 1993. The

industrial demand showed a noticeable increase in 1988 from 3.25 mgd to 3.60 mgd. The demand increased moderately to 3.89 mgd in 1992, but dropped to 3.63 mgd in 1993.

The top nine industrial customers accounted for 71 percent of the total industrial usage in 1992, and their overall usage has shown a slight increase since 1988. A majority of these customers are located in the southwest portion of the service area in the vicinity of the former stockyards. Some recent changes in the industrial base, however, will effectively decrease the demand in this sector.

The largest industrial customer, Monfort Pork, a meat processing and packaging division of ConAgra which employed approximately 1,050 people, closed effective 12/31/93. They were MAWC's largest customer in St. Joseph, using 0.941 mgd in 1992. Despite a 1991 layoff which ended with a call-back of employees, as well as the addition of a second shift, Monfort officials deemed it no longer economically feasible to keep the plant in operation.

Carnation, MAWC's largest industrial customer since the closing of Monfort Pork, has exhibited fairly stable usage since 1988, with a 1992 demand of 0.404 mgd. Only slight increases are expected in their usage. Ag Processing, the second largest industrial customer, has had fairly stable usage, with a demand of 0.317 mgd in 1992. They project their usage to increase to 0.400 mgd by 2009, with the potential expansion of their soy processing plant by 50 percent. The Blueside Company is the third largest industrial user, and they process cattle hides which are sold to a worldwide market for the manufacture of fine quality leather. Their usage has remained fairly stable and is expected to show only a slight increase, from a 1992 usage of 0.265 mgd to 0.292 in 2009. The fourth largest industrial customer is Seitz Foods, producers of luncheon meats. Their usage has remained relatively unchanged since 1989, with a 1992 usage of 0.239 mgd, and only slight increases are expected. The Quaker Oats Company, producers of cereals and flour, showed a decrease in their 1992 usage, down from 0.292 mgd in 1991 to 0.179 mgd in 1992. Their usage is projected to increase to 0.240 mgd by 2009. They employ approximately 700 people and are the fifth largest industrial customer. The sixth largest customer, Silgan Containers Corporation, has shown a slight decrease in usage since 1988, and their future usage is projected to decrease to 0.150 mgd in 2009. Sherwood Medical Company, with about 772 employees, was the eighth largest customer in 1992 with a usage of 0.125 mgd. However, after the flood in July of 1993, they decided to move the company from St. Joseph. The ninth largest

customer in 1992, and now the seventh largest, Swift Chemicals used 0.107 mgd in 1992. They have shown fairly steady usage since 1988, and this is expected to continue.

The impact of the Monfort Pork and Sherwood Medical Company closings could be eased once licensing of riverboat gambling takes effect. Approximately 500 jobs are to be filled for the startup of this industry. In addition, the outlook for the sale of both the Monfort Pork and Sherwood Medical facilities is promising. Monfort is a fairly new facility which has recently been renovated.

According to discussions with the St. Joseph Development Corporation, plans are under way for a new industrial park on the extreme east side of town, located north of highway 36 and east of Riverside Road. This would be a multi-year, long-term project aimed at light industries. An additional industrial park is being considered at the Port Authority on the west side of town, to be developed further in the future and aimed at heavy industry. Since the time frame for these projects is long-term, there is no considerable change expected in the industrial customer base in the next five to ten years. Possible start-up of construction could be in the next three to five years at the earliest, and ten to fifteen years at the latest. Therefore, if the early estimates of the Development Corporation are correct, some growth may be seen in approximately ten years, at the latter stages of this planning period. There is no indication of any new industrial customers in the immediate future in the St. Joseph area.

Based on the past trend and future projections, the industrial customer base is expected to increase by 1 customer to 115 by 1999, increase by 2 customers to 117 by 2004, and increase by 3 customers to 120 by 2009. Increased growth may occur beyond 2009 depending on the status of the new industrial parks.

