ORIGINAL

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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STATE OF ILLINOIS
Pollution Control Board

PROPOSED ADJUSTED STANDARD APPLICABLE TO ILLINOIS-AMERICAN WATER COMPANY'S ALTON PUBLIC WATER SUPPLY REPLACEMENT FACILITY DISCHARGE TO THE MISSISSIPPI RIVER	)	AS 99- 6 (Adjusted Standard)

NOTICE OF FILING

To: Attached Service List

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the Petition for Adjusted Standard of Illinois-American Water Company and Appearances of Nancy J. Rich and James E. Mitchell, copies of which are herewith served upon you.

Nancy J. Rich

March 19, 1999

Katten Muchin & Zavis
525 W. Monroe Street
Suite 1600
Chicago, Illinois 60661-3693
312-902-5200

THIS FILING IS SUBMITTED ON RECYCLED PAPER

SERVICE LIST

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
PROPOSED ADJUSTED STANDARD APPLICABLE TO ILLINOIS-AMERICAN WATER COMPANY'S ALTON PUBLIC WATER SUPPLY REPLACEMENT FACILITY DISCHARGE TO THE MISSISSIPPI RIVER	)	AS 99-6 (Adjusted Standard)

APPEARANCE

I hearby file my appearance in this proceeding, on behalf of Illinois-American Water Company.

Nancy J. Rich
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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
PROPOSED ADJUSTED STANDARD	)	
APPLICABLE TO ILLINOIS-	)	
AMERICAN WATER COMPANY'S	)	AS 99-6
ALTON PUBLIC WATER SUPPLY	)	(Adjusted Standard)
REPLACEMENT FACILITY	)	
DISCHARGE TO THE MISSISSIPPI	)	
RIVER	)	

APPEARANCE

I hearby file my appearance in this proceeding, on behalf of Illinois-American Water Company.

James E. Mitchell

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IN THE MATTER OF: PROPOSED ADJUSTED STANDARD APPLICABLE TO ILLINOIS-AMERICAN WATER COMPANY'S ALTON PUBLIC WATER SUPPLY REPLACEMENT FACILITY DISCHARGE TO THE MISSISSIPPI RIVER	)	AS 99-6 (Adjusted Standard)

PETITION FOR ADJUSTED STANDARD

Petitioner, Illinois-American Water Company ("Water Company"), by its attorneys, Katten Muchin & Zavis, pursuant to Section 28.1 of the Illinois Environmental Protection Act ("the Act"), 415 Ill. Comp. Stat. 5/28.1 (formerly Ill. Rev. Stat. 1991, ch. 111 ½, para. 1028.1), and Part 106 of the Procedural Rules of the Illinois Pollution Control Board ("Board"), 35 Ill. Adm. Code Part 106, respectfully requests the Board to grant an adjusted standard from 35 Ill. Adm. Code 304.124 for discharges of total suspended solids ("TSS") and total iron ("iron") for the Water Company's proposed replacement public water supply treatment facility ("replacement facility") located in Alton, Madison County, Illinois. The Water Company also requests the Board to grant, to any extent it deems necessary to fashion complete relief, an adjusted standard from two additional sections of its regulations: 1) 35 Ill. Adm. Code 304.106, which provides in relevant part that no effluent shall contain settleable solids or sludge solids, and that turbidity must be reduced below obvious levels; and 2) the analogous water quality provision, 35 Ill. Adm. Code 302.203, which provides in relevant part that waters of the State shall be free from sludge or bottom deposits and turbidity of other than natural origin.[1] In support of its Petition for an Adjusted Standard ("Petition"), the Water Company states as follows:

BACKGROUND

1. Section 28.1 of the Act enables the Board to approve adjusted standards to regulations of general applicability for persons who can justify such an adjustment consistent with subsection (a) of Section 27 of the Act. Section 27(a) provides that:

> In promulgating regulations under this Act, the Board shall take into account the existing physical conditions, the character of the area involved, including the character of surrounding land uses, zoning classifications, the nature of the existing air quality, or receiving body of water, as the case may be, and the technical feasibility and economic reasonableness of measuring or reducing the particular type of pollution.

415 Ill. Comp. Stat. 5/27(a).

2. Pursuant to this grant of authority, the Board promulgated procedural regulations for the approval of adjusted standards. *See* 35 Ill. Adm. Code 106.701 *et seq.* Specifically, Section 106.703 of the Board's Procedural Rules provides that any person may singly or jointly with the Illinois Environmental Protection Agency ("Illinois EPA") file a written petition for an adjusted standard. In addition, Section 106.705 identifies the content requirements of the adjusted standard petition. Those requirements

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[1] None of the four public water supply facilities to which the Board has previously granted relief (the existing Alton facility, and the facilities which serve Rock Island, East Moline, and East St. Louis) have sought relief from either of these regulatory provisions. As discussed herein, the Water Company also believes that the replacement facility's discharge will not be substantively different from those of the public water supply facilities to which the Board has already granted relief. The Water Company is also unaware that exemptions from these sections have been sought by any of the other dischargers to waters of the State whose effluent contains settleable solids. Nonetheless, at the suggestion of Illinois EPA the Water Company seeks relief from these regulatory provisions in order to ensure complete relief.

and other relevant regulatory provisions are discussed under the applicable headings below.

3. The Water Company files this Petition because it intends to construct a public water supply treatment facility in Alton, Madison County, Illinois to replace the existing facility in Alton ("existing facility"), which was inundated by the Mississippi River (the "River") in 1993 and threatened again in 1995. The Water Company seeks to relocate its existing facility to minimize the potential for future flooding and to replace the aged facility. The severity of the 1993 flood, which shut down the facility for four days and required consumers to boil their water for ten days, is documented in the photographs provided as Attachment A hereto.

4. The Water Company has conducted a Site-Specific Impact Study ("SSIS"), attached hereto and incorporated by reference as Attachment B, to address the site-specific / adjusted standard factors enumerated in Section 27(a) of the Act. These factors include the character of the raw water (*i.e.*, Mississippi River), environmental impact, technical feasibility, and economic reasonableness of potential alternatives.[2] In September, 1996, the Water Company met with Illinois EPA to discuss a draft workplan for conducting the SSIS. The Water Company thereafter developed the draft workplan

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[2] In addition to the adjusted standard factors listed in the Act, the SSIS also anticipated and addressed the Best Professional Judgment ("BPJ") standard that, during any future permit process, Illinois EPA must apply pursuant to Section 402(a) of the federal Clean Water Act's National Pollutant Discharge Elimination System ("NPDES") program, 33 U.S.C. § 1342(a). Please note that even though BPJ is a permit requirement, it provides a means of setting effluent standards for an individual discharger, which is exactly what the Water Company is asking the Board to do here for the replacement facility. As applied to public water supply discharges, the BPJ permit factors overlap many of the adjusted standard factors -- *e.g.*, the technical feasibility and economic reasonableness of reducing the particular type of pollution, and other unique factors such as existing physical conditions. Also note that, with the exception of the Section 28.3 and Best Degree of Treatment ("BDT") (35 Ill. Adm. Code 304.102) factors discussed below, there are no other directly relevant standards for evaluating the merits of a public water supply facility's request for relief from the Board's general industrial effluent standards.

and forwarded it to Illinois EPA for review and comment. The Water Company incorporated Illinois EPA's comments in the final SSIS workplan. Due to a change in project location from Godfrey, Illinois to Alton, Illinois to capture a greater than six million dollars savings in pipeline and construction costs, the Water Company met with Illinois EPA in August, 1997 to revisit the SSIS workplan to identify any additional site-specific factors for the replacement facility. As a result of this meeting, a habitat characterization/protected species survey for mussels was added to the workplan. *See* SSIS at Appendix B. Pursuant to a follow-up meeting and subsequent correspondence with Illinois EPA, the Water Company performed and incorporated into the SSIS a Discharge TSS Modeling Evaluation, which also included a Particle Deposition Study. *See* SSIS at Appendix F.

5. The SSIS provides a brief description of the existing facility and a general design of the proposed replacement facility. The design, together with the results of pilot facility testing, was used to develop estimates of effluent flows and concentrations anticipated from the replacement facility. The proposed 10.5 million gallons per day ("MGD") annual average flow replacement facility will have two processes generating effluent discharges (plus a periodic cleaning-related maintenance discharge), which were identified as potentially requiring treatment to meet TSS and iron standards.

6. Pursuant to the site-specific rule codified at Section 304.206 of the regulations, the existing facility has no effluent limitations for TSS and iron. The Board granted this site specific relief in 1984 as follows:

Section 304.206. Alton Water Company Plant Discharges.

> This Section applies to the existing 18.3 million gallons per day potable drinking water treatment plant owned by the Alton Water Company which is located at, and discharges into, river mile 204.4 on the Mississippi River. Such discharges shall not be subject to the effluent standards for total suspended solids and total iron of 35 Ill. Adm. Code 304.124.

35 Ill. Adm. Code 304.206.

A copy of the Board's final Opinion and Order in that case, PCB 82-3, is appended hereto as Attachment C. The Board subsequently granted relief from its general industrial effluent standards to all of the other public water supply facilities located on the River in Illinois that do not use lime to soften the raw water -- *i.e.*, Rock Island, Moline and East St. Louis. Copies of the Board's final Opinions and Orders in those cases are appended hereto as Attachment D (Rock Island, PCB AS 91-13, October 19, 1995), Attachment E (East Moline, PCB AS 91-9, May 19, 1994) and Attachment F (East St. Louis, PCB AS 91-11, May 20, 1993).

7. Rock Island, East St. Louis and East Moline all obtained adjusted standards pursuant to Section 28.3 of the Act, 415 Ill. Comp. Stat. 5/28.3. Section 28.3 was intended to prompt a quick resolution of existing public water supply facilities' inability to meet the general effluent standards absent installation of potentially economically infeasible technology and thus the filing deadline relief under Section 28.3 has passed. Nonetheless, the factors that the legislature directed the Board to consider under Section 28.3 continue to be relevant to public water supply facilities which do not use lime softening and receive their raw water supply from the highly turbid and variable River. These highly relevant Section 28.3 factors include:

> An adjusted standard ... shall be based upon water quality effects, actual and potential stream uses, and economic considerations, including those of the

> discharger and those affected by the discharge. ... Justification based upon discharge impact shall include, as a minimum, an evaluation of receiving stream ratios, known stream uses, accessibility to stream and side land use activities (residential, commercial, agricultural, industrial, recreational), frequency and extent of discharges, inspections of unnatural bottom deposits, odors, unnatural floating material or color, stream morphology and results of stream chemical analyses. Where minimal impact cannot be established, justification shall also include evaluations of stream sediment analyses, biological surveys (including habitat assessment), and thorough stream chemical analyses that may include but are not limited to analysis of parameters regulated in 35 Ill. Adm. Code 302.

415 Ill. Comp. Stat. 5/28.3.

8. The National Pollution Discharge Elimination System ("NPDES") permit for the existing facility requires daily monitoring of flow and monthly monitoring of pH, TSS, iron and total residual chlorine ("TRC"). An effluent limitation exists for pH of 6.0 to 9.0 standard units ("SU"). As a result of the site-specific rule applicable to the existing facility, no treatment is required for the discharge effluent except for dechlorination, which was implemented in November 1998 as required by the facility's NPDES permit.

9. The existing facility directly returns to the River the residual natural silts and sediments contained in the raw River water, along with a very small percentage of water treatment additives used to treat the raw water -- *i.e.*, the percentage of naturally-occurring material in the total solids returned to the River is typically 91% or greater. SSIS at 6-2. The remaining 8.7% of total solids are contributed by the coagulant. Of this, only a trace amount is comprised of any of metals of concern (aluminum), and this is only about **one third of one percent** (0.348%) of the facility's solids discharge. This percentage is comparable to that achieved at the Water Company's East St. Louis water treatment facility, which uses these same coagulants and, pursuant to an adjusted standard

codified at 35 Ill. Adm. Code 304.220, also returns its discharge solids to the River. The other 99 2/3 percent of the discharge solids are derived directly from the raw River water or are from coagulant constituents that are not comprised of any of the metals of concern -- *i.e.*, non-metal, biodegradable polymer constituents, and trace amounts of inorganics (primarily sulfates). SSIS at 6-2. In addition, the mussel habitat characterization found that the area does not support any unionid communities (*Id.* at 4-4 and 5-21), and that there are no discernable impacts from silt deposition (*Id.* at 5-10). The Discharge TSS Modeling Evaluation also found no adverse impacts from the discharge of the residuals into the River. *Id.* at 5-22 to 5-23.

10. Rather than subject the replacement facility to Board regulations with which no other similarly situated public water supply facility has ever been required to comply, an adjusted standard should be developed through analysis of the site-specific factors specified in Sections 28.1, 27(a) and 28.3 of the Act and pursuant to the Best Professional Judgment ("BPJ") requirements of Section 402(a) of the federal Clean Water Act ("CWA"), 33 U.S.C. § 1342(a).[3]

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[3] BPJ for public water supply facilities is established by applying the factors listed in 40 C.F.R. § 125.3(c)(2), which applies to facilities or categories of facilities for which there are no federal effluent standards. BPJ is reached by considering: (i) the appropriate technology for the category or class of point sources of which the applicant is a member (*e.g.*, public water supplies on large, turbid rivers), and (ii) any unique factors relating to the applicant (*e.g.*, it does not use lime softening). Two other elements must also be considered in determining BPJ: best practicable control technology currently available ("BPT") and best conventional pollutant control technology ("BCT"). 40 C.F.R. § 125.3(d).
BPT factors are: (i) the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application; (ii) the age of equipment and facilities involved; (iii) the process employed; (iv) the engineering aspects of the application of various types of control techniques; (v) process changes; and (vi) non-water quality environmental impact (including energy requirements). 40 C.F.R. § 125.3(d)(1). The BCT analysis includes the BPT issues and one additional factor: the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources.

INFORMATIONAL REQUIREMENTS

Description of the Regulation of General Applicability

11. Section 106.705(a) of the Procedural Rules provides that the petition must describe the standard from which an adjusted standard is sought. This shall include the Administrative Code citation to the regulation of general applicability imposing the standard as well as the effective date of that regulation. The regulation of general applicability, Section 304.124 of the Board's Water Pollution Regulations, 35 Ill. Adm. Code 304.124, establishes effluent standards which are applicable to dischargers to the waters of the State of Illinois. The Water Company seeks an adjusted standard for discharges of iron and TSS. Section 304.124 establishes a discharge limitation of 2 mg/l for total iron and 15 mg/l for TSS. Section 304.106 of the Board's effluent standards, 35 Ill. Adm. Code 304.106, provides in relevant part that no effluent shall contain settleable solids or sludge solids, and that turbidity must be reduced below obvious levels. The analogous water quality provision, Section 302.203, 35 Ill. Adm. Code 302.203, provides in relevant part that waters of the State shall be free from sludge or bottom deposits and turbidity of other than natural origin.

12. The effluent limitations provided in Section 304.124 apply to all discharges to waters of the State of Illinois, regardless of the nature of the receiving stream or the environmental impact of the discharge. The Board's effluent standards, including the iron and TSS limitations now codified at Section 304.124, became effective on January 6, 1972. *See* Opinion of the Board, PCB R 70-8 *et al.*, Jan. 6, 1972, a copy of which

is appended hereto as Attachment G.[4] These standards were not developed on an industrial category basis like the subsequent federal effluent standards. As a result, certain dischargers, such as public water supplies located on large rivers, are subject to two potentially contradictory standards for obtaining their NPDES discharge permit -- the generally applicable Illinois effluent standards and the federal BPJ requirement under the CWA.

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[4] As noted on page 1, above, the Water Company seeks relief, as the Board deems necessary, from the effluent standard of Section 304.106 and the water quality standard of Section 302.203. In 1972, the Board promulgated a general effluent standard for "Offensive Discharges," now codified at Section 304.106. Opinion of the Board, PCB R 70-8 *et al.*, Jan. 6, 1972, at 5; 35 Ill Adm. Code 304.106. This effluent standard was adopted from the earlier Sanitary Water Board prohibition on the discharge of nuisance materials to any waters, which required the equivalent of primary treatment for all discharges. Opinion of the Board, PCB R 70-8 *et al.*, Jan. 6, 1972, at 5. In support of the prohibition of Offensive Discharges, the Board stated that "[a] nuisance anywhere is unacceptable." *Id.*

Specifically, the Offensive Discharge effluent standard, now codified at Section 304.106, provides that:

> No effluent shall contain settleable solids, floating debris, visible oil, grease, scum or sludge solids. Color, odor and turbidity must be reduced to below obvious levels.

35 Ill. Adm. Code 304.106.

In the same 1972 rulemaking, the Board adopted an analogous water quality standard for "Offensive Conditions," which similarly restricted nuisance conditions, and which is now codified at Section 302.203:

> Waters of the State shall be free from sludge or bottom deposits, floating debris, visible oil, odor, plant or algal growth, color or turbidity of other than natural origin.

35 Ill. Adm. Code 302.203.

In 1990, the Board amended the Offensive Conditions water quality standard. *See* Opinion and Order of the Board, PCB R88-21(A), Jan. 25, 1990. The Board determined that the water quality standard of Section 302.203 is equivalent to ("no more restrictive than") the effluent standard of Section 304.106. *Id.* at 12. The proposed discharge will not create a "nuisance" as understood by the Board when it adopted the Offensive Conditions and Offensive Discharge rule. The Water Company's Particle Deposition Study shows that the proposed discharge will not result in an Offensive Condition as defined in Section 302.203. SSIS at 5-22 to 5-23; Appendix F.

Relationship of the Regulation of General
<u>Applicability to Federal Environmental Requirements</u>

13. Section 106.705(b) of the Procedural Rules provides that the petition must state whether the regulation of general applicability was promulgated to implement, in whole or in part, the requirements of certain federal environmental laws or programs under such laws. The effluent standards were reviewed in 1975 and 1976 by the Illinois Effluent Standards Advisory Group ("IESAG"), which was formed at the request of the Director of the State of Illinois Institute for Environmental Quality, which was subsequently renamed the Illinois Department of Energy and Natural Resources. IESAG has concisely explained the ways in which the Illinois effluent standards differ from the subsequently enacted federal effluent discharge control legislation:

> [The federal] ... law required ... that the U.S. Environmental Protection Agency promulgate by industrial category (and subcategory if necessary) effluent limitations guidelines for existing sources and standards of performance for new sources. Thus, PL 92-500 [the federal law] differs from Illinois law, in requiring industrial category-specific guidelines whereas the Illinois standards apply equally to all dischargers.

Evaluation of Effluent Regulations of the State of Illinois ("IESAG Evaluation"), Illinois Institute for Environmental Quality, Document No. 76/21, (1976), Attachment H hereto, at pp. 4-5

14. The United States Environmental Protection Agency ("U.S. EPA") has never enacted effluent standards for public water supply treatment facilities. *See, e.g.*, Opinion and Order of the Board, PCB R85-11, February 2, 1989, attachment I hereto, at p. 10. As a result, the Illinois effluent limitations and subsequent amendments thereto, including the standards for iron and TSS for which the Water Company seeks an adjusted standard, were not promulgated to implement, either in whole or in part, the

requirements of the federal Clean Water Act, the NPDES program, or any other federal environmental laws or programs. Similarly, U.S. EPA has never enacted federal pretreatment regulations for public water supply treatment facilities which discharge to publicly owned treatment works. The Illinois legislature implicitly recognized the lack of categorical pretreatment standards by enacting Section 28.3 of the Act.

Level of Justification Required for an Adjusted Standard

15. Section 106.705(c) of the Procedural Rules provides that the petition must state the level of justification as well as other information or requirements necessary for an adjusted standard as specified by the regulation of general applicability, or a statement that the regulation of general applicability does not specify a level of justification or other requirements.

16. The regulation of general applicability -- that is, the Board's effluent regulations, including Sections 304.124 and 304.106, and water quality criteria of Section 302.203 -- does not specify a level of justification or other requirement for an adjusted standard.

17. The level of justification required for the adjusted standard sought by the Water Company is, however, specified at Section 28.1(c) of the Act:

> 1. factors relating to [the Water Company] are substantially and significantly different from the factors relied upon by the Board in adopting the general regulation applicable to [all industrial dischargers];[5]
>
> 2. the existence of those factors justifies an adjusted standard;

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[5] As noted in paragraph 7 above, Section 28.3(c) of the Act lists a number of the unique factors that are relevant to determining adjusted standard relief for public water supply facilities. As discussed below, the Water Company addressed all of these factors in detail in the SSIS.

3. the requested standard will not result in environmental or health effects substantially and significantly more adverse than the effects considered by the Board in adopting the rule of general applicability; and

4. the adjusted standard is consistent with any applicable federal law.

415 Ill. Comp. Stat. 5/28.1(c).

<u>Nature of the Activity for Which the Proposed Adjusted Standard is Sought</u>

18. Section 106.705(d) of the Procedural Rules provides that the petition must describe the nature of the petitioner's activity which is the subject of the proposed adjusted standard. The operations of the replacement facility will be very similar to the existing facility and, except for being moved up to the bluff to reduce future flooding, will be in the same general location. As a result, operational information regarding the existing facility will also be relevant to the operations of the replacement facility. The SSIS provides a detailed description of both current and anticipated future operations as a prerequisite for the SSIS' analysis of their site specific impacts. Much of the information in the following sections is also addressed in the SSIS, and the following sections will provide citations to the SSIS for reference and completeness.

19. The Water Company's existing public water supply water treatment facility is located along the River at approximately River Mile 204 in Alton, Illinois. The River is the sole public water supply source for the community. There are approximately 265 miles of water main in the distribution system and the system serves a population of approximately 76,430 people and 17,480 households/businesses.

20. The existing facility has been supplying water to the City of Alton and nearby residents -- and discharging to the River in the same general location -- since the

1890s.[6] The original Main Service facility was expanded in the 1930s to 13.3 MGD. An additional 5 MGD High Service facility was constructed in 1981, at the same site. The Main Service facility consists of two mixing tanks, one circular clarifier, two rectangular sedimentation basins, sand filters, 650,000 gallons of filtered water storage and raw and filtered water pumping stations. The High Service facility consists of one mixing tank, two clarifiers, four filters, raw, transfer, and filtered water pump stations, and one million gallons of filtered water storage. The two facilities share a common side channel intake structure at the River. At the existing facility, water is taken from the River through a side channel intake into two wet wells in the facility Gate House. Two travelling screens are located at these wet wells to strain out debris. The screens are regularly cleaned with finished water, and the expelled materials and screen wash water are returned directly to the River. Three pumping units transmit raw water to the two flocculation tanks in the Main Service facility. Three pumping units convey raw water to the mixing tank in the High Service facility.

21. At the Main Service facility, open rectangular steel channels convey raw water from the mixing tanks to the circular clarifier where sand and heavy sediment are removed. From the clarifier, the water is split into approximately equal proportions. The clarified water enters the lower chamber of each of the two parallel rectangular sedimentation basins. From the lower chamber, the water rises to the upper chamber. From the sedimentation basins the treated water enters the former recarbonation tank

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[6] In the event that adjusted standard relief is granted in this proceeding, the Water Company plans to continue to use the same general area of the River for the replacement facility discharge.

where additional treatment chemicals are added. From the recarbonation tank, the treated water flows to nine sand filters.

22. At the High Service facility, flocculation occurs in the mixing tank in which one side wall mixer is mounted. From the mixing tank, water flows by gravity to two Claricone sludge blanket type clarifiers. From the clarifiers, water flows by gravity to fours/and/anthracite filters. Treatment to aid in sedimentation begins as water leaves the intake, where the primary coagulant, Clar$^+$Ion®, is added to coagulate the sediment in the water. Powdered activated carbon may be added at the intake in order to control odor and taste. Lime or caustic may be added at this point as well when alkalinity is low. Based on historical records, alkalinity is low during high flows or high turbidities. In the mixing tanks, the retention time and gentle mixing promote coagulation. The coagulated sediment will then settle in the clarifier and sedimentation basins in the Main Service facility or in the Claricone clarifiers at the High Service facility. Disinfection is provided by chlorine addition immediately after flocculation and again after clarification in the sedimentation basins. Ammonia is added before clarification to promote chloramine formation. SSIS at 3-1 and 3-2.

<u>Current Effluent Discharges</u>

23. As discussed in detail in paragraph 6, the existing facility discharges its effluent directly to the River pursuant to the site specific rule codified at 35 Ill. Adm. Code 304.206. Effluent discharges from the existing facility's treatment system are operational and maintenance discharges. Operational discharges are those flows that occur regularly, on a daily or weekly basis, during periods when the facility is treating

raw water. Maintenance discharges occur during the cleaning of accumulated solids in the clarifier, sedimentation basins, and mixing tanks. Residuals from the existing Alton facility are stored in a dedicated wet well at the Gate House. They can be discharged by gravity or can be discharged by using a dedicated transfer pump during high river levels. All facility residuals are discharged from this location. SSIS at 3-2.

24. The two Main Service operational discharges consist of intermittent clarifier blowdown and filter backwash. *Id.* Approximately 30,000 gallons per day ("gpd") of blowdown are discharged two days a week from the clarifier; however, the frequency and duration of blowdowns are variable, because they are dictated by raw water turbidity. In addition, approximately 630,000 gpd of backwash are discharged from nine sand filters used at the Main Service facility. The sand filters used at the Main Service facility are backwashed daily for approximately 15 minutes. Each filter runs approximately 24 to 30 hours between backwashings. *Id.*

25. Maintenance discharges from the Main Service facility arise from cleaning, three times per year, accumulated solids from the clarifier, sedimentation basins, and mixing tanks. SSIS at 3-3. The two sedimentation basins do not include sludge removal equipment, so the basins are dewatered prior to manual sludge removal. Approximately 72,000 gpd of carrier water with residuals are discharged during the five day long maintenance activity (*i.e.*, total annual discharge is 1,080,000 gallons). *Id.*

26. The High Service operational discharges include Claricone clarifier blowdown, filter backwash and cleaning of the Claricone clarifier. Operators release clarifier residuals based on the condition and thickness of the sludge blanket.

Approximately 12,000 gpd of carrier water with residuals are discharged from the clarifier. Two of the four sand/anthracite filters at the High Service facility are backwashed daily for approximately 15 minutes. Each filter runs approximately 48 hours between backwashings. Approximately 210,000 gpd of backwash are discharged from the filters. Finally, the Claricone clarifiers are cleaned once a year. Approximately 24,000 gpd of cleaning residuals are discharged during two days of maintenance activity. SSIS at 3-3.

Existing Facility History and Replacement Facility

27. The existing facility is located within a physically restricted parcel of level land approximately twenty feet above the normal River summer level. The facility is bounded directly to the northeast by the Norfolk Southern Railroad and Illinois Route 100 and bounded to the southwest by the River. Across the railroad and highway corridor, the land slopes steeply up to the bluffs overlooking the River. Due to its proximity to the River, the existing facility is subject to occasional flooding. In August 1993, the entire site was flooded and both the Main Service and High Service facilities were out of service for four days. Consumers in the Alton service area were required to boil tap water over a ten day period. Limited service was provided initially by the High Service facility. Full service was reinstated soon thereafter. Sandbagging to protect the facility from flooding was required in 1973, 1986, 1993, 1994 and 1995. SSIS at 3-3.

28. In order to avoid future flooding and to replace the aged existing facility, the replacement facility will be constructed approximately sixty (60) feet higher than the existing facility on property located directly across Illinois Route 100 in Alton, Illinois.

The Water Company evaluated nine sites for replacing the water supply facility before choosing this alternative. The site was selected because of its industrial zoning, proximity to the existing facility and infrastructure, favorable site topography for construction, size, and proximity to the existing raw water intake location. SSIS at 3-4.

Replacement Facility Design, Capacity, Flows and Discharges

29. The replacement facility is designed to treat sufficient raw water to make available, on average, 10.5 MGD[7] of potable water for the Alton area. The hydraulic design capacity of the replacement facility is 16 MGD. Based on an internal facility demand (*i.e.*, not going into the Water Company's distribution system) of 1 MGD (for Superpulsator® blowdowns, filter backwash, *etc.*), at a peak potable water demand of 15 MGD, the actual distribution capacity is 15 MGD. The estimated average proportional internal facility demand is 0.7 MGD for the average potable water flow of 10.5 MGD. The combined flow, 10.5 + 0.7 = 11.2 MGD, was therefore used for purposes of evaluating potential discharge impacts in Section 5.0 of the SSIS, discussed below.

30. The replacement facility will consist of a new raw water intake and pumping station, clarification and filtration units, filtered water storage, and chemical feed facilities. Clarification of raw water at the replacement facility will be provided by four Superpulsator® units (high rate sludge-blanket type clarifiers manufactured by Infilco Degremont, Inc.). SSIS at 3-4 and 3-5.

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[7] The 10.5 MGD value was selected as the average daily potable water demand based on projections of future water demand conducted as part of the Water Company's Comprehensive Planning Study (SSIS at Appendix E). The study estimated water demand by using predicted demographic trends through the year 2010, which predict a modest growth in population in Madison County. Population growth is likely to be influenced by the newly constructed multi-lane highway bridge across the River at Alton, highway improvements, continued downtown development in Alton, and increased tourist attractions.

31. Filtration will be provided by six gravity dual media (sand/granular activated carbon) units. Each filter will be equipped with a rate of flow controller, filter to waste piping, an air wash system and automatic monitors for flow rate, head loss and water level. SSIS at 3-5.

32. One additional maintenance discharge will occur at the new facility. This discharge will be from periodic wet well cleaning (once every five (5) years). This discharge, however, will be minor in amount and duration, will use raw water for cleaning, and will not contain process-generated chemicals (*i.e.*, coagulant) and, therefore, it has been eliminated from further consideration in analysis of potential new facility impacts. *Id.*

33. Operation of the replacement facility will be highly automated. The required equipment will include an analyzer, controller, flow proportioning system, an automatic switchover device, diffuser, scale for cylinders, and an SO_2 detector. *Id.* at 3-6. Residual discharges from the replacement facility will consist of Superpulsator® blowdown, filter backwash, and Superpulsator® cleaning water. *Id.* at 3-5. The quantity of residuals discharged will be equal to the sum of the suspended solids introduced in the influent River water and those added as coagulant aids. *Id.*

34. Chlorine may be used at a variety of points within the replacement facility. Chlorine may be added on a seasonal basis prior to Superpulsator® or filter backwash treatments. Ammonia and chlorine will be applied at rates necessary to achieve a TRC sufficient for disinfection in the treatment process and to provide a final TRC for disinfection in the potable water distribution system. The Water Company will use the

process of chloramination at the replacement facility. Ammonia is applied just after chlorine treatment in order to form chloramines rather than free chlorine residual. Chloramines may be added to the raw water prior to the Superpulsator®. Based on similar treatment facilities, a TRC of 3.0 to 4.0 mg/l could be expected at this point. Alternatively, if chlorine is added, the Superpulsator® TRC could range from 1.0 to 1.5 mg/l. The settled solids will be continuously removed from the Superpulsator® and routed to the effluent discharge. *Id.* at 3-5 and 3-6.

35. Water from the Superpulsator® will flow to six carbon/sand dual media filter units. This filtration will cause substantial reduction in free chlorine residuals and TRC. TRC would be expected in the filter backwash water, which constitutes nearly half of the total effluent discharge. *Id.* Chlorine and ammonia will be applied to the filtrate to maintain a disinfectant residual in the potable water distribution system; however, these application points will not affect the discharge, because the discharge stream is split away prior to this part of the process. *Id.* at 3-6.

36. The replacement facility will prevent unacceptable TRC concentrations in the effluent discharge through dechlorination with sulfur dioxide. Two dechlorination systems will be used to treat the Superpulsator® and filter backwash discharges, respectively. Separation of the filter backwash water from the other effluent volumes will allow the Water Company to apply dosages that are appropriate for the residual chlorine in each stream. SSIS at 3-6.

Characteristics of Replacement Facility Site

37. The replacement facility site consists of approximately 22 acres located within the City of Alton, Illinois in Madison County; the suitable area for construction is limited due to existing topography. Alton is located in southwestern Illinois on a bend in the Mississippi River north of St. Louis, Missouri. The property is a former quarry site, with residential subdivisions located along the western and northeastern corners of the property. The site is composed of both hilly and flat areas. The central flat portion of the site, which is the old quarry floor, is largely bedrock with sparsely vegetated open areas. Portions of the site are covered with trees and woody vegetation overlying quarry debris. SSIS at 4-2.

38. 18 acres of the area are zoned M-2, Heavy Industrial District. The remaining four acres are zoned residential and would need to be rezoned if construction of treatment facilities were to occur. In the immediate vicinity of the site, other zoned uses include mostly residential areas. The site is abutted by both single and multi-family residences. Land uses near the site include moderate and higher income single family residences, apartments and industrial sites. Barges tie up along the River banks just downstream of this area prior to or after traveling through the Melvin Price Locks and Dam. SSIS at 4-2.

Hydrologic Characterization of Mississippi River at Alton

39. Hydrologic data are available for the River near Alton from four local United States Geological Survey ("USGS") gaging stations.[8/] The stations measure flow emanating from a 171,300-171,500 square mile drainage basin. Based on sixty (60) years of USGS data, the average mean monthly flow of the River is 106,859 cubic feet per second ("cfs"). *Id.* at 4-3. Data were collected at USGS gaging station #05587500 (Alton) from April 1933 through September 1988 and at USGS gaging station #05587450 (Grafton) from October 1990 through September 1995. Recorded mean monthly flows ranged from 20,200 to 469,300 cfs (July 1947 and July 1993, respectively). The minimum seven day, ten year flow ("7Q10") is 21,500 cfs. The data demonstrate that March to June are typical peak flow months and August to January are lower flow months. SSIS at 4-3.

40. River depths in the vicinity of the proposed facility range to 30 feet. The normal high water level for this section of the River is 419 feet above mean sea level ("MSL") with a low water level of 413 feet above MSL. SSIS at 4-3.

Water Quality of the Mississippi River at Alton

41. The raw water quality of the River at the intake point is highly variable. Based on data from the existing facility (January 1990 through December 1995), the turbidity of the influent varies dramatically on a daily basis. For example, in May 1990 the influent turbidity changed from 39 nephelometric units ("NTU") to 964 NTU (the

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[8/] The Alton stations (#05587500 and #05587550) were discontinued after 1989, following relocation and construction of Lock and Dam No. 26. Hydrologic and water quality measurements were resumed at the Grafton stations (#05587450 and #05587455).

maximum value over the six-year period of record) during one month. The minimum daily turbidity value for the period of record was 8 NTU in January 1994. Similarly, the mean of annual averages and the monthly averages differ substantially. The mean of annual averages for the six year period of record is 90 NTU, while the maximum of monthly averages is 430 NTU. SSIS at 3-6.

42. To account for the natural variability of River water quality, three River turbidity conditions were evaluated for conceptual design purposes and to support the potential impact evaluation conducted for the SSIS. The turbidity values were correlated to suspended solids concentrations ("mg/l TSS") using a ratio of 1:2 NTU/TSS. The ratio of turbidity to suspended solids in rivers similar to the Mississippi River ranges from 1:1.8 to 1:2. For purposes of the SSIS, in order to consider maximum solids production, the ratio of 1:2 was selected.[9/] SSIS at 3-7.

43. The long-term River water quality is represented by the mean of the annual turbidity averages, or 90 NTU (180 mg/l TSS). Discharges calculated based on this condition were used to design long-term treatment units, such as lagoons. The medium term River water quality is represented by the maximum of the monthly turbidity values or 430 NTU (860 mg/l TSS). Discharges calculated based on this condition were used to design all the residual handling equipment such as belt filter presses. The short term River water quality is represented by the maximum daily value or 964 NTU (1928 mg/l TSS). Residual discharges calculated based on this condition were used to design the

[9/] Due to the importance of this value for determining potential residual loads, this value was peer-reviewed by two engineering firms: Hazen & Sawyer and Burns and McDonnell.

initial equalization basins so that storage volume would be provided to handle this worst case condition. SSIS at 3-7.

44. The Company conducted modeling of anticipated exceedances of water quality standards using the discharge values in paragraphs 29-36, above. These values include discharge flows and concentrations under defined ambient flow TSS and flow conditions. These values were used to model potential worst-case and average flow scenarios to evaluate the potential for the discharged effluent to exceed Illinois Water Quality or Effluent Standards. SSIS at 3-7.

45. Water quality data were obtained from the USGS District Office in Rolla, Missouri. Data for TSS were available for the four USGS gaging stations noted in paragraph 8, n.8, above. Data were available from two of the four gaging stations (#05587450 and #05587455) in the period following the relocation and construction of Lock and Dam No. 26. The average mean monthly TSS value over the period from October 1989 to September 1995 ranged from 29 to 605 mg/l with an average monthly value of 171 mg/l. SSIS at 4-3. The USGS District Office in Rolla also collected data from individual sampling events. During the period after the relocation and construction of Lock and Dam No. 26, TSS concentrations for single grab samples ranged from 17 to 506 mg/l (January 1990 and April 1994, respectively).[10] SSIS at 4-4. Despite the greater range of TSS concentration for single grab samples, the mean value of TSS from these data is 156 mg/l, which is consistent with the average monthly value of 171 mg/l

[10] Data are available from both before and after the relocation and construction of Lock and Dam No. 26, from 1975 to 1994. During the period prior to the relocation and construction of Lock and Dam No. 26, TSS in grab samples ranged from 3 to 1,310 mg/l (July 1987 and June 1981, respectively), with a mean value of 175 mg/l.

and that found in a more intensive sample collection.[11] The raw intake TSS for the current Alton facility (as estimated by turbidity) is 180 mg/L. Therefore the four estimates of annual average TSS at Alton (156, 171, 175, and 180 mg/L) are fairly consistent and representative. *Id.*

46. The data also suggest that TSS concentrations fluctuate seasonally. Peak months for TSS correlate with peak flow months (*i.e.*, March through June). March has the highest TSS, due to spring thawing action and subsequent mobilization of eroded clays and silts in the watershed. SSIS at 4-4. The applicable regulations do not specify any water quality standard for TSS, and the general use water quality standard for total dissolved solids ("TDS") is 1,000 mg/l. 35 Ill. Adm. Code 302.208.