Aside from the seven largest industrial customers, the remaining customers have averaged 9,870 gpcd over the past five years, and this per customer usage has remained fairly stable. Based on these numbers, 10,000 gpcd will be used to project the demand of existing industrial customers, aside from the seven largest users. Most of the new industrial customers are not expected to be large water users; however, it is likely that one or two large industrial customers may buy the facilities vacated by Monfort Pork and Sherwood Medical. If these facilities do become operational again, the water usage at these sites is expected to be significantly lower than the previous usage, which will decrease the overall industrial demand. Future water usage at these sites cannot be accurately predicted. It is

estimated that a new customer at the former Monfort Pork facility would have a usage of approximately 0.20 mgd, down significantly from the previous usage of 0.94 mgd by Monfort Pork. All other new customers are projected at 10,000 gpd. Therefore, the average usage projected for new customers will be 40,000 gpd. The usage of the seven largest customers is separately projected at the following amounts: 1.78 mgd in 1999, 1.83 mgd in 2004, and 1.87 mgd in 2009. Using this approach, the industrial demand is projected to reach 2.88 mgd in 1999, 3.01 mgd in 2004, and 3.17 mgd in 2009.

3.1.4 St. Joseph "Other" Customer Classification

The "other" customer classification remained fairly constant from 1977 until 1990, and increased by 9 and 7 customers in the next two years to a 1992 level of 176 customers. By the end of 1993, there were 177 customers. This category includes bulk sales to four public water service districts located on the north, east and south sides of the service territory. The cities of Elwood and Wathena in Kansas also purchase their entire water supply from MAWC. The reclassification of the customers in the Southern Buchanan County Service from commercial to residential accounts had the effect of decreasing the "other" demand in 1992, declining from 2.82 mgd in 1991 to 2.40 mgd in 1992. 1993 usage was down to 2.08 mgd, but this is primarily the result of wet weather conditions.

Re-sale customer usage accounted for 75 percent of the total "other" customer usage in 1992. The sales to the five systems since 1988, along with their projected usage, is shown below in Table 3-2. All of the resale customers obtain their entire water supply from MAWC. The projected usage was obtained from a questionnaire sent to each Water District. Since they comprise such a large portion of the demand in this category, their projected usage is an important factor.

Table 3-2

Resale Customer Usage and Projections (mgd)

	Past Usage					Projections		
Customer	1988	1989	1990	1991	1992	1999	2004	2009
Andrew County No. 1	0.248	0.301	0.301	0.324	0.354	0.474	0.574	0.834
Andrew County No. 2	0.584	0.562	0.557	0.587	0.581	0.639	0.705	0.800
Buchanan County No. 1	0.189	0.172	0.185	0.199	0.184	0.250	0.260	0.265
DeKalb County No. 1	0.147	0.234	0.219	0.250	0.233	0.400	0.440	0.484
Elwood-Wathena System	0.448	0.378	0.422	0.455	0.456	0.455	0.455	0.455

As can be seen from Table 3-2, usage in the Elwood-Wathena System is projected to remain stable over the course of the planning period. In Andrew County PWSD No. 1, there exists the possibility of another expansion of at least five square miles. They have also been installing approximately 50 new services each year. In Buchanan County PWSD No. 1, a new extension is planned that will take in areas north, east and south of DeKalb, adding more than 100 customers. DeKalb County PWSD No. 1 is also constructing distribution mains, which will service about 700 additional customers.

Schools and colleges are also part of the "other" customers. Two colleges are located in St. Joseph: Missouri Western State College, with an enrollment of 4,600; and Northwest Missouri Community College. Also, there are 18 public elementary schools, 4 junior high schools, 3 high schools, plus a few private schools. Their usage is expected to remain fairly constant.

"Other" customer demand remained fairly constant from 1988-1991, averaging 2.64 mgd. During this same time period, the average per customer usage was slowly increasing, averaging 16,240 gpcd. However, aside from sales to the resale customers, the average per customer usage over the past five years has been 2900 gpcd.

To project future demand in this category, the existing customers and new customers will be projected at 2900 gpcd. This does not include the demand of the resale customers, which will be added on separately, based on the projections given in Table 3-2. Customer growth is expected to be 1 per year

for a total of 192 in 2009. Therefore, "other" demand is projected to increase slightly to 2.73 mgd by 1999, 2.96 mgd by 2004, and 3.38 mgd by 2009.

3.1.5 St. Joseph Fire Service Customer Classification

There is no day to day consumption associated with fire service customers. Water consumption for these customers is addressed under the non-revenue classification since this usage occurs only under special conditions.

Since 1977 the fire service customer base increased on average by 2.7 per year. This trend is expected to continue through this study period leading to a customer base of 283 by 1999, 297 by 2004, and 310 by 2009.