47. Dissolved iron concentrations in the River near Alton were also available from USGS data records. The daily values over the period from March 1989 through September 1994 (based on data collected on individual days in a scheduled month) ranged from 3 to 710 micrograms per liter ("ug/l") (May 1993 and November 1992, respectively), with an average value of 36 ug/l.[12] SSIS at 4-4. The general use water quality standard for dissolved iron is 1 mg/l -- *i.e.*, 1,000 ug/l. 35 Ill. Adm. Code 302.208(g). USGS records of daily aluminum values from March 1989 through September 1994 ranged from 10 to 220 ug/l (the latter on only one occasion in

[11] The mean value of TSS from grab sample data both before and after the relocation and construction of Lock and Dam No. 26 (the years 1975 to 1994) is 175 mg/l, which also is consistent with the average monthly value of 171 mg/l.

[12] The daily values for dissolved iron over the period both before and after the relocation and construction of Lock and Dam No. 26, based on sampling from January 1975 through September 1994 ranged from 3 to 1,000 ug/l (July 1985 and January 1985, respectively), with an average value of 63 ug/l.

November 1993), with an average of 26 ug/l.[13] SSIS at 4-4. Illinois has no water quality standards for aluminum.

Mussel Habitat Near the Replacement Facility Site

48. Discussions with Illinois EPA in August, 1997 identified the need for a characterization of the potential mussel habitat near River Mile 204 in the vicinity of the proposed intake and discharge pipes. Based on a protocol reviewed and approved by Illinois EPA, the survey was undertaken to characterize the potential mussel habitat found offshore of the replacement facility site and to determine the potential presence of protected (*i.e.*, threatened and endangered) mussel species. Sampling was conducted at six (6) transects bracketing the existing Alton facility. The upstream limit was 100 meters upstream of the existing intake location and the downstream limit was 400 meters below the proposed discharge location. Diver surveys were conducted along these six transects. SSIS at 4-5.

49. The survey results show that the area does not support a unionid community. *See* SSIS at Appendix B ("Unionid Survey"), p. 5. No living animals were found in the study area and only the shells of eight species were collected. None of the collected species were federal or Illinois protected mussel species. Only the shells of *Leptodea fragilis* were represented by freshly dead shells; the remaining shells were weathered or sub-fossil. SSIS at 4-5. The Unionid Survey concludes: "Given that habitat conditions within the study area are unsuitable for unionid colonization, and no

[13] Daily aluminum values from both before and after the relocation and construction of Lock and Dam No. 26, including samples between November 1982 and September 1994, also ranged from 10 to 220 ug/l, but with an average of 42 ug/l.

unionids were found, construction and operation of the water intake and treatment discharge should not impact unionids." *Id.* at Appendix B, p. 8. A follow-up communication from the consultant who performed the study confirmed that both upstream and downstream of the facility, silt deposition was similar at comparable depths. *Id.* at 5-16 to 5-17.

Compliance Alternatives and Efforts Which
<u>Would Be Necessary to Achieve Compliance</u>

50. Section 106.705(e) of the Procedural Rules provides that the petition must describe the efforts which would be necessary if the petitioner were to comply with the regulation of general applicability. Further, the petition must discuss all compliance alternatives, with the corresponding costs for each alternative. The discussion of costs shall include the overall capital costs as well as the annualized capital and operating costs. Illinois EPA suggested, and the Water Company agrees, that the SSIS should evaluate treatment technologies for residual control in detail and determine which treatment technology provides the best degree of treatment ("BDT") for the Superpulsator® and filter residuals using the factors identified in 35 Ill. Adm. Code 304.102.[14/]

[14/] This Board regulation also encompasses several integral BPJ factors, including examination of the process employed, the engineering aspects of the application of various types of control techniques, process changes, and a cost-benefit analysis. It requires that dischargers must provide the Best Degree of Treatment ("BDT") consistent with technological feasibility, economic reasonableness and sound engineering judgment. BDT factors considered in this context are: 1) the degree of waste reduction that can be achieved by process change, improved housekeeping and recovery of individual waste components for reuse; and 2) whether individual process wastewater streams should be segregated or combined.

51. As a first step in the determination of BDT, it is necessary to identify available treatment technologies and select appropriate candidate technologies for application at the proposed replacement site. The SSIS identifies a number of residuals management control technologies as available treatment technologies for residual control. One major consideration in the selection of candidate technologies is the turbid and hydrologically variable nature of the River near Alton. This variability is documented in Section 4.3 of the SSIS, based on over 20 years of USGS data and available intake water turbidity of the current Alton facility. The records indicate average TSS levels of 180 mg/l, average turbidity at 90 NTU and extremely dynamic variation on a daily, seasonal, and yearly basis. These environmental conditions constitute a scenario which had been recognized as problematic during the development of proposed national guidelines. The fact that EPA never promulgated industry-wide effluent standards indicates that water supply facilities and their source waters are too different for industry-wide standards to be useful. Consequently, ability to deal with a highly dynamic TSS load is an important selection factor. SSIS at 6-2.

52. Six technologies were screened to select appropriate candidate technologies for application at the replacement facility site: 1) direct discharge to the River; 2) land application; 3) temporary storage and dewatering in lagoons, and off-site landfilling; 4) permanent storage in monofills; 5) discharge to the Alton Publicly Owned Treatment Works ("POTW"); and 6) sludge dewatering and subsequent landfilling. SSIS at 6-2 to 6-7. The technologies were screened based on site-specific factors including the nature

and quantity of settled solids produced, climatic factors, land availability, and past performance history of various technologies.

53. The SSIS provides the following discussion of the respective control technologies.

1) <u>Direct Discharge to River</u>

Direct discharge of all residuals from the proposed replacement facility to the River will serve as the base case. It is predicted that an estimated average of 3,358 dry tons of solids will be discharged from the replacement facility each year. Of the total solids discharged annually (based on a coagulant dosage rate of 40 ppm), approximately 8.7 percent, or 580,000 pounds, are coagulant residuals. That is, they are produced by the addition of the chemical coagulants themselves. Of this amount, metals only constitute a small fraction. For example, Clar+Ion® is approximately 20 percent organic polymer and about 80 percent alum, of which aluminum accounts for 5 percent (based on molecular weight). Therefore, the amount of coagulant-based aluminum in the effluent is 8.7 percent X 0.8 X 0.05 = 0.348 percent, which constitutes a very minor percentage (and is comparable to the East St. Louis drinking water facility). As noted above, the production rates of total suspended solids are highly variable, depending on River suspended solids. The current practice of direct discharge to the River provides operational flexibility when dealing with the wide variations expected in the rate of solids generation.

2) Land Application

The management of residuals by land application includes temporary storage of residuals at the proposed replacement facility site, followed by transportation and application of residuals to local agricultural land. The residuals would be applied either as a liquid form or as dewatered residuals termed "cake." For the former application method, liquid residuals (*e.g.*, 5% solids) would be stored, loaded into 6,000 gallon tanker trucks and hauled to the application area. The liquid residuals would then be injected into the soil (fallow or with crops) by specialized equipment or applied to the soil surface with spray equipment. Residuals applied to the soil surface would then be disked or plowed into the soil within 24 hours of application. Land application of liquid residuals (including hauling and application) can cost between $70 to $300 per dry ton (depending on the hauling distance). Since significant agricultural land is not available in the immediate vicinity of the facility and is less likely to be available in the future (as there is an increasing trend for residential growth in the area), the high end of the cost range was considered more appropriate. The total cost of land application of liquid residuals, including on-site holding facilities, was considered comparable to the cost of dewatering lagoons or belt press dewatering followed by landfilling (*see* Option 6B or 6C discussed below).

Application of dewatered cake was also considered. Dewatered residuals (*e.g.*, 25% solids) would be stored, loaded into lined dump trucks and hauled to the application area. Weather permitting (*i.e.*, ground not frozen or saturated), the residuals could then be applied in thin layers to the soil directly from the truck or by using equipment like a manure spreader. Similar to the liquid form, the cake residuals would then be incorporated into the soil via disking or plowing. Land application of dewatered residuals (including hauling and application) can cost between $20 and $68 per dry ton. This method is very similar to that of Option 6C (*i.e.*, landfill disposal after mechanical dewatering), except that the final destination is widespread application to farm fields rather than to a landfill facility.

For either land application method, weather, public acceptance, permit requirements, and land availability can limit feasibility. In the Alton area, inclement weather does not seriously limit land application, but application or injection to frozen soil may not be feasible for some winter months. Biosolids from the Godfrey wastewater treatment plant have been successfully applied to nearby land ten months of the year for the last 10 years; however, public acceptance of residuals may be considerably less than for biosolids (considered a soil enhancement due to carbon and nutrient content) because the residuals add little to (or detract from) soil fertility. Land application is further complicated by permit regulations concerning the content of applied materials.

Based on the estimated average annual mass of approximately 3,358 tons of residual solids from outfalls potentially containing coagulant residuals, and a representative drinking water facility residual metals content, an estimate of annual metals loading was made. Due to the manganese content of these solids (1760 ppm) and the Illinois (35 Ill. Adm. Code 391.420(c)) lifetime recommended cumulative mass loading of 900 pounds of manganese per acre, 263 acres acquired every twenty years for land application of these residuals to soils would be required. Potential concerns with other heavy metals and elements may also exist in a land application scenario. Due to the potentially large amount of land required for every twenty years of operation (based on the maximum potential manganese load), this technology would be less preferable.

While land application of residuals is technically feasible, it is associated with considerable uncertainty, due to the highly variable nature of the River and the resulting variability of the residuals. Further, the potential costs appear to be similar to other more conventional residuals management techniques. Given these factors, land application was eliminated from further consideration.

3) Temporary Storage and Dewatering in Lagoons, and Offsite Landfilling

This technology would involve the construction of on-site lagoons for dewatering of the water treatment residuals. Residuals flow would be diverted into the dewatering lagoons and would be dewatered to approximately 4% solids. Then, the residuals would be removed and further dewatered by a mechanical dewatering system to approximately 25% solids. Following the second dewatering, the residuals would be shipped to an offsite landfill.

4) Permanent Storage in Monofills

This technology involves the construction of impoundments for permanent storage of the residual solids. The supernatant from the impoundment can either be recycled to the head of the treatment facility or it could be treated if necessary prior to discharge. Based on the average loading of 92 tons of wet residuals (10% solids) per day over a typical 20 year operating period, a 40-acre monofill (14 foot depth) would be required. The proposed Alton facility property is not large enough for such a facility. Additional farmland offsite would have to be purchased (at $6,000 to $10,000 per acre) to implement this option. However, the construction of a large, lined impoundment would cost at least $20 million, based on preliminary estimates. Annual operation and maintenance costs would be approximately $1.3 million. Further drawbacks of this technology are that disposal in monofills will likely limit the future use of the land and replacement monofills will be continually required. Due to these factors, this technology is less preferable and has been eliminated from further consideration.

5) Discharge to Alton POTW

This option was investigated because it is commonly used by many other potential NPDES dischargers; however, the estimated flow and mass of solids could not be treated at the relatively small POTW without POTW expansion. The flexibility of POTW future operations would be severely curtailed by accepting the water treatment facility residuals. This option has been explored on a preliminary basis with the Alton POTW staff who have indicated that it is not feasible, based on potential hydraulic overload of the adjacent sewer system, inadequate slope of the inceptor sewer, elimination of the POTW's reserve capacity, and a quadrupling of the solids loading (*see* letter from James Blaine to Kim Gardner in Appendix A of the SSIS).

The cost and technical feasibility of expansion of the POTW would be similar to that of the petitioner constructing an on-site treatment facility (such as the lagoon or belt press systems described here). Based on consideration of the above factors, the POTW alternative is less preferable and has been eliminated from further consideration.

6) Sludge Dewatering and Subsequent Landfilling

In the screening of this family of technologies, non-mechanical and mechanical dewatering techniques were reviewed as methods to prepare the settled solids for offsite landfilling. Analysis of residuals handling methods was based on industry experiences with alum-based residuals. The proposed replacement facility will use a Clar⁺Ion® type alum-organic polymer coagulant. However, these methods are expected to be directly applicable for treatment of Clar⁺Ion®-based residuals.

6)A) Non-Mechanical Dewatering Processes

Either non-mechanical dewatering or mechanical dewatering (6B, below) would be required for sludge dewatering and subsequent landfilling (alternative 6). Non-mechanical dewatering relies on drainage, decanting, evaporation, and freezing processes. It is commonly used for dewatering residuals, because of its simplicity and low operational costs. However, non-mechanical processes are often subject to disruptions, due to climatic fluctuations. Also, non-mechanical processes, perhaps even more so than mechanical processes, could be plagued by having a low overload capacity in the event that the rate of solids production were to be higher than planned. Potential non-mechanical technologies include sand drying beds and natural freeze-thaw drying beds. The most efficient way to utilize a drying bed system is to combine the freeze-thaw operation and conventional sand drying operations during the course of the year. This option is similar in feasibility and cost to dewatering lagoons. However, because it requires more area than dewatering lagoons and construction costs are slightly higher (based on preliminary unit cost estimates), the drying beds were not considered further.

6)B) Mechanical Dewatering Processes

A variety of mechanical dewatering methods have been screened. These processes are typically utilized in the water industry when insufficient space is available for non-mechanical processes, high solids concentrations are required for disposal, or when economics dictate their use. Mechanical processes are less susceptible than non-mechanical processes to inclement weather conditions. The mechanical processes included in this initial screening included vacuum filtration, filter pressing, and centrifugation.

(i) In the vacuum filtration of residuals, a pre-coated rotating drum surface is subjected to a vacuum to dewater the solids and to form a cake. While vacuum filters have been routinely used in the wastewater treatment industry, they have been reportedly evaluated only on pilot scale for a sludge application due to problems with the conditioning chemicals and the poor cake yield. Therefore, no further consideration will be given to vacuum filtration.

(ii) The belt filter press utilizes a well known and reliable technology which has been used in the water industry for 25 years.

Conditioning of residuals is required prior to press operations, and operational data indicate that a solids concentration of 15 to 25 percent is typically achieved. Despite the higher capital and operating costs associated with a filter press compared to certain non-mechanical means, the higher density sludge may translate into cost savings, due to the lower volume of material to be landfilled. As a result of the belt filter press method's reliability and operational characteristics, further analysis was performed for the filter press dewatering process and subsequent landfilling of the dried cake. Land is available at the proposed site to house the required filter press units and associated tankage.

(iii) Centrifugation is the final mechanical process considered. Several different varieties of centrifuges are commercially available. However, the solid bowl centrifuge is the most common. These units can operate in either the co-current or counter-current flow modes. Centrifuges have become an acceptable mechanical dewatering technology and have proven to be capable of dewatering sludges. The centrifugation and filter press technologies would require similar auxiliary equipment and the resulting costs would likely be the same. However, due to the fact that mechanical belt filter presses are the more common technology, are in use at other public water supply facilities to which Illinois-American has direct technical access (*i.e.*, "sister" operations in other locations in the U.S.) and centrifugation has had a poor success record in dealing with

Mississippi River silts, the belt filter press technology was selected as the mechanical dewatering technique for which further analysis would be performed.

6)C) Landfilling of Dewatered Residuals

Not an alternative in itself, this technology was considered as a potential component of several technology alternatives, such as temporary storage and dewatering in lagoons with offsite landfilling (alternative 3), and the mechanical and non-mechanical dewatering processes (alternatives 6A and 6B). The landfilling of dewatered water treatment facility residuals in Illinois is permissible. Provided that the dewatered solids are not hazardous waste under Resource Conservation and Recover Act ("RCRA") regulations, the dewatered solids can be landfilled in a permitted non-hazardous special waste landfill.

Preliminary discussions with the operator of the nearest landfill (Waste Management Inc.) which accepts water treatment facility residuals, located in Granite City, Illinois, indicate that there is sufficient landfill capacity to receive these residuals for 30 years. However, as landfill capacity diminishes and tipping fees escalate, it is likely that it may become more economical to construct dedicated landfills solely for the management of the water treatment facility residuals. As noted in the discussion of monofills (*i.e.*, Treatment Technology Number 4), the diminishment of existing landfill capacity and the high capital cost of constructing new landfill capacity are major drawbacks to landfill disposal.

54. Based on their technical feasibility and economic reasonableness, two candidate technologies were selected for further evaluation along with the direct discharge option. Application of either of the two candidate technologies would result in the estimated Alton effluent discharges meeting Illinois water quality standards for TSS. The two selected technologies are:

- Construction of four on-site sludge storage lagoons for dewatering of the solids by non-mechanical means, and subsequent offsite landfilling of the dewatered residuals;
- A belt filter press for dewatering of the solids by mechanical means, at the facility, and subsequent offsite landfilling of the dewatered residuals.

SSIS at 6-7.

Temporary Storage and Dewatering in Lagoons was selected for the following reasons:

- Reliable operation with minimal maintenance requirements; and
- Site is large enough to construct lagoon system.

Belt Filter Press Dewatering was selected for the following reasons:

- Site is large enough for buildings required to house the press dewatering system; and
- Reliable operation which produces consistently dense residuals.

55. In order for the facility to produce an average of 10.5 MGD of potable water (forecasted demand in 15 years), 11.2 MGD of water must be withdrawn from the

River. Under average river sediment conditions (TSS = 180 mg/l) at the flows described above, the facility will produce approximately 3,400 tons of dry solids per year from proposed discharges which will require treatment for removal of solids. Under these conditions, the average discharge flow rate of this effluent will be 1.0 MGD. SSIS at 6-8.

56. It is anticipated that temporary storage and dewatering in lagoons (non-mechanical dewatering) with subsequent off-site landfilling would require construction of four on-site lagoons for dewatering the water treatment residuals. Residuals flow would be diverted into one of the four dewatering lagoons. Residuals would be stored in the lagoons to allow dewatering to approximately four percent (4%) solids. The residuals would then be removed and further dewatered by a temporary mechanical dewatering system which would dewater the lagoon residuals to approximately twenty five percent (25%) solids. Following the dewatering the residuals would be transported to an off-site landfill. SSIS at 6-4.

57. The second candidate technology involves belt filter press dewatering -- a permanent mechanical dewatering process which would involve conditioning the residuals prior to press operations. Operational data indicate that a solids concentration of 15 to 25 percent is typically achieved through this process. This candidate technology also requires off-site landfilling of the dewatered residuals.

58. Originally each each of the candidate technologies (lagoons alone and belt filter press dewatering alone) was considered separately. The original lagoon design called for two, three-acre lagoons. Upon consideration of additional site information

(*i.e.*, required site preparation), the lagoon design was refined to include four, one-acre lagoons combined with additional mechanical dewatering equipment. The four lagoons require less subsurface exacavtion and less land area than the previous design. SSIS at 6-8. Cost estimates were made for the lagoon (non-mechanical) dewatering technology alone, for the belt filter press (permanent mechanical) dewatering technology alone, and for the combination of the two. For purposes of comparison, cost estimates for both non-mechanical and mechanical dewatering technologies, as well as the combination of the two are presented in Appendix D of the SSIS.

59. The cost estimate for non-mechanical dewatering as originally designed (two, three-acre on-site lagoons and off-site landfilling) is detailed in Table D-1 of Appendix D of the SSIS. Major cost items associated with this option are: (1) construction of two on-site solids dewatering lagoons; (2) collection of the supernatant from the lagoons and discharge of water to the River; and (3) landfilling dried sludge at a local landfill. The annualized total cost for this option is approximately $1,580,000.[15] The overall capital cost for this option is approximately $4,580,000, the annualized capital cost is approximately $450,000, and the annualized operation cost is approximately $1,130,000.

60. The cost estimate for the refined (combined) technology of four on-site lagoons, permanent mechanical dewatering by belt filter presses, and subsequent landfilling is detailed in Table D-1A of Appendix D of the SSIS. Major cost items associated with this option include: (1) construction of four on-site solids dewatering

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[15] All costs are rounded to the nearest $10,000. The annualized costs figure assumes capital costs are amortized over 30 years at a 9% interest rate.

lagoons; (2) collection of the supernatant from the lagoons and discharge of water to the River; (3) installation of permanent filter presses to mechanically dewater lagoon residuals to a solids concentration of 25%; and (4) landfilling dried sludge at a local landfill. The annualized total cost for this option is approximately $1,140,000. The overall capital cost for this option is approximately $7,380,000, the annualized capital cost is approximately $720,000 and the annualized operation cost is approximately $420,000.

61. The cost estimate for the belt filter press dewatering and subsequent landfilling option (without lagoons) is detailed in Table D-2 of Appendix D of the SSIS. Major cost items associated with this option are: (1) installation of one equalization/storage tank; (2) construction of on-site residual collection tanks and ancillary equipment; (3) installation of one thickener; (4) installation of large filter presses and backup units and associated auxiliary facilities sized to handle peak hydraulic conditions; (5) collection of overflow and discharge to the River; (6) collection of filtrate/washwater and return to the treatment facility; and (7) landfilling sludge at a local landfill at a solids concentration of 25% in the treated sludge. The annualized total cost for this option is approximately $1,630,000. The overall capital cost is for this option is approximately $10,800,000, the annualized capital cost is approximately $1,130,000, and the annualized operation cost is approximately $570,000.

Narrative Description of the Proposed Adjusted Standard

62. Section 106.705(f) of the Procedural Rules provides that the petition must include a narrative description of the proposed adjusted standard as well as proposed language for a Board order which would impose the standard. Efforts necessary to achieve this proposed standard and the corresponding costs must also be presented. Such cost information shall include the overall capital cost as well as the annualized capital and operating costs.

63. The Water Company petitions the Board to adopt the following adjusted standard as Section 304.223 (or other appropriate designation) under the Board's regulations governing effluent standards, 35 Ill. Adm. Code Subtitle C, Part 304:

> This section applies to the replacement potable drinking water treatment facility owned by Illinois-American Water Company ("Company") which will be located near River mile 204 in Alton, Illinois, and which will obtain its raw water supply from, and discharge to, the Mississippi River. Such discharges from the facility shall not be subject to the effluent standards for total suspended solids and total iron of Section 304.124, nor to the regulation of discharge solids or turbidity provided in Sections 304.106 and 302.203.

64. Efforts and costs necessary to achieve the proposed adjusted standard: Achieving the proposed adjusted standard at the replacement facility will require the facility to implement all requirements which may be imposed in its permit, such as BDT requirements. As discussed in the next section, the SSIS data and the replacement facility's use of new, state of the art equipment, such as the Superpulsator®, will ensure that the impact of its discharge is equal to or better than that of the discharge from all of the similarly situated Mississippi River facilities, all of which the Board has allowed

to discharge to the River -- *i.e.*, the existing Alton facility, Rock Island, East Moline and East St. Louis.

The Quantitative and Qualitative Impact of the Petitioner's Activity on the Environment Resulting from Compliance with the Regulation of General Applicability as Compared to Compliance with the Proposed Adjusted Standard

65. Section 106.705(g) of the Procedural Rules provides that the petition must compare the qualitative and quantitative nature of emissions, discharges or releases which would be expected from compliance with the regulation of general applicability as opposed to that which would be expected from compliance with the proposed adjusted standard. To the extent applicable, the petitioner must also discuss cross-media impacts (those which concern subject areas other than those addressed by the regulation of general applicability and the proposed adjusted standard). Finally, Section 28.1(c)(3) of the Act, which applies to all adjusted standard petitions, requires the petitioner to submit adequate proof that "the adjusted standard will not result in environmental or health effects substantially and significantly more adverse than the effects considered by the Board in adopting the rule of general applicability."

66. As a preliminary matter, the Water Company notes that because of a lack of significant adverse environmental impact, combined with significant adverse economic impact and discharge disposal concerns, relief from the generally applicable industrial effluent standards is the appropriate *de facto* rule of general applicability for public water supply treatment facilities which receive their raw water from the River and do not use the lime softening process. This is the category of facilities to which the replacement facility belongs, as do the facilities currently serving Rock Island, Alton, East Moline

and East St. Louis. As a result, the qualitative and quantitative factors pertaining to the replacement facility should be judged similarly to these facilities for purposes of the Act's adjusted standard factors (*i.e.*, Sections 28.1 and 28.3 of the Act and the BPJ and BPT factors).

67. The potential environmental impacts from the effluent of the replacement facility on water quality and biota of the River in the vicinity of the potential discharge are evaluated in the SSIS in significant detail. The SSIS examines impacts to both the water column and sediments. Also, potential impacts to biota are evaluated.

68. Other impacts considered under the site-specific analysis include: identification of frequency and extent of discharges; identification of potential for unnatural bottom deposits, odors, unnatural floating material or color; stream morphology and results of stream chemical analyses; evaluation of stream sediment analyses; and pollution prevention evaluation. As discussed in this section of the Petition, the SSIS found that no adverse environmental impacts will result from the proposed rule.

<u>Modeling Water Quality Effects</u>

69. Water quality effects of the replacement facility discharges were evaluated by analyzing physical and chemical impacts from increases in the dissolved or total suspended load to the River and the effect of materials settling out and accumulating on the bottom of the River. Since it is unlikely that all the discharge TSS will remain completely in suspension or completely settle out, the results of these types of modeling

analyses were used as end points to estimate the potential range of environmental effects. SSIS at 5-2.

70. In addition, the SSIS evaluates the effect of chemical coagulant used in the replacement facility. The primary coagulant proposed to be used at the replacement facility is Clar⁺Ion®, an alum-organic polymer mixture. The SSIS also evaluates the potential for iron (all of which is from the River) and aluminum from the replacement facility to pose any adverse ecological effects. Of these two chemicals, only dissolved iron has an Illinois Water Quality Standard, which is 0.5 mg/l. 35 Ill. Adm. Code 302.208. Aluminum has an Ambient Water Quality Criteria ("AWQC") value of 0.87 mg/l (87 ug/l). *See* 63 Fed. Reg. 68354 (1998).

71. A series of analyses were made of potential impacts on the receiving waters (*i.e.*, the River near River Mile 204) from the proposed Alton facility effluent discharges. The purpose of the modeling was to predict final mixed concentrations of TSS, iron, and aluminum at the edge of the mixing zone and to provide estimates of elevated concentrations of TSS downstream of the Alton discharge. These results were then compared to ambient receiving water conditions to indicate the relative effect of the discharges. SSIS at 5-2.

72. Two types of modeling were conducted: (1) a simple mass balance equation to predict the final mixed concentrations of the Mississippi River; and (2) a dynamic model using CORMIX to predict concentrations within the mixing plume. The former was used to evaluate final concentrations, whereas the latter was used to prove

a visual estimate (or "footprint") of elevated TSS values below the discharge points. Details of the CORMIX modeling are provided in Appendix F of the SSIS.

73. Several models were developed to determine potential impacts on the River from the replacement facility's effluent discharges. Two flow/TSS/coagulant scenarios were examined. Test parameters were as follows: application of coagulant was modeled with two receiving water TSS concentrations (approximate daily minimum and monthly maximum values for the River near Alton) under two receiving water flows (the seven day, ten year low flow and the annual average flow, respectively). Under the low flow model scenario (*i.e.*, low ambient river TSS and 7Q10 low flow), the dimensions of the discharge plume (defined by a limit of a >1.0 mg/l increase in TSS above ambient) are approximately 400 ft. by 25 ft. (0.28 acre), of which about 175 ft. by 30 ft. (0.12 acre) reaches the River surface at TSS concentrations of 1.0 - 2.5 mg/l above ambient levels. Design flows and concentrations of the Superpulsator® and filter backwash for evaluation of the proposed replacement facility were determined by application of removal rates on incoming raw water, based on pilot facility results and the design described in Section 3.0 of the SSIS. The flow amount and effluent TSS concentration of the removal technologies were sensitive to intake TSS amounts. SSIS at 5-2.

74. The modeling results indicate that, under worst case, low flow conditions, incremental increases from the replacement facility's operations will not lead to significant changes in water quality and will not cause violations of ambient water quality criteria ("AWQC"). To test the potential magnitude of change for TSS, design low flow and the daily minimum regime were examined. The test conditions assumed a 7Q10 low

flow and a river TSS of 20 mg/l. Only 25% of the River volume was used for the area of mixing, as allowed by 35 Ill. Adm. Code 302.102 for constituents whose existing ambient levels in the receiving water do not exceed water quality standards.[16] The results indicate that, regardless of the ambient TSS condition, TSS concentrations of the River increase by less than 0.5% over a wide range of ambient conditions. The negligible River TSS increases are well within daily variation and are likely to be analytically undetectable. SSIS at 5-3.

75. The results of the dynamic mixing zone model are shown graphically in Figures 5-1 and 5-2 of the SSIS. Figure 5-1 presents an aerial view of the location of the predicted TSS plume resulting from the discharge. Figure 5-2 presents a more detailed aerial view of the same predicted TSS plume as presented in Figure 5-1. Contours (or isopleths) are plotted for various TSS concentrations above ambient conditions between 1.0 and 5.0 mg/l. The figure shows that the River velocity quickly overcomes the initial discharge momentum (perpendicular to flow away from the shoreline). The edge of the plume, represented by a 1.0 mg/l contour, reaches approximately 400 feet downstream and achieves a maximum width of approximately 30 feet. The distance at which the plume reaches the surface is approximately 225 feet, and all predicted concentrations are below 2.5 mg/l; therefore this model predicts that a River surface area of approximately 175 ft. by 25 ft. (or 0.12 acre) will be subject to TSS concentrations 1.0 to 2.5 mg/l higher than ambient. This range of TSS concentrations

[16] There is no applicable Illinois Water Quality Standard for TSS, and these test conditions were simply used for comparative purposes.

represents values that are 5 to 13% above ambient levels. The SSIS concludes that the lower end of the range represents a value that will be difficult to visually discern and very difficult to measure with conventional instrumentation. SSIS at 5-4.

76. Similarly, the results of projecting the proposed effluent discharges on ambient dissolved aluminum and iron River concentrations -- representing the annual mean value and daily maximum under low flow conditions -- indicate that the amount of coagulant added will not lead to an exceedance of the respective federal AWQCs for either aluminum or iron, even under low flow conditions. SSIS at 5-4. As such, these incremental increases will not adversely impact water quality. *Id.* In projecting these impacts, the amount of dissolved aluminum or dissolved iron arising from use of Clar⁺Ion® coagulant was considered. The dissolved fractions were used to address potential ecotoxicological concerns, because particulate fractions are usually considered non-bioavailable. *Id.*

77. To project the impacts of effluent discharges on dissolved aluminum and iron River concentrations, the amount of metal/metalloid in the Superpulsator® effluent was based on coagulant application rates (function of TSS levels) and stoichiometric considerations. For Clar⁺Ion® type coagulants; the percentage of aluminum is approximately 4%. To estimate dissolved iron, the average value of clarifier and filter backwash effluent discharge concentrations were used. All of the aluminum or iron was assumed to be in the dissolved fraction; as this is unlikely to occur under actual field conditions, this assumption provides a conservative, worst-case scenario. Mean values of iron concentrations from a series of analyses from the filter backwash of the existing

Alton facility were used to estimate metal concentrations in the clarifier backwash. Total and dissolved fractions of iron were measured in samples of the River and the existing Alton facility discharges taken in December 1996 and February 1997. During this period, Clar$^+$Ion® was used as the primary coagulant at the existing Alton facility. The filter backwash had a mean dissolved iron value of 0.009 mg/l, which is below the water quality standard of 0.5 mg/l for the receiving water. This value was judged to be acceptable, because most of the coagulant is added prior to the Superpulsator® and is likely to be mostly discharged with Superpulsator® effluent; the basic filter backwash technology will not be altered in the proposed facility; and the incoming River silts remain the same. SSIS at 5-4.

78. As a further check, the potential for the proposed facility effluent discharge to cause an exceedance of the Illinois Water Quality Standard for total dissolved solids ("TDS") of 1,000 mg/l was also qualitatively evaluated. Review of available USGS water quality data from the gaging station below Grafton from 1990 to 1997 (over 50 observations) indicates that the average TDS concentration in the River at this point is 273 mg/l. There are no TDS data from the existing Alton facility discharge, but it was assumed for purposes of the SSIS that TDS equals TSS discharge levels. This is a highly conservative assumption, because the residual discharge is comprised primarily of settled particulate material. Using these assumed values for discharge and receiving water TDS, the proposed effluent outfall does not lead to an exceedance of the water quality standard even at effluent TDS concentrations two orders of magnitude greater than the conservatively assumed levels; therefore it can be

concluded that the proposed facility discharge will not lead to an exceedance of TDS standards in the receiving waters. SSIS at 5-4.

79. Since average flow conditions are more representative of typical flow conditions, a series of tests similar to those discussed in paragraphs 69 *et seq.*, above for low flow conditions were conducted using average annual flow of the River as the underlying hydrologic conditions, while conservatively assuming maximum monthly TSS discharges from the replacement facility. Under the typical flow model scenario (*i.e.*, monthly maximum TSS and mean River flow) the dimensions of the discharge plume (defined by a limit of a >2.5 mg/l increase in TSS above ambient) are approximately 5,250 ft. by 75 ft. (9.04 acre), of which about 650 ft. by 75 ft. (1.12 acre) reaches the River surface at TSS concentrations of 2.5 - 5.0 mg/l above ambient. These TSS inputs represent a 0.4 - 0.8% increase over ambient levels. As expected, test results for average flow conditions indicate an even lesser impact than under low flow conditions. SSIS at 5-5. The results also indicate that there is no potential that the replacement facility discharge will raise ambient water quality above acceptable levels. *Id.* Water quality is also not adversely impacted under average flow conditions. *Id.*

80. The potential for "turbidity of unnatural origin" was evaluated based on the results of the water quality TSS modeling and the likelihood of such turbidity resulting in an Offensive Condition (35 Ill. Adm. Code 302.203). Based on the level and spatial extent of the predicted turbidity increases, the SSIS concludes that the discharge from the replacement facility will not result in an Offensive Condition. SSIS at 5-22 to 5-23. In conjunction with modeling water column effects, the deposition of settleable

solids in the potential effluent discharges from the Superpulsators® and filter backwash were modeled to determine potential areal distribution in the sediments of the River. The analysis included performing particle deposition modeling based on several very conservative assumptions. SSIS at 5-6 to 5-10. Modeling results demonstrate that the daily residuals buildup is negligible under both critical low flow and average flow conditions. *Id.* at 5-10. The impact of the modeled discharges is hardly measurable. Long-term impact is also negligible, because River velocity and bedload transport also prevent buildup of deposited materials over time. *Id.*

81. The deposition of settleable solids in the potential effluent discharges from the Superpulsator® and filter backwash were modeled to determine potential areal distribution in the sediments of the Mississippi River. Settling velocities of the suspended solids in the discharges were analyzed to provide information on their quiescent settling behavior. Residuals arising from both the Claricone (comparable to proposed Superpulsator®) and filter backwash operations were available for analysis. The cumulative effect of both discharges (Superpulsator®, filters) were used for estimation of the potential benthic deposition from the proposed replacement facility. SSIS at 5-6.

82. The objective of particle deposition modeling was to predict rates of particle deposition on the riverbed as a result of the proposed outfall. A particle deposition model, based on the equations and methodologies presented in the U.S. EPA Section 301(h) Technical Support Document (U.S. EPA, 1994), was selected and applied. *See* Attachment J hereto. This model is recommended by U.S. EPA for screening level particle deposition evaluations. The particle deposition model results in

predictions of particle mass per area per time (*e.g.*, $g/m^2/yr$) deposited onto the riverbed. For details of the particle deposition model, *see* Appendix F of the SSIS. SSIS at 5-6.

83. Particle deposition modeling was focused on predicting long-term rates of particle deposition and accumulation resulting from the proposed outfall. Also, predictions of deposition and accumulation resulting from transient events, such as low river flows and filter backwashing, were required. Thus, a steady-state particle deposition scenario and two transient particle deposition scenarios were developed to evaluate particle deposition resulting from the proposed discharge. The steady-state scenario applied average values for River flowrate, River TSS concentration, discharge flowrate, and discharge TSS concentration, because the objective of the steady-state evaluation was to predict the long-term average rate of deposition. The transient scenarios specify extreme conditions (*e.g.*, high TSS or low flow) with the goal of predicting the impacts of worst-case transient events. Particle deposition modeling scenarios are specified below:

<u>Steady-State Scenario</u>

- River flowrate at average value of 106,589 cfs;
- Average annual discharge flowrate of 1.6 cfs (0.046 m^3/sec); and
- Average daily discharge TSS concentration of 2,092 mg/l.

<u>Transient Scenario #1: 7Q10 River Flowrate</u>

- River flowrate at the seven-day, 10-year low flow (7Q10) value of 21,500 cfs;
- Discharge flowrate of 1.6 cfs (equivalent to 0.046 m^3/sec);

- Average daily discharge TSS concentration of 296 mg/l; and
- Duration of event: 7 days in every 10 years.

Transient Scenario #2: Filter Backwash

- River flowrate at average value of 106,589 cfs;
- Discharge flowrate of 2.5 cfs (0.071 m^3/sec);
- Maximum daily discharge TSS concentration of 4,333 mg/l; and
- Duration of event: 15 minutes every 24 hours.

SSIS at 5-7.

84. The SSIS particle deposition modeling evaluation, however, is based on several very conservative assumptions, which result in the overprediction of the mass of particles settling on the riverbed. It is, for example, assumed that all particles settle out of the water column and onto the riverbed. The presence of large TSS concentrations (*e.g.*, up to 2,000 mg/l) in the ambient Mississippi River clearly indicates that all suspended solids do not settle out of the water column in this waterway. In addition, according to US Army Corps of Engineers ("US ACOE") personnel, suspended solids that are settleable generally settle in harbors or backwater areas, rather than in the main channel of the River. The proposed outfall is located near the main channel of the River. SSIS at 5-7.

85. The SSIS particle deposition modeling evaluation also overpredicts long-term sediment accumulation, because it assumes only average river flows, neglecting above average flows. Above average river flows and especially very large river flows are known to transport particles more effectively than smaller flows. Also, large river

flows are known to produce scour of the riverbed, picking up deposited materials and transporting them downstream. The net result of sediment scour is that more particles are deposited in areas with lower water velocities (*e.g.*, backwater areas) and less particles are deposited in the main channel. The particle deposition modeling evaluation assumes that no sediment scour occurs. SSIS at 5-7.

86. Relevant characteristics of the Mississippi River near the Alton facility were derived from a river stretch depth profile provided by the US ACOE, St. Louis office, and the literature. An estimate of velocity during low flow conditions was made by dividing 7Q10 river flow by the cross-sectional area of the channel near the discharge point at River Mile 204. Three channel cross-sections representing transects above, at, and below River Mile 204 are shown in Figure 4-7 of the SSIS. The average cross-sectional area of the three transects is approximately 63,813 square feet. The estimated velocity is approximately 0.34 ft./s or 0.10 m/s. A similar analysis for flow velocity during average annual flows provides a velocity of 1.35 ft./s or 0.411 m/s. SSIS at 5-8.