3.1.6 St. Joseph Non-Revenue Usage and Unaccounted-For Water

The amount of non-revenue usage in the St. Joseph District has averaged 0.90 mgd since 1983, and over the past four years, the usage has averaged 0.96 mgd. The percentage of non-revenue usage averaged 5.8 percent of the average day demand over the past ten years, and was at 5.7 percent in 1992 and 7.3 percent in 1993. Non-revenue usage is projected at 5.8 percent of the projected average day demand. Therefore, the non-revenue usage is projected to increase slightly to 0.94 mgd in 1999, 0.96 mgd in 2004, and 1.01 mgd in 2009.

Over the past ten years, UAF averaged 10.8 percent of the average day demand. In 1991, it reached a low of 8.2 percent and was at 9.4 percent in 1993.

To control UAF, MAWC-St. Joseph maintains a leak detection program and a meter replacement program. A distribution supervisor is responsible for routinely checking the entire distribution system for leaks. Using an L100 listening device, he spends approximately six days per month on foot listening for leaks. Each month he covers one area, enabling him to check the entire system in the course of one year. During 1992, 82 leaks were located through the leak detection program, with the majority of them in hydrants. The meter replacement program is up to date, and the meters are replaced on a schedule depending on the size of the meter. The UAF water as a percentage of total demand is projected to remain at 12 percent through the planning period, up from 10 percent used in the last CPS due to the aquisition of the Sourthern Buchanan County service area. This newly acquired

area presents many difficulties for leak detection due to the many additi
rural area. Therefore, the UAF water is expected to reach 1.94 mgd in
2.08 mgd in 2009.

3.1.7 St. Joseph Average and Maximum Day Demands

The average day demand has shown slight increases since 1977, with a
followed by fairly constant demands up until 1993, as increasing reside
have been roughly balanced by reductions in unaccounted for water. B
for each customer category, the average day demand is projected to reach 16.13 mgd by 1999, 16.59 mgd by 2004, and 17.34 mgd by 2009.

The projected future maximum to average day demand ratio was developed using the historic ratios from the demands since 1977. A statistical analysis was conducted to determine the 95 percent confidence interval around the sample mean, which is the level used to base long term capital planning decisions on. Based on the results of this analysis, it has been determined that there is a 95 percent confidence that the ratio of maximum day to average day demands will not exceed 1.60. Applying this ratio to the projected average day demands yields projected maximum day demands of 25.81 mgd in 1999 26.55 mgd in 2004, and 27.74 mgd in 2009.

The results of the average and maximum day demand projections for the St. Joseph service area are summarized in Table 3-3 and are presented graphically in Exhibit 3-1.

3.1.8 Alternate Demand Scenarios for St. Joseph

The point estimate of the historic maximum to average day ratios, which reflects a value for which the past ratios were higher 50 percent of the time and lower 50 percent of the time, is 1.44. Therefore, in any given year there is a 50 percent confidence that the ratio of maximum day to average day demands will not exceed 1.44. Applying this ratio to the projected average day demands yields maximum day demands of 23.23 mgd in 1999, 23.89 mgd in 2004, and 24.97 mgd in 2009. While these values are not adequate to base long term capital planning decisions on, they can be used to estimate annual operational parameters. The 50 percent confidence interval is evaluated along with the 95 percent confidence interval to illustrate the probable variation in maximum day demands that will likely be

experienced during the next fifteen years. The corresponding maximum day projections for both the 50 percent and 95 percent confidence intervals can be seen in Exhibit 3-2.

It is also helpful to illustrate other potential demand scenarios within the range of demands which could conceivably occur in the MAWC system within the planning horizon. These projections show the sensitivity and uncertainty of system demands relative to rate increases which are expected as a result of the new treatment plant. Exhibit 3-2 includes the average day demands for the planning scenario, which are based on the previous discussion in this section, and also a low scenario, which is adjusted based on consideration of reduced customer consumption in response to the expected rate increases. The projected maximum day demands are also shown for the planning scenario, using a 95 percent confidence interval (CI), and also using a 50 percent confidence interval based on the planning scenario average day.

The rate increases could conceivably have the largest effect on the large industrial users and the resale customers. Therefore, to project this consideration in the low scenario, the projected demand of all the customer categories is reduced five percent to account for a potential elasticity effect of the rate increase. Also, for the resale customers, slower than anticipated growth in the outlying areas could also reduce their demand projections. Therefore, the projected demand in the industrial and "other" categories will be reduced with this scenario, and this is displayed in Exhibit 3-2.

3.2 REGIONALIZATION

3.2.1 DESCRIPTION OF GENERAL SERVICE AREA

The areas directly served by MAWC consist of a diversity of industrial, commercial and residential customers, while the surrounding areas consist almost exclusively of rural/farming populations. The St. Joseph service area provides water to an estimated 85% of the population in Andrew and Buchanan Counties in Missouri and Doniphan County in Kansas. The remainder of the residents are served by municipal systems, Public Water Supply Districts (PWSD) or by individual supplies. Municipal systems serve several of the smaller incorporated cities or towns that are not served by MAWC, while PWSDs have been formed to construct and operate water and sewer systems in unincorporated rural areas.

Table 3-3

Demand Summary
St. Joseph Service Area

HISTORIC CUSTOMERS AND DEMAND (mgd)										
YEAR	CUSTOMER NUMBER	RESDNTL	COMMRL	INDUSTRL	OTHER	NON-REVENUE	UAF WATER	AVG DAY	MAX DAY	MAX/AVG RATIO
1977	26703	3.89	2.31	4.09	1.44	1.26	2.26	15.25	22.39	1.47
1978	26795	3.87	2.35	4.04	1.60	2.22	1.63	15.71	21.65	1.38
1979	27096	3.86	2.34	3.80	1.76	1.48	2.23	15.47	19.54	1.26
1980	27130	4.32	2.43	3.03	1.97	1.43	2.00	15.18	21.16	1.39
1981	27134	4.13	2.40	3.05	1.91	1.64	1.79	14.92	21.48	1.44
1982	26917	3.97	2.35	3.34	1.74	1.81	2.35	15.56	19.81	1.27
1983	26958	4.34	2.45	2.91	1.94	0.95	2.26	14.85	23.80	1.60
1984	27056	4.34	2.45	3.03	2.00	1.08	1.55	14.45	22.39	1.55
1985	27247	4.18	2.34	3.23	2.10	0.67	1.51	14.03	21.43	1.53
1986	27309	4.20	2.34	3.23	2.17	0.50	1.49	13.93	20.76	1.49
1987	27402	4.34	2.38	3.25	2.11	0.68	1.82	14.58	21.20	1.45
1988	27635	4.90	2.61	3.60	2.56	1.04	1.64	16.35	24.39	1.49
1989	27768	4.67	2.45	3.70	2.54	1.13	1.63	16.12	20.76	1.29
1990	27836	4.53	2.43	3.61	2.64	0.85	2.48	16.54	22.91	1.39
1991	27940	4.74	2.68	3.84	2.82	0.96	1.35	16.39	25.62	1.56
1992	29841	4.60	2.50	3.89	2.40	0.90	1.60	15.89	21.98	1.38
1993	30178	4.63	2.44	3.63	2.08	1.13	1.44	15.35	21.62	1.41
PROJECTED CUSTOMERS AND DEMAND (mgd)										
1999	30717	4.94	2.71	2.88	2.73	0.94	1.94	16.13	25.81	1.60
2004	30868	4.95	2.72	3.01	2.96	0.96	1.99	16.59	26.55	1.60
2009	31024	4.97	2.73	3.17	3.38	1.01	2.08	17.34	27.74	1.60