87. The exact location and depth of the replacement facility effluent discharge has not been determined. The discharge was assumed approximately 33 feet (10 m) offshore at a depth approximately equal to the maximum elevation for preserving the navigation clearance, or 4.5 feet. This corresponds to a height above bottom of 16.4 feet (5 m). SSIS at 5-8.

88. Five water samples were collected from the discharge of the current Alton facility on five separate dates in December 1996 and another set of four were sampled in February 1997. The first set of samples was collected before, during, and after

commencement of the filter backwash discharge. The second set of samples was taken at the initiation, during, and following clarifier blowdown. During both periods Clar+Ion® was being used as the primary coagulant. The initial TSS were measured, as was the final turbidity (in NTU) of the supernatant of the settled sample. Settling behavior of the solids was measured in an Imhoff cone, by monitoring over time the volume of settleable solids in the cone, as determined by observing the interface between the clear supernatant and turbid solids region. The data for these measurements from both clarifier and filter backwash are presented in Appendix C of the SSIS. SSIS at 5-8.

89. The settleable solids volume as a function of time is presented in Figure 5-5 (clarifier) and Figure 5-6 (filter backwash) of the SSIS. The results suggest little settling during the first 10 minutes (note: the settling interface is often hard to visually detect initially), but a major portion of the settling takes place within the first 20 minutes, with hindered settling and compression taking place thereafter. An average settling curve was constructed by averaging the results of the 4 or 5 trials for each process type. The average settling curve was used to estimate settling velocity. SSIS at 5-8.

90. Settling velocity was estimated by dividing a settling distance by an average settling time. The settling distance is the depth of clear supernatant from the top of the one liter mark of the Imhoff cone to the interface with the cloudy settleable solids portion. The settling distance was measured at the time (settling time) at which the initial linear portion of the settling curve ended and hindered settling and compaction began. Dilution of the discharge by River water will likely result in a settling regime more closely associated with discrete settling than with hindered settling or compaction,

which occurs under relatively quiescent conditions of low velocity and within a confined area. Therefore, only the initial linear part of the settling curve was used to compute settling velocities. The calculated settling velocity for the average settle curve was analyzed. From these calculations, an average settling velocity for the clarifier and filter backwash of 2.46×10^{-4} m/sec was estimated. SSIS at 5-9.

91. In order to quantify predictions of particle settling behavior resulting from the discharge of residual-associated TSS, three discrete particle sizes were chosen. These three representative particle size groups were then evaluated to determine settling rates, deposition areas, and accumulation rates for the three scenarios described in paragraph 89-90, above. The following three particle size ranges were assumed to characterize discharge TSS:

Large particle size: 25% of discharge TSS, particle size > 0.062 mm in diameter.

Medium particle size: 50% of discharge TSS, particle size between 0.062 mm and 0.039 mm in diameter.

Small particle size: 25% of discharge TSS, particle size between 0.039 mm and 0.0039 mm in diameter.

Particle size groups were assigned based on Imhoff cone settling measurements collected from the present discharge waters as discussed in paragraphs 89-90, above and sieve tests performed by the USGS on River water in Alton. Particle size groups selections are conservative in that all particles are assumed to be settleable. Also, the particle sizes listed above were validated using U.S. EPA guidance documents and were found to be typical of fine sand, silty sand, silt, silty clay, and clay that would be expected to be found in the discharge waters. SSIS at 5-10.

92. Results of modelling for the three scenarios were as follows:

Steady-State Scenario: Results of the steady-state particle deposition modeling scenario are presented in aerial view in Figure 5-7 of the SSIS. Table 5-6 of the SSIS contains the areas, deposition rates, accumulation rates predicted in the steady-state modeling scenario. Particle deposition rates of 4.38 $kg/ft^2/yr$, 0.037 $kg/ft^2/yr$, and 0.012 $kg/ft^2/yr$ were obtained for the three particle size groups, respectively. The large size particles were predicted to settle over an area of 4.1 acres and to accumulate 2.2 in/yr. Medium and small size particles were predicted to accumulate very little (less than 0.01 in/yr) over a larger area (565 acres). Due to the overlap of settling zones for the two smaller particle classes, only two zones of deposition are indicated on Figure 5-7 of the SSIS.

Transient Scenario #1: 7Q10 River Flow: Results of the transient scenario #1 particle deposition modeling are in Table 5-6 of the SSIS. Particle deposition rates of 0.039 kg/ft^2 and accumulation of 0.0275 inch per event over an area of 0.06 acres were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible. SSIS at 5-10.

Transient Scenario #2: Filter Backwash: Results of the transient scenario #2 particle deposition modeling are in Table 5-6 of the SSIS. Particle deposition rates of 0.003 kg/ft^2 and accumulation of 0.001 inch per event over an area of 1.04 acres were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible. SSIS at 5-10.

93. The SSIS concludes that the amount of daily buildup is negligible for the residuals either under critical low flow or average flow conditions. The impact of either of these modeled discharges can hardly be measured in the vertical. The current velocity and bedload transport will also tend to prevent buildup of deposited materials over time. SSIS at 5-10.

Characterization of Potential Environmental Impacts

94. The SSIS evaluates, in significant detail, the biological communities and habitats expected to occur in the vicinity of the proposed outfall and evaluates the types of potential impacts. The SSIS also considers sensitive species and habitats.

95. Major habitats near River Mile 204, as classified by the Baker system, include main channel, nearshore bank areas, pools and backwater slough areas. The proposed discharge location is within the nearshore bank habitat and adjacent to the other habitats. SSIS at 5-12. The SSIS also identifies fish and macroinvertebrates likely to occur in the vicinity of the proposed discharge based on their typical occurrence in the types of nearby habitats. The habitats are characterized as follows:

Main Channel Habitat: The main channel forms the major path for water flow in the river and is characterized by high current speeds, a fairly uniform sand and gravel substrate, high bottom bedload movement, and high suspended solids levels. In the vicinity of the proposed discharge, the main channel is actively used for navigation (*i.e.*, river barge traffic) which also leads to disturbance of the bottom and resuspension of materials. Due to the need to maintain navigation depths, the main channel is periodically dredged.

Nearshore Bank Habitat: Nearshore bank areas adjoin and merge with the channel habitat. These areas include both natural and artificially reinforced (*i.e.*, rip-rapped) shorelines. Current speeds are highly variable along banks, as a function of several factors including water depth, distance from shoreline, substrate type, and both natural (*e.g.*, fallen trees) and man-made (*e.g.*, transverse dike dams) obstructions. Upstream flow eddies may be present. Substrates are variable and may include consolidated clays and silts, sand and gravels, and muds. Water quality is similar to that of the channel habitat. Nearshore bank areas are found on the Illinois side of the River near the proposed discharge.

Pool Habitat: Pools are relatively deep, slack or slow-moving flow areas within the main River banks. Pools often form downstream of islands and usually adjoin sandbar and channel habitat. Pools are characterized by slow currents, relatively greater depths, and generally fine sediments. The areas and depths of river pools are usually dependent on river stage (*i.e.*, elevation). Pool water quality is usually less turbid, slightly warmer, and may exhibit higher primary productivity than the channel.

Slough Habitat: Sloughs are formed from abandoned or secondary river channels, which may be isolated from the main channel for varying periods of time. They are moderate-sized, slackwater habitats which form a continuous connection with the main channel during average to high river stages. Current speeds are often insufficient to scour the bottom so that large amounts of organic debris accumulates at the bottom. The enclosed channel, north of Piasa Island; the former river channels found on the Missouri side; and associated vegetated emergent bars provide slough habitat. SSIS at 5-13.

96. Fish and macroinvertebrates likely to occur in the vicinity of the proposed discharge were identified based on their typical occurrence in the types of habitats described in paragraph 95, above - namely main channel, nearshore bank areas, pools, and sloughs. Fish typically found in these subhabitats are identified in Table 5-7 of the SSIS, which provides both common and scientific names. The fish community in the main channel is comprised of a diverse mixture of open water species (*e.g.*, shads, skipjack herring, goldeneye and white and striped bass) and bottom-dwellers (*e.g.*, shovelnose sturgeon, carp, blue sucker, buffalofishes, catfishes, and freshwater drum). A similar suite of species typically occurs in nearshore bank areas along with American eel, white and black crappie, sauger, and a variety of smaller fishes (*e.g.*, sunfishes, minnows, silversides). Many of the same species listed above occur in pools and slough habitats, but pools may host paddlefish and sloughs may contain bowfin, pirateperch, mosquitofish, and largemouth bass. Macroinvertebrate communities vary among the habitats described above. Macroinvertebrate communities in the main channel are generally found to be low in diversity and abundance, dominated by clams, oligochaetes, chironimids, and nematodes, and concentrated in silt and clay accumulations. Nearshore macroinvertebrate communities in the area are often more diverse, due to more moderate velocity, substrate heterogeneity, and less disturbance, due to decreased bedload transport. Caddisflies (*trichopterans*) often dominate in areas of artificial materials, while mayflies (*ephemeropterans*) are found in natural shorelines with clayey substrates.

Depending on the nature of the substrate clams, oligochaetes, mayflies, caddisflies, or chironimids may be found in high abundance. Sloughs may contain similar types as well as phantom midge larvae (*Chaoborus*), if isolated from the main channel for extended periods. SSIS at 5-14

97. Physical (non-toxic) and toxic potential impacts were considered. Potential non-toxic impacts of suspended solids on biota include light reduction, abrasion feeding interference, sedimentation, and destruction of habitat. SSIS at 5-15 to 5-16. Certain fish species may tend to avoid waters of high TSS levels (*e.g.*, >500 mg/l) such that a small zone of avoidance may exist downstream of the replacement facility discharge. The CORMIX mixing model indicates that high TSS would be restricted to a small area immediately downstream of the discharge. This area should not adversely affect fish movements of migration, due to the small area of elevated TSS, the limited exposure duration during plume transit, and adaptation of the indigenous fish community to naturally-occurring TSS levels. *Id.* at 5-16.

98. Based on the ambient suspended solids content of the River and the minor increase in ambient TSS concentrations, no significant impact to riverine biota is expected in the area of the discharge plume and potential depositional area. This conclusion is based on the magnitude of the incremental increase in TSS (less than 1 percent under low flow conditions), the location and areal extent of above-ambient TSS concentrations, and the nature of the River flora and fauna. The River biota is routinely exposed to ambient TSS levels well above the anticipated incremental level in the vicinity of the discharge and the areal extent of elevated TSS concentrations is very limited.

Inspection of monthly TSS values from 1989-1995 indicates an approximate mean ambient River TSS of 175 mg/l and an average monthly range of 81 to 362 mg/l. Maximum suspended solid concentrations in the spring and early summer can run well above 600 mg/l.[17] SSIS at 5-16.

99. The River fish community is composed of warmwater species which are adapted to the highly turbid conditions which are characteristic of large rivers. Fish movement and migration of local species should be unaffected by the slight increase in suspended solids, which is negligible in magnitude to the seasonal patterns of suspended solids. The incremental increase of less than 1.0 mg/l predicted is unlikely to be discernible to these species. The limited areal distribution of the elevated TSS below the discharge would be easily avoided under any circumstances. The impact of the minor increase in total suspended solids (<1 percent) on ambient levels under low flow conditions should have no discernible effect on the underwater light regime. The impact of the elevated suspended solids on smaller planktonic organisms should likewise be negligible. The nature of the released solids (mainly raw River solids) should be compatible with the use of the water column by zooplankters and other filter-feeders. Filtration rates may be slightly adjusted in response to higher suspended particle concentrations, but levels are well below the natural range of suspended solids encountered by these species. SSIS at 5-16.

[17] Monthly TSS values from 1974-1995 (before and after relocation and construction of Lock and Dam No. 26) indicate an approximate mean ambient River TSS of 175 mg/l and an average monthly range of 81 to 464 mg/l. Maximum suspended solid concentrations in the spring and early summer have run above 1,300 mg/l at times from 1974-1995.

100. Finally, the minor rates of deposition of silty material on the River bottom predicted by the SSIS settling analysis are unlikely to bury sessile organisms found there. This conclusion is based on the nature of the bottom habitat characterization conducted by ESI in 1997 indicating unsuitable habitat conditions for unionid colonization and a relatively depauperate unionid community within a silty bottom environment. A follow-up communication from ESI confirmed that silt deposition was uniform with depth from both shoreline upstream and downstream of the facility. *See* letter in Appendix B of SSIS. This indicates that no observable silt accumulation has occurred due to the current facility discharge despite 100 years of operation at the site. These observations are consistent with the predictions of the particle deposition model and the dynamic nature of bottom contours in the River. These factors tend to further mitigate potential impacts to the benthos. SSIS at 5-17.

101. The evaluation of aluminum and iron included considering chemical characteristics of the receiving water, coagulant content of the effluent discharges, potential concentrations of coagulant in the mixing zone, other benchmark values (such as AWQCs), and results from other studies.

102. Aluminum is one of the most common elements in natural materials and is a major component of geologic materials and soils. Aluminum has been shown to be toxic to many types of aquatic life, but the degree of toxicity is highly dependent upon water chemistry and relative proportions of various aluminum forms or species. Studies indicate that the aluminum that is occluded in minerals, clays, and sand or is strongly adsorbed to particulate matter is not toxic, nor is likely to be toxic under natural

conditions. Evaluation of toxicity is made more difficult, because of the complex nature of aluminum geochemistry and its ubiquitous presence in high abundance in the environment. SSIS at 5-17.

103. Despite its abundance in geologic materials and soils, aluminum rarely occurs in solution in natural waters in concentrations above 1.0 mg/l, but exceptions are seen in waters of low pH. Reported concentrations of 1.0 mg/l in neutral pH waters containing no unusual concentrations of complexing ions probably consist of largely particulate material, including aluminum hydroxide and aluminosilicates. Mineral complexes such as gibbsite are very small (near 0.1 μm diameter) and may pass through conventional filters used to operationally separate "dissolved" fractions in water quality analyses. The long term average dissolved aluminum concentration in the River near Alton is 0.026 mg/l (SSIS, Table 4-7), with a range of 0.010 to 0.220 mg/l. It is not known what proportion of this aluminum is in a dissolved, monomeric form. Most toxicity studies of aluminum have been associated with investigations of the environmental effects due to acidic deposition, commonly referred to as "acid rain." Toxicity from aluminum has been shown to occur in dilute, softwater (poorly buffered) lakes or streams with low ambient pH conditions (*e.g.*, pH <6.0 standard units). The literature also indicates that aluminum has little toxic effect at pH >6.5. A recent United States Fish and Wildlife Service (USFW) compendium of the effects of aluminum on wildlife referred to it as being "innocuous under circumneutral or alkaline conditions." Typical pH values in the River near Alton are circumneutral to alkaline, typically between 7.5 and 9.0. SSIS at 5-18.

104. Application of the AWQC for aluminum (87 ug/l) was used for comparison purposes, but has no regulatory standing for the proposed replacement facility. A water quality criterion for aquatic life has regulatory impact only after it has been adopted in a State water quality standard. Illinois Water Quality Standards do not have a standard for aluminum. Comparison of the results described in Section 5.1.1 of the SSIS indicate that under all flow conditions the contribution of the coagulant-generated aluminum does not cause an exceedance of the 87 ug/l AWQC. Inspection of the aluminum AWQC document indicates the criteria value is due, in large part, to potential toxicity to certain salmonid species. Application of the criteria to protect salmonids is inappropriate, because this portion of the River does not contain preferred salmonid habitat. SSIS at 5-18. Further, comparison of AWQC toxicity results based on laboratory experiments in which the aluminum is directly applied as soluble salts (*e.g.*, aluminum chloride or aluminum sulfate) under low hardness conditions to predict toxicity of ambient dissolved aluminum concentrations in the River is probably conservative, due to the potential biologically unavailable aluminum. As indicated earlier, the high pH values found in the River would prevent aluminum toxicity from being a concern. *Id.*

105. A similar analysis was conducted for iron. Modeling of the concentration impact was conducted using the measured clarifier and filter backwash levels. The average filter discharge value of dissolved iron was 0.009 mg/l. The results of these models indicate that the discharge does not pose a threat to exceed the value of Illinois Water Quality Standard for dissolved iron of 1.0 mg/l in the mixing zone. Ill. Adm. Code 302.208(g); SSIS at 5-19.

106. Like aluminum, iron is both ubiquitous and found in a variety of mineral and complexed forms. It is largely biologically unavailable, except for the dissolved form, which is typically found in significant proportion under conditions of low pH and/or low oxygen. The pH levels of the River are consistently above 7.0 and the river stretch in question is unlikely to suffer from low dissolved oxygen due to its shallowness and velocity. SSIS at 5-19.

107. The SSIS reaches the following conclusions regarding toxic potential impacts: (1) site specific (*i.e.*, non-salmonid) species are more tolerant and potential aluminum toxicity is unlikely; (2) the River normal pH range is 7.5-9.0; (3) the hardness of the River is greater than 50 mg/l as $CaCO_3$; (4) impact to the benthic community was addressed by conducting a mussel survey which indicated no unionid community at the discharge location; (5) water velocity at the discharge point is moderate, approximately 1.4 feet per second or higher; and (6) an environmental assessment was made considering water use, sediments, water chemistry, hydrology, and receiving water biology. SSIS at 5-20.

108. The only metal of concern generated by the coagulant is aluminum, and this is only a trace amount of the facility's solids discharge -- about **one third of one percent** (0.348%). As such, based on the high levels of natural complexation of aluminum and the low probability of toxic effects from this very small addition, the replacement facility's discharge poses no significant potential impact to the River environment.

109. The replacement facility's discharge will have no significant impact on the River biota in the area of the discharge plume and potential depositional area because: 1) the discharge will result in only a minor increase in the naturally high suspended solids content of the River; and 2) the River biota is routinely exposed to ambient TSS levels well above the anticipated incremental level in the vicinity of the discharge. SSIS at 5-11; 5-17. Similarly, the iron and aluminum content of the effluent discharge was found to have no significant potential impact on the River environment and its biota. *Id.* at 5-21.

Justification of the Proposed Adjusted Standard

110. Section 106.705(h) of the Procedural Rules provides that the petition must contain a statement which explains how the petitioner seeks to justify, pursuant to the applicable level of justification, the proposed adjusted standard. Section 28.1(c) of the Act explains how this requirement must be met for petitions brought pursuant to Section 28.1.

111. The level of justification required for the adjusted standard sought by the Water Company is specified at Section 28.1(c):

1. factors relating to [the Water Company] are substantially and significantly different from the factors relied upon by the Board in adopting the general regulation applicable to [the Water Company];
2. the existence of those factors justifies an adjusted standard;
3. the requested standard will not result in environmental or health effects substantially and significantly more adverse than the effects considered by the Board in adopting the rule of general applicability; and
4. the adjusted standard is consistent with any applicable federal law.

415 Ill. Comp. Stat. 5/28.1(c).

112. Factors exist relating to the Water Company which are substantially and significantly different from factors relied upon by the Board in adopting the general regulation applicable to the Water Company. The existence of these factors justifies an adjusted standard, and the requested standard will not result in environmental or health effects substantially and significantly more adverse than the effects considered by the Board in adopting the rule of general applicability. As well, the adjusted standard is consistent with applicable federal law (*See* paras. 144-163, below). Specifically:

(i) The iron and TSS content of the Water Company's proposed discharge will not affect domestic uses, nor will it result in significant bottom deposits or excessive turbidity, which are the factors the Board relied upon in adopting these effluent criteria. When the Board adopted effluent criteria for iron (dissolved and total), it relied on the determination that "[w]hile iron's toxicity to man is low, excessive iron can cause a nuisance for domestic uses or undesirable bottom deposits." Opinion of the Board, PCB R 70-8 *et al.*, Jan. 6, 1972, at 16. The Board based the effluent criterion for total suspended solids on the determination that "[t]here is a need to keep down other suspended solids too in order to prevent excessive turbidity and harmful bottom deposits." *Id.* at 19.

(ii) Site specific impacts of the proposed Alton replacement facility will not vary significantly from those which would result from application of candidate control technologies – *i.e.*, on-site lagoons with subsequent off-site landfilling; and on-site lagoons combined with belt filter press dewatering and subsequent off-site landfilling.

The feasible candidate control technologies therefore do not provide effluent reduction benefits with regard to receiving water quality. The application of TSS treatment technology will not result in perceptible improvements in water quality or sediment quality, will not enhance habitat quality, and has no effect on local biota.

(iii) Although compliance with the regulation of general applicability is technically feasible in the sense that compliance can be achieved if the Water Company is required to implement on-site treatment technologies at considerable expense, direct discharge is warranted on economic grounds.

(iv) As noted above, the Board has granted relief to all similarly situated (non-lime softening) water treatment facilities that use the River as their raw water source. As a result of a lack of significant adverse environmental impact, combined with significant adverse economic impact and discharge disposal concerns, relief from the generally applicable industrial effluent standards is the appropriate *de facto* rule of general applicability for public water supply treatment facilities which receive their raw water from the River and do not use the lime softening process. This is the category of facilities to which the replacement facility belongs.

Discussion of Factors Justifying Adjusted Standard

113. Factors relating to the Water Company that justify the proposed adjusted standard turn on the absence of significant site specific environmental and health impacts of the replacement facility. Moreover, those impacts are not substantially or significantly more adverse than compliance with the generally applicable rule by means of one of the

candidate technologies -- *i.e.*, on-site lagoons with subsequent off-site landfilling and on-site lagoons combined with belt filter press dewatering and subsequent off-site landfilling.

114. To fully evaluate site specific impacts of the proposed Alton replacement facility, it is first necessary to examine what is considered BDT, as guided by the factors identified in 35 Ill. Adm. Code 304.102. Each of these factors is considered in detail below.

1) Technological Feasibility

115. A review of candidate control technologies for TSS control is provided in Section 6.1 of the SSIS and is discussed in specific detail in the Petition, above. *See* paras. 52-61, above. The various technologies assessed included direct discharge (current practice), land application, monofills, discharge to POTW, and various sludge dewatering methods with subsequent landfilling. From this evaluation (*see* Table 6-1 of the SSIS) it was noted that:

- the two options initially identified as most technically feasible (in addition to direct discharge) are: (1) on-site lagoons with subsequent off-site landfilling; and (2) on-site lagoons combined with belt filter press dewatering and subsequent off-site landfilling, and
- control technologies found to be <u>not</u> feasible on a long term basis include land application, monofills, and direct discharge to the Alton POTW. Vacuum filtration and centrifugation, while

feasible, have been shown to be less desirable than filter belt presses (*see* Table 6-1 of the SSIS for summary).

1) Economic Reasonableness

116. This factor requires the examination of the cost-benefit relationship between removal of effluent TSS to resulting effluent reduction benefits. Important factors for site specific relief include:

- the unusually high, naturally-occurring level of silt and suspended solids indigenous to the Mississippi River near Alton;
- statements by EPA that natural conditions found in larger highly turbid rivers may result in unreasonable cost-benefit relationship;
- EPA's acknowledgement that returning raw waste sludge to a highly turbid source can result in an imperceptible increase in TSS above ambient levels;
- the difficulty of handling alum-based residuals and its poor performance as landfill material;
- identification of two candidate technologies which are potentially capable of treating large volumes of effluent TSS -- *i.e.*, on-site lagoons with subsequent off-site landfilling; and on-site lagoons combined with belt filter press dewatering and subsequent off-site landfilling;
- total capital cost estimates for candidate control technologies which range in the millions of dollars; and

- operation and maintenance costs, which represent a continuing and potentially escalating cost for future facility operation. SSIS at 6-10.

117. Application of either of the candidate technologies discussed above would result in the estimated Alton effluent discharges meeting Illinois water quality standards for TSS. A cost-benefit analysis, however, demonstrates that considerable costs would be incurred by the proposed replacement facility to meet these effluent limitations without a clearly-defined improvement to the aquatic environment. In other words, application of candidate control technologies does not provide effluent reduction benefits with regard to receiving water quality. The application of TSS treatment technology will not result in perceptible improvements in water quality or sediment quality, will not enhance habitat quality, and has no effect on local biota. These factors are controlled by the nature of the receiving water, the River. Further, the TSS treatment: (i) is not needed for control of sludge or bottom deposits, visible oily odors, or plant or algal growth; and (ii) has no effect on stream morphology, and *de minimis* effect on stream chemistry and sediment chemistry. Because the discharge is comprised (>91%) of river silts, it will exhibit little or no differences in color. Turbidity was evaluated through water quality modeling (*see* Section 5.1 of the SSIS). The results of the CORMIX model indicate small areas (<0.5 acres) where surface receiving water TSS is predicted to be >5% above ambient conditions (*see* SSIS Figures 5-2, 5-4). As noted earlier, these areas may be interpreted as representing introduction of turbidity of "unnatural origin" but the level and spatial

extent of these areas does not result in an "Offensive Condition" exceedance. SSIS at 6-11.

118. The operation and maintenance ("O&M") costs for residual management for the proposed candidate technologies (*i.e.*, belt presses and lagoons) represent an increase of approximately 60% to 70%, respectively, of the current operational costs for potable water production at the existing Alton facility. In other words, for the same volume of potable water produced, the additional O&M costs of residual management will increase the facility's operational costs 1.6 to 1.7 times their current level. SSIS at 6-11.

119. Rate payer and community impacts are factors in considering the economic reasonableness of the BDT option. The costs of the control technology will be borne by Water Company rate payers. Annualized costs for the candidate technologies range from $1.14 to $1.63 million dollars per year. If these costs are divided by the number of households/businesses served (rounded to 17,500 people), the per unit cost ranges from $65 to $93 per year. In addition, some individual families could be adversely impacted as a result of construction, operation and transportation activities associated with a nearby residuals treatment facility.

120. Socioeconomic costs may be incurred by the potential loss of real estate value due to the presence of a lagoon in a residential area. Neighborhood concerns regarding lagoons have already been identified in recent public meetings, namely noise, odor, and traffic problems. The potential number of truck trips necessary to dispose of the treated sludge is estimated at approximately 750 trips per year. Additional truck

traffic results in potential noise, congestion, and increased traffic hazard. Some individual families could be particularly adversely impacted (*e.g.*, houses which potentially abut or overlook lagoons). Additional community impacts may be incurred due to the effect of increased traffic to activities associated with the newly-authorized City of Alton Park located next to the proposed facility entrance road. The park contains the natural bluff area and features a cliff painting of the "Piasa Bird." Potential conflicts exist for trucks entering and exiting the site to park traffic, park visitors, and bike park traffic. Better delineation of potential conflicts will require finalization of the park design. SSIS at 6-12.

121. As part of determining the appropriate discharge requirements, the Company considered the potential for pollution prevention and waste minimization. The following two factors were considered:

- waste reduction opportunities by process change, improved housekeeping and recovery of waste components for reuse; and
- segregation or combining of process wastewater streams.[18]

122. The type of process employed to make potable water is a critical factor which helps determine the nature, amount, and treatability of residuals produced. In the "Draft Development Document For Effluent Limitations Guidelines and Standards of Performance, Water Supply Industry," sub-categories for the water supply industry were based on the type of processes or combinations of processes used at a facility (U.S. EPA, 1975). *See* Attachment K hereto. The proposed replacement facility will rely on

[18] These are also required factors in the BDT determination.

coagulation of river silt by Clar+Ion® to achieve potable water. This type of process means that:

- the percentage of naturally-occurring material in the total solids returned to the River is typically 91% or greater;
- only a trace amount of the 8.7 percent discharge solids contributed by the coagulant is comprised of the metals of concern (*i.e.*, only 0.348 percent of the total discharge volume is comprised of aluminum or iron);
- conversely, the residual solids contain a minor amount of process-derived chemicals; and
- use of an alum-organic polymer such as Clar+Ion® leads to potentially greater disposal costs due to its poor storage and handling characteristics.

123. The possibility of incorporating a number of process changes to reduce the quantity of and to improve the quality of the effluent was considered for the proposed replacement facility. Evaluation of these process changes indicated that:

- stringent housekeeping measures (in effect at the existing facility) will be implemented at the proposed replacement facility;
- recovery of the small percentage of alum in the Clar+Ion® is not practicable at the proposed replacement facility due to the high silt content in the residuals; and
- segregation of waste streams will not reduce the treatment required nor improve the effluent quality.

Thus, no process design changes were identified to significantly reduce the quantity and improve the quality of the effluent. SSIS at 6-13.

124. As part of the BDT determination, sound engineering judgment was applied to integrate the various site specific factors and technical elements. A review of the cost-benefit analysis of the factors considered above indicates that technologically feasible methods exist for reducing TSS in discharge effluent to Illinois Water Quality Standards (*i.e.*, 15 mg/l daily average). The capital cost of these options could range from approximately $7.38 million to $10.8 million to implement. As discussed in paragraphs 59-61, above, operating costs would be substantial. SSIS at 6-13.

125. Important factors in determining the appropriate site specific discharge standards for the proposed replacement facility include the large amounts of naturally-derived TSS in the discharge with only minor quantities of process-generated TSS, and the discharge's lack of discernable environmental impact. The lack of discernable environmental impact is significant, because the economic reasonableness analysis on which BDT is based (and thus reasonably also on which site specific relief is based) presumes the existence of such impacts. Conventional treatment of process-generated TSS typically contends with only a small fraction of silt in the process influent water. In contrast, the River provides large volumes of silt in the intake water. This volume of silt translates into large residual volumes which must be disposed. Little environmental purpose is served in retaining these residuals and disposing of them on land at considerable economic cost to the Water Company, and ultimately its rate-paying customers. SSIS at 6-14.

126. Based on a review of modeled physical, chemical, and biological impacts to the River, the large naturally-occurring volumes of TSS and the lack of discharge environmental impact make the technically feasible treatment options unwarranted under BDT. It appears that little, if any, tangible environmental benefit will be derived from solids reduction. Water quality and biological communities will not be measurably enhanced by this solids reduction nor do they appear impacted by the cumulative impact of current discharges. These findings are similar to those reported from water treatment facilities on similar large, turbid rivers. Available aluminum and iron data indicates that dissolved concentrations of either are highly unlikely to impact biological communities in the River. SSIS at 6-14.

127. Benefits usually associated with solids reduction are improvement or enhancement of water quality of receiving waters. Solids reduction in this case will provide negligible improvement to the water quality parameters in question and no enhancement of existing biological communities or designated uses of the River. In addition, continuation of the return of effluent TSS from residuals does not result in degradation of the receiving water, as judged by potential impacts. SSIS at 6-14.

128. Application of the candidate control technologies -- *i.e.*, on-site lagoons with subsequent off-site landfilling; and on-site lagoons combined with belt filter press dewatering and subsequent off-site landfilling -- provides negligible reduction benefits. Based on a careful weighing of these factors, a determination of no treatment of TSS in the discharge is BDT for the proposed replacement facility. SSIS at 6-14.

129. Although compliance with the regulation of general applicability is

technically feasible (in the sense that compliance can be achieved, if the Water Company is required to implement on-site treatment technologies at considerable expense), direct discharge is warranted on economic grounds. As noted above, the Board has granted relief to all similarly situated (non-lime softening) water treatment facilities that use the River as their raw water source -- *i.e.*, the facilities that currently serve Rock Island, East Moline, Alton and East St. Louis. The replacement facility is not significantly different from these other facilities when analyzed pursuant to the factors relevant to evaluating adjusted standard relief for these types of public water supply facilities under the Act -- *i.e.*, Sections 28.1 and 28.3, BPJ, and BPT. Recent U.S. EPA action for a similar Missouri River facility also supports granting relief for the replacement facility on grounds including economic infeasibility. *See* Attachments M and N hereto.

3. Specific reasons for selection of direct discharge option

(i) Direct discharge is appropriate, because the effluent from the replacement facility will not adversely impact water quality of the River or the River environment.

130. As discussed in detail in paragraphs 65 *et seq.*, above, the replacement facility's direct discharge of residuals to the River will not adversely impact the River's water quality, or the environment. Water quality data on the River indicate that TSS and iron concentrations of the raw River water exceed the general effluent standards. As noted in paragraphs 107-109, above, the replacement facility's discharge will cause an imperceptible increase in the ambient water quality and will pose no significant impact on the River and the River environment. Therefore, the application of treatment technologies will not result in perceptible improvements in water or sediment quality,

will not enhance habitat quality, and will have no effect on local biota. As such, the current direct discharge allowed for the existing facility is also appropriate for the replacement facility.

(ii) U.S. EPA regulations, guidance documents and its recent determination for a similar facility recognize that direct discharge is appropriate.

131. U.S. EPA's decision not to promulgate effluent standards for the water industry and two key U.S. EPA guidance documents also suggest, like the Board's prior grant of relief to the facilities serving Rock Island, Alton, East Moline and East St. Louis, that residuals from raw water in large, highly turbid rivers should not be governed by general effluent standards. As a result, effluent standards for the water industry must be determined on a site-specific basis. U.S. EPA regulations and key guidance documents provide that discharge limitations should be determined on a site-specific basis and should take into account unique factors of the site. The guidance documents also support the proposition that silt removed from raw water may appropriately be returned to the River. Those documents are the U.S. EPA Permit Policy Statement #13 issued September 18, 1974 ("Permit Policy #13") and the Draft Development Document for Effluent Limitation Guidelines and Standards of Performance - Water Supply Industry (1975) ("Draft Development Document"). Permit Policy #13 and the Draft Development Document are attached hereto and incorporated by reference as Attachments L and K, respectively.

132. Permit Policy #13 concerns "Disposal of Supply Water Treatment Sludges"

and the following excerpts directly relate to the replacement facility:

- It is inappropriate to arbitrarily prohibit silt removed from public water supply streams from being returned to the stream. Rather, one must consider the "supply water silt burden, nature and quantity of chemical clarification aids used, availability of land disposal sites, economic impact, navigational considerations and water quality standards, to mention a few." (Page 1); and

- U.S. EPA recognized that in some instances the general effluent standards need not apply to the Mississippi River. "Because silt is indigenous to certain River waters, notably the Mississippi and Missouri Rivers, and because our priority concern is process generated pollutants, and because unreasonable cost-benefit relationships may result in some areas of these Rivers and others, it would be within the intent of best practicable control technology currently available to authorize, in some instances, either the partial or total return of silt type sludge to the receiving waters." (Page 2).

133. These excerpts emphasize two important points. First, U.S. EPA distinguishes sludges composed mainly of naturally occurring silts from water treatment sludges with high concentrations of process generated chemicals. This implies that discharge of the naturally occurring silt is not the type intended to be restricted and need not necessarily conform to the general effluent standards. Second, U.S. EPA acknowledges that because of the high silt content of the Mississippi River, return of these silts to the River can constitute the best technology option.

134. The Draft Development Document provides further insight into U.S. EPA's position on water supply treatment effluents. The document establishes TSS as a pollutant parameter for all subcategories of water treatment facilities. The Draft Development Document also acknowledges that: 1) return of residuals to a highly turbid

River will cause an imperceptible increase in turbidity; 2) treating such discharges is not cost-effective; and 3) alum-containing coagulant sludges present unique handling and disposal problems. Specifically, the Draft Development Document notes that:

- Extensive studies made at facilities along one highly turbid River have shown that returning the raw waste sludge to the highly turbid source increases the turbidity of the stream by an insignificant increment. In some instances the incremental increase in turbidity is less than the precision of many turbidimeters used for routine monitoring. (Page 46);

- These studies have also shown that the benefit-cost ratio for dewatering the sludge and hauling to landfills is very low, and that the amount of energy used in treating and hauling it is very high. Because of these factors the disposal of sludge from facilities that must use highly turbid water as feeds (>200 JTU on an annual average basis) should be judged on an individual basis. (Page 46); and

- Alum sludge is difficult to dewater by lagooning. However, it will gradually consolidate sufficiently to provide a 10% to 15% solids content. Water removal is normally by decantation or by evaporation with some drainage. Evaporation may provide a hard crust on the surface but the sludge below the crust is thixotropic, capable of turning into a viscous liquid upon agitation with near zero shear resistance under static load. Therefore, lagooned alum sludge cannot be easily handled nor will it make good landfill material. (Pages 75-76).

135. These excerpts demonstrate U.S. EPA's recognition that the costs of imposing TSS limitations on water treatment supply facility effluents, especially coagulant or alum sludges, outweigh the negligible improvement in water quality resulting from control technology. These U.S. EPA documents directly apply to the discharge by the replacement facility, and support direct discharge for the facility's process residuals.

136. The case for direct discharge is further supported by U.S. EPA's own recent determination that direct discharge is BPJ for Missouri-American Water Company's public water supply treatment facility located on the Missouri River in St. Joseph, Missouri. A copy of U.S. EPA's letter stating that direct discharge is BPJ is attached hereto and incorporated by reference as Attachment M. The Best Professional Judgment Study Report on which U.S. EPA's determination was based is attached hereto and incorporated by reference as Attachment N.

(iii) The Water Company's discharge will contain only trace elements of the metals of concern (aluminum and iron), which is insignificant as compared to the alum and iron returned by two other water treatment facilities currently permitted for direct discharge.

137. The U.S. EPA guidance documents confirm that the process employed to treat water is a critical factor which helps determine the nature, amount and treatability of residuals. As noted in paragraph 22, above, the replacement facility intends to rely on coagulation of river silt by Clar⁺Ion® to achieve potable water. This process generally means that the percentage of naturally-occurring materials in the total solids returned to the River is typically 91% or greater. SSIS at 6-12. The coagulant contributes approximately 8.7% of the total solids content of the discharge. *Id.* Only 4% of the 8.7% coagulant total solids content is comprised of the metals of concern (*i.e.*, aluminum and iron), and none of the iron is generated by the coagulant. Aluminum contributes approximately only 0.348% -- approximately <u>one third of one percent</u>, by weight -- of the total solids content returned to the River. *Id.* at 6-2.

138. This minute fraction presents a marked contrast to the Board's findings regarding the Rock Island and East Moline public water supply facilities. The Board found that "it is undisputed" that 25 percent of the solids in East Moline's discharge are "added in the course of treatment." Opinion and Order of the Board, R87-35, March 8, 1990, Attachment O hereto, at p. 4. The percentage of solids discharged resulting from treatment additives was even worse in Rock Island. In analyzing Rock Island's proposal in its Petition to convert from an indirect to a direct discharge to the Mississippi River, the Board stated that:

> We do know that in this case the city's contribution of solids, as a percentage of the total solid content of its discharge, would be substantial, *on the order of 50%*; this is not merely a case of returning solids to the River.