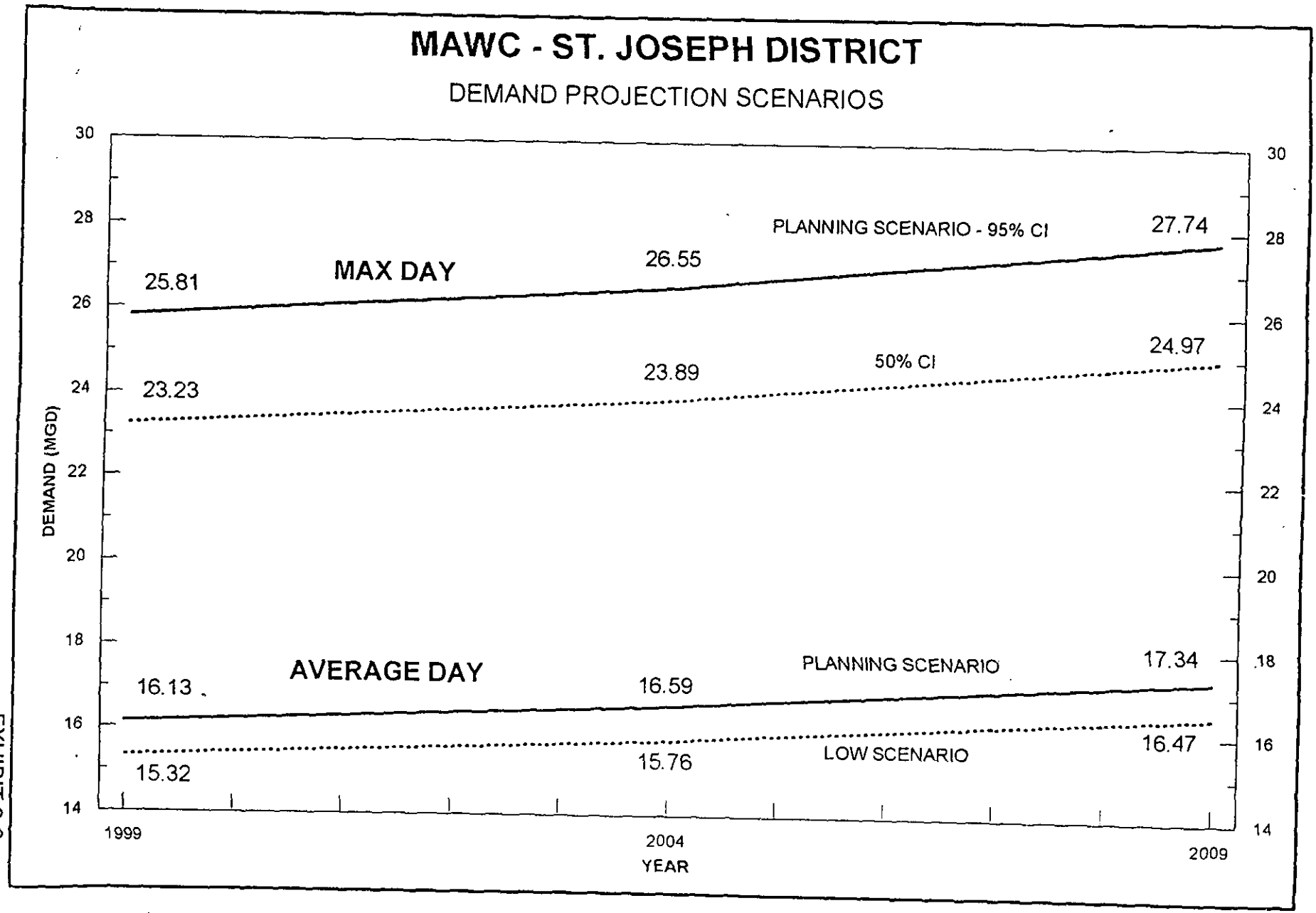

MAWC - ST. JOSEPH DISTRICT
DEMAND PROJECTION SCENARIOS
DEMAND (MGD)
30
28
26
24
22
20
18
16
14
MAX DAY
25.81
26.55
27.74
PLANNING SCENARIO - 95% CI
23.23
23.89
24.97
50% CI
AVERAGE DAY
16.13
16.59
17.34
PLANNING SCENARIO
15.32
15.76
16.47
LOW SCENARIO
1999
2004
2009
YEAR

EXHIBIT 3-2

3.2.2 DESCRIPTION OF NEARBY SYSTEMS

St. Joseph is the largest city within a 30 mile radius which includes portions of the State of Kansas. The nearest large city is Kansas City, Missouri, which is forty-five miles to the south. The present service territory boundary for this service area includes the City of St. Joseph and the area to the south which represents the former Buchanan County Public Water Supply District No. 2, which was acquired three years ago. In addition to the area directly served by MAWC, as indicated in Table 3-4 the following are the sale for resale customers which MAWC serves, including the reported number of customers each system supplies:

Table 3-4

St. Joseph Service Area
Sale for Resale Systems

	Number of Customers	
	1988	1994
Buchanan County PWSD No. 1	655	2,205
DeKalb County PWSD No. 1	877	6,965
Andrew County PWSD No. 1	856	3,897
Andrew PWSD No. 2	875	3,423
Ellwood, Kansas	N/A	1,110
Wathena, Kansas	N/A	1,608

These customers who obtain their entire supply of water from MAWC, and who combined total 19,208 customers, purchased a total of over 620 million gallons of water during 1993. As may be seen from the above table, the four PWSD's have seen substantial growth in the last six years. It is believed that the major reason for the growth in customers seen by the water districts is due to the expansion of their respective systems throughout their service areas, rather than an actual increase in population, which is not occurring in the County.