Opinion and Order of the Board, R87-34, March 22, 1990, Attachment P hereto, at p. 13, emphasis added. Although the final orders granting direct discharge relief to the Rock Island and East Moline facilities required these facilities to attempt to reduce their volumes of coagulant based solids, the Water Company's replacement facility is already designed to implement state of the art best management practices to limit its discharges as much as possible to the solids it has withdrawn from the River, while still treating the river water in a manner which results in potable water that meets safety requirements under the federal Safe Drinking Water Act. The Water Company's discharge will unquestionably contain far less metal-based treatment additives than that of Rock Island and East Moline.

(iv) The costs, economic and non-economic, of the two candidate technologies significantly outweigh the negligible benefit of eliminating an imperceptible impact to the River's water quality.

139. Little environmental purpose is served in retaining the process residuals and disposing of them on land at considerable economic cost to the Water Company, and ultimately its rate paying customers. The imperceptible improvement to the water quality and aquatic environment of the River does not justify the considerable costs associated with the two candidate technologies -- *i.e.*, on-site lagoons with subsequent off-site landfilling; and belt filter press dewatering with subsequent off-site landfilling. As demonstrated in the SSIS, the direct discharge of process residuals will have no significant impact on water quality or sediment quality and will have no effect on local biota. As such, the application of the candidate technologies will not result in perceptible improvements to the water quality or local biota. Therefore, the significant annualized costs for the candidate technologies -- approximately $1,140,000 to $1,630,000 -- cannot be justified.

140. Furthermore, in considering economic reasonableness, rate payer and community impacts must be considered. The costs of residuals handling/treatment will be passed on to rate payers. Since the annualized costs of the candidate technologies are approximately $1,140,000 and $1,630,000, the annual cost per household/business served would be approximately $65 and $93, respectively -- a 22% to 31% annual water bill increase.[19] Again, the significant rate payer cost increase is not justified by the

[19] This calculation assumes the costs are spread across the approximately 17,500 rate payers within the Company's Alton District (*i.e.*, households and businesses to be served from the replacement facility) and that costs are spread equally among the rate payers.

negligible improvement to the River water quality (or State or federal regulations) which would result from residuals treatment/handling.

141. Finally, the cost-benefit analysis must also consider other intangible factors including, but not limited to, reduced and/or more expensive landfill capacity in the future, potential operational problems with the candidate technologies, and other socioeconomic costs.

(i) First, the candidate technologies would require significant landfill space to dispose of the process residuals. The use of available landfill space to dispose of what is largely naturally-occurring River silt would be an extremely ineffective use of landfill capacity.

(ii) Second, the candidate technologies could potentially experience operational difficulties. Operational difficulties should be anticipated, because of the wide range of TSS concentrations in the raw water and the variable quantity of solids to be handled. The likelihood of inclement weather would also lead to operating difficulties. These potential operating difficulties also argue against selecting either of the candidate technologies.

(iii) Finally, other socioeconomic costs and community impacts must be considered. Neighborhood concerns over potential loss of real estate value, noise, odor and traffic problems are likely to be associated with lagoons and site-related operations. For example, the number of truck trips necessary to dispose of the treated sludge is estimated at approximately 750 trips per year. This truck traffic could cause congestion, road degradation, and likely would be an increased traffic hazard. These traffic concerns are heightened by the City of Alton's plans to use the road over which the trucks would travel as the entry and exit road for a tourist attraction which features a painting of the legendary Piasa Bird.[20]

142. As noted in paragraphs 66; 129-138, above, Rock Island and East Moline have received Board relief from the generally applicable standards. The Board has also provided relief from the general effluent standards for water treatment facilities owned by the Water Company on two previous occasions. First, the Board promulgated a site-specific rule for the Water Company's existing water treatment facility in Alton. 35 Ill. Adm. Code 304.206. The Board provided that the existing facility's discharge into the River would not be subject to the effluent standards for TSS and iron of 35 Ill. Adm. Code 304.124. Similarly, the Board granted an adjusted standard for the Water Company's water treatment facility located in East St. Louis. 35 Ill. Adm. Code 304.220. There, the Board provided that the facility's discharge into the River would not be subject to the effluent standards for TSS and iron of 35 Ill. Adm. Code 304.124, provided that the Water Company used only biodegradable coagulants approved by U.S. EPA. The Water Company currently uses such biodegradable coagulants at the existing Alton facility and intends to continue to do so at the replacement facility.

143. As shown by the Water Company's detailed evaluation of all appropriate state and federal requirements for the replacement facility, relief from the general effluent standards is also warranted in this case.

[20] The Piasa Bird is a legendary creature traditionally believed to have inhabited the bluffs.

Consistency with Federal Law

144. Section 106.705(i) of the Procedural Rules provides that the petition must contain a statement with supporting reasons that the Board may grant the proposed adjusted standard consistent with federal law. The petitioner must inform the Board of all procedural requirements imposed by federal law, but not by the Board's adjusted standard procedural requirements, which are applicable to the Board's decision on the petition. Citations to relevant regulatory and statutory authorities should also be included.

145. As noted in paragraph 14, above, the federal government has not promulgated any NPDES effluent standards for public water supply treatment facilities. As discussed below, recent U.S. EPA action for a similar Missouri River water treatment facility also supports the consistency of the proposed relief with federal law. The Board has noted that there are no federal effluent regulations for public water supply treatment facilities and has concluded that:

> In the absence of such regulations, effluent limitations are to be established on a case by case basis under Section 402(a)(1) of the Clean Water Act. (33 U.S.C. 1342(a)(1).) The Board continues to believe that directives from U.S. EPA give the Board and the Agency (as permitting authorities) broad discretion in determining the level of control to apply to discharges from water treatment plants.

Proposed Opinion and Order of the Board, PCB R85-11, June 16, 1988, at p. 8. *See* Attachment I hereto. In addition, U.S. EPA has found that direct discharge is appropriate for the St. Joseph, Missouri facility. *See* Attachment M hereto. Therefore, the proposed adjusted standard is consistent with federal law. As noted in paragraph 6, above, pursuant to this authority the Board has granted relief to all similarly situated non-lime softening facilities on the River when they have sought such relief.

146. As noted in paragraph 12, above, the need for an adjusted standard for the replacement facility is in part based on the need to apply the federal BPJ requirements in the replacement facility's NPDES permit. U.S. EPA guidance documents, discussed below, also provide that discharge limitations should be determined on a site-specific basis and must take into account unique factors, such as the turbid nature of the raw water. The guidance documents state that, in appropriate instances, residuals from public water supply systems may be returned to the River.

147. Pursuant to Section 402(a) of the CWA, developing effluent limitations on a case-by-case basis requires application of the BPJ factors listed in 40 C.F.R. § 125.3(d) and consideration of: (i) the appropriate technology for the category or class of point sources of which the applicant is a member, based on available information; and (ii) any unique factors relating to the applicant. 40 C.F.R. § 125.3(c)(2).[21] Evaluation of two specific elements is also required in setting BPJ for the replacement facility -- best practicable control technology currently available ("BPT") and best conventional pollutant control technology ("BCT"). 40 C.F.R. § 125.3(d).

148. BPT factors are: (i) the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application; (ii) the age of

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[21] As noted, the BPJ permit factors overlap many of the factors the Board will apply to adjusted standards pursuant to Section 28.1 of the Act -- *e.g.*, the technical feasibility and economic reasonableness of reducing the particular type of pollution, and other unique factors such as existing physical conditions. Along with the Section 28.3(c) factors and BDT (35 Ill. Adm. Code 304.102) factors, these are the directly relevant factors for evaluating the merits of a public water supply facility's request for relief from the Board's general industrial effluent standards.

equipment and facilities involved; (iii) the process employed; (iv) the engineering aspects of the application of various types of control techniques; (v) process changes; and (vi) non-water quality environmental impact (including energy requirements). 40 C.F.R. § 125.3(d)(1). The BCT analysis includes the BPT issues and one additional factor: the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources. *Id.*

149. Developing effluent limits on a case-by-case basis pursuant to federal law requires consideration of: (i) the appropriate technology for the category or class of point sources of which the applicant is a member, based on available information; and (ii) any unique factors relating to the applicant. 40 C.F.R. § 125.3(c)(2). It is also necessary to consider the appropriate factors listed in 40 C.F.R. § 125.3(d) in developing these effluent limits.

Consideration of Appropriate Technology and Unique Factors

150. Paragraphs 52 through 61 and 18 through 49, above, discuss appropriate technologies for water treatment facilities and unique factors relating to the Water Company. The Water Company respectfully refers the Board to those sections for a full discussion of the Water Company's compliance with these federal requirements.

Determination of BPT Under Best Professional Judgment

151. As noted in paragraph 148, above, 40 C.F.R. § 125.3(d)(1) provides the factors necessary for the determination of BPT. Many of these factors have been

previously considered in this Petition and the relevant paragraphs will be referenced as appropriate. The remainder of the factors will be discussed in detail below.

152. The first factor to consider for BPT is the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application. 40 C.F.R. § 125.3(d)(1)(i). Essentially, this factor examines the cost-benefit relationship between removal of effluent TSS to resulting effluent reduction benefits and has been evaluated in paragraphs 139-141, above; see also, SSIS at 6-15 to 6-20.

153. The second factor to consider under BPT is the age of equipment and facilities involved. 40 C.F.R. § 125.3(d)(1)(ii). All equipment at the replacement facility will be new; therefore, this factor is not a constraint for the facility.

154. The third factor under BPT is the process employed. 40 C.F.R. § 125.3(d)(1)(iii). The type of process employed to treat the raw River water is a critical factor which helps determine the nature, amount, and treatability of residuals produced. As noted in paragraph 22, above, the replacement facility intends to rely on coagulation of River sediments by Clar⁺Ion® to achieve potable water. Under this type of process, the percentage of naturally-occurring material in the total solids returned to the River is typically 91% or greater. SSIS at 6-12. Of the 8.7% total solids which is contributed by the coagulant, only a trace amount is comprised of aluminum -- only about **one third of one percent** (0.348%), by weight, of the facility's solids discharge. SSIS at 6-2.

155. The fourth factor to consider under BPT is the engineering aspects of the application of various types of control techniques. 40 C.F.R. § 125.3(d)(1)(iv).

Consideration of this factor is provided in paragraphs 52-58, above; *see also*, SSIS at 6-1 to 6-9.

156. The fifth factor under BPT is process changes. 40 C.F.R. § 125.3(d)(1)(v). As part of the BDT consideration, pollution prevention and/or waste minimization at the replacement facility was investigated. However, there is little or nothing the Water Company can do to further minimize waste or prevent pollution for the following reasons:

- There is limited potential for treatment process change, as the replacement facility must treat the River water to a potable level which meets Safe Drinking Water Act requirements.

- Process changes, including minimization of the amount or the nature of chemicals added, have already been implemented by the Water Company to the extent feasible. In any event, process changes in themselves will not greatly reduce the amount of residuals, because the quantity of residuals will always be dictated by the differences between raw water quality and the drinking water standards.

- Operational improvements, such as the continuous discharge of residuals through the use of Superpulsators® instead of conventional clarifiers have already been incorporated.

- Stringent housekeeping measures (in effect at the existing facility) will be implemented at the replacement facility.

- Recovery of the small percentage of aluminum in the Clar⁺Ion® is not practicable at the replacement facility, due to the high silt content in the residuals.

- Segregation of waste streams will not reduce the treatment required nor improve the effluent quality.

See SSIS at 5-23 to 5-24 and 6-12 to 6-13. Thus, no process design changes exist to significantly reduce the quantity or improve the quality of the effluent.

157. The last factor to consider under BPT is the non-water quality environmental impact (including energy requirements). 40 C.F.R. § 125.3(d)(1)(vi). Non-water quality environmental impacts, most of which were discussed above (*e.g.*, paras. 118-121; 141), include: 1) landfill space requirements for the dewatering lagoon and mechanical filter press techniques; 2) land acreage needed for storage lagoons; 3) potential energy requirements for handling and pumping sludges; 4) loss of viable farm land during the foreseeable future (*i.e.*, next 30 years); 5) approximately 750 truckloads per year to transport and dispose of treated sludge; and 6) community stakeholder issues regarding noise, odor, and aesthetic concerns.

158. Based on consideration of the statutory and unique factors, BPT for the facility, determined through BPJ, is no treatment of the discharge.

Determination of BCT Under Best Professional Judgment

159. 40 C.F.R. § 125.3(d)(1) provides the factors necessary for the determination of BCT. All but one of the factors have been previously considered in this Petition. The remaining factor will be discussed below.

160. The additional factor under BCT is the comparison of the cost and level of reduction of such pollutants from the discharge from POTWs to the cost and level of reduction of such pollutants from a class or category of industrial sources. 40 C.F.R. § 125.3(d)(2)(ii). This factor examines the cost reasonableness of the TSS control technology (*i.e.*, pressure filtration) as it compares to the cost and level of reduction of TSS from the discharge from POTWs.

161. The BCT methodology is undertaken to determine whether it is cost-reasonable for industry to control conventional pollutants at levels more stringent than BPT limitations. To "pass" the POTW portion of the cost test, the cost per pound of conventional pollutant removed by industrial dischargers in upgrading from BPT to the candidate BCT must be less than the cost per pound of conventional pollutant removed in upgrading POTWs from secondary treatment to advanced secondary treatment. 51 Fed. Reg. 24974-25002 (1986). In general, the upgrade cost to industry must be less than EPA's POTW benchmark cost of $0.25 per pound of TSS (in 1976 dollars). *Id.*

162. For the replacement facility, a final unit operation process of pressure filtration will reduce the TSS concentration of the effluent from the generally applicable regulatory limit of 15 mg/l TSS[22] to essentially zero.[23] SSIS at 6-18, 6-19. The annualized costs (in 1976 dollars) per pound of TSS removed by the pressure filtration process amounts to $4.38 per pound of TSS.[24] *Id.* at 6-23. When compared to EPA's benchmark of $0.25 per pound of TSS, the pressure filtration candidate technology fails the cost reasonableness test by orders of magnitude.

22/ As explained in the SSIS, U.S. EPA suggested in the St. Joseph permit proceeding that when the BPJ process indicates that BPT is direct discharge, the cost-reasonableness issue under BCT should nonetheless (for this purpose only) presume that BPT is conventional treatment. Thus, the BPT number for this calculation is the generally applicable effluent standard of 15 mg/l.

23/ The pressure filtration system has been sized based on an estimated hydraulic flow rate of the total residuals.

24/ The annualized cost for a pressure filtration system was calculated by amortizing the capital costs over 30 years at a 9 percent interest rate and adding the yearly operation and maintenance costs. This cost was then indexed to 1976 dollars.

163. Based on the results of the POTW cost test, the candidate BCT technology is not cost-reasonable. As a result, direct discharge is the appropriate control technology under both BPT and BCT.

Hearing Request or Waiver

164. Section 106.705(j) of the Procedural Rules provides that the petition must state whether the petitioner requests or waives its right to a hearing on the petition. Hearings are evidentiary in nature and are held before a hearing officer appointed by the Board and are transcribed before a court reporter. Pursuant to the requirements of Section 106.713 of the Procedural Rules; the Water Company requests that the Board give notice of the petition and schedule a hearing in accordance with 35 Ill. Adm. Code Part 103.

Supporting Documents and Legal Authorities

165. Section 106.705(k) of the Procedural Rules provides that the petition must cite to supporting documents or legal authorities whenever such are used as a basis for the petitioner's proof. Relevant portions of such documents and legal authorities other than Board decisions, state regulations, statutes and reported cases shall be appended to the petition. The Water Company has appended to the Petition the following documents:

Attachment A--Photographs of River Flood at the Existing Facility, Summer 1993
Attachment B--Site Specific Analysis for Replacement Facility, March 1999
Attachment C--Final Opinion and Order of the Board, PCB R82-3, March 9, 1994
Attachment D--Opinion and Order of the Board, PCB AS 91-13, Oct. 19, 1995
Attachment E--Opinion and Order of the Board, PCB AS 91-9, May 19, 1994
Attachment F--Opinion and Order of the Board, PCB AS 91-11, May 20, 1993
Attachment G--Opinion of the Board, PCB R70-8 et al., January 6, 1972
Attachment H--Illinois Institute for Environmental Quality's Evaluation of Effluent Regulations of the State of Illinois, June 1976

Attachment I--Proposed Opinion and Order of the Board, PCB R85-11, June 16, 1988

Attachment J--U.S. EPA's Amended Section 301(h) Technical Support Document, Sept. 1994

Attachment K--U.S. EPA's Draft Development Document for Effluent Limitations Guidelines and Standards of Performance, March 1975

Attachment L--U.S. EPA's Permit Policy 13, Sept. 1974

Attachment M--Memo and letter from John Dunn (U.S. EPA) to Gale Hutton (Missouri Department of Natural Resources)

Attachment N--BPJ Evaluation of Existing NPDES Effluent Limitations at Missouri-American Facility, St. Joseph, MO

Attachment O--Final Opinion and Order of the Board, PCB R87-35, March 8, 1990

Attachment P--Opinion and Order of the Board, PCB R87-34, March 22, 1990

CONCLUSION

WHEREFORE, for all the reasons stated above, Illinois-American Water Company respectfully requests that the Board set this Petition for hearing and grant the adjusted standard specified herein for the Water Company's replacement public water supply treatment facility in Alton, Madison County, Illinois.

Respectfully Submitted,

ILLINOIS-AMERICAN
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CERTIFICATE OF SERVICE

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Illinois-American Water Company

Belleville, Illinois

ENSR®

Site-Specific Analysis of Impacts of Potential Alternatives for Handling Public Water Supply Residuals at Proposed Alton, IL Facility

ENSR

March 1999

Document Number 549307CP.DFM, 3995-007-500

Illinois-American Water Company

Belleville, Illinois

Site-Specific Analysis of Impacts of Potential Alternatives for Handling Public Water Supply Residuals at Proposed Alton, IL Facility

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LIST OF ACRONYMS

AWQC	Ambient water quality criteria
BCT	Best Conventional Pollutant Control Technology
BDT	Best Degree of Treatment
BPJ	Best professional Judgement
BPT	Best Practicable Control Technology Currently Available
cfs	cubic feet per second
CWA	Clean Water Act
gpd	Gallons per day
IEPA	Illinois Environmental Protection Act
Illinois EPA	Illinois Environmental Protection Agency
MGD	Million gallons per day
msl	mean sea level
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
PACl	Polyaluminum chloride
PAC	Powered activated carbon
SSIS	Site Specific Impact Study
SU	Standard units (for pH)
TSS	Total suspended solids
TRC	Total residual chlorine
U.S. ACOE	United States Army Corps of Engineers
USFW	United States Fish and Wildlife Service

1.0 INTRODUCTION

Illinois-American Water Company ("Water Company") plans to construct a public water supply treatment plant to replace the existing plant, which is near the end of its useful life and was inundated by Mississippi River (the "River") flood waters in 1993 and threatened again in 1995. The replacement plant will be located on property located at a higher elevation across the Great River Road (i.e., Illinois Route 100) from the existing plant in order to minimize the potential for future flooding. The Water Company's existing plant directly returns to the River the residual natural silts and sediments contained in the raw River water, along with a very small percentage of water treatment additives used to separate the sediments from the raw water to produce potable water. The Water Company has conducted a Site Specific Impact Study (SSIS) that addresses the environmental impact, technical feasibility, and economic reasonableness of potential alternatives to determine the best degree of treatment for handling the discharge from the replacement plant. The discharge effluent from the proposed replacement facility has the potential to exceed Illinois general industrial standards for total suspended solids (TSS) and iron. This document reports the findings of the SSIS and provides justification for the recommended effluent limitations.

1.1 Purpose and Organization of the Site Specific Impact Study

The purpose of the SSIS is to provide sufficient information to evaluate the reasonableness of various technologies to treat the residuals arising from the preparation of potable drinking water including returning the residuals back to the Mississippi River, the original source of the vast majority of natural silts comprising the residuals. This study is structured to satisfy state requirements under Section 27(a) of the Illinois Environmental Protection Act (the "Act"), satisfy federal concerns which arise out of the Clean Water Act (CWA), as well as address Illinois Environmental Protection Agency (Illinois EPA) concerns.

The SSIS report is divided into seven section tasks. Section 1.0 outlines the general purpose of the study and the underlying regulatory requirements at both the state and federal levels, including the Best Professional Judgement (BPJ) process to be met for compliance with CWA requirements. Section 2.0 describes the Water Company's SSIS work plan based on its meetings with Illinois EPA and its current understanding of Illinois EPA's comments on the draft work plan. This section also documents Water Company responses to Illinois EPA comments on the draft workplan and describes the plan used to solicit and incorporate stakeholder input.

Section 3.0 provides a brief description of the existing Alton waterworks and presents the critical design elements of the proposed facility. The plant and treatment process design elements are developed in sufficient detail to predict the nature and magnitude of the effluents to be potentially discharged into the Mississippi River from the replacement plant. Section 4.0 describes the physical and ecological characteristics of the local environment in the vicinity of the proposed plant, with special focus on the receiving water (Mississippi River), its hydrology, water quality, and biota, including a mussel habitat survey. This section also identifies potential stakeholder concerns regarding the structure and operation of the proposed drinking water facility that were raised during public meetings held to discuss a replacement facility.

Section 5.0 evaluates the potential changes in river conditions due to the proposed effluent discharge. The potential impacts of the discharge to river water quality were evaluated under two flow and water quality scenarios developed in discussion with the Illinois EPA. Potential impacts to the biological community of the Mississippi River were also evaluated. Impacts considered included physical and chemical characteristics, habitat changes, possible toxic effects, and adverse effects to sensitive species and/or habitats.

Section 6.0 develops the best degree of treatment (BDT) for residuals handling. It identifies treatment technologies that could be applied to the residuals from the proposed Alton facility. Candidate technologies were identified from the suite of available technologies, and cost estimates were prepared. Other community impacts were identified and described. Based on these factors, BDT was determined for the replacement Alton plant. In addition, the report establishes the federally required BPT and BCT for the facility through review of the statutory factors used in a case-by-case determination (including a cost-reasonableness test) that meet the legal requirements of Best Professional Judgment (BPJ) under the CWA.

Section 7.0 reviews and summarizes the findings of the site specific analysis and unique factors applicable to the proposed drinking water facility. These factors were considered in arriving at final recommended permit effluent limitations for the replacement drinking water facility.

1.2 Regulatory Compliance

Pursuant to the site specific rule codified at 35 IAC 304.206, the National Pollution Discharge Elimination System (NPDES) permit of the current Alton drinking water facility does not contain numerical effluent limitations for TSS or iron. Historically, the facility has discharged the residuals arising from the water purification process back to the Mississippi River. While the replacement drinking water plant will be at the same location (but at a higher elevation) as the existing plant, it is appropriate to perform an SSIS to determine whether the replacement plant should be subject to effluent limitations listed in the general effluent standards (35 IAC 304 Subpart A), particularly those listed in 35 IAC 304.124(a) including total iron (2.0 mg/L) and TSS (15.0 mg/L). If these limitations are not to be generically applied to the replacement facility, effluent limitations should be developed through the site specific factors analysis specified in Section 27(a) of the Act. Similarly, there are no federal categorical effluent limitations for drinking water plants (see Section 1.4) and effluent limitations are developed on a site specific basis using BPJ as defined by the CWA. In addition, the SSIS evaluated whether other constituents in the discharge (particularly aluminum arising from the use of Clar$^+$Ion$^\bullet$ polymers in plant operations) would have a potential impact to the environment.

The SSIS addresses the site specific regulatory factors provided in Section 27(a) and Section 28.3 of the Act, and it will also incorporate the federal BPJ factors into this analysis. Both analyses are required to fulfill regulatory or site specific relief requirements under the Act and CWA. Table 1-1 identifies the factors considered under both state and federal regulations. Additional determination of BDT (as described under 35 IAC 304.102) for the plant was recommended by Illinois EPA in comments on the SSIS workplan (see Section 2.2) and incorporated into the SSIS.

1.2.1 Illinois Environmental Protection Act's Site Specific Regulatory Requirements

The relevant site specific factors under Section 27(a) of the Act include: existing physical conditions, the character of the area involved, the nature of the receiving body of water, and the technical feasibility and economic reasonableness of discharge reduction alternatives. These factors can be used to establish a best degree of treatment (BDT) for the discharge and should incorporate waste minimization and pollution prevention practices. Additional Section 27(a) factors, such as the existing industrial character and the residential development adjacent to the site, are also considered in the site specific analysis.

Section 28.3 public water supply factors for direct discharge of waste solids to the Mississippi or Ohio Rivers from clarifier sludge and filter backwash generated in the River water purification process are also relevant to the issue of under what circumstances it may be appropriate to directly discharge residuals from public water supply purification of Mississippi River water. Although the legislature imposed a filing deadline for the specific type of adjusted standard relief provided in Section 28.3, it did not provide that Section 28.3 was repealed after the filing deadline, and it remains part of the Act. The Section 28.3 factors are: water quality effects, actual and potential stream uses, and economic considerations, including those of the discharger and those affected by the discharge. Justification based on discharge impact shall include, as a minimum, an evaluation of receiving stream ratios; known stream uses; accessibility to stream and side land use activities (residential, commercial, agricultural, industrial, recreational);

frequency and extent of discharges; inspections of unnatural bottom deposits, odors, unnatural floating material or color; stream morphology and results of stream chemical analyses. Where minimal impact cannot be established, justification shall also include evaluations of stream sediment analyses, biological surveys (including habitat assessment), and stream chemical analyses that may include, but are not limited to, analyses of parameters regulated in 35 IAC 302. A description of the proposed alternative control strategy and the discharge limitations associated with the strategy is also required.

1.2.2 Requirement for Consistency with Federal Law

In addition to the state factors described above, the federal BPJ factors are relevant because the Water Company must demonstrate that the discharge proposal it develops in the study is consistent with federal law, including the NPDES permit requirements. The federal CWA requires the Illinois EPA to impose technology-based treatment requirements in the NPDES permit it will issue for the replacement facility. As noted by the Illinois Pollution Control Board (Board) in an opinion and order pertaining to a site specific relief petition filed in the 1980s for the Water Company's East St. Louis public water supply facility, Illinois EPA sets effluent limits for public water supplies on a case-by-case basis under CWA Section 402(a). Because of the huge variability in raw water sources, U.S. EPA never established industry-wide limits for public water supplies (see Section 1.4 for discussion).

The federal regulations provide at 40 CFR 125.3(c)(2) that the permit writer shall develop case-by-case limits under CWA Section 402(a) by applying the appropriate factors listed in 125.3(d) and shall consider: (i) the appropriate technology for the category or class of point sources of which the applicant is a member, based on available information; and (ii) any unique factors relating to the applicant.

The 40 CFR 125.3(d) factors are divided into factors which the permit writer must consider for the two elements of BPJ relevant to non-toxic pollutants--best practicable control technology currently available ("BPT") and best conventional pollutant control technology ("BCT"). These factors are listed in Table 1-1. For purposes of evaluating the proposed replacement facility, both BPT and BCT must be considered. For BPT, the factors are: (i) the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such reduction; (ii) the age of equipment and facilities involved; (iii) the process employed; (iv) the engineering aspects of the application of various types of control techniques; (v) process changes; and (vi) non-water quality environmental impact (including energy requirements). For BCT requirements, the permit writer must consider: (i) the reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived; (ii) the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources; (iii) the age of equipment and facilities involved; (iv) the process employed; (v) the engineering aspects of the application of various types of control techniques; (vi) process changes; and (vii) non-water quality environmental impact (including energy requirements). The relationships between BPT and BCT are discussed further in Section 1.5 of this report.

1.3 Current Permit Conditions

The NPDES permit for the current Alton facility water treatment supply plant is IL #0000299 and covers one discharge (001-0). This permit requires daily monitoring of flow, while pH, TSS, total iron, and TRC are monitored on a monthly basis. An effluent limitation range exists for pH between 6.0 to 9.0 standard units (SU). As a result of the site specific rule applicable to the existing plant, no treatment is required for the discharge effluent other than dechlorination which will be required as of November 1998.

1.4 Background Information on Effluent Limitations for Public Water Supply Facilities

In part, the need for site specific effluent limitations for the Alton water supply plant is based on the lack of national effluent limitations guidelines for the water supply industry. Under these circumstances, a permit writer drafting a NPDES permit must develop effluent limitations on a case-by-case basis using Best Professional Judgement (previously known as Best Engineering Judgement) following consideration of the factors listed in 40 CFR 125.3 (see Section 3 for statutory factors). However, the permit writer also needs to consider "any unique factors relating to the applicant" (40 CFR 125.3(c)).

In developing the case-by-case considerations, a permit writer may consider proposed national effluent limitation guidelines, draft development documents, available technical data from similar facilities, or other regulatory guidance. Therefore, it is important to review information contained in the draft development document and related U.S. EPA communiques as part of the case-by-case development of effluent limitations for the Alton facility under BPJ.

In this regard, two key U.S. EPA documents are the U.S. EPA Permit Policy Statement #13 issued September 18, 1974 (U.S. EPA, 1974) and the Draft Development Document for Effluent Limitation Guidelines and Standards of Performance - Water Supply Industry (U.S. EPA, 1975) hereafter referred to as the "Draft Development Document". Both of these U.S. EPA documents contain information which is directly relevant to development of effluent limitations for the Alton facility.

Permit Policy Statement #13 concerns "Disposal of Supply Water Treatment Sludges" and contains language which directly relates to the Alton facility, including:

- its suggestion of possible subcategories of sludges such as: 1) silt removed from raw water; and 2) chemical water treatment sludges such as lime;

- its statement that it is not appropriate to arbitrarily prohibit silt removed from public water supply streams from being returned to the stream, due to considerations of *"...supply water silt burden, nature and quantity of chemical clarification aids used, availability of land disposal sites, economic impact, navigational considerations and water quality standards, to mention a few"* [U.S. EPA, 1974; pg. 1] and

- specific identification of the Mississippi River as a special case. *"Because silt is indigenous to certain river waters, notably the Mississippi and Missouri Rivers, and because our priority concern is process generated pollutants, and because unreasonable cost-benefit relationships may result in some areas of these rivers and others, it would be within the intent of best practicable control technology currently available to authorize, in some instances, either the partial or total return of silt type sludges to the receiving waters."* [U.S. EPA, 1974; pg. 2].

As these sections underscore, the Permit Policy Statement recognizes two important points. The first is the distinction U.S. EPA makes between sludges composed mainly of naturally-occurring silts as opposed to water treatment sludges with a high concentrations of process generated chemicals. The second point is the acknowledgement that due to the high silt content of the Mississippi River, return of these silts to the river can constitute BPT.

Additional insight into U.S. EPA concerns toward water supply treatment effluents is provided in the Draft Development Document (U.S. EPA, 1975). The document established total suspended solids as a pollutant parameter for all subcategories of water treatment plants. The Draft Development Document also contains key passages which acknowledge that: (1) return of residuals to a highly turbid river will cause an imperceptible increase in turbidity; (2) treating such discharges is not cost-effective; and, in addition, (3) coagulant sludges present unique handling and disposal problems. Specifically, the Draft Development Document notes that:

- *"... extensive studies made at plants along one highly turbid river have shown that returning the raw waste sludge to the highly turbid source increases the turbidity of the stream by an insignificant increment. In some instances the incremental increase in turbidity is less than the precision of many turbidimeters used for routine monitoring."* [U.S. EPA, 1975; pg. 46];

- *"These studies have also shown that the benefit-cost ratio for dewatering the sludge and hauling to landfills is very low, and that the amount of energy used in treating and hauling it is very high. Because of these factors the disposal of sludge from plants that must use highly turbid water as feeds ... should be judged on an individual basis."* [U.S. EPA, 1975; pg. 46]; and

- *"Sludge is difficult to dewater by lagooning. However, it will gradually consolidate sufficiently to provide a 10% to 15% solids content. Water removal is normally by decantation or by evaporation with some drainage. Evaporation may provide a hard crust on the surface but the sludge below the crust is thixotropic, capable of turning into a viscous liquid upon agitation with near zero shear resistance under static load. Therefore, lagooned sludge cannot be easily handled nor will it make good landfill material."* [U.S. EPA, 1975; pg. 75-76].

These passages indicate the recognition by the U.S. EPA that imposition of TSS effluent limitations for water treatment supply plant effluents, especially coagulant sludges would provide an inadequate cost-benefit ratio, particularly when dealing with return to raw water sources where negligible improvements in water quality would result from control technology.

U.S. EPA decided in 1977 not to promulgate national effluent guidelines for the public water supply industry. Since that time, U.S. EPA's comments on regional guidance documents indicate that the nature and magnitude of water quality impacts should be considered in determining the appropriate treatment, and that regional differences in environmental conditions are relevant (U.S. EPA, 1991b).

1.5 Background Information on BPT and BCT Requirements

To apply BPJ to the proposed Alton replacement facility as a case-by-case determination, a number of factors were considered, including those specified at 40 CFR 125(d)(1) and (d)(2), those identified by U.S. EPA Permit Policy Statement #13 (U.S. EPA, 1974), as well as unique factors as provided at 40 CFR 125.3 (c) including economic achievability. Addressing these factors provides a comprehensive approach to deriving effluent limitations and satisfied the required analysis and fact-finding process which a permit writer is directed to employ under BPJ.

Discharge permits developed under the NPDES process may contain effluent limitations or permit conditions such as monitoring and reporting requirements. The CWA requires that NPDES permit effluent limitations be developed either as a technology-based treatment or a water quality-based limit (whichever is more stringent). In cases where technology-based promulgated effluent guidelines are absent, CWA Section 402(a)(1) requires that the NPDES permit issuing authority develop case-by-case effluent limitations reflecting BPJ.

Since national effluent limitations have not been issued for the water supply industry, technology-based treatment is developed on a case-by-case basis through BPJ. The permit writer will determine the appropriate limitations without the use of national industry-specific effluent limitation guidelines. Rather the permit writer will apply a series of statutory factors listed in 40 CFR 125.3(d) and consider (1) the appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information; and (2) any unique factors relating to the applicant.

On the basis on his/her consideration of these factors, the permit writer is required to develop the analysis of the application of the statutory factors which lead to the proposed effluent limitations. This analysis is usually put on a fact sheet which accompanies the proposed permit.

In considering the statutory factors contained in 125.3(d), it is necessary to consider the nature of the water quality effluent parameters. Since the effluent parameters in question include TSS and iron, "conventional" water quality pollutants, the appropriate control technology is based on best conventional pollution control treatment or BCT. However, in order to establish the BPJ basis for the current effluent limitation of the Alton facility, it may be applicable to consider best practicable control treatment currently available or BPT, as well as BCT. This is because BCT must be at least as stringent as the effluent limitations developed under BPT.

In essence, to evaluate the specific-case effluent limits for the post-clarifier residuals developed under BPJ for the Alton facility, a two-step technical analysis was required. First, it was necessary to examine whether the proposed replacement facility residuals handling methods are BPT (based on current practices or adaption of treatment technologies). Second, the possible limitations developed as BCT will be compared to BPT limits.

Factors which are to be considered by the permit writer for the setting of BPT effluent limitations are listed in 40 CFR 125.3(d)(1), and are presented below:

(i) The total cost of application of technology in relation to the application of technology in relation to the effluent reduction benefits to be achieved from such application;

(ii) The age of the equipment and facilities involved;

(iii) The process employed;

(iv) The engineering aspects of the application of various types of control techniques;

(v) Process changes; and

(vi) Non-water quality environmental impact (including energy requirements).

Factors which are to be considered by the permit writer for the setting of BCT effluent limitations are listed in 40 CFR 125.3(d)(2) and are presented below:

(i) The reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived;

(ii) The comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources;

(iii) The age of the equipment and facilities involved;

(iv) The process employed;

(v) The engineering aspects of the application of various types of control techniques;

(vi) Process changes; and

(vii) Non-water quality environmental impact (including energy requirements).

While an effluent limitation established by BPJ must consider these factors, the permit writer also must consider additional available information and site specific or unique factors (see 40 CFR 125.3(c)(2)). In particular, BPJ takes into account any site specific factors which make the Alton facility unrepresentative of the water supply industry in general, such as those identified by the U.S. EPA 1974 Permit Policy Statement (water supply silt burden, nature and quantity of clarification aids, etc.). This "unique factors" consideration is an important component of the case-by-case determination.

For the purposes of the analysis of the Alton discharge effluent limitations, Best Professional Judgement was based on:

- Establishment of effluent limitations as BPT through consideration of the factors listed in 125.3(d)(1), as well as additional available information including U.S. EPA policy documents and applicable state regulations;

- Establishment of effluent limitations as BCT through consideration of the factors listed in 125.3(d)(2), as well as comparison of effluent limitations established by BPT;

- Consideration of relevant "unique" factors (125.3(c)(2)) including but not limited to:

  - the hydrology and water quality of the Mississippi River at Alton;

  - potential impacts of TSS in the effluent discharges on the water quality and biota of the Mississippi River;

  - potential environmental impacts caused by land disposal of effluent residuals;

  - additional information from water treatment plants located along large, turbid rivers; and

  - economic achievability.

TABLE 1-1
Regulatory Components of Site-Specific Impact Study

Best Degree of Treatment ("BDT")	Best Practicable Control Technology ("BPT")	Best Conventional Pollutant Control Technology ("BCT")
Sections 27(a) and 28.3 of the Act 35 IAC 304.102	40 CFR 125.3(d)1	40 CFR 125.3(d)2
Section 27(a) i) Existing physical conditions ii) The character of the land involved iii) The nature of the receiving body of water iv) Technical feasibility and economic reasonableness of discharge reduction alternatives Section 28.3 i) Water quality effects ii) Actual and potential stream uses III) Economic considerations, including those of the discharger and those affected by the discharge 35 IAC 304.102 i) Technological feasibility ii) Economic reasonableness iii) Sound engineering judgement iv) What degree of waste reduction can be achieved by process change, improved housekeeping and recovery of individual waste components for reuse? v) Whether individual process wastewater streams should be segregated or combined	i) The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application ii) The age of the equipment and facilities employed iii) The process employed iv) The engineering aspect of the application of various types of control techniques v) Process changes vi) Non-water quality environmental impact (including energy requirements)	i) The reasonableness of the relationship between the costs of attaining a reduction in effluent and effluent reduction benefit derived ii) The comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources iii) The age of the equipment and facilities involved iv) The process employed v) The engineering aspect of the application of various types of control techniques vi) Process changes vii) Non-water quality environmental impact (including energy requirements)

2.0 REGULATORY REVIEW AND DEFINITION OF SITE SPECIFIC FACTORS

The SSIS was designed to address relevant factors provided in Section 27(a) and 28.3 of the Act as well as potential Illinois EPA or other regulatory agency concerns not explicitly addressed by those sections. A preliminary scoping meeting was held with Illinois EPA to discuss the necessary elements of the SSIS. As a result of that meeting a draft SSIS Workplan was developed and sent to Illinois EPA for review and comment (Section 2.1). The resulting comments were incorporated into the final SSIS Workplan (Section 2.2) which defines the site specific factors to be addressed. As part of the Workplan, the Water Company developed a program to identify potential stakeholder concerns about the project (Section 2.3). A second meeting with Illinois EPA was held to discuss project status and revisit the SSIS Workplan and was followed by several meetings with Illinois EPA to discuss portions of the SSIS Report or additional information requested by them (Section 2.4).