The water districts generally consist of smaller diameter piping which covers the rural areas surrounding St. Joseph. As these systems are rapidly expanding, the average age of the piping will tend to be newer and of a larger diameter than that which was installed in past years. In general, these systems do not provide fire flows to the majority of their customers, but do accommodate the filling of

fire trucks by the volunteer fire districts which serve these areas. The water consumption rates charged by these systems range from a low of $1.90/1,000 gallons to a high of $4.00/1,000 gallons. This would result in rates being anywhere from 35% to 190% greater than that currently charged by MAWC.

In addition to the water systems supplied directly from MAWC, Andrew County PWSDs No. 3 and No. 4, along with the City of Savannah to the north of St. Joseph, and Platte County PWSD No. 9 to the south, are adjacent water systems which are totally supplied from their own sources which consist of wells. Since these systems are totally independent from water supplied from the MAWC, and no known water shortages exist, it is not considered likely that one strong interest presently exists in working toward a regionalization of the water supplies.

The Elwood-Wathena water systems which are on the west side of the Missouri River, in Kansas, are totally supplied from MAWC. While there may be some growth potential in this area, it is not believed to be significant, and most likely will be offset by a decline in population in these two communities as a result of the record flooding which occurred in 1993 along the Missouri River.

As discussed in Section 3 of this report, the St. Joseph regional area is not projected to experience significant population growth in the future. For MAWC, a significant increase in the number of customers directly served could be achieved through the acquisition of the PWSDs which are presently being served as wholesale customers. This approach would offer a way for the Company to spread costs over a larger customer base, while at the same time potentially reducing the rates charged to the PWSD customers. Prior to acquisition of any of the PWSDs, a thorough engineering and financial analysis of the potential acquisition should be conducted. In particular, any commitment by the Water Company to provide fire protection to these rural areas must be considered carefully, as the PWSD distribution systems generally consist of smaller diameter pipe, and such a commitment could require substantial distribution system reinforcement.

In general, a regional plan for the supply, treatment and distribution of water throughout this area would be in the best interests of all concerned, both from a standpoint of water rates, as well as quality of water and service provided. As the largest purveyor in the Region, MAWC is well-suited to take a lead role in any such regionalization activities.

MISSOURI-AMERICAN WATER COMPANY
CASE NO. WR-2000-281/SR-2000-282
Public Counsel Data Request

Requested From: Dean L. Cooper
Date Requested: February 14, 2000
Requested By: Ted L. Biddy, P.E., P.L.S.
Information Requested:

Please furnish the average daily and the maximum daily flows per ERC for the test year ending September 30, 1999.

Information Provided:

The Company does not calculate or use ERC (equivalent residential connection). Average daily delivery for year ending 9/30/99 was 15.865 MG. Maximum day delivery for year ending 9/30/99 was 21.888 MG. (on 7/30/99)

Schedule TLB-12

The information provided to the Office of Public Counsel in response to the above data information request is accurate and complete, and contains no material misrepresentations or omissions based upon present facts known to the undersigned. The undersigned agrees to immediately inform the Office of Public Counsel if any matters are discovered which would materially affect the accuracy or completeness of the information provided in response to the above information.

Data Response Received: _____

Signed By: John Young/SC/LSC

Prepared By: John Young/SC/LSC

RATIONALE AND CALCULATION OF USED AND USEFUL PERCENTAGE FOR TREATMENT PLANT

1. Treatment Plants by regulation must be designed for Maximum Daily Flow (MDF)

2. Allow two years growth from plant completion in 2000 to the year 2002

3 MDF for the year 2002 was determined to be 24.135 MGD based on MAWC's projections and response to data request. (see Exhibits TLB –10 & 11)

3. Therefore in the year 2002, the treatment plant will be used & useful at a percentage equal to the MDF of year 2002 divided by the plant capacity as follows:

Used & Useful = 24.135 MGD / 30 MGD = 80.45%