2.1 Preparation of Workplan for Illinois EPA Review

A September 12, 1996 meeting was held between the Water Company and Illinois EPA to review the overall project, determine relevant regulatory requirements, identify additional Illinois EPA concerns, and discuss the proposed timetable of the SSIS in the context of the planning and construction of the Alton replacement plant. As a result of that meeting, the Water Company prepared a draft SSIS workplan. That document served as the draft work plan of the site specific factors analysis, including BPJ factors, and was submitted to Illinois EPA for review and comment. The workplan was intended to provide sufficient detail to clearly outline the proposed approach and intended analyses.

2.2 Response to Illinois EPA Comments and Suggestions

The draft SSIS Workplan was submitted to Illinois EPA for review in early October 1996. Illinois EPA provided comments on the draft SSIS workplan in a letter from Thomas G. McSwiggin (Manager, Permits Section) to the Water Company dated December 16, 1996 (Illinois EPA, 1996). Illinois EPA concerns identified in that letter included the potential plant construction impacts on terrestrial endangered species; evaluation of any site historical significance; more complete evaluation of effluent standards under 35 IAC 304; and consideration of all expected pollutants in the area of mixing. A copy of the comment letter is included in Appendix A.

2.3 Development of Plan for Seeking Stakeholder Input

An important part of the SSIS is the identification and incorporation of stakeholder concerns into the overall site specific evaluation. Relevant stakeholders for the proposed Alton replacement facility include abutters, local residents, community groups, local government leaders, and other interested parties. The Water Company had identified and met with several stakeholders for the former proposed site on an informal basis. However, a more comprehensive plan to seek stakeholder input was developed to formalize and document this input.

As part of this plan, the Water Company conducted a series of presentations to the stakeholders and interested local community. These meetings were scheduled to provide an opportunity for Illinois EPA to participate. The first of these stakeholder meetings was held on December 18, 1996 and included a presentation by Mr. McSwiggin (Manager, Permits Section) regarding the regulatory requirements. The December meeting and emergent identified issues are further described in Section 4.4. A second stakeholder meeting was held on February 26, 1997 but no new additional environmental issues were identified. Subsequent to the meeting in February 1996, Illinois-American decided to develop the property at the former Mississippi Lime site rather than the Godfrey site. A third public meeting was held on July 21, 1998 to discuss the proposed Alton facility. Comments and issues raised by the stakeholders for both the Godfrey and Alton sites were similar and are addressed by the SSIS, if applicable, or otherwise considered in the planning and development of the final plant design and/or operations.

2.4 Additional Meetings with Illinois EPA

Due to a change in project location, specifically the decision to construct the replacement plant on property adjacent (including property across Route 100) to the current Alton plant rather than a proposed site in Godfrey, IL to capture a greater than six million dollar savings in construction costs, a second meeting with Illinois EPA was held on August 21, 1997. The purpose of this second meeting was to inform Illinois EPA of the project status and to revisit the SSIS Workplan to identify any additional site specific factors which needed to be considered for the Alton replacement facility. Based on this meeting, a mussel habitat characterization and protected species survey was added to the Workplan prior to its implementation.

Subsequent meetings between the Water Company and Illinois EPA were held in May 1997, October 1998, and December 1998 to discuss portions of the SSIS Report and outstanding issues. As a consequence of these meetings, the Water Company supplied additional information and/or analyses to Illinois EPA to provide sufficient information for the agency to evaluate the proposed facility, and all outstanding issues were addressed.

3.0 DETERMINATION OF PREDICTED EFFLUENT DISCHARGES

3.1 Current Plant Configuration

Illinois-American Water Company, Alton District owns and operates the water treatment facility located along the Mississippi River at approximately River Mile 204 (latitude 38°, 53", 56' north; longitude 90° 12" 11' west) in Alton, Illinois. The Mississippi River is the sole source of water supply for the facility and the District. As of 1998, there were approximately 265 miles of water main in the distribution system and the District served a population base of 76,429 customers and 17,479 households/businesses.

The Alton facility has been supplying water to the City of Alton and nearby residents since the 1890s. The original 13.3 million gallons per day (MGD) Main Service Plant was constructed in the 1930s. An additional 5 MGD High Service Plant was constructed in 1981 at the same site. The Main Service Plant consists of two mixing tanks, one circular clarifier, two rectangular sedimentation basins, sand filters, 650,000 gallons of filtered water storage and raw and filtered water pumping stations. The High Service Plant consists of one mixing tank, two clarifiers, four filters, raw, transfer, and filtered water pump stations, and one million gallons of filtered water storage. The two plants share a common side channel intake structure at the River. The existing treatment process is summarized in Figure 3-1.

At the existing facility, water is taken from the Mississippi River through a side channel intake into two wet wells in the facility Gate House. Two traveling screens are located at these wet wells to strain out debris. The screens are regularly cleaned with finished water, and the expelled material and screen wash water are returned directly to the Mississippi River. Three pumping units transmit raw water to the two flocculation tanks in the Main Service plant. Three pumping units convey raw water to the mixing tank in the High Service Plant.

At the Main Service plant, open rectangular steel channels convey the raw water from the mixing tanks to the circular clarifier where sand and heavy sediment are removed. From the clarifier, the water is split into approximately equal proportions. The clarified water enters the lower chamber of each of the two parallel rectangular sedimentation basins. From the lower chamber, the water rises to the upper chamber. From the sedimentation basins the treated water enters the former recarbonation tank where additional treatment chemicals are added. From the recarbonation tank, the treated water flows to nine sand filters.

At the High Service plant, flocculation occurs in the mixing tank in which one side wall mixer is mounted. From the mixing tank, water flows by gravity to two Claricone sludge blanket type clarifiers. From the clarifiers, water flows by gravity to four sand/anthracite filters.

Treatment to aid in sedimentation begins as water leaves the intake, where the primary coagulant (Clar+Ion®) is added to coagulate the sediment in the water. Powdered activated carbon (PAC) may be added at the intake in order to control odor and taste. Lime or caustic may added at this point as well when alkalinity is low. Based on historical records, alkalinity is low during high flows or high turbidities. In the mixing tanks, the retention time and gentle mixing promote coagulation. The coagulated sediment will then settle in the clarifier and sedimentation basins in the Main Service plant or in the Claricone clarifiers at the High Service plant.

Disinfection is provided by chlorine addition immediately after flocculation and again after clarification in the sedimentation basins. Ammonia is added before clarification to promote chloramine formation.

3.2 Current Effluent Discharges

There are two types of effluent discharges from the Alton treatment system - operational and maintenance discharges. Operational discharges are those flows which occur regularly, on a daily or weekly basis, during periods when the plant is producing potable water. Operational discharges include return of intake screen wash, return of pre-sedimentation silts from the clarifier, blowdown from sedimentation basins and filter backwash. The second category of discharge (maintenance) is the annual cleaning of accumulated solids in the clarifier, the sedimentation basins, and the mixing tanks.

Residuals from the existing Alton plant are stored in a dedicated wet well at the Gate House. They can be discharged by gravity or can be discharged using a dedicated transfer pump during high river levels. All plant residuals are discharged from this location.

The two Main Service plant operational discharges consist of intermittent clarifier blowdown and filter backwash. Blowdowns occur based on the turbidity of the clarifier influent and effluent. Plant operators manually open the drain valve for approximately one hour to blow down the residuals. On the average, approximately 30,000 gallons per day (gpd) of blowdown are discharged two days a week from the clarifier. However, the frequency and duration of blowdowns are very variable since they are dictated by raw water turbidity. The sand filters used at the Main Service plant are backwashed daily for approximately 15 minutes. Each filter runs approximately 24 to 30 hours between backwashings. On the average, approximately 630,000 gpd of backwash is discharged from these filters.

The Main Service plant maintenance discharges are produced during cleaning of the clarifier, sedimentation basins, and mixing tanks. The two sedimentation basins do not include sludge removal equipment so the basins are dewatered prior to manual sludge removal. The sedimentation basins, mixing tanks and clarifier are cleaned three times per year. Approximately 72,000 gpd of water (carrier water with residuals) are discharged during this five day-long maintenance activity (i.e., total annual discharge is 1,080,000 gallons).

The High Service plant operational discharges include Claricone clarifier blowdown, filter backwash, and cleaning of the Claricone clarifier. Plant operators release clarifier residuals based on the condition and thickness of the sludge blanket. On the average, 12,000 gpd of blowdown residuals are discharged from the clarifier on a regular basis. Two of the four sand/anthracite filters at the High Service plant are backwashed daily for approximately 15 minutes. Each filter runs approximately 48 hours between backwashings. On the average, approximately 210,000 gpd of backwash is discharged from these filters. The Claricone clarifiers are cleaned once a year. Approximately 24,000 gpd of water (carrier water with residuals) is discharged during the two days of maintenance activity.

3.3 Plant History and Replacement Facility

As noted earlier, portions of the existing Illinois-American Alton facility are over 100 years old. The Alton facility has been supplying water to the City of Alton since the 1890s. In the 1930s the 13.3 MGD Main Service Plant was constructed. In 1981, an additional 5 MGD High Service Plant was constructed at the same site.

The entire facility is located within a physically-restricted parcel of level land approximately 20 feet above the normal river summer level. The facility is bounded directly to the northeast by the Norfolk Southern Railroad and Illinois Route 100 and bounded to the southwest by the Mississippi River. Across the railroad and highway corridor, the land slopes steeply up to the bluffs overlooking the River.

Due to its proximity to the Mississippi River, the site is subject to an increasing frequency of flooding. Sandbagging to protect the facility from flooding was required in 1973, 1986, 1993, 1994, and 1995. In August of 1993, the entire site was flooded. Both the Main Service and High Service plants were out of service for four days. Limited service was provided initially by the High Service plant. Full service was reinstated soon thereafter. Consumers in the Alton service area were required to boil tap water over a 10 day period.

In order to replace the aging facility and avoid future flooding, a replacement water treatment plant will be constructed approximately 60 feet higher than the existing facility on property located directly across the Illinois Route 100 in the City of Alton, IL. The Water Company evaluated nine alternatives for a water supply replacement facility site before choosing the proposed site. This site is preferred due to its industrial zoning, proximity to the existing plant and infrastructure, favorable site topography for construction, size, and proximity to the existing raw water intake location. Other alternative supplies/locations had significant drawbacks.

3.4 Replacement Plant Design, Capacity, Flows and Discharges

At this stage, the key design elements and process treatments have been selected. This provides sufficient detail to allow evaluation of the discharges of the proposed plant.

3.4.1 Plant Flows

The proposed replacement plant has been designed to produce, on average, up to 10.5 MGD of potable water for the Alton area. The hydraulic design capacity of the plant will be 16 MGD. The value of 10.5 MGD was selected as the average daily potable water demand, based on projections of future water demand conducted as part of Illinois-American's Comprehensive Planning Study (Illinois-American, 1996). [Note: relevant sections of the Comprehensive Planning Study are included in Appendix E.] Water demand was estimated using predicted demographic trends through the year 2010, which predict a modest growth in population in Madison County. Population growth is likely to be influenced by the newly constructed multi-lane highway bridge across the Mississippi River at Alton, highway improvements, continued downtown development in Alton, and increased tourist attractions.

Based on an internal plant demand (i.e., not going into Illinois-American's distribution system) of 1 MGD for Superpulsator® blowdowns, filter backwashes, etc. at a peak potable water flow of 15 MGD, a proportional internal plant demand of 0.7 MGD was estimated for the average potable water flow of 10.5 MGD. The combined flow, 10.5 + 0.7 = 11.2 MGD, was used to evaluate potential discharge impacts in Section 5.0.

3.4.2 Plant Design

The new plant will consist of a new raw water intake and pumping station, clarification and filtration units, filtered water storage and chemical feed facilities. The proposed treatment process is summarized in Figure 3-2.

Clarification of raw water at the new plant will be provided by four Superpulsator® units (high rate blanket-sludge type clarifiers manufactured by Infilco Degremont Inc). An initial presettler unit, such as the lamella inclined plate clarifier, may be considered during final design.

Filtration will be provided by six gravity dual media (sand/granular activated carbon) units. Each filter will be equipped with a rate of flow controller, filter to waste piping, an air surface wash system and automatic monitors for flow rate, head loss and water level.

Residual discharges from the proposed Alton replacement plant will be composed of Superpulsator® blowdown, filter backwash, and Superpulsator® cleaning water as summarized in Figure 3-3 for average river turbidity and Clar⁺Ion® addition. Note that the amount of residuals produced (measured as dry solids) balances with the suspended solids introduced in the influent river water (measured as dry solids) and added as coagulant aids (measured as dry solids). The amount of residuals produced by coagulants is minor in comparison to that introduced naturally as sediments in the raw water.

One additional maintenance discharge will arise from the replacement plant. This discharge is from periodic wet well cleaning (once every 5 years). Since this discharge is minor in amount and duration, uses raw water for cleaning, and does not contain process-generated chemicals (i.e., coagulant) it has been eliminated from further consideration.

Chlorine will be used at a variety of points within the proposed Alton replacement drinking water facility. Chlorine may be added on a seasonal basis prior to the Superpulsator® or filter backwash treatments. Ammonia and chlorine are applied at rates necessary to achieve a total chlorine residual sufficient for disinfection in the treatment process and to provide a final TRC for disinfection in the potable water distribution system. Figure 3-2 indicates the process locations of all chemical additions, including ammonia and chlorine addition.

The Water Company will use the process of chloramination at the proposed Alton facility. Ammonia is applied just after chlorine treatment in order to form chloramines rather than free chlorine residual. Chloroamines may be added to the raw water prior to the Superpulsator®. If treatment is similar to other plants, a TRC of 3 to 4 mg/L could be expected in the Superpulsator® unit. A trace of free chlorine would also be expected at this point. Alternatively, if chlorine is added, the Superpulsator® TRC would be expected to range from 1.0 to 1.5 mg/L. The settled solids are continuously removed from the Superpulsator® and routed to the effluent discharge.

Water from the Superpulsator® will flow to six carbon/sand dual media filter units. Due to this filtration through the carbon, some minimal reduction in free chlorine residual and TRC would be expected. TRC would be expected in the filter backwash water, which constitutes nearly half of the total effluent discharge.

Chlorine and ammonia will be applied to the filtrate (i.e., at the clearwells) to maintain a disinfectant residual in the potable water distribution system. However, these application points do not effect the discharge, since the discharge stream is split away prior to this part of the process.

The proposed replacement facility will prevent unacceptable TRC concentrations in the effluent discharge through dechlorination. To dechlorinate the effluent discharge from the Alton replacement facility, two dechlorination systems will be used to treat the Superpulsators® and filter backwash discharges, respectively. Separation of the filter backwash water from the other effluent volumes will allow the Water Company to treat only the water which contains the residual chlorine and reduce the volume of water requiring treatment. This will provide flexibility and redundancy for the plant.

Operation of the treatment facility is assumed to be highly automated. The required equipment includes an analyzer, controller, flow proportioning system, automatic switchover gage, diffuser, scale for cylinders, and a SO_2 detector. In addition, storage and restocking of chemicals and seasonal maintenance are required.

3.5 Variability of River Water Quality

The raw water quality of the Mississippi River at the river intake is highly variable. Based on data from the existing Alton facility (January 1990 through December 1995), the turbidity of the influent varies dramatically on a daily basis. For example, in May 1990 the influent turbidity changed from 39 nephelometric turbidity units (NTU) to 964 NTU (the maximum value over the six year period of record) over the month. The minimum daily turbidity value was 8 NTU in January 1994. Similarly, the mean of annual averages and the monthly averages differ substantially. The mean of annual averages for the six year period is 90 NTU whereas the maximum of monthly averages is 430 NTU.

To account for this natural variability, three River turbidity conditions were evaluated for conceptual design purposes and to support the potential impact evaluation conducted in Section 5.1. The turbidity values (NTU) were correlated to suspended solids concentrations (mg/L TSS) using a ratio of 1:2 NTU/TSS. The ratio of turbidity to suspended solids in rivers similar to the Mississippi River ranges from 1:1.8 to 1:2. In order to consider maximum solids production, the ratio of 1:2 was selected. [Note: Due to the importance of this value for determining potential residual loads, this value was peer-reviewed by two engineering firms: Hazen & Sawyer, and

Burns and McDonnell]. The long term river water quality is represented by the mean of the annual turbidity averages, or 90 NTU (180 mg/L TSS). Discharges calculated based on this condition were used to design long term treatment units such as lagoons. The medium term river water quality is represented by the maximum of the monthly turbidity values or 430 NTU (860 mg/L TSS). Discharges calculated based on this condition were used to design all the residual handling equipment such as belt filter presses. The short term river water quality is represented by the maximum daily value or 964 NTU (1928 mg/L TSS) . Residual discharges calculated based on this condition were used to design the initial equalization basins so that storage volume would be provided to handle this worst case condition. The residual discharge volumes and solids content are summarized in Table 3-1 for the three river water quality conditions.

3.6 Modeling of Anticipated Exceedances

Modeling of anticipated exceedances of water quality standards was conducted using the discharge values derived in Section 3.4. These values include discharge flows and concentrations under variable flow TSS and flow conditions selected in consultation with Illinois EPA. These values were used to model potential worst-case and average flow scenarios to evaluate the potential for the discharged effluent to exceed Illinois Water Quality or Effluent Standards. Details of the characteristics of the receiving water are given in Section 4.0, while the modeling of water quality effects is presented in Section 5.1.

TABLE 3-1
Predicted Effluent Discharges
Illinois-American Water Company
New Alton Water Treatment Plant
11.2 MGD

Unit Discharge (under variable influent turbidity)	Frequency	Flow (gpd)	Estimated TSS (mg/l)	Predicted Solids Load
Average Annual Turbidity				
(TSS = 180 mg/l)				(tons/year)
Superpulsator	Continuous	433,099	5,000	3296.9
Filter Backwash	Intermittent	620,400	65.0	61.4
Total		1,053,499		3,358
Max Monthly Turbidity				
(TSS = 860 mg/l)				(tons/month)
Superpulsator	Continuous	1,002,018	10,000	1233.6
Filter Backwash	Intermittent	930,600	207.0	24.4
Total		1,932,618		1258.0
Max Daily Turbidity				
(TSS = 1928 mg/l)				(tons/day)
Superpulsator	Continuous	2,194,206	10,000	89.9
Filter Backwash	Intermittent	930,600	464.1	1.8
Total		3,124,806		91.7

Assumed Clarion A410-P Coagulant

REV112.wk402/08/9910:37 AM

399503A

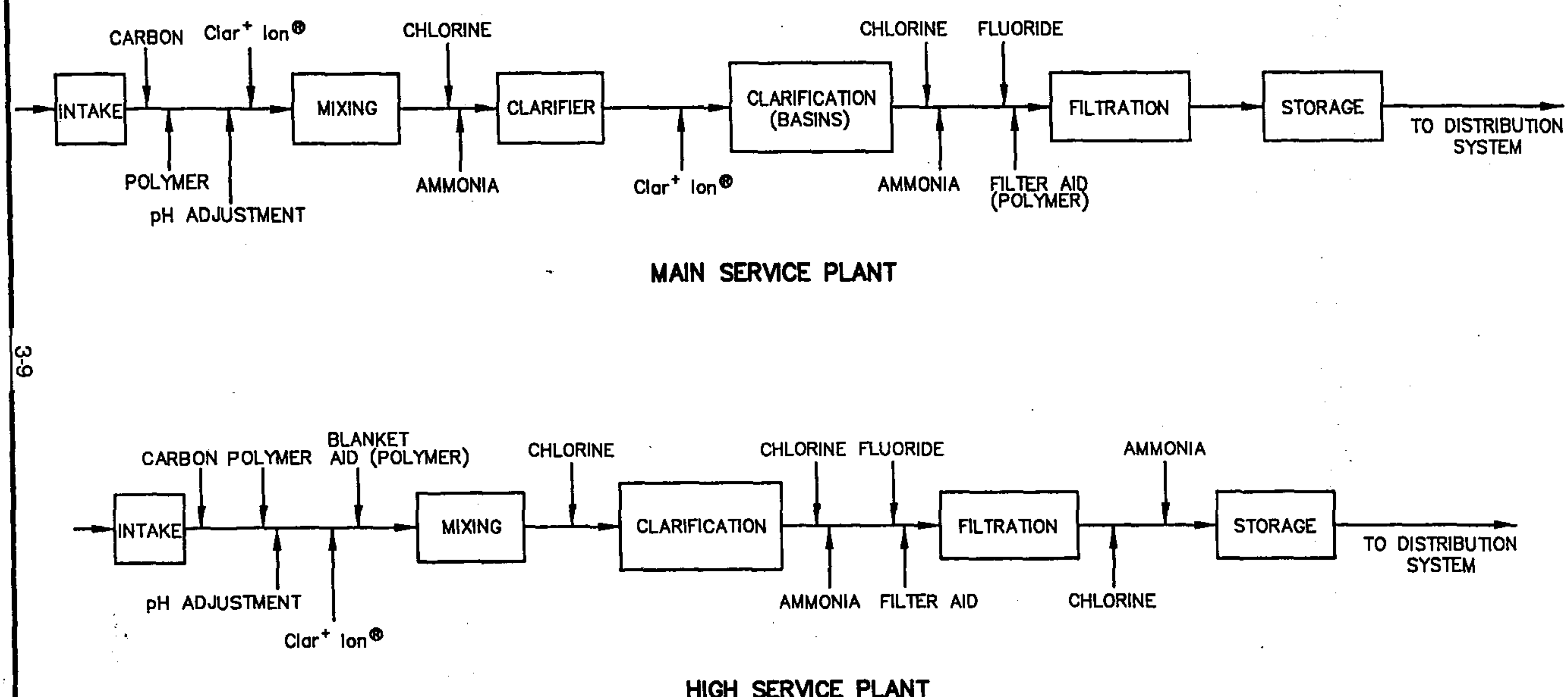


FIGURE 3–1
EXISTING TREATMENT PROCESS
ILLINOIS – AMERICAN WATER COMPANY
ALTON DISTRICT

399501A

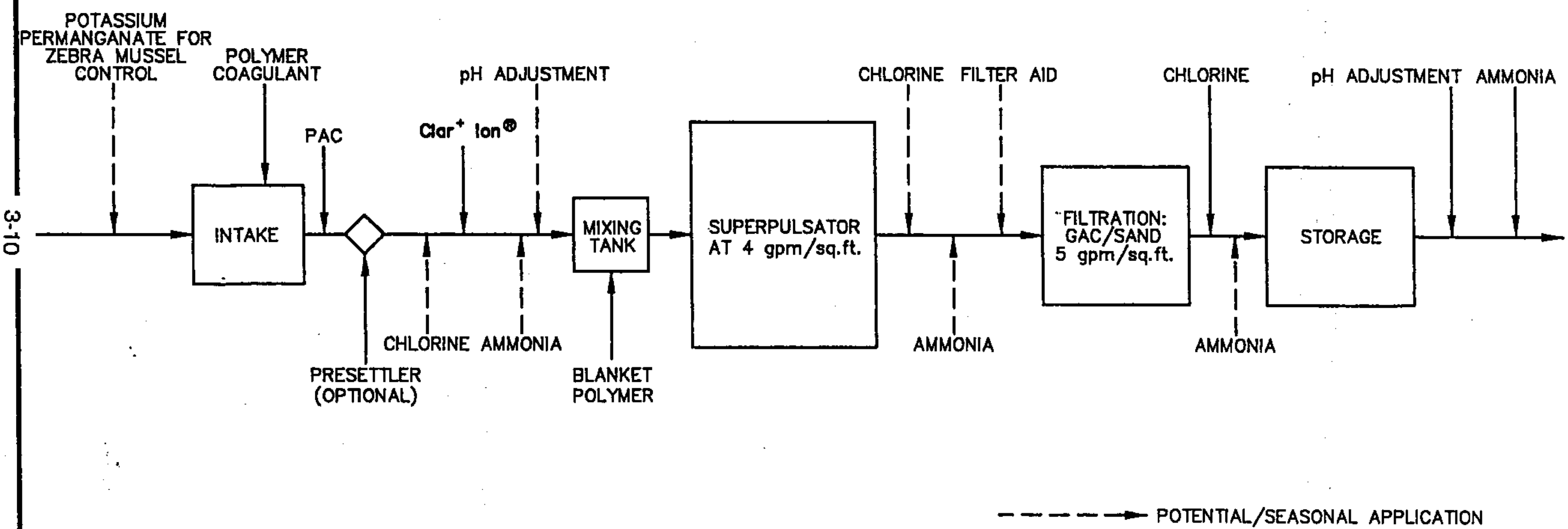


FIGURE 3–2
PROPOSED TREATMENT PROCESS
ILLINOIS – AMERICAN WATER COMPANY
ALTON DISTRICT

FIGURE 3-3 NEW ALTON WTP - ILLINOIS AMERICAN WATER COMPANY
Design Basis, Solids Removal (and backwash rate)

Primary Coagulant = Clarion
Average Turbidity

RIVER WATER

TSS (mg/l) =	180
Flow (MGD)	11.2
Dry solids weight (tons/day) =	8.4

↓

4 Superpulsators
Blanket Sludge Clarifier
Loading Rate = 4 gpm/sf

DISCHARGES

	superpulsator
TSS Removal (%) =	98
TSS (tons/day) =	8.2
TSS (mg/l) =	5000
Solids Content (%) =	0.5
Wet weight (ton/day) =	1648
Residual Spec.Grav. =	1
Residual flow (gpd) =	395,030

↓

Chemical Sludge

	chemical residuals
TSS (tons/day) =	0.8
TSS (mg/l) =	5000
Solids Content (%) =	0.5
Wet weight (ton/day) =	159
Residual Spec.Grav. =	1
Residuals flow (gpd) =	38,070

↓

6 Gravity GAC/Sand Filters
Surface Area = 470 sf/filter
Loading Rate = 3 gpm/sf

	filters
Washwater flow (gpd)=	620,400
TSS Removal (%) =	2
TSS (tons/day) =	0.2
TSS (mg/l) =	65
Solids Content (%) =	0.01
Wet weight (ton/day) =	2588
Residuals Spec.Grav. =	1
Flow (gpd) =	620,400

↓

FINISHED WATER

TSS (mg/l) =	0
Flow (MGD)	10.2

4.0 ENVIRONMENTAL CHARACTERISTICS OF PROPOSED SITE

The environmental characteristics of the proposed Alton replacement facility and vicinity were identified. This included the existing physical conditions (Section 4.1); land use (Section 4.2); characterization of the receiving waters (Section 4.3); and stakeholder concerns (Section 4.4). A series of photographs depicting the current facility, the proposed replacement facility site, and the Mississippi River near River Mile 204 are provided in Plates #1 - #10.

4.1 Existing Physical Conditions

The proposed site consists of approximately 18 acres located within the bounds of the City of Alton, Illinois in Madison County (Figure 4-1). Alton is located in southwestern Illinois on a bend in the Mississippi River north of St. Louis, Missouri (Plates #1 and #2). Other local population centers near Alton include the towns of East Alton, Elsah, Grafton, and Bethalto. Highways that pass near the vicinity of the site include Illinois Routes 3, 67, 100, 111, 140, 143, and 267. The proposed site is located on Illinois Route 100 (Great River Road), a four-lane highway along the Mississippi River, at the site of a former quarry (Figure 4-2). Access to the site is from Illinois Route 100. The site can also be accessed from Grand Avenue, an unimproved street.

4.1.1 Historical Significance

The proposed replacement facility will be located in Alton, IL. Alton is a small city located in the northwestern corner of Madison County. The region of the proposed replacement facility has a rich historical heritage. Alton was founded in 1818 and was named after the eldest son of the town's founder, Colonel Rufus Easton. Colonel Easton valued the location as an important ferry position on a major route to the western frontier. In 1673, Marquette and Joliet recorded sighting the "Piasa Bird" painted on the bluff upriver of Alton. In the winter of 1803-1804, Lewis and Clark made Wood River, just downstream, as their starting point for the historic exploration of the northwestern United States. The final debate between Stephen Douglas and Abraham Lincoln took place in Alton in 1858. During the Civil War, Alton served as a stop on the underground railway; housed a Confederate prison, hospital, and cemetery; and functioned as a main supply depot for the Union Army.

To meet the requirements of the Illinois State Agency Historic Resources Preservation Act, the Illinois Historic Preservation Agency was requested to review potential historic, architectural, and archaeological impacts resulting from the proposed replacement plant. Due to the site's history (quarry) and heavily disturbed nature, the Preservation Agency stated that no significant historical, architectural, or archaeological resources are expected to exist on the site. The request and response letters are contained in Appendix A.

4.2 Land Use

The 22-acre property is located on a former quarry site. Residential subdivisions are located above the western and northeastern corners of the property (Figure 4-2). The triangular-shaped property is bounded by Illinois Route 100 to the south, by Grand Avenue and residential areas accessed by Jefferson Avenue, Upper Hawthorne Road, and Woodcliff Drive. The site is composed of both hilly and flat areas. The central flat portion of the site, the old quarry floor, is largely bedrock with sparsely vegetated open areas (Plates #3-#5). The flat area is constricted by the bluffs to the west and an elevated area to the east which may be composed of old quarry debris (Figure 4-2). Portions of the site are covered with trees and woody vegetation overlying quarry debris. The eastern portion of the site is accessible via Grand Avenue, which is bordered by thick vegetation (Plates #6-#7). The northern half of the site is less constricted by bordering slopes (Plates #8, #9). The quarry site is elevated about 50 feet above the current plant, but is easily accessible to the current intake location (Plate #10). Approximately 10 acres of the property are suitable for construction.

The majority of the site (18 acres) is zoned as M-2, Heavy Industrial District with four acres zoned residential (Figure 4-3). In the immediate vicinity of the site, other zoned uses include mostly residential areas (Alton Zoning Office, 1997). The immediate area is nearly fully developed with minimum vacant land available. The general character of the land use in the area can be seen in an aerial photograph of the area (Figure 4-4).

The site is abutted by both single and multi-family residences. Land uses near the proposed site include higher and moderate income single family residences, apartments, and industrial sites. Barges tie up along the river banks just downstream of this area prior to passage through the Melvin Price Locks and Dam.

4.3 Characterization of Mississippi River at Alton, Illinois

The prominent natural feature of the area and the central environmental resource, due to its role as both raw water source and potential receiving water, is the Mississippi River. The Mississippi River near Alton was characterized as to hydrology (Section 4.3) and water quality (Section 4.3.2).

4.3.1 Hydrology

Hydrologic and water quality data are available for the Mississippi River near Alton from three local United States Geological Survey (USGS) gaging stations listed in Table 4-1. It should be noted that the Alton stations (i.e., #05587500, and #05587550) were discontinued after 1989 following relocation and construction of Lock and Dam No. 26 and that hydrologic and water quality measurements were resumed at the identified Grafton stations (i.e., #05587450, and #05587455). The stations measure flow emanating from a 171,300-171,500 square mile drainage basin. Based on 60 years of USGS data, the average mean monthly flow of the Mississippi River is 106,859 cubic feet per second (cfs) (Table 4-2). Data were collected at USGS gaging station #05587500 (Mississippi River at Alton) from April, 1933 through September, 1988 and at USGS gaging station #05587450 (Mississippi River at Grafton) from October, 1990 through September, 1995. Recorded mean monthly flows ranged from 20,200 to 469,300 cfs (July, 1947 and July, 1993, respectively). The minimum seven day 10 year flow (7Q10) is 21,500 cfs (Skelton, 1976). The mean monthly flows represented in Figure 4-5 show that March through June are the typical peak flow months and August to January are the lower flow months.

Cross sectional profiles of the Mississippi river have been determined by the Army Corps of Engineers who are responsible for maintaining depth in the navigation channels. River depths in the vicinity of the proposed plant range from 0 to 30 feet deep (U.S. ACOE, 1994). The normal high water level for this section of the river is 419 feet above mean sea level (MSL) with a low water level at 413 feet MSL (Orlins and Voigt, 1996). A map indicating water depth in the vicinity of the proposed intake (about River Mile 204) are shown in Figure 4-6. Three cross-sections of transects slightly above, at, and slightly downstream of River Mile 204 are shown in Figure 4-7 (location of transects are given in Figure 4-6).

4.3.2 Water Quality in the Mississippi River

Water quality data were obtained from the USGS District office in Rolla, Missouri. Data for total suspended solids (TSS) were collected at the three USGS gaging stations listed in Table 4-1, using different methodologies for different time periods. Table 4-3 contains data that were collected at USGS gaging station #05587455 (Mississippi River below Grafton) from October, 1993 through September, 1995 and at USGS gaging station #05587450 (Mississippi River at Grafton) from October, 1989 through September, 1993. The average mean monthly TSS value ranged from 29 to 605 mg/L with an average monthly value of 171 mg/L. The data represented in Table 4-3 are based on daily monitoring events by an automated gaging station and are thought to be more representative than the data in Table 4-4 since the monthly averages are based on averaged daily sampling rather than once-per-month sampling.

TSS concentrations listed in Table 4-4 are based on individual sampling events collected by the Water Quality group at the USGS district office in Rolla, Missouri. Data were collected at USGS station #05587455 (Mississippi River below Grafton) from March, 1989 through September, 1994. Individual readings ranged from 17 to 506 mg/L (January 1990 and April 1994, respectively). Despite the greater range of TSS concentration resulting from single grab samples, the mean value of TSS from these data is 156 mg/L which is consistent with the average value of 171 mg/L found in the more intensive sample collection (Table 4-3). The raw intake TSS for the current Alton facility (as estimated by turbidity) is 180 mg/L. Thus, the three estimates of annual average TSS at Alton are fairly consistent (i.e., 156, 171, 180 mg/L) and considered representative.

Seasonal fluctuations in TSS can be seen (Figure 4-8) using the more reliable data in Table 4-3. The peak months for TSS are the same as the peak flow months (i.e., March through June). March has the highest TSS due to spring thawing action and subsequent mobilization of eroded clays and silts in the watershed. Representative TSS values for characterizing daily minimum (20 mg/L) and monthly maximum (600 mg/L) were selected following discussion with Illinois EPA (pers. comm. Robert Mosher).

Dissolved iron concentrations in the Mississippi River near Alton were available from USGS data records. The daily values ranged from 3 to 710 µg/L (May 1993 and November 1992, respectively) with an average value of 36 µg/L. Data were collected on individual days in a scheduled month from March 1989 through September 1994 at USGS station #05587455 (Mississippi River below Grafton). The dissolved iron values are shown in Table 4-5.

Dissolved aluminum data were also collected by USGS and are shown in Table 4-6. The daily values ranged from 10 to 220 µg/L (10 µg/L on several occasions, 220 µg/L in November, 1993) with an average value of 26 µg/L. Data were collected from March, 1989 through September, 1994 at USGS station #05587455 (Mississippi River below Grafton).

4.3.3 Mussel Habitat Near the Proposed Site

Discussions with Illinois EPA at the August 21, 1997 meeting identified the need for a characterization of the potential mussel habitat near River Mile 204 in the vicinity of the proposed intake and discharge pipes. To meet this request, Illinois-American (through its consultant ENSR) selected Ecological Specialists, Inc. (ESI) to conduct a unionid (mussel) survey of the Mississippi River at the proposed site. The goal of this survey was to characterize the potential mussel habitat found offshore of the proposed site and to determine the potential presence of *protected* (i.e., threatened and endangered) mussel species. ESI conducted the survey on October 27-28, 1997 using a protocol reviewed and approved by Illinois EPA (see letter from

Heidi Dunn to Robert Mosher in Appendix A). Sampling was conducted at 6 transects bracketing the present Alton facility. The upstream limit was 100 meters (m) upstream of the present intake location and the downstream limit was 400 m below the proposed discharge location. Diver surveys were conducted along these 6 transects with sampling at the points indicated in Figure 4-9. The proposed replacement plant discharge location is located approximately between Transects No. 3 and No. 4.

The survey results show that the area currently does not support a unionid community. No living animals were found in the study area and only the shells of eight species were collected. None of the collected species were federal or Illinois protected mussel species. Only the shells of *Leptodea fragilis* was represented by freshly dead shells; the remaining shells were weathered or sub-fossil.

ESI reported that substrate composition apparently limited unionid distribution in the study area. Substrate throughout the study area consisted of deep silt (0.75 m) from the bank to approximately 50-60 m riverward, and then gradually changed to unstable sand farther into the navigation channel. The report noted that the study area is upstream of Melvin Price Locks and Dam and that similar depositional substrate commonly results from low flow conditions typically found upstream of navigational dams. The study concluded "Given that habitat conditions within the study area are unsuitable for unionid colonization, and no unionids were found, construction and operation of the water intake and treatment discharge should not impact unionids." The full ESI report is contained in Appendix B.

4.4 Potential Stakeholder Concerns

The Water Company hosted a public meeting on December 18, 1996 at the Ramada Inn in Alton. Ron Skrabacz (then Alton District Superintendent) opened the meeting with a welcome and a brief description of the need to build a new facility to serve the Alton area. [Note: At that time, the proposed facility location was in Godfrey. However, most of the stakeholder concerns are of a general nature and would apply to the proposed site.] Kim Gardner (Director of Engineering) described the new plant project to the attendees. Karen Tsikteris (then Director of Water Quality) gave an overview of the methods for disposing of residuals. Thomas McSwiggin, the Illinois EPA permits manager, gave a regulatory perspective on the project. After the speakers, the floor was open to questions from the public.

Major concerns included the aesthetic impacts of the new plant, particularly that of noise. Concerns were raised over the potential impact on land values from the building of a new, industrial structure. These issues were addressed by the panel, who explained that Illinois-American planned to build a plant which would blend with the surroundings, described the type of motors and pumps used in a modern plant, and noted that they do not produce an excessive amount of noise. Traffic issues were addressed, including the potential for increased traffic on access roads and number of potential truck trips. Other concerns raised in the meeting included the impact on resident wildlife at the site, the threat of spills in the river contaminating the drinking water, the safety and aesthetics of the intake pipes, and the fate of the old plant and associated land.

A second public meeting was convened at February 26, 1996 at the Ramada Inn in Alton. Karen Tsikteris presented the elements of the SSIS and approach used to evaluate environmental impacts. No additional environmental issues regarding water quality or ecological impacts were identified at this second meeting, although comments were raised on proposed facility building and infrastructure (e.g., lighting, signage, Iroquois Trail traffic, vandalism, setbacks, the Piasa Bird monument). A summary table listing the concerns and public comments arising from these two meetings is provided in Table 4-7.

Subsequent to the meeting in February 1966, Illinois-American decided to develop the property adjacent to the current plant, rather than the proposed Godfrey site. A third public meeting was held on July 21, 1998 to discuss the proposed Alton facility. Illinois-American staff (Tsikteris (now Cooper), Gregory, Gardner, Lawhon, Schultz) presented information and responded to stakeholder questions. Thomas McSwiggen and Roger Selbert from Illinois EPA were in attendance. Alton Mayor Don Sondich and other city officials (Aldermen Loy, Brake, and Hakes) were present and indicated the City of Alton's support of the proposed plant.

Stakeholder questions included discussion of the development of the former Mississippi Lime Site, the nature of possible lagoons, the fate of the old plant, noise associated with superpulsator operation, the amount of site lighting, the exterior design of the proposed main building, visual issues, site enclosure (fencing), lagoon dewatering, placement of facility buildings, the bike path easement, and access through Grand Avenue.

TABLE 4-1

USGS Gaging Stations on Mississippi River in Vicinity of Proposed Replacement Facility

USGS Station ID	Title	Lat/long	Description of Location	Data Available
05587450	Mississippi River At Grafton	38°58'05"/90°25'-42"	218.6 miles upstream from the mouth of the Ohio River	Hydrologic 1989-present Water Quality 1989-1993
05587455	Mississippi River Below Grafton	38°57'04"/90°22"-16"	214.6 miles upstream from the mouth of the Ohio River	Water Quality 1993-1995
05587500	Mississippi River At Alton	38°53'06"/90°10' 51"	202.7 miles upstream from the mouth of the Ohio River	Hydrologic 1933-1989 (discontinuous)

Table 4-2. Mississippi River Near Alton: Mean Monthly Flow (cfs)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Min Value	Max value
1933				189900	195300	125200	69860	41160	30380	34280	31320	27610	82779	27610	195300
1934	29830	32350	38370	69870	46680	31720	38260	30150	35940	48100	57670	88640	45632	29830	88640
1935	68540	79360	148400	158700	182800	162300	156900	77600	48310	38360	65900	45280	102704	38360	182800
1936	40070	48670	173900	155100	130100	68400	30280	22340	53670	59830	53970	33830	72513	22340	173900
1937	76920	92800	173000	125900	158500	117000	70900	42810	32180	31520	34010	29380	82077	29380	173000
1938	42500												42500	42500	42500
1939										27830	30370	33380	30527	27830	33380
1940	23960	25740	51470	86310	65210	75630	49370	55730	42000	31140	41210	51990	49980	23960	86310
1941	54160	54920	75580	156700	103700	116900	59910	29040	100100	186200	177600	92410	100602	29040	186200
1942	63700	140100	135600	156100	132100	192200	140000	88760	93670	94520	102800	88550	119008	63700	192200
1943	103400	121300	135300	186600	263400	261500	175500	109300	60870	44370	52760	45860	130013	44370	263400
1944	42840	52500	147400	224300	271500	236600	148300	60050	49870	46090	45840	39040	113694	39040	271500
1945	37700	59600	152500	256300	204000	244700	111500	74190	71480	73880	61700	59360	117243	37700	256300
1946	171400	91340	197700	164300	103300	140200	118400	62250	57500	61290	121100	59820	112383	57500	197700
1947	64880	62570	89190	248000	206800	317300	20200	46440	44340	35510	46770	57550	103296	20200	317300
1948	47940	51960	231500	194000	125700	52250	74430	40730	29510	25130	32830	33740	78310	25130	231500
1949	77150	116700	163600	155000	76180	70190	76070	46730	32980	42000	32440	55020	78672	32440	163600
1950	110700	101700	152600	197800	216700	168300	96130	54300	41990	34940	29400	36790	103446	29400	216700
1951	43360	100900	156100	278300	269000	158200	245100	109800	94510	96550	115900	78470	145516	43360	278300
1952	101200	106200	180700	249000	226700	122500	120500	105500	52800	33150	40400	45380	115336	33150	249000
1953	43930	76610	118900	166700	121500	114900	114100	102200	46260	30950	34220	41950	84352	30950	166700
1954	37980	34900	55390	104500	156500	137700	121000	59110	58860	115700	65110	52960	83309	34900	156500
1955	79010	77700	115600	139900	102600	101800	67490	49160	32710	43870	36300	37110	73604	32710	139900
1956	32510	37710	54150	115300	100500	68810	63320	60550	37560	22720	35020	35460	55301	22720	115300
1957	37310	46870	57920	115900	127900	130400	130500	63700	49800	41540	52190	58180	76018	37310	130500
1958	49050	44780	81920	80580	56370	99980	132500	80740	41840	29670	41990	29740	64097	29670	132500
1959	29060	91620	145800	157500	116000	89950	70360	53700	59350	105700	79000	66230	88689	29060	157500
1960	121100	87830	74780	301700	253800	191500	123500	56790	60370	44290	61170	43770	118383	43770	301700
1961	35840	50300	144300	171000	150200	76650	65220	63590	100800	92450	164200	79650	99517	35840	171000
1962	67500	109400	182900	280100	169900	153600	108700	65950	80910	64110	47580	40770	114285	40770	280100
1963	34600	33000	133200	106100	111900	71370	54340	45010	29840	27730	30120	26440	58638	26440	133200
1964	27960	32040	51430	109200	118900	68960	42940	27460	52250	33050	37540	35150	53073	27460	118900
1965	68930	76690	147200	297300	285300	157400	81730	49550	151400	141100	74350	102300	136104	49550	297300
1966	91620	120900	137000	182400	188000	142300	67690	47690	38110	35140	37200	52660	95059	35140	188000
1967	44150	65200	88690	221900	126300	147900	117500	46450	37330	47760	79840	84590	92301	37330	221900
1968	50830	87780	58460	85230	106000	121300	152400	88220	63730	88880	98930	67900	89138	50830	152400
1969	104600	131200	130500	255900	228900	143000	263500	94130	52270	99890	56870	42920	133640	42920	263500
1970	46280	58810	95600	157000	231500	201400	69850	94600	141400	115100	124400	92880	119068	46280	231500
1971	61920	107800	199100	188600	125400	107500	83190	46000	36190	44080	76300	96020	97675	36190	199100
1972	62330	50100	128600	185700	208600	117200	95240	150300	123800	143800	176400	97180	128271	50100	208600
1973	175800	167700	276500	392200	387800	263200	128800	93820	78240	141300	94340	115900	192967	78240	392200

Table 4-2. Mississippi River Near Alton: Mean Monthly Flow (cfs)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Min Value	Max Value
1974	142100	176500	197800	200600	244500	314400	176300	76050	49640	39950	71100	62810	145979	39950	314400
1975	79270	98500	153400	217400	266300	159100	131900	53220	64460	40510	54210	80580	116571	40510	266300
1976	46040	84300	186500	203800	174800	70070	47070	27860	21360	22120	23040	23640	77550	21360	203800
1977	23930	37220	70990	73110	72160	34850	38720	57420	101000	128300	109500	80590	68983	23930	128300
1978	68860	46160	139200	245700	210300	128200	192100	82080	98410	67180	56600	52050	115570	46160	245700
1979	40130	53530	238100	381100	289300	141000	110300	119700	102000	50830	81850	67570	139618	40130	381100
1980	61520	59030	104800	153400	73750	166300	58150	88050	136000	86980	58550	60130	92222	58150	166300
1981	42550	64110	81940	129700	172500	144600	207500	145600	105700				121578	42550	207500
1982	56050	136500	256700	285300	223500	187500	188900	95990	90820	95650	157400	281300	171301	56050	285300
1983	136100	131400	229100	348500	286500	165500	163300	82550	65700	83040	116900	125200	161149	65700	348500
1984	79440	151100	203200	251900	250900	222200	198600	74170	51890	75780	140300	90650	149178	51890	251900
1985	96260	114200	306400	220900	142000	86100	64120	69980	73080	144300	198400	151800	138962	64120	306400
1986	79920	109900	177400	235200	237500	191400	179100	113200	117600	334900	171300	130100	173127	79920	334900
1987	86930	92680	108300	138500	90540	87020	71750	82820	78210	38150	33270	31810	78332	31810	138500
1988	34800	53550	159700	82570	185900	235900	199500	134000	91160				130787	34800	235900
1989															
1990										66390	72430	95640	78153	66390	95640
1991	98820	106600	170100	247700	248000	222900	130700	82170	72870	64630	115800	156400	143058	64630	248000
1992	94310	103700	186100	178600	146500	70710	117000	86450	98850	68650	157800	169900	123214	68650	186100
1993	161000	113600	210400	342100	333300	244200	469300	416900	309900	201900	139900	113900	254700	113600	469300
1994	78840	97400	151500	179500	183700	110800	122000	82630	76040	82060	112900	105900	115273	76040	183700
1995	91710	89390	111400	214800	310300	240400	118700	103400	71850				150217	71850	310300
ANNUAL													***106859***	***20200***	***469300***
MONTHLY	***69511***	***83569***	***143515***	***193174***	***179556***	***145611***	***117635***	***78133***	***71554***	***73187***	***78419***	***72101***			

Blanks indicate that the data is not available for that month/year.
Data in this table was collected by the USGS, Missouri District.
April 1933-September 1988 data collected at USGS gaging station no. 05587500, Mississippi River at Alton, Lat. 38 53'06", Long. 90 10'51".
October 1990-September 1995 data collected from USGS gaging station no. 05587450, Mississippi River at Grafton, Lat. 38 58'05", Long. 90 25'42".
Values listed in cubic feet per second.

Table 4-3. Mississippi River Near Alton: Mean Monthly Total Suspended Solids

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Min Value	Max Value
1989										272	135	44	150	44	272
1990	49	99	318	45	605	462	279	146	53		110	254	220	45	605
1991		100	454	404	417	382	205	29	38	64	111	164	215	29	454
1992	29	49	172	188	118	59	144	110	184	71	352	194	139	29	352
1993	448	89	360	103	103	158	196			135	96	41	173	41	448
1994	105	141	187	284	150	140	128	62	97	115	102	110	135	62	284
1995	146	144	208	236	244	151	154	133	74				166	74	244
ANNUAL													*171*	*29*	*605*
MONTHLY	*155*	*104*	*283*	*210*	*273*	*225*	*184*	*96*	*89*	*131*	*151*	*135*			

Blanks indicate that the data is not available for that month/year.
Data in this table is based on daily values collected by automated gaging stations of the USGS, Missouri District.
October 1993-September 1995 data collected at USGS gaging station, no. 05587455, Mississippi River below Grafton, Lat. 38 57'04", Long. 90 22'18".
October 1989-Sepember 1993 data collected from USGS gaging station no. 05587450, Mississippi River at Grafton, Lat. 38 58'06", Long. 90 25'42".
Values listed in mg/l

Table 4-4. Mississippi River Near Alton: Total Suspended Solids (mg/l)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Minimum Value	Maximum Value
1989			68		59		13		89		33		52	13	89
1990	17		72		67				109		61		65	17	109
1991	51				447		56		399		480		287	51	480
1992	36										239	318	198	36	318
1993	161		186	218	88	158	112	65	267			46	145	46	267
1994	201			506	235	118	145	49	63				188	49	506
Annual													156	13	506
Monthly	93		109	362	179	138	81	57	185		203	182			

Blanks indicate that data is not available for that month/year.
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
March 1989 - September 1994 data collected from USGS Station No. 05587455 Mississippi River below Grafton, Lat. 38 57'04", Long.90 22'16" (above Lock and Dam No. 26).
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
Data is collected on a single day in the scheduled month. When more than one datum existed for a given month, the average value is given.

Table 4-5. Mississippi River Near Alton: Dissolved Iron (mg/l)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Minimum Value	Maximum Value
1989					14		6				7		9	6	14
1990	13				6	14					13		12	6	14
1991	30				160		6				29		56	6	56
1992	19				5		38				13	54	26	5	54
1993			34		3	12	35	5	14	10	710	23	94	3	710
1994			24	59		30	3	3	3				20	3	59
Annual													36	3	710
Monthly	21		29	59	38	19	18	4	9	10	154	39			

Blanks indicate that data is not available for that month/year.
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
March 1989 - September 1994 data collected from USGS Station No. 05587455 Mississippi River below Grafton, Lat. 38 57'04", Long.90 22'16" (above Lock and Dam No. 26).
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
Data is collected on a single day in the scheduled month. When more than one datum existed for a given month, the average value is given.

Table 4-6. Mississippi River Near Alton: Dissolved Aluminum (ug/l)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean Value	Minimum Value	Maximum Value
1989					10		10				10		10	10	10
1990	10				10	20					10		13	10	20
1991	10				130		10				10		40	10	130
1992	10				20		10				20	30	18	10	30
1993			20		10	30	15	30	10	10	220	10	39	10	220
1994	15			160		20	10	10	10				38	10	160
Annual													26	10	220
Monthly	11		20	160	36	23	11	20	10	10	54	20			

Blanks indicate that data is not available for that month/year.
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
March 1989 - September 1994 data collected from USGS Station No. 05587455 Mississippi River below Grafton, Lat. 38 57'04", Long.90 22'16" (above Lock and Dam No. 26).
Data in the table was collected by the Water Quality group at the USGS, Missouri District.
Data is collected on a single day in the scheduled month. When more than one datum existed for a given month, the average value is given.

TABLE 4-7

Public Comments on Proposed Alton Water Treatment Plant
Illinois-American Water Company

Name of Commenter	Affiliation	Comments/Concerns
Pete Zimmer	Resident, Kaskaskia Trail	Noise and aesthetics associated with pumping station
Norine Steele	Resident, across from proposed pumping station	Noise associated with pumping station, drilling rig, construction activities Traffic on Iroquois Trail Parties on Illinois American property if road is opened to public
Bob Higgins	Abuttor, farmer	Iroquois Trail is recognized as a public road, not more accessible than it is currently (he has contributed $25-30K on road improvements, and intends to continue to use it to access his adjacent farm)
Melodie Bradford	Mrs. [Norine] Steele's daughter	[Potential] increase in traffic associated with water company trucks Effect of pumping station on property values Noise level, building design Potential presence of electromagnetic fields are possible relationship to Alzheimer's Disease Facility lighting, effects on quality of living, deer Protective devices aimed at preventing water users (jet skiers, water skiers) from being sucked into the intake View of intake structure from waterfront homes

TABLE 4-7

Public Comments on Proposed Alton Water Treatment Plant
Illinois American Water Company
(Cont'd)

Name of Commenter	Affiliation	Comments/Concerns
Janice Ricks	Godfrey resident	Nature and level of noise (intermittent vs. constant; type of engine) Effects on environment in the hollow - pipes above or underground, stream bed alterations, habitat for birds/small animals/deer/pileated woodpeckers/eagles
Lee Imming	Resident, Michael Drive	Odor associated with lagoons Noise and nature of plant lighting ("lit up like a supermarket/mall")
Patti Wright	Resident, West Delmar (east of proposed plant)	Trees bordering her property to remain? Location of facility access road
Jim Bradford		Discharge system vs. lagoon system
Jim Bensman	Sierra Club	Future plans for existing plant Future of open field habitat, areas to be disturbed Effects of potential barge spills of pollutants on water supply, removal of pollutants
Eric Voyles	River Bend Growth Assocation	Approves project
Annie Hoagland	Alton Lake Heritage Parkway Commission, Chairperson	Raised issues regarding deposition of existing facility

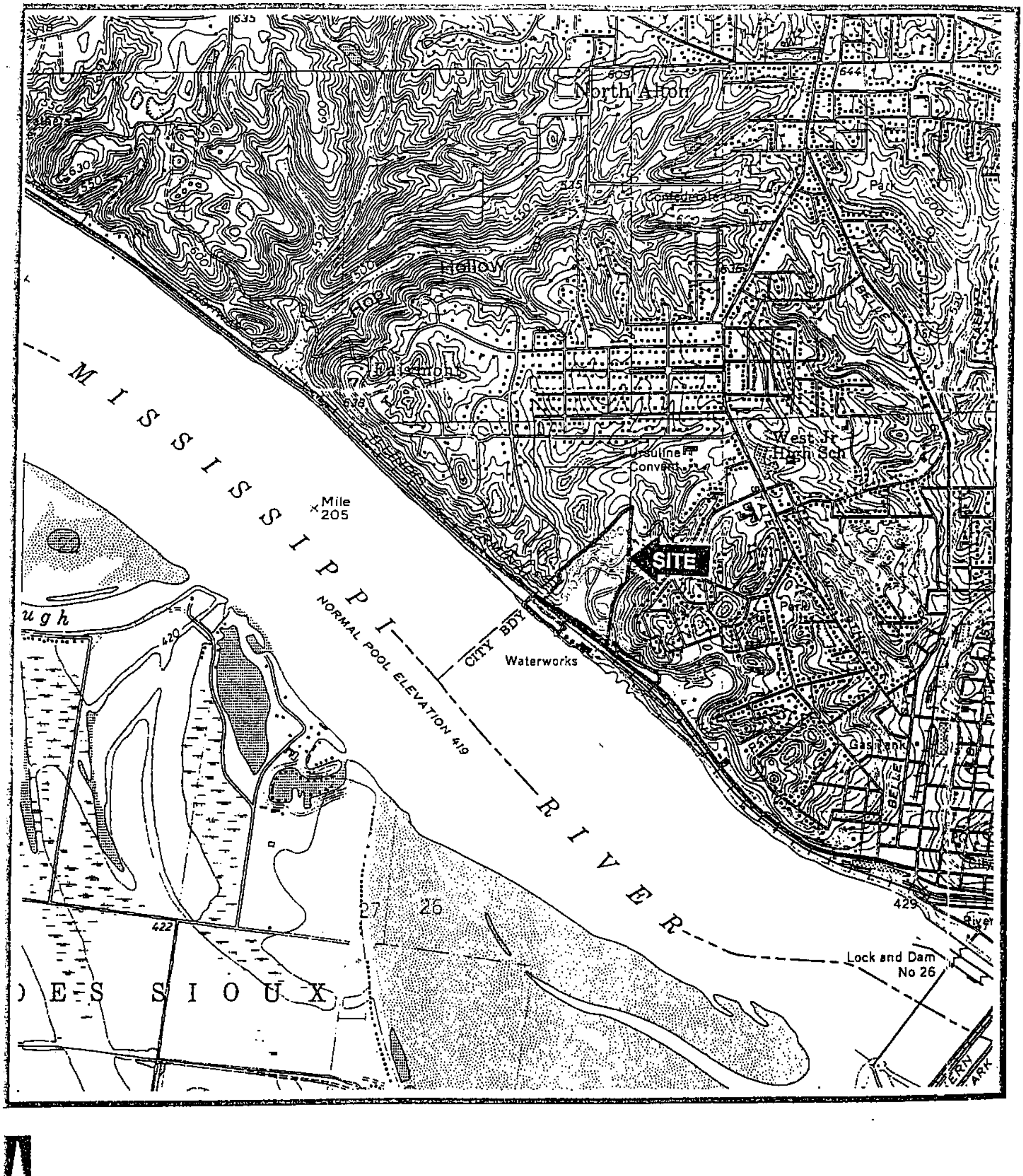


FIGURE 4-1
Topographic Map of Area near Proposal Site

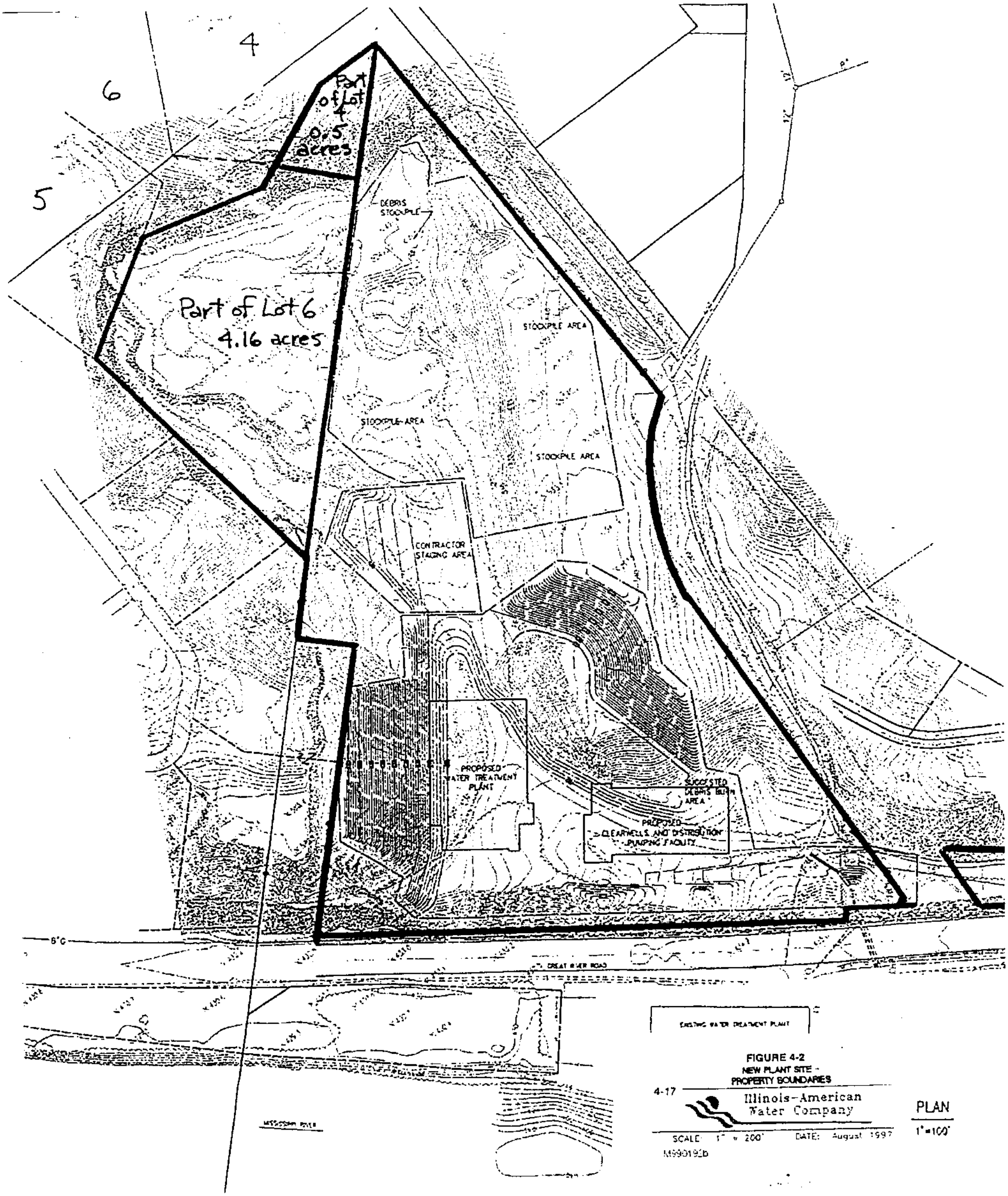


FIGURE 4-2
NEW PLANT SITE - PROPERTY BOUNDARIES

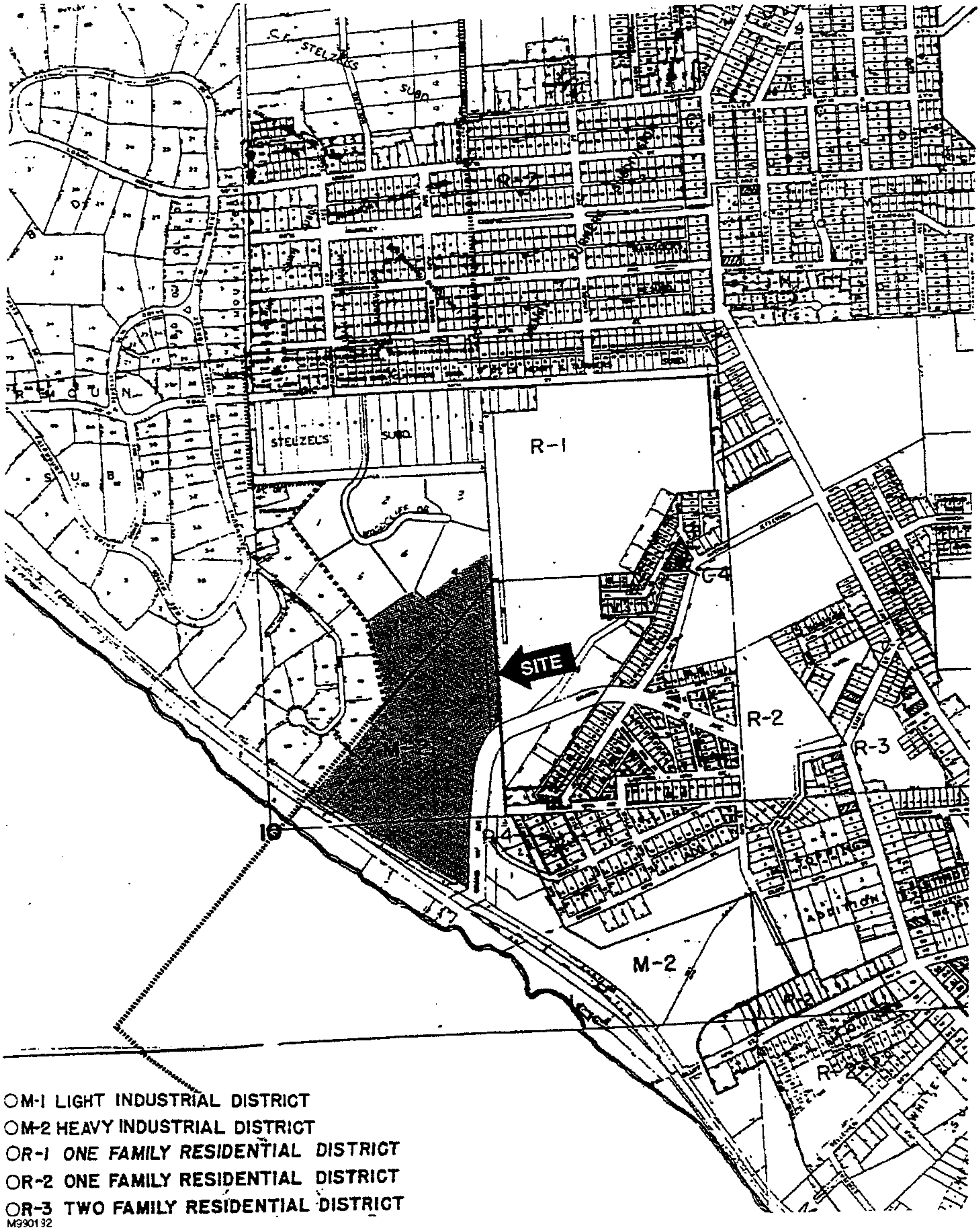


FIGURE 4-3
Zoning Map of Proposed Site

May 1999

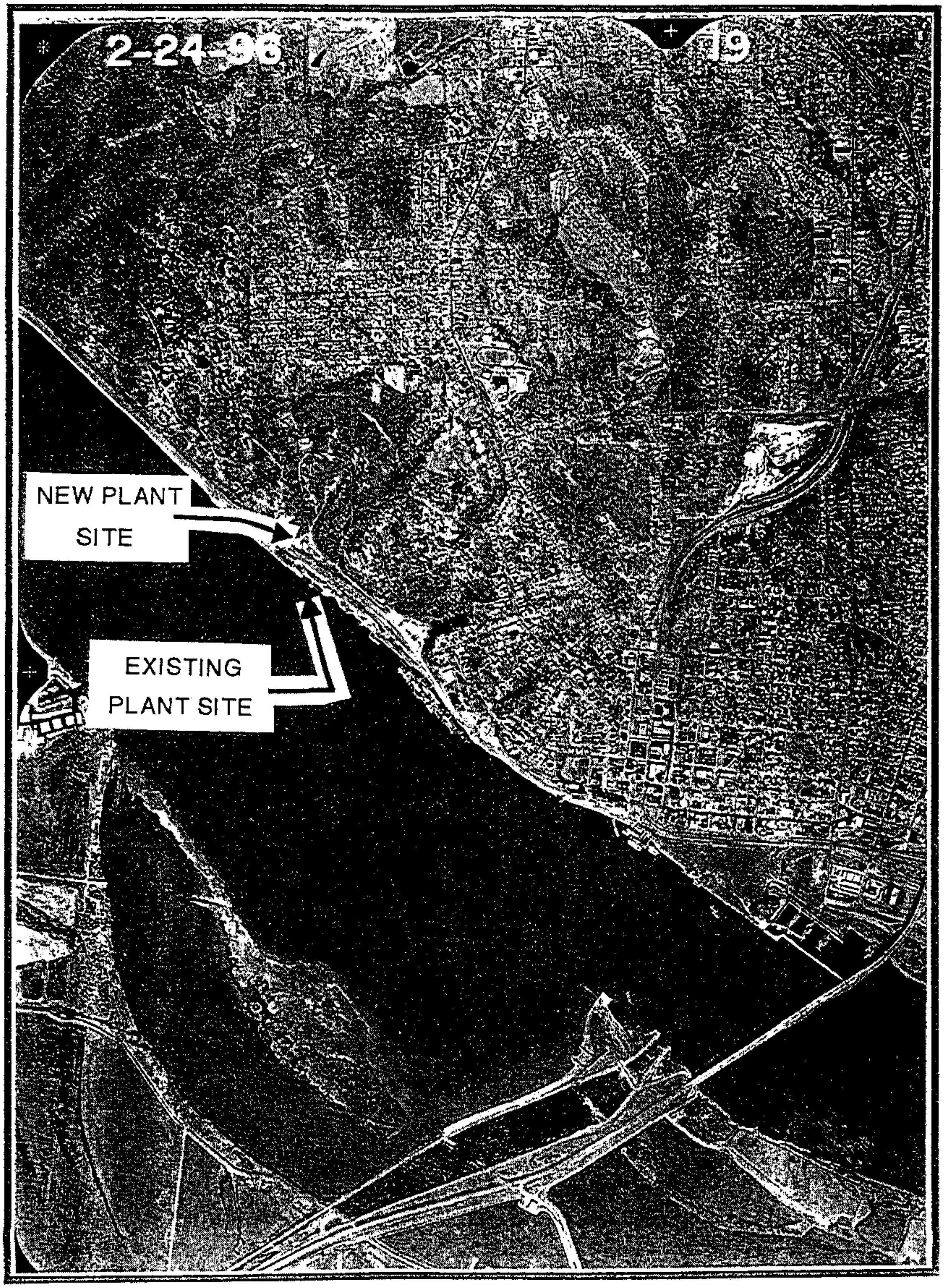
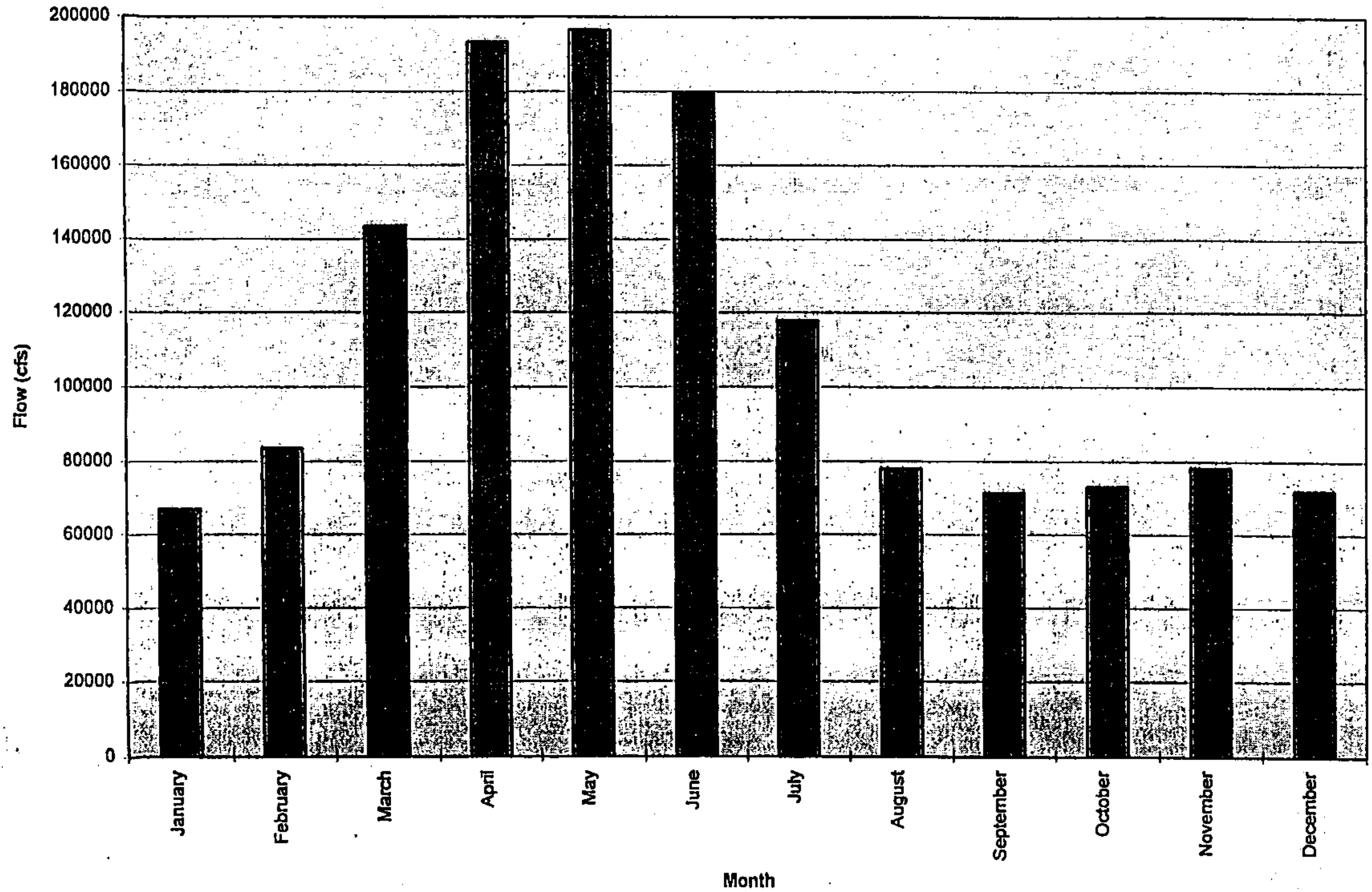


FIGURE 4-4
Aerial view of Proposed Plant Area

Figure 4-5. Mean Monthly Flow 1933-1995



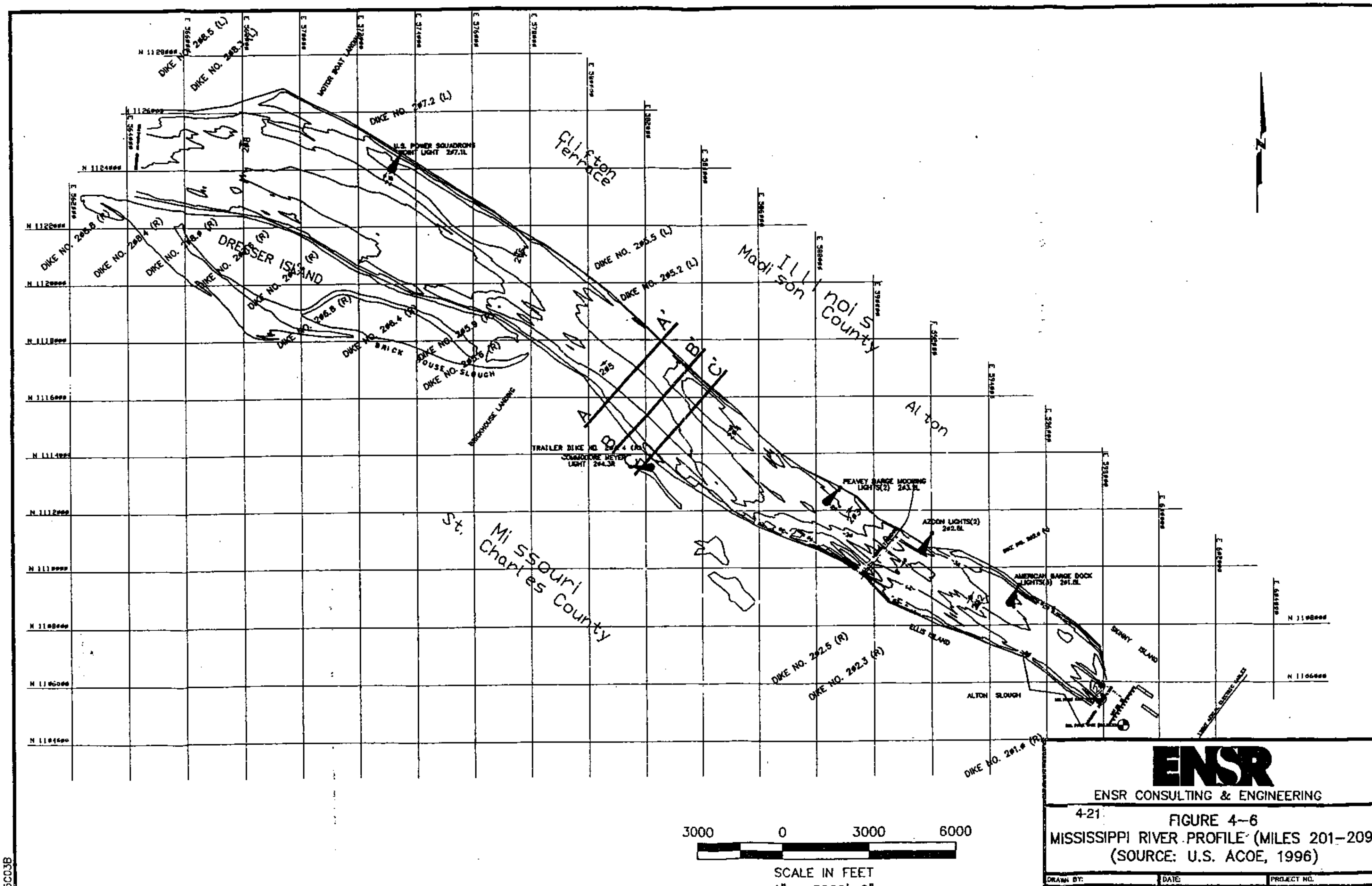


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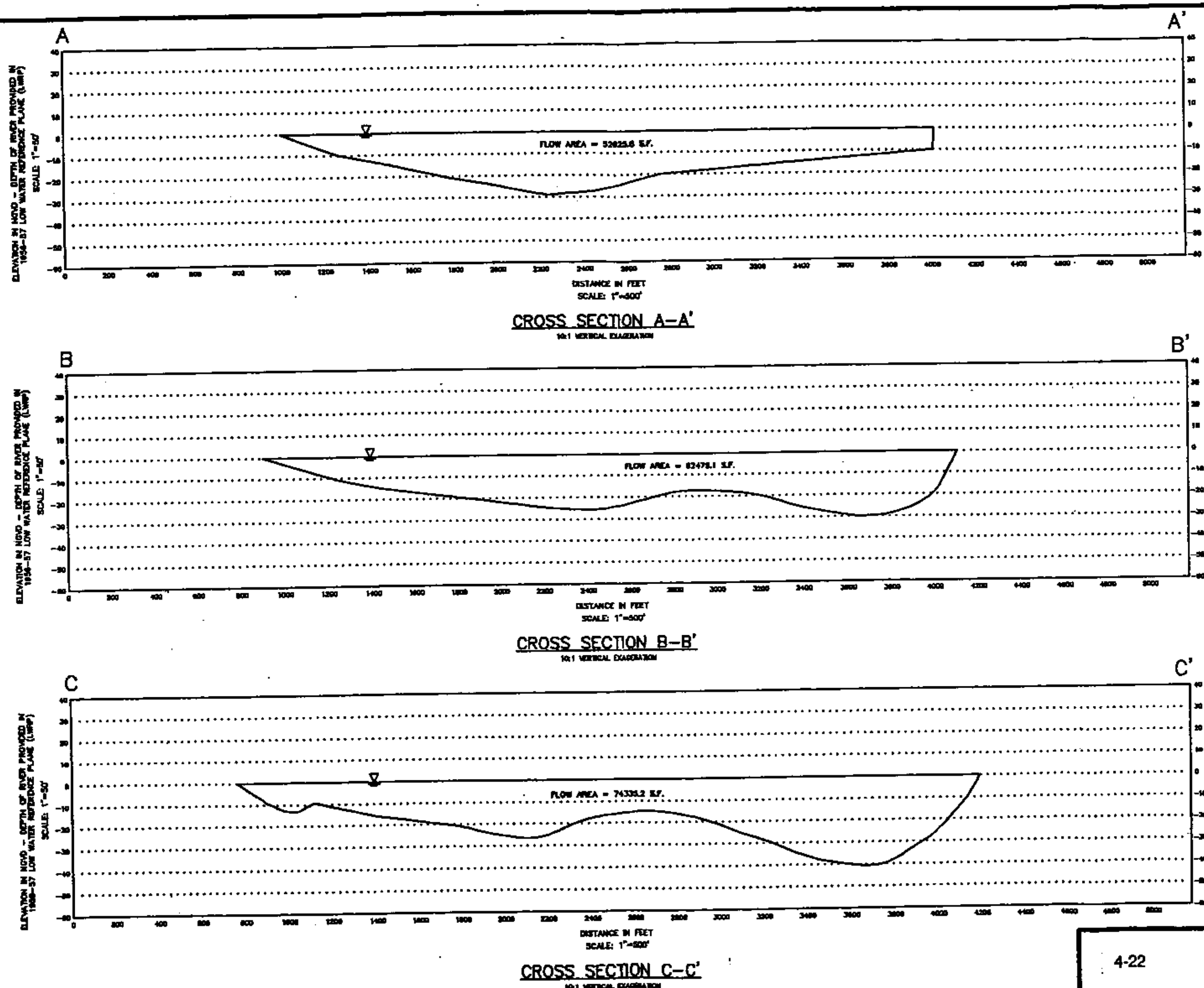
FIGURE 4–6
MISSISSIPPI RIVER PROFILE (MILES 201–209)
(SOURCE: U.S. ACOE, 1996)

DRAWN BY:	DATE:	PROJECT NO.

95C03B



4-22

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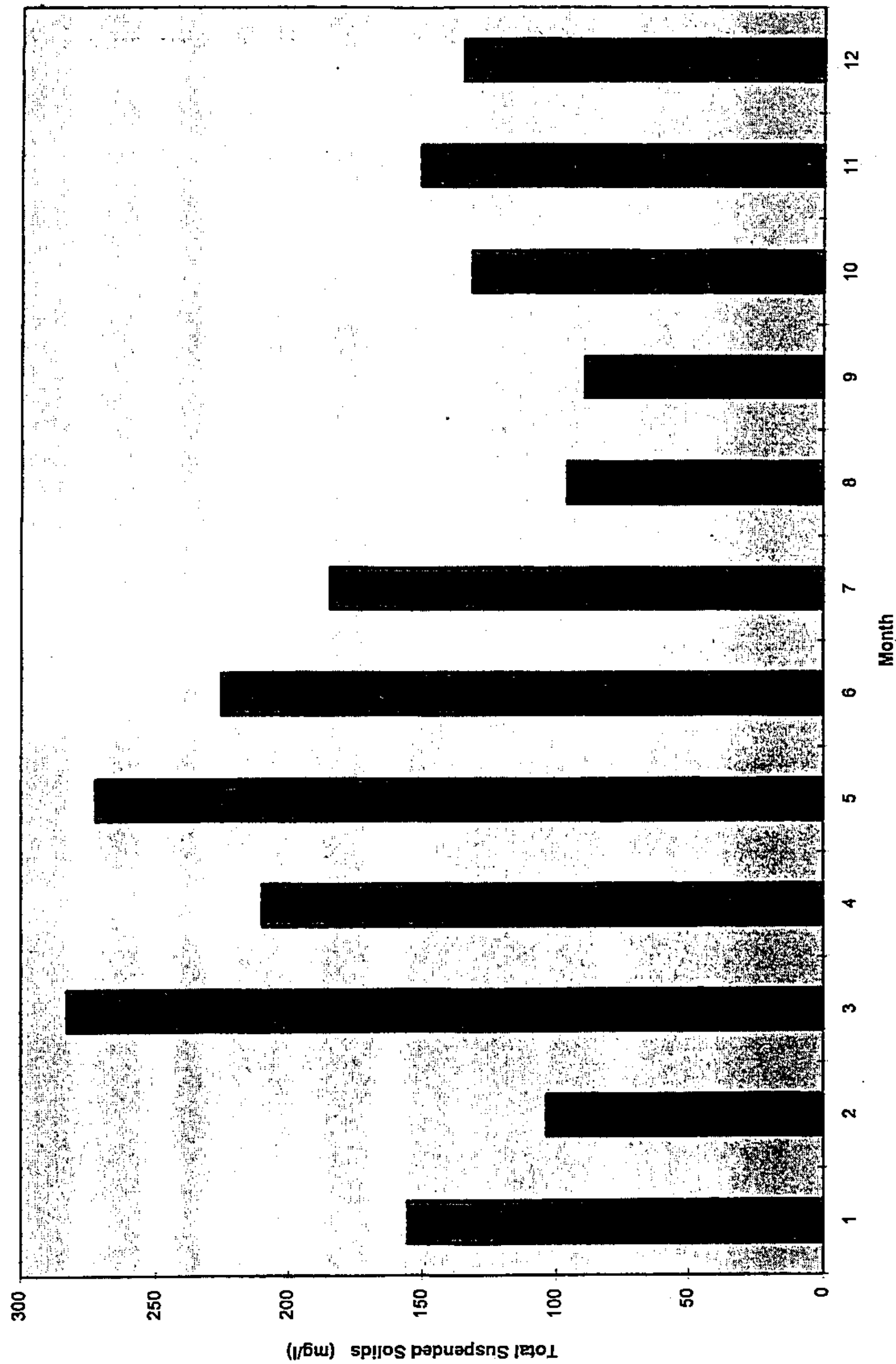
FIGURE 4-7
CROSS SECTIONAL AREAS
MISSISSIPPI RIVER NEAR RIVER MILE 204

DRAWN BY: DATE: PROJECT NO.

95C04B

Figure 4-8. Mean Monthly Total Suspended Solids (mg/l)



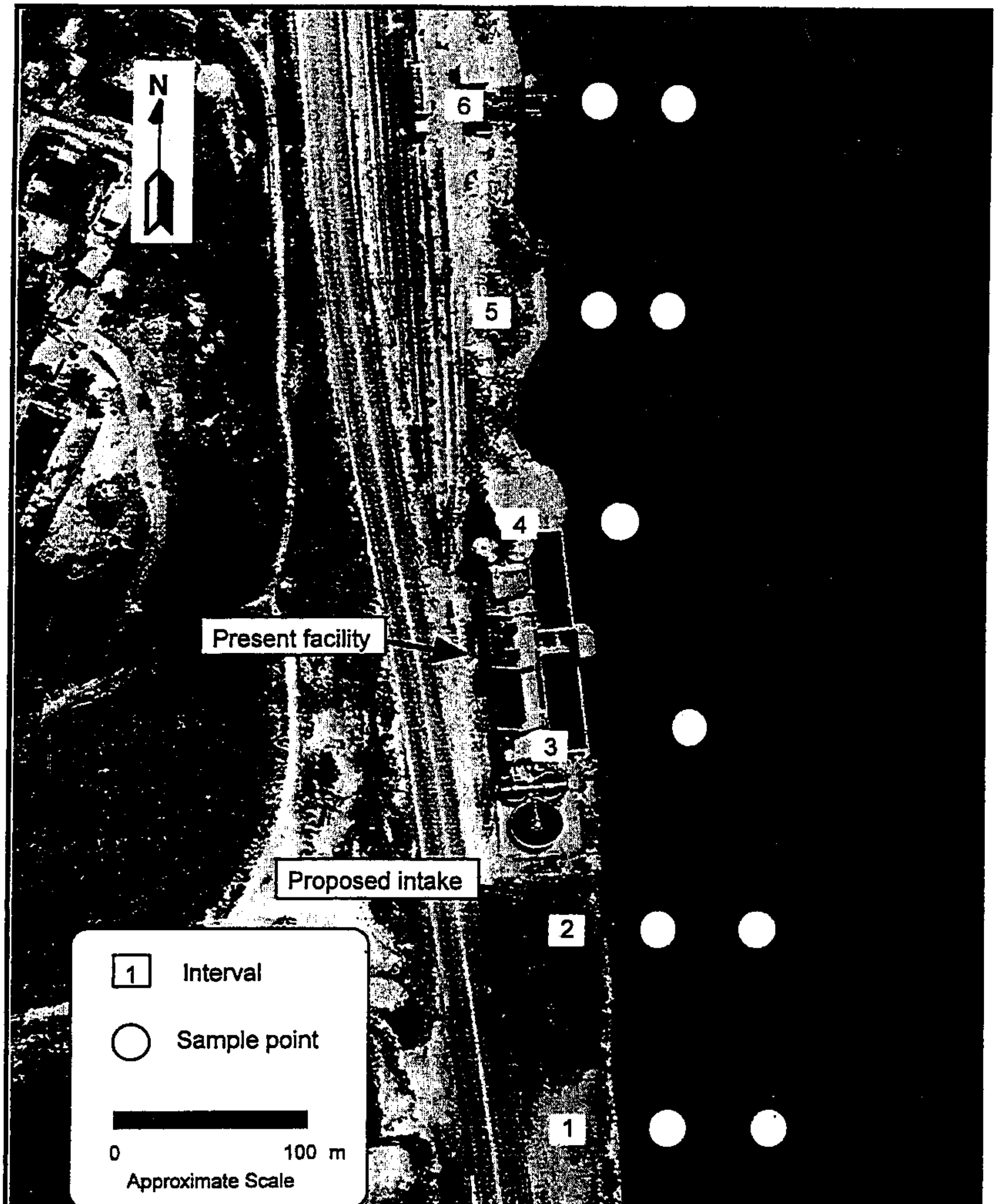


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Figure 4-9 Sample Points at Intervals on the Mississippi River near Alton, Illinois

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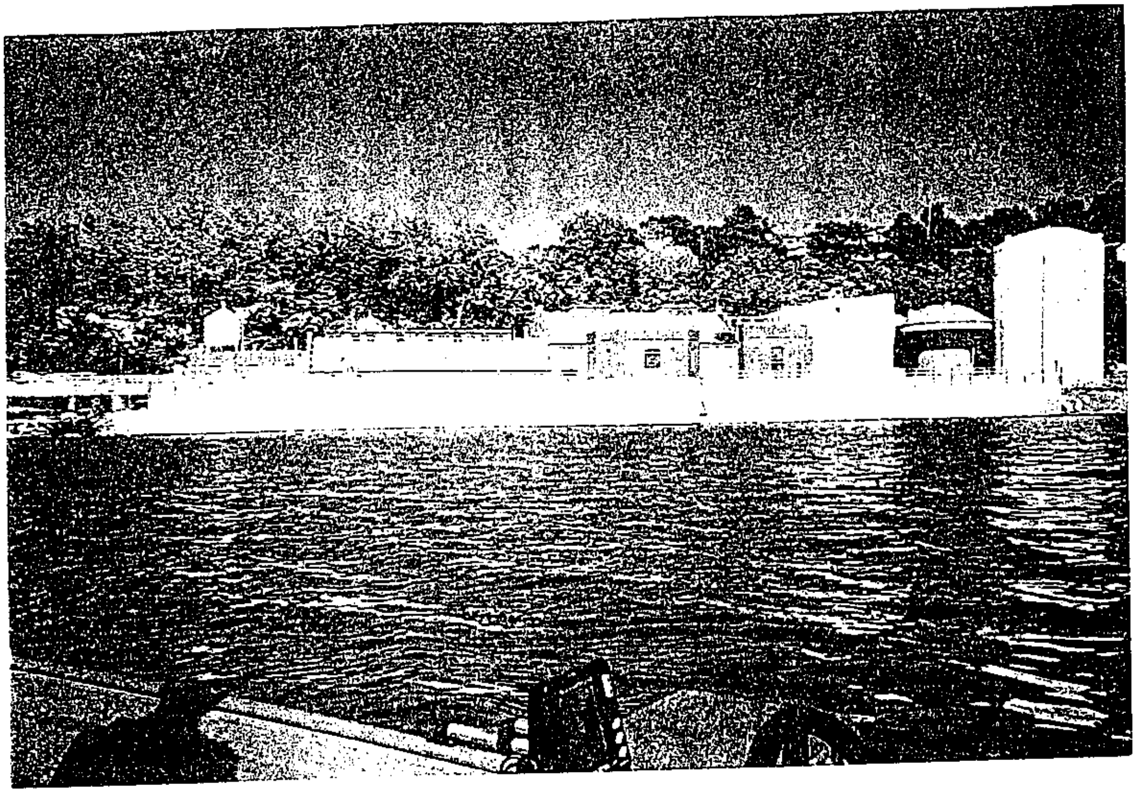

Plate 1. View of Existing Illinois-American Water Company Drinking Water Facility at Alton, IL near River Mile 204.

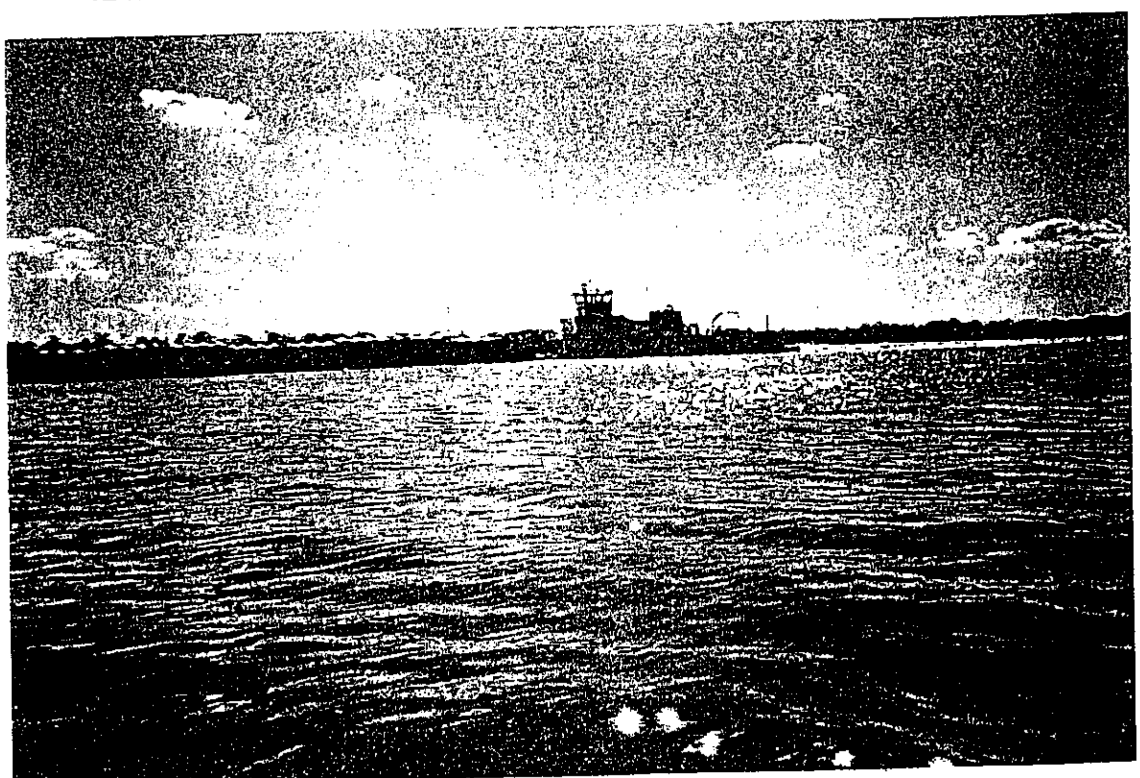

Plate 2. Barge Traffic on Mississippi River near Alton, IL.

Plate 3. View of Access Road to Quarry Site (parallels Illinois Route 100 at quarry elevation).

Plate 4. View North From Southern Central Area Into Quarry Site Interior.

Plate 5. View South from Quarry Site Interior Back to Mississippi River.

Plate 6. View North along Grand Avenue near Eastern Side of Quarry Site

Plate 7. Additional View North along Grand Avenue (paper street) near Eastern Side of Quarry Site.

Plate 8. Northern View from Northern Central Area on Quarry Site.

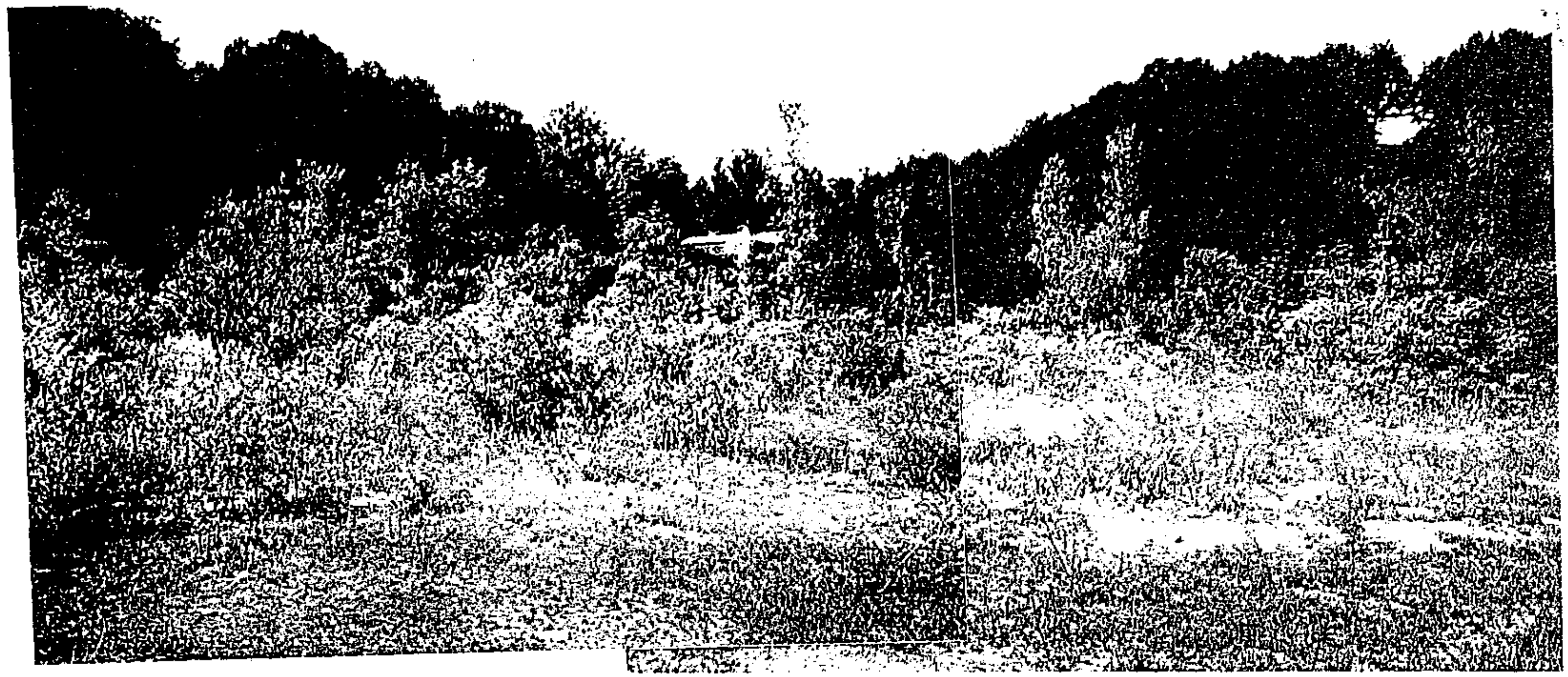

Plate 9. Western View from Northern Central Area on Quarry Site.

Plate 10. View from Southern Central Area on Quarry Site to Proposed Intake Point on Mississippi River.

5.0 POTENTIAL ENVIRONMENTAL IMPACTS OF EFFLUENT

Potential environmental impacts of the proposed Alton replacement facility on water quality and biota of the Mississippi River in the vicinity of the potential discharge were evaluated. For assessment of water quality, impacts on both the water column (Section 5.1.1) and sediments (Section 5.1.2) were modeled. Potential impacts to biota (both aquatic and terrestrial) are evaluated in Section 5.3. Other impacts considered under site specific analysis included: identification of frequency and extent of discharges (Section 5.4); identification of potential for unnatural bottom deposits, odors, unnatural floating material or color (Section 5.5); stream morphology and results of stream chemical analysis (Section 5.6); evaluation of stream sediment analyses (Section 5.7); and pollution prevention evaluation (Section 5.8).

5.1 Modeling of Water Quality Effects

Effects on the water quality of discharges from the proposed Alton facility were evaluated. Potential physical and chemical impacts may arise from either an increase in dissolved or total suspended load to the river, or the effect of materials settling out and accumulating on the riverbed. Because it is unlikely that the totality of the discharge TSS will remain in suspension or will completely settle out, the results of the two analyses should be used as endpoints to estimate the potential range of environmental effects. In all likelihood, a portion of the discharge TSS will settle out while a larger percentage will remain in suspension in the Mississippi River at the discharge location.

The effect of chemical coagulant used in the proposed replacement plant was also evaluated. The primary coagulant proposed to be used at the replacement facility is Clar$^+$Ion®, an alum-organic polymer mixture. The potential for both iron and aluminum from the proposed replacement facility to pose an adverse ecological effect was evaluated. Of these two chemicals, only dissolved iron has a water quality standard under the Illinois Water Quality Standards (35 IAC 302.208) of 0.5 mg/L. Aluminum has an Ambient Water Quality Criteria (AWQC) value of 0.87 mg/L (87 µg/L).

Potential water column effects are described in Section 5.1.1. and potential sediment impacts in Section 5.1.2.

5.1.1 Water Quality

Analyses of potential impacts of the proposed Alton facility effluent discharge on the receiving waters were made (i.e., Mississippi River near Mile 204). The objective of the modeling was to predict final mixed concentrations of TSS, iron and aluminum at the edge of the area of mixing and to provide estimates of elevated concentrations of TSS downstream of the Alton discharge. The results were compared to ambient receiving water conditions to determine the relative effect of the discharges.

Two types of modeling approaches were used: (1) a simple mass balance equation was applied to predict final mixed concentrations of the Mississippi River; and (2) the dynamic model CORMIX was applied to predict concentrations within the area of mixing. The former was used to evaluate final concentrations, whereas the latter was used to provide a visual estimate (or "footprint") of TSS values below the discharge location. Details of the CORMIX modeling are provided in Appendix F.

Potential water quality effects were evaluated under two conditions. Discharge composition and flow characteristics are based on the plant design presented in Section 3.0, while the hydrologic and water quality characteristics of the Mississippi River near Alton are as described in Section 4.3. Discharges were assumed from cumulative contributions of the Superpulsator and filter backwash effluents. Application of the coagulant Clar+Ion was modeled with two receiving water TSS concentrations under two receiving water flows. Clar+Ion, an alum-organic polymer mixture is the coagulant expected to be routinely used to flocculate TSS in raw water at the Alton replacement facility. The two ambient values of 20 and 600 mg/L respectively represent the minimum daily and maximum monthly TSS concentrations for the Mississippi River near Alton. The receiving water flows of 21,500 cfs and 106,589 cfs respectively represent the 7-day, 10-year low flow (7Q10) and the annual average river flow. [Note: These combinations of flow and TSS value were selected in consultation with Illinois EPA (Robert Mosher, pers. comm)]. The two scenarios evaluated are presented below:

Scenario 1:

- Low flow (7Q10) of 21,500 cfs
- Ambient TSS 20 mg/L

Scenario 2:

- Annual average flow of 106,589 cfs
- Ambient TSS 600 mg/L

Design flows and concentrations of the Superpulsator and filter backwash for evaluation of the proposed replacement facility were determined by application of removal rates on incoming raw water based on pilot plant results. As may be expected, the flow amount and effluent TSS concentration of the removal technologies are sensitive to intake TSS amounts. Design quantities are presented in Table 5-1.

5.1.1.1 Impacts of the Proposed Facility Discharge under Low Flow Conditions

Potential increases in TSS, dissolved iron and dissolved aluminum in the Mississippi River due to daily discharges from the proposed Alton replacement facility were evaluated. The results indicate that the discharges attributed to the proposed facility do not lead to significant changes in water quality in the receiving body of water nor do they violate ambient water quality criteria (AWQC) even under low flow conditions.

To test the potential magnitude of change for TSS, the design low flow and the approximate daily minimum annual sediment regime were examined. The test conditions assumed a 7Q10 low flow and a river TSS of 20 mg/L. [Note: this scenario was selected in consultation with Illinois EPA (Robert Mosher pers. comm.)]. As noted above, only 25 percent of the river volume was used for the area of mixing, as allowed by 35 IAC 302.102 for constituents whose existing ambient levels in the receiving water do not exceed water quality standards. It should be noted that there is no applicable water quality standard for TSS and that these test conditions were simply used for comparative purposes. The results of this test are shown in Table 5-2. These results indicate that final Mississippi River TSS concentrations increase by less than 0.5% over a wide range of ambient conditions. These levels of increase are well within daily variation, are likely to be analytically undetectable, and constitute a negligible increase.

The results of the dynamic area of mixing model are shown graphically in Figures 5-1 and 5-2. Figure 5-1 presents an aerial view of the location of the predicted TSS plume resulting from the discharge. Figure 5-2 presents a more detailed aerial view of the same predicted TSS plume as presented in Figure 5-1. Contours (or isopleths) are plotted for various TSS concentrations above ambient conditions between 0.5 and 5 mg/L. Figure 5-2 shows that the river velocity quickly overcomes the initial discharge momentum (perpendicular to flow, away from the shoreline). The edge of the plume, represented by a 1.0 mg/L contour, extents to about 400 feet downstream with a maximum width of approximately 30 feet. The distance at which the plume reaches the surface is about 225 feet and, at that point, all predicted concentrations are below 2.5 mg/L. The model therefore predicts that a river surface area of approximately 175 feet by 30 feet (or 0.12 acres) will be subject to concentrations 1.0 - 2.5 mg/L higher than ambient levels. This change in TSS concentrations is about 5-13% higher than ambient. The low values of TSS increase will likely not be visually noticeable and difficult to measure with conventional instrumentation.

The potential for aluminum and iron from the discharge of the proposed facility to impact receiving water quality was also assessed. The amount of dissolved aluminum or dissolved iron arising from the use of Clar+Ion coagulant was considered. The dissolved fractions were used to address potential ecotoxicological concerns since particulate fractions are usually considered non-bioavailable. For further discussion on bioavailability, see Section 5.3.

The amount of dissolved metal/metalloid in the Superpulsator effluent was calculated from coagulant application rates (function of TSS levels) and stoichiometric considerations. For Clar+Ion type coagulants, the percentage of aluminum is about 4% (C. Linde, pers. Comm.). For estimation of the dissolved iron, the average values of clarifier and filter backwash effluent discharge concentrations were used. All of the aluminum or iron was assumed to be in the dissolved fraction. This is highly unlikely to occur under actual field conditions and provides a highly conservative worst-case scenario. Mean values of iron concentrations from a series of analyses from the filter backwash or the current Alton plant were used to estimate metal concentrations in the clarifier backwash. Total and dissolved fractions of iron were measured in samples of the Mississippi River and the current Alton facility discharges taken in December 1996 and February 1997. During this period, Clar+Ion was being used as the primary coagulant at the facility. The filter backwash had a mean dissolved iron value of 0.009 mg/L; which is well below the water quality standard of 0.5 mg/L for the receiving water. This value was judged to be acceptable since: (1) most of the coagulant is added prior to the Superpulsator; (2) is likely to be mostly discharged with Superpulsator effluent; (3) the basic filter backwash technology will not be greatly altered in the proposed plant; and (4) the incoming river silts remain the same.

The results of projecting the proposed effluent discharges on ambient dissolved aluminum and iron river concentrations representing the annual mean value are shown in Table 5-3 and Table 5-4, respectively. It can be shown that under low flow conditions, the amount of coagulant added does not lead to exceedance of the respective federal AWQCs for either aluminum (87 µg/L) or iron (500 µg/L). In addition, the expected effluent concentration for dissolved iron is well below the Illinois Water Quality Standard for General Use of 1.0 mg/L (35 IAC 302.208(g)). Based on these values, it is unlikely that the increases in constituents due to discharges from the proposed facility will adversely affect water quality.

Potential exceedance of the Illinois Water Quality Standard for total dissolved solids was also considered. Review of available USGS water quality data from the gauging station below Grafton, IL between 1990 and 1997 (> 50 observations) indicates that the average TDS concentration in the Mississippi River at this point is 273 mg/L. No TDS data is available for the current Alton facility but for it was assumed, for the purpose of this work, that TDS = TSS discharges. This is a highly conservative assumption since the residual discharge is comprised primarily of settled particulate material. Using the assumed values for discharge and receiving water TDS, the proposed effluent outfall does not lead to an exceedance of the water quality standard even at effluent TDS concentrations two orders of magnitude greater that the conservative levels assumed. Therefore, it can be concluded that discharge from the proposed facility will not lead to exceedance of TDS standards in the receiving water.

5.1.1.2 Impacts of the Proposed Facility Discharge under Average Annual Conditions

A second set of tests was conducted to evaluate the potential impacts of the Alton plant under average conditions. The average annual flow of the Mississippi River was used as the underlying hydrologic condition, combined with background TSS levels of 600 mg/L. [Note: this scenario was selected in consultation with Illinois EPA (Robert Mosher, pers. comm.)]. The maximum monthly discharge turbidity of the proposed plant was assumed. The results for the mass balance equation model for the final mixed concentrations are given in Table 5-2 for TSS, Table 5-3 for aluminum and Table 5-4 for iron. As was the case for low flow conditions, values obtained for this second scenario show relatively small effects on receiving water quality and indicate no increase above acceptable levels.

An area of mixing analysis was conducted using CORMIX to provide an estimate of TSS concentration profile under high TSS discharge and average flow conditions. Results of the modeling effort are shown in Figure 5-3 and Figure 5-4. Figure 5-3 presents an aerial view of the predicted TSS plume downstream of the proposed discharge, and Figure 5-4 presents a more detailed view of the TSS plume. Contours (or isopleths) are plotted for various TSS concentrations above ambient conditions between 2.5 and 100 mg/L. Figure 5-4 shows that the river velocity quickly overcomes the initial discharge momentum (perpendicular to flow, away from the shoreline). The plume, represented by a 2.5 mg/L contour, extends on a distance of about 5,250 feet and achieves a maximum width of approximately 75 feet. The plume reaches the water surface at approximately 4,600 feet downstream. At that point, the predicted concentration is below 10 mg/L. The model therefore predicts that a river surface area of approximately 650 feet by 75 feet (or 1.1. acre) will be subject to TSS concentrations 2.5-5 mg/L higher than ambient levels. This represents an increase of 0.4-0.8% above ambient. The low values of TSS increase will likely not be visually noticeable and difficult to measure with conventional instrumentation.

5.1.2 Impacts of Sediments

A complementary analysis of the deposition of settleable solids in the proposed effluent discharges was also conducted. The objective of the analysis was to estimate potential areal distribution in the Mississippi River of sediments originating from the Superpulsator and filter backwash operations. Settling velocities of the discharge suspended solids were analyzed to provide information on their quiescent settling behavior. Residuals arising from both the Claricone (comparable to the proposed Superpulsator) and filter backwash operations were available for analysis. The cumulative effect of both discharges (Superpulsator and filters) was considered.

A particle deposition model based on the equations and methodology presented in the U.S. EPA Section 301(h) Technical Support Document (U.S. EPA, 1994) was selected and applied. This model is recommended by U.S. EPA for screening level particle deposition evaluation. The particle deposition model results is predictions of particle mass per area per time (e.g. $g/m^2/yr$) deposited onto the riverbed. For more details for the particle deposition model, see Appendix F.

It is recognized that additional physical factors in the river such as flocculation, turbulence and transport affect actual settling characteristics. However, the following analysis is appropriate to provide "order of magnitude" information since more detailed characterization of river flow would not change the conclusion but only further refine the predictions. Since the main interest resides in the range of possible outcomes (i.e., effects of total suspension or total sedimentation), this level of detail provided here is sufficient for worst-case analysis.

5.1.2.1 Specification of Model Scenarios

Particle deposition modeling was focused on predicting long-term rates of particle deposition and accumulation resulting from the proposed outfall. In addition, predictions of deposition and accumulation resulting from transient events such as filter backwashing were required. A steady-state particle deposition scenario and two transient particle deposition scenarios were developed to evaluate particle deposition resulting from the proposed discharge. The steady-state scenario used average values of river flow, ambient TSS concentration, discharge flow, and discharge TSS concentration to predict long-term average rate of deposition. The transient scenarios represent extreme events (e.g. low flow, filter backwash) and are used to predict the potential impact of these events. Particle deposition modeling scenarios are specified below.

Steady-State Scenario

- Average flow of 106,589 cfs
- Average daily discharge TSS concentration of 2,092.0 mg/L

Transient Scenario #1: 7Q10 River Flow

- Low flow (7Q10) of 21,500 cfs
- Minimum daily discharge TSS concentration of 295.86 mg/L
- Duration of event:7 days in every 10 years

Transient Scenario #2: Filter Backwash Scenario

- Average river flow rate of 106,589 cfs
- Maximum monthly discharge TSS concentration of 4,332.5 mg/L
- Duration of event: 15 minutes every 24 hours

The particle deposition modeling evaluation was based on several very conservative assumptions. Firstly, it is assumed that all particles settle out of the water column and onto the riverbed. The presence of large TSS concentrations (e.g. up to 2,000 mg/L) in the ambient Mississippi River clearly indicates that all suspended solids do not settle out of the water column in this waterway. In addition, according to US Army Corps of Engineers (US ACOE) personnel, suspended solids that are settleable generally settle in harbors or backwater areas, rather than in the main channel of the river (Mr. Jerry Rapp, US ACOE, personnel correspondence, 6/10/98). The proposed outfall is located near the main channel of the Mississippi River. Thus, the modeling evaluation results in overpredictions of the mass of particles settling on the riverbed.

The particle deposition modeling evaluation is also conservative in that it assumes average river flows. As a result, the model simulations neglect above average river flows. Above average river flows and especially very large river flows are known to transport particles more effectively than smaller flows. Also, large river flows are known to produce scour of the riverbed, picking up deposited materials and transporting them downstream. The net result of sediment scour is that more particles are deposited in areas with lower water velocities (e.g., backwater areas) and less particles are deposited in the main channel. The particle deposition modeling evaluation assumes that no sediment scour occurs, and therefore, results in overprediction of long-term sediment accumulation.

5.1.2.2 Assumptions on the Mississippi River

Relevant characteristics of the Mississippi River near the Alton facility were derived from a river stretch depth profile provided by the U.S. ACOE (St. Louis office) and the literature. An estimate of velocity during low flow conditions was made by dividing 7Q10 river flow by the cross-sectional area of the channel near the discharge point at River Mile 204. Three channel cross-sections representing transects above, at, and below River Mile 204 are shown in Figure 4-7. The average cross-sectional area of the three transects is approximately 63,813 sq. ft. The estimated velocity is approximately 0.34 ft/s or 0.10 m/s. A similar analysis for flow velocity during average annual flows provides a velocity of 1.35 ft/s or 0.411 m/s.

The exact location and depth of the replacement plant effluent discharge has not been determined. The discharge was assumed approximately 33 feet (10 m) offshore at a depth approximately equal to the maximum elevation for preserving the navigation clearance, or 4.5 feet. This corresponds to a height above bottom of 16.4 feet (5 m).

5.1.2.3 Settling Behavior of Solids Being Potentially Discharged

Five water samples were collected from the discharge of the current Alton facility on 5 separate dates in December 1996 and another set of four were sampled in February 1997. The first set of samples were collected before, during, and after commencement of the filter backwash discharge. The second set of samples were taken at the initiation, during, and following clarifier blowdown. During both periods Clar⁺Ion® was being used as the primary coagulant. The initial TSS were measured, as was the final turbidity (in NTU) of the supernatant of the settled sample. Settling behavior of the solids was measured in an Imhoff cone, by monitoring over time the volume of settleable solids in the cone, as determined by observing the interface between the clear supernatant and turbid solids region. The data for these measurements from both clarifier and filter backwash are presented in Appendix C.

The settleable solids volume as a function of time are presented in Figure 5-5 (clarifier) and Figure 5-6 (filter backwash). The results suggest little settling during the first 10 minutes (note: the settling interface is often hard to visually detect initially), but a major portion of the settling takes place within the first 20 minutes, with hindered settling and compression taking place thereafter. An average settling curve was constructed by averaging the results of the 4 or 5 trials for each process type. The average settling curve was used to estimate settling velocity for the analysis below.

Settling velocity was estimated by dividing a settling distance by an average settling time. The settling distance is the depth of clear supernatant from the top of the one liter mark of the Imhoff cone to the interface with the cloudy settleable solids portion. The settling distance was measured at the time (settling time) at which the initial linear portion of the settling curve ended and hindered settling and compaction began. Dilution of the discharge by river water will likely result in a settling regime more closely associated with discrete settling than with hindered settling or compaction, which occurs under relatively quiescent conditions of low velocity and within a confined area. Therefore, only the initial linear part of the settling curve was used to compute settling velocities.

The calculated settling velocity for the average settle curve was analyzed (see appendix for calculations). From these calculations, an average settling velocity for the clarifier and filter backwash of 2.46×10^{-4} m/sec was estimated (Table 5-5).

5.1.2.4 Estimated Particle Size

The particle sizes for the average clarifier and filter backwash particles were calculated assuming Stokesian settling. Stokes Law is: $V_s = g(p_s - p)d^2/18\ \mu$. Using $g = 9.8\ ms/s^2$, $p_s - p = 1650\ kg/m^3$ and $\mu = 0.89 \times 10^{-3}\ ms/m^2$, d was calculated to be 15.6 µm for $V_s = 2.46 \times 10^{-4}$ m/sec (average clarifier and filter backwash settling velocity). Based on the size of the suspended sediment, it would be classified as silt. The suspended solids being discharged from the filters are assumed to be similar to natural river sediments, in terms of size and settling behavior.

5.1.2.5 Particle Size Groups

In order to quantify predictions of particle settling behavior resulting from the discharge of residual-associated TSS, three discrete particle sizes were chosen. These three representative particle size groups were then evaluated to determine settling rates, deposition areas and accumulation rates for the three scenarios described above.

The following three particle size ranges were assumed to characterize discharge TSS:

Large particle size: 25% of discharge TSS, particle size > 0.062 mm in diameter.

Medium particle size: 50% of discharge TSS, particle size between 0.062 mm and 0.039 mm in diameter.

Small particle size: 25% of discharge TSS, particle size between 0.039 mm and 0.0039 mm in diameter.

Particle size groups were assigned based on Imhoff Cone settling measurements collected from the present discharge waters as discussed above and sieve tests performed by the USGS on Mississippi River water in Alton. Particle size groups selections are conservative in that all particles are assumed to be settleable. Also, the particle sizes listed above were validated using US EPA guidance documents and were found to be typical of fine sand, silty sand, silt, silty clay, and clay that would be expected to be found in the discharge waters.

5.1.2.6 Particle Deposition Modeling Results

Steady-State Scenario

Aerial view of the results of the steady-state particle deposition modeling scenario is presented in Figure 5-7. Table 5-6 contains the areas, deposition rates and accumulation rates predicted. Particle deposition rates of 4.38 kg/ft^2/yr, 0.037 kg/ft^2/yr and 0.012 kg/ft^2/yr were obtained for the three particle size groups, respectively. The large size particle were predicted to settle over an area of 2.7 acres and to accumulate 2.2 in/yr. Medium and small size particles were predicted to accumulate very little (less than 0.01 in/yr) over a larger area (565 acres). Due to the overlap of settling zones for the two smaller particle classes, only two zones of deposition are indicated on Figure 5-7.

Transient Scenario #1: 7Q10 River Flow

Results of the transient scenario #1 particle deposition modeling are presented in Table 5-6. Particle deposition rates of 3.9 g/ft^2 and accumulation of 0.001 inch per event were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible.

Transient Scenario #2: Filter Backwash Scenario

Results of the filter backwash transient scenario are presented in Table 5-6. Particle deposition rates of 82.1 g/ft^2 and accumulation of 0.275 inch per event were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible.

The amount of daily buildup is negligible for residuals either under critical low flow or average flow conditions. The impact of either of these modeled discharges can hardly be measured in the vertical. The current velocity and bedload transport will also tend to prevent buildup of deposited materials over time.

5.1.2.7 Uncertainties

The settling analysis described above uses several key assumptions and thus is subject to uncertainties, which were addressed by using a highly conservative analytical approach. The major uncertainties are associated with river dynamics, TSS mass loading rates and the settling behavior of the discharge. The estimated horizontal extent of the deposit on the bed is directly proportional to the horizontal river velocity and inversely proportional to settling velocity. The potential influence of turbulence has not been factored in. Similarly, the estimated vertical dimension of the deposit is directly proportional to the mass loading rate and to the particle settling velocity and inversely proportional to the horizontal river velocity. This being the case, changes in the assumed values of any of these parameters can result in a wide range of estimated deposition horizontal and vertical dimensions. The assumed parameter values used in the calculations presented above, and the resultant estimated horizontal and vertical deposit dimensions, are conservative estimates based on engineering judgement and the best available plant operation and river dynamics information. This conservative approach has resulted in modeling of what are likely to be worst-case conditions and a very conservative estimate of average conditions.

5.1.3 Summary of Water Quality Impacts

The predicted discharges of total suspended solids pose no significant impact to the receiving body of water. It the material settles out, it probably will be transported on the river bottom as bedload. The dimensions of this bottom deposit are dependent on river dynamics and settling behavior of the suspended solids. The dimensions of this deposit were estimated based on laboratory measurements and simplified calculations. It was shown that the vertical dimension of the typical bedload plume is minimal (2.2 in/yr over 2.7 acres) and was also insignificant for daily transient events.

On the other hand, if turbulence of the river prevents settling, it has been shown that the increase in total suspended solids concentration of the Mississippi river would be minimal, even during low flow conditions. This calculation was based on only 25% of the river flow being available for mixing and used an extreme low flow event (7Q10) as the design flow. Under more typical flow conditions, such as the average mean flow, the increase is even lower.

Since the discharge from the proposed replacement Alton plant will not result in either measurable sedimentation or observable TSS, the overall conclusion is that the total suspended solids content of the proposed discharge will not affect water quality of the Mississippi River. Similar conclusions are reached regarding aluminum and iron in the discharge effluent.

5.2 Definition of Area of Mixing

The area of mixing for evaluation of potential water quality impacts was defined according to 35 IAC 302.102 "Allowed Mixing, Mixing Zones, and ZIDs." Accordingly, the area of mixing was defined as 25% of the cross-sectional area or volume of flow of the Mississippi River at River Mile 204.

For the proposed Alton replacement facility, the area of mixing is either 25% of the available flow (using 7Q10 flow for compliance with standards) or 25% of the mean cross-sectional area of 63,813 square feet (= 15,953 sq ft). For purposes of the SSIS, the former definition was generally used for evaluation. This is likely to be a conservative estimate since the location of the navigation channel close to the proposed discharge location suggests that 25% of the relevant cross-sectional area may contain >25% of the flow volume of the Mississippi River at this point.

5.3 Characterization of Potential Environmental Impacts

The potential environmental impacts of the discharge to the biota and habitats in the Mississippi River was investigated. The biological communities expected to occur in the vicinity of the proposed outfall are described in Section 5.3.1 and the types of impacts are evaluated in Section 5.3.2. Consideration of sensitive species and habitat evaluation are contained in Section 5.3.3.

5.3.1 Biological Communities

The potential impacts of the proposed Alton facility discharge to the aquatic ecosystem were evaluated. The aquatic receptors of concern are the fish and macroinvertebrate communities which inhabit the water column and bottom (benthic) habitat of the Mississippi River near the proposed discharge. The major habitats and aquatic receptors found in the Mississippi River near this point are described below.

5.3.1.1 River Habitats near River Mile 204

Although the Mississippi River is a single water body, it is ecologically divided into many habitats. Major habitats found in the Mississippi River near River Mile 204 were judged to include main channel, nearshore bank areas, pools and backwater slough areas, following the classification system of Baker et al. (1991). The proposed discharge location is within the nearshore bank habitat, but is adjacent to other habitats as well. These habitats are described below.

Main Channel Habitat

The main channel forms the major path for water flow in the river and is characterized by high current speeds, a fairly uniform sand and gravel substrate, high bottom bedload movement, and high suspended solids levels (Richards, 1982). In the vicinity of the proposed discharge, the main channel is actively used for navigation (i.e., river barge traffic) which also leads to disturbance of the bottom and resuspension of materials. Due to the need to maintain navigation depths, the main channel is periodically dredged.

Nearshore Bank Habitat

Nearshore bank areas adjoin and merge with the channel habitat. These areas include both natural and artificially reinforced (i.e., rip-rapped) shorelines. Current speeds are highly variable along banks, as a function of several factors including water depth, distance from shoreline, substrate type, and both natural (e.g., fallen trees) and man-made (e.g., transverse dike dams) obstructions. Upstream flow eddies may be present. Substrates are variable and may include consolidated clays and silts, sand and gravels, and muds. Water quality is similar to that of the channel habitat. Nearshore bank areas are found on the Illinois side of the Mississippi River near the proposed discharge.

Pool Habitat

Pools are relatively deep, slack or slow-moving flow areas within the main river banks. Pools often form downstream of islands and usually adjoin sandbar and channel habitat. Pools are characterized by slow currents, relatively greater depths, and generally fine sediments. The areas and depths of river pools are usually dependent on river stage (i.e., elevation). Pool water quality is usually less turbid, slightly warmer, and may exhibit higher primary productivity than the channel.

Slough Habitat

Sloughs are formed from abandoned or secondary river channels, which may be isolated from the main channel for varying periods of time. They are moderate-sized, slackwater habitats which form a continuous connection with the main channel during average to high river stages. Current speeds are often insufficient to scour the bottom so that large amounts of organic debris accumulates at the bottom. The enclosed channel north of Piasa Island, the former river channels found on the Missouri side, and associated vegetated emergent bars provide slough habitat.

5.3.1.2 Fish and Macroinvertebrate Communities

Fish and macroinvertebrates likely to occur in the vicinity of the proposed discharge were identified based on their typical occurrence in the types of habitats described above - namely main channel, nearshore bank areas, pools, and sloughs. Fish typically found in these subhabitats are identified in Table 5-7 which provides both common and scientific names (Lee et al., 1980; Baker et al., 1991).

The fish community in the main channel is comprised of a diverse mixture of open water species (e.g., shads, skipjack herring, goldeneye and white and striped bass) and bottom-dwellers (e.g., shovelnose sturgeon, carp, blue sucker, buffalofishes, catfishes, and freshwater drum) (Baker et al., 1991). A similar suite of species typically occurs in nearshore bank areas along with american eel, white and black crappie, sauger, and a variety of smaller fishes (e.g., sunfishes, minnows, silversides). Many of the same species listed above occur in pools and slough habitats, but pools may host paddlefish and sloughs may contain bowfin, pirateperch, mosquitofish, and largemouth bass (Baker et al., 1991).

Macroinvertebrate communities vary among the habitats described above. Macroinvertebrate communities in the main channel are generally found to be low in diversity and abundance, dominated by clams, oligochaetes, chironimids and nematodes, and concentrated in silt and clay accumulations (Beckett et al., 1983; Well and Demas, 1979 - both cited in Baker et al., 1991). Nearshore macroinvertebrate communities in the area are often more diverse, due to more moderate velocity, substrate heterogeneity, and less disturbance due to decreased bedload transport. Caddisflies (trichopterans) often dominate in areas of artificial materials, while mayflies (ephemeropterans) are found in natural shorelines with clayey substrates (Baker et al., 1991). Depending on the nature of the substrate clams, oligochaetes, mayflies, caddisflies, or chironimids may be found in high abundance. Sloughs may contain similar types as well as phantom midge larvae (Chaoborus), if isolated from the main channel for extended periods.

5.3.2 Stream Chemical Analyses

To evaluate the potential environmental impacts of the discharge effluent on biota in the Mississippi River, both the physical (non-toxic) and toxic potential impacts were considered. Section 5.3.2.1 discusses the general effects of increased levels of TSS on the water column and benthic habitat. Section 5.3.2.2 considers the specific potential impacts of TSS from the replacement Alton facility to the local conditions in the Mississippi River. Section 5.3.2.3 looks at the potential toxic effects of coagulant-associated metals in the post-clarifier discharge *residuals and* Section 5.3.2.4 provides a summary of potential impacts. Section 5.3.3 examines potential impacts to identified critical habitats and threatened and endangered species.

5.3.2.1 Potential Non-Toxic Effects of Suspended Solids on Biota

The potential non-toxic effects of elevated concentrations of solids to the receiving Mississippi River were considered. These effects are associated with physical changes to the environment or direct effects on typical river biota. Some of the more important potential non-toxic impacts of high levels of suspended solids on biota include light reduction, abrasion, feeding interference, sedimentation, and destruction of habitat (Sorenson et al., 1977). These effects can be associated with either the water column or the river bottom. The results of the quantitative analysis of potential effects associated with potential discharge from the replacement facility on the receiving waters were discussed previously in Section 5.1.

The higher turbidity associated with TSS can reduce light penetration (light quantity) and the spectral distribution (light quality). This reduces the compensation depth for photosynthetic activity, limiting phytoplankton production and distribution of rooted aquatic macrophytes. This reduction of primary productivity would be expected to be transmitted to higher trophic levels. Low light levels also reduce the effective feeding distance for sight-feeding predators. Further, low light could have some implications for migration and orientation responses.

The physical abrasion of sensitive membranes (e.g., gill membranes, egg chorion) is another deleterious effect of high levels of suspended solids (Muncy et al., 1979). For some fish species, particularly coldwater salmonids, excessively high suspended solids level (e.g., > 500 mg/L) have been shown to increase respiratory distress and death (Sorenson et al., 1977). However, these effects depend not only on the absolute level of TSS, but on the nature of the suspended material (i.e., organic vs. inorganic). In general, non-salmonid species exhibit greater tolerance of suspended solids.

Interference with filter-feeding activities by organisms is another potential effect of high suspended solids concentrations. This includes zooplankters feeding within the water column, and mobile (e.g., burrowing mayflies) and sessile bottom dwellers (e.g., freshwater mussels). This can occur because the size spectrum of the food particles and the suspended solids can overlap, leading to decreasing feeding effectiveness and/or ingestion of non-digestible particles. Both the concentration and composition of the suspended material is important. For example, Daphnia magna was not affected by pond sediment concentrations up to 1458 mg/L, but was harmed by charcoal suspension of 82 mg/L (reported in Sorenson et al., 1977).

Sedimentation of suspended solids with subsequent burial of organisms or habitat is another potential concern. High levels of sedimentation could lead to burial of sessile organisms unable to clear themselves or migrate from the sediment. For fish species, the degradation of spawning beds by fine sediment can lead to reductions in reproductive success for some species. Fish with complex patterns of reproductive behavior are more susceptible to effects from high suspended solids at a number of critical behavioral phases during the spawning process.

5.3.2.2 Effects of Increased Suspended Solids on Biota

Based on the ambient suspended solids content of the Mississippi River and the minor increase in ambient TSS concentrations, a small but finite impact to riverine biota is expected in the immediate area of the discharge plume and potential depositional area. The elevated TSS concentrations in the immediate discharge zone may lead to avoidance behavior by some aquatic species, but should not lead to any significant impact to fish or aquatic communities in the River near Mile 204. This conclusion is based on the magnitude of the incremental increase in TSS (less than 1 percent under low flow conditions), the location and areal extent of above-ambient TSS concentrations (i.e., Figures 5-1 - 5-4), and the nature of the Mississippi River flora and fauna. The Mississippi River biota is routinely exposed to ambient TSS levels well above the anticipated incremental level in the vicinity of the discharge and the areal extent of elevated TSS concentrations is very limited. Inspection of monthly TSS values from 1989-1995 indicates an approximate mean ambient river TSS of 170 mg/L (see Tables 4-3 and 4-4) and an average monthly range of 81 to 362 mg/L. Maximum suspended solid concentrations in the spring and early summer can run well above 600 mg/L.

The Mississippi River fish community is composed of warmwater species which are adapted to the highly turbid conditions which are characteristic of large rivers. Fish movement and migration of local species should be unaffected by the slight increase in suspended solids, which is negligible in magnitude to the seasonal patterns of suspended solids. The incremental increase of less than 1.0 mg/L predicted (see Section 5.1.1) is unlikely to be discernible to these species. The limited areal distribution of the elevated TSS below the discharge would be easily avoided under any circumstances.

The impact of the minor increase in total suspended solids (<1 percent) on ambient levels under low flow conditions should have no discernible effect on the underwater light regime. The impact of the elevated suspended solids on smaller planktonic organisms should likewise be negligible. The nature of the released solids (mainly raw river solids) should be compatible with the use of the water column by zooplankters and other filter-feeders. Filtration rates may be slightly adjusted in response to higher suspended particle concentrations, but levels are well below the natural range of suspended solids encountered by these species.

Finally, the minor rates of deposition of silty material on the river bottom predicted by the settling analysis (Section 5.1.2) are unlikely to bury sessile organisms found there. This conclusion is based on the nature of the bottom habitat characterization conducted by ESI in 1997 indicating unsuitable habitat conditions for unionid colonization and a relatively depauperate unionid community within a silty bottom environment. A follow-up communication from ESI confirmed that silt deposition was uniform with depth from both shoreline upstream and downstream of the facility (see letter in Appendix B). This indicates that no observable silt accumulation has occurred due to the current plant discharge despite 100 years of operation at the site. These observations are consistent with the predictions of the particle deposition model and the dynamic nature of bottom contours in the Mississippi River. These factors tend to further mitigate potential impacts to the benthos.

5.3.2.3 Potential Toxic Effects of Replacement Facility Discharge on Biota

Potential toxicity to aquatic life due to coagulant-associated metal/metalloid addition to the Mississippi River in water treatment plant residuals was evaluated. This pertains to coagulants introduced into the system from the Superpulsator® and the filter backwash discharge.

The evaluation of aluminum and iron consisted of consideration of the chemical characteristics of the receiving water, the coagulant content of the effluent discharges, the potential concentrations of coagulant in the area of mixing, comparison to benchmark values, such as the AWQC, and results from other studies. These evaluations are presented below.

Aluminum

Aluminum is one of the most common elements in natural materials and is a major component of geologic materials and soils. Aluminum has been shown to be toxic to many types of aquatic life, but the degree of toxicity is highly dependent upon water chemistry and relative proportions of various aluminum forms or species (U.S. EPA, 1988). Studies indicate that the aluminum which is occluded in minerals, clays, and sand or is strongly adsorbed to particulate matter is not toxic nor is likely to be toxic under natural conditions (U.S. EPA, 1988). Evaluation of toxicity is made more difficult because of the complex nature of aluminum geochemistry and its ubiquitous presence in high abundance in the environment (Hem, 1986; U.S. EPA, 1988).

Despite its abundance in geologic materials and soils, aluminum rarely occurs in solution in natural waters in concentrations above 1.0 mg/L, but exceptions are seen in waters of low pH. Reported concentrations of 1.0 mg/L in neutral pH waters containing no unusual concentrations of complexing ions probably consist of largely particulate material, including aluminum hydroxide and aluminosilicates (Hem, 1986). Mineral complexes such as gibbsite are very small (near 0.1

µm diameter) and may pass through conventional filters used to operationally separate "dissolved" fractions in water quality analyses. The long term average dissolved aluminum concentration in the Mississippi River near Alton is 0.026 mg/L (Table 4-7), with a range of 0.010 to 0.220 mg/L. It is not known what proportion of this aluminum is in a dissolved, monomeric form.

Most toxicity studies of aluminum have been associated with investigations of the environmental effects due to acidic deposition, commonly referred to as "acid rain" (Driscoll et al., 1980; Campbell and Stokes, 1985). Toxicity from aluminum has been shown to occur in dilute, softwater (poorly buffered) lakes or streams with low ambient pH conditions (e.g., pH <6.0 standard units). The literature also indicates that aluminum has little toxic effect at pH >6.5. A recent United States Fish and Wildlife Service (USFW) compendium of the effects of aluminum on wildlife referred to it as being "innocuous under circumneutral or alkaline conditions" (Sparling and Lowe, 1996). Typical pH values in the Mississippi River near Alton are circumneutral to alkaline, typically between 7.5 and 9.0.

Application of the AWQC for aluminum (87 µg/L) was used for comparison purposes, but has no regulatory standing for the proposed replacement facility. A water quality criterion for aquatic life has regulatory impact only after it has been adopted in a State water quality standard (U.S. EPA, 1988). Illinois Water Quality Standards do not have a standard for aluminum. Comparison of the results described in Section 5.1.1 indicate that under all flow conditions the contribution of the coagulant-generated aluminum does not cause an exceedance of the 87 µg/L AWQC.

Inspection of the aluminum AWQC document indicates the criteria value is due, in large part, to potential toxicity to certain salmonid species (U.S. EPA, 1988). Application of the criteria to protect salmonids is inappropriate, because this portion of the Mississippi River does not contain preferred salmonid habitat. Further, comparison of AWQC toxicity results based on laboratory experiments in which the aluminum is directly applied as soluble salts (e.g., aluminum chloride or aluminum sulfate) under low hardness conditions to predict toxicity of ambient dissolved aluminum concentrations in the Mississippi River is probably conservative, due to the potential biologically unavailable aluminum. Further, as indicated earlier, the high pH values found in the Mississippi River would prevent aluminum toxicity from being a concern.

Other studies have examined the impact of water treatment sludges on aquatic life. Toxicity tests using freshly precipitated sludge with rainbow trout (Oncorhynchus mykiss) found that at pH 7 to 9, the aluminum in the water was present as filterable, nonexchangeable fractions and was not lethal to the fish (Ramamoorthy, 1987).

Hall and Hall (1990) evaluated chronic toxicity from a water treatment plant sludge to Ceriodaphnia dubia and Pimephales promelas test populations. Total aluminum concentrations in the test vessels were usually in excess of 100 mg/L, but measurable soluble aluminum was always below 0.5 mg/L. The authors concluded that the majority of aluminum in the effluent was undissolved and apparently unable to exert substantial toxicity. Both species had "no observable adverse effects concentrations" (NOEC) at 50 percent effluent, indicating only a 1:1 dilution of effluent with receiving water was necessary to eliminate any adverse effects.

Iron

A similar analysis was conducted for iron (see Section 5.1.1). Modeling of the concentration impact was conducted using the measured clarifier and filter backwash levels. The average filter discharge value of dissolved iron was 0.009 mg/L. The results of these models indicate that the discharge does not pose a threat to exceed the value of Illinois Water Quality Standard for dissolved iron of 1.0 mg/L (per 302.208(g) of 35 IAC) in the area of mixing.

Like aluminum, iron is both ubiquitous and found in a variety of mineral and complexed forms. It is largely biologically unavailable, except for the dissolved form, which is typically found in significant proportion under conditions of low pH and/or low oxygen. As noted elsewhere, the pH levels of the Mississippi River are consistently above 7.0 and the river stretch in question is unlikely to suffer from low dissolved oxygen due to its shallowness and velocity.

Observed Effects of Residuals on Benthic Communities

The results of these reports may also be compared to the 1984 field investigation undertaken by the Illinois Water Survey to assess potential impacts of discharge to the water quality and benthic fauna downstream of a water treatment plant of another large, high velocity river, in this case the Mississippi River at East St. Louis, IL (Lin et al., 1984). The Illinois State Water Survey (Water Survey) report concluded that there was neither a detectable increase in water column suspended solids nor a blanket of deposits on the bottom. The Water Survey report also considered the poor diversity of the benthic macroinvertebrate community to be more determined by the instability of the sandy habitat and influence of navigation traffic (i.e., river barges), factors which may also be relevant at the proposed replacement facility site. These findings corresponded with the conclusions of investigations of the potential toxic and non-toxic impacts of the Water Company's East St. Louis facility effluent (ENSR, 1992).

In addition to these toxicological studies, several environmental studies have been conducted to assess the effect of the water plant residual discharges on the water quality and biota of the Missouri River and have concluded that no significant adverse effects occur (see Novak and

King, 1974; Novak and King, 1981; O'Connor, Banerji, and Uhazy, 1986; summarized in Banerji and Brazos, 1990). A recent study by Banerji and Brazos (1990) analyzed river water and bottom sediments near a number of water treatment plants on the Missouri River. The authors were trying to determine whether return of treatment residuals have a demonstrable adverse impact to either river water quality or benthic macroinvertebrate communities.

The results of their field investigation confirmed earlier studies in showing that there was no significant change in Missouri River water quality and minimal to negligible impacts to benthic fauna downstream of the discharge outfalls (Banerji and Brazos, 1990). Overall, Banerji and Brazos concluded that most of the water treatment solids would likely remain in suspension due to high flow velocities of the river.

The findings of these reports are quite comparable to the potential impacts of the proposed replacement facility predicted by the present ENSR analyses (i.e., settling tests and ambient TSS changes), both in magnitude and in implications for the receiving water ecosystem.

A recent study of the impacts of sludge to the aquatic environment was prepared for the American Water Works Research Foundation (George et al., 1990). This study investigated sludge impacts at a variety of drinking water facilities on various rivers. The major recommendations from this study included: (1) toxicity evaluation of site specific organisms; (2) no discharge of alum to streams with pH < 6; (3) no discharge of alum to soft surface waters (i.e., hardness < 50 mg/L as $CaCO_3$); (4) impacts to benthic macroinvertebrates should be evaluated; (5) sludge should be discharged during periods of fast water movement to avoid deposition and potential impact to benthic invertebrates; and (6) an environmental assessment needs to be undertaken for any sludge disposal to surface waters. Such an assessment should consider receiving water use, sediment structure, water chemistry, system hydrology, and receiving water biology.

Applying these recommendations to the proposed replacement facility finds that all are being followed: (1) site specific (i.e., non-salmonid) species are more tolerant and potential aluminum toxicity is unlikely (see above); (2) the Mississippi River normal pH range is 7.5-9.0 (see Section 4.3); (3) the hardness of the Mississippi River is greater than 50 mg/L as $CaCO_3$ (Sawyer and McCarty, 1978); (4) impacts to the benthic community was addressed by conducting a mussel survey which indicated no unionid community at the discharge location; (5) water velocity at the discharge point is moderate, approximately 1.4 feet per second or higher (see Section 5.2); and (6) an environmental assessment was made considering water use, sediments, water chemistry, hydrology and receiving water biology (see Section 6.0).

5.3.2.4 Summary of Impact Analyses

Based on the negligible increase to ambient total suspended solids concentrations, the minor nature of the sediment deposition area and mass, a local biota ecologically adapted to naturally high levels of suspended solids, the high levels of natural complexation of aluminum (and iron) and the low probability of toxic effects from alum addition, it is concluded that the proposed replacement facility discharge has no significant potential impact to the river environment and its biota.

5.3.3 Sensitive Species and Habitat Evaluation

As part of the consideration of the environmental effects of the proposed replacement facility effluent TSS to the Mississippi River ecosystem, potential impacts to sensitive species and critical habitats were investigated. Contact was made with the USFW and the Illinois Department of Natural Resources, requesting consultation of their database to ascertain whether species or habitats of potential concern existed at the proposed facility site and potential discharge location. Correspondence received from the agencies is included in Appendix A.

Letters requesting information concerning endangered, threatened, rare and special status species in the vicinity of the proposed Alton Water Treatment Plant were sent to Ms. Joyce Collins (U.S. Fish and Wildlife Service) and to Ms. Kim Roman (Illinois Department of Natural Resources, Office of Resource Conservation, Division of National Heritage).

Ms. Collins of the U.S. Fish and Wildlife Service indicated that no federally listed threatened and endangered (T/E) species would be expected at the site. There is no designated critical habitat in the project area (see letter in Appendix A).

Ms. Heather Hostetler of the DNR indicated that there are no records of endangered or threatened species near the proposed site (see letter in Appendix A). The DNR did identify the Alton Geological Area, John M. Olin Nature Preserve and Olin Tract, and Oblate Father's Woods Nature Preserve as natural features or conservation areas in the vicinity of the proposed site. There are no known occurrences of state-listed threatened and endangered species at these natural areas and nature preserves.

Finally, Illinois-American conducted a mussel habitat characterization (performed by ESI). This survey indicated no unionid community near the proposed discharge location, with no evidence of state or federal-listed mussel species at the location.

5.4 Identification of Frequency and Extent of Discharges

The frequency and extent of discharges has been previously addressed in Section 3.4. The underlying cause of the variation in the frequency and extent of effluent discharges is the level of TSS in the raw water source (Mississippi River).

5.5 Identification of Potential for Unnatural Bottom Deposits, Odors, Unnatural Floating Material or Color

Potential compliance of the proposed discharge with 35 IAC 302.203 "Offensive Conditions" section of the General Use Water Quality Standards was evaluated. This section states:

> *Waters of the State shall be free from sludge or bottom deposits, floating debris, visible oil, odor or turbidity of other than natural origin. The allowed mixing provisions of Section 302.102 shall not be used to comply with the provisions of this Section.*

The potential for unnatural bottom deposits, odors, and unnatural floating material or color has been largely addressed by Section 5.1. In that section, it was shown that the potential water quality effects or bottom deposit impacts are either confined to a small surface area or is negligible in accumulation. No visible oils or odor are expected. Since the discharge does not elevate nutrients in the receiving water, no additional plant or algal growth is expected to result. Due to the naturally occurring character of the majority of the effluent material (i.e., river silts), no unusual discoloration (i.e., unnatural tint or hue) will result from the discharge. Turbidity above ambient levels is likely to briefly occur and is discussed in detail below.

Turbidity is a measure of the interference of the passage of light into water caused by suspended material in the water. Thus, it is a function of the TSS concentrations found in the water. Turbidity will potentially exceed ambient concentrations below the proposed Alton facility discharge as indicated in Figures 5-2 and 5-4. Since this discharge is comprised of natural river silts plus trace amount of coagulants, there will be little, if any, difference in the apparent color or hue of the plume, but the intensity may increase.

As described earlier, the discharge plume is not expected to reach the surface until some distance downstream (approximately 90-1000 ft) at which time the surface concentrations range from 25 to 50 mg/L TSS above ambient but quickly decrease to <10 mg/L. Based on the background TSS values in the Mississippi River, it is extremely doubtful that these areas of elevated surface TSS will be discernible due to the small incremental increase in river turbidity and the limited surface area (<0.15-1.1 ac) affected.

Turbulence due to natural flow, local navigational traffic, or activities in the barge tugboat docking area will likely produce similar variations in turbidity levels. Further, at elevated turbidity levels, incremental increases cannot be detected visually due to the opaqueness of the media. Finally, there should not be impairment or loss of current water used for the Mississippi River downstream of this location.

Turbidity of "unnatural origin" occurs in the Waters of the State any time that TSS is introduced into a receiving water by human activity. Unless 35 Ill. Adm. Code 302.203 is read to prohibit all discharges of TSS to Waters of the State from human activities, the issue is whether such discharges cause "Offensive Conditions" per the title of the regulation. In consideration of the factors discussed above, it was concluded that the level and spatial extent of the transient TSS increases from the proposed Alton discharge do not result in an "Offensive Condition" exceedance.

5.6 Stream Morphology and Results of Stream Chemical Analyses

The receiving water morphology and chemical analyses have been described in Section 4.3. Due to the considerable channel size, the potential for high volume and high velocity flows, the negligible quality of discharge material relative to natural sediment loads, and the existing influence of periodic disturbance due to operation and maintenance of the nearby navigation channel, the conclusion is that the proposed Alton replacement facility will have no impact on stream morphology or water chemistry.

5.7 Evaluations of Stream Sediment Analyses

No site specific stream sediment surveys were conducted for the SSIS. The potential for the proposed replacement plant to affect stream sediments was evaluated by consideration of the potential magnitude of bottom deposits (Section 5.1.2) and evaluation of reports from the literature on bottom dwelling invertebrates found downstream of drinking water plant outfall (see discussion in Section 5.3.3). Based on these factors, it was concluded that the proposed Alton replacement facility will not pose an adverse risk to either sediment chemistry or the health and integrity of benthic communities.

5.8 Pollution Prevention Evaluation

As part of the BDT consideration, the potential for pollution prevention and/or waste minimization at the proposed Alton replacement facility was investigated. Pollution Prevention (P2) is defined by the *Illinois* EPA as "an in-plant practice that reduces or eliminates the amount, hazard potential, and/or toxicity or pollutants that otherwise would become waste material." Application of P2 is now mandatory in Illinois for NPDES stormwater permits, or for special considerations as authorized for extending areas of mixing, but is otherwise a voluntary program. The potential for application of P2 to the proposed Alton replacement facility was further investigated.

Contact was made with Mr. Kevin Green (Illinois EPA) of the P2 Program to further understand the program. According to Mr. Green, P2 is a voluntary program currently subscribed to by over 200 companies in Illinois. Companies participating in the P2 program are inspected by qualified state staff (usually graduate interns) who inspect the facility and its treatment processes to identify potential product changes, process changes, and improved operating practices which could result in reduced waste material generation or release to the environment.

Further discussion with Mr. Green indicated that the P2 program has little experience with drinking water facilities. He understood that the only facility which was involved in the P2 program was a public water supply facility in Champaign, IL which is working with the Illinois Waste Management and Research Center to facilitate nitrate removal in the source water via reverse osmosis.

The Water Company is willing to participate in the P2 program but initial indications are that many of the components of the program are not likely to affect the proposed replacement facility or its performance or significantly reduce residual production. This assessment is based on:

- there is limited potential for product change in that the proposed replacement facility must produce potable water. The level of product quantity and quality is dictated by the continuing need for potable water for the current population base which meets Safe Drinking Water Act requirements;

- process changes, including minimization of the amount or the nature of chemicals added, have already been implemented by Water Company staff, but are limited by Illinois-American's voluntary adherence to Partnership for Safe Water treatment goals which requires greater addition of coagulants to meet these more stringent goals;

- process changes, in themselves, will not greatly reduce the amount of residuals produced. Regardless of the process used, the amount of residuals will always be largely dictated by the differences between raw water quality and the drinking water standards. There is nothing that the Water Company can do to reduce the amount of residuals derived from the raw water source; and

- operational improvements, such as the continuous discharge of residuals through the use of Superpulsators® instead of conventional clarifiers have already been incorporated.

Table 5.1 Proposed Alton Replacement Facility Test Design Conditions

Coagulent Type Used	Test Miss. River TSS (mg/l)	River TSS Condition	Test Miss. River Flow (mgd)	River Flow Condition	S-Pulsator Effluent TSS (mg/l)	S-Pulsator Effluent Flows (mg/d)	Filter B-Wash Effluent TSS (mg/l)	Filter B-wash Effluent Flows (mg/d)
Clar+Ion	20	Mimimum Daily Value	3474	0.25 * 7Q10 Flo	726.2	0.433	7.2	0.620
Clar+Ion	600	Maximum Monthly Value	17265	0.25 * Avg. Flo	10000	0.688	144.4	0.931

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Table 5.2 TSS Increases from Proposed Alton Replacement Facility Test Discharge

Coagulent Type Used	Test Miss. River TSS (mg/l)	River TSS Condition	Test Miss. River Flow (mgd)	River Flow Condition	Predicted TSS Conc. (mg/l)	Incremental TSS increase (mg/l)	% Increase in Ambient Conditions
Clar+Ion	20	Mimimum Daily Value	3474	0.25 * 7Q10 Flo	20.1	0.1	0.43
Clar+Ion	600	Maximum Monthly Value	17265	0.25 * Avg. Flo	600.3	0.3	0.06

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Table 5.3 Dissolved Aluminum Increases from Proposed Alton Replacement Facilty Test Discharge

Coagulent Type Used	Test Miss. River TSS (mg/l)	River TSS Conditions	Test Miss. River Flow (mgd)	River Flow Condition	Predicted Al Conc. (mg/l)	Incremental Al increase (mg/l)	% Increase in Ambient Conditions
Clar+Ion	20	Mimimum Daily Value	3474	0.25 * 7Q10 Flo	0.029	0.003	10.2
Clar+Ion	600	Maximum Monthly Value	17265	0.25 * Avg. Flo	0.221	0.001	0.5

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Table 5.4 Dissolved Iron Increases from Proposed Alton Replacement Facilty Test Discharge

Coagulent Type Used	Test Miss. River TSS (mg/l)	River TSS Conditions	Test Miss. River Flow (mgd)	River Flow Condition	Predicted Fe Conc. (mg/l)	Incremental Fe increase (mg/l)	% Increase in Ambient Conditions
Clar+Ion	20	Mimimum Daily Value	3474	0.25 * 7Q10 Flo	0.036	<0.000	0.00
Clar+Ion	600	Maximum Monthly Value	17265	0.25 * Avg. Flo	0.710	<0.000	0.00

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Table 5.5 Estimated Discharge Residuals Settling Velocities Illinois-American Proposed Alton Facility

Discharge Type and Flow Condition	Mean Initial TSS (mg/l)	Discrete Settling Time (min)	Settled Volume (ml/l)	Settled Distance (cm)	Settling Velocity (m/sec)
Clarifier Residuals at 7Q10 Flow (Vr= 0.10 m/sec)	698	10	210	16.7	2.78E-04
Clarifier Residuals at Avg. Flow (Vr= 0.51 m/sec)	698	10	210	16.7	2.78E-04
Filter Backwash at 7Q10 Flow (Vr= 0.10 m/sec)	232	20	86	25.7	2.14E-04
Filter Backwash at Avg. Flow (Vr= 0.51 m/sec)	232	20	86	25.7	2.14E-04

Notes: 1) Discrete settling time is that time at which the initial linear portion of the settling curve ends and hindered settling and compaction begins.

2) Settling distance is distance, at time T, from 1000 ml line to the interface between relatively clear supernatant and the cloudy settleable solids region.

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TABLE 5-6
Summary of Particle Deposition Results

Scenario and Event	Particle Group	Area (acres)	Event Duration	Deposition Rate (g/ft^2)	Accumulation Rate (in)	Deposition Rate (g/ft^2)	Accumulation Rate (in/yr)
Steady-State	Large	2.69				6660	2.229
	Medium	565				36.66	0.012
	Small	565				12.22	0.004
Scenario #1 7Q10	Large	0.06	7 day/10 yr	82.1	2.75E-02		
	Medium	356	7 day/10 yr	0.014	4.71E-06		
	Small	565	7 day/10 yr	0.003	1.13E-06		
Scenario #2 Filter Backwash	Large	1.04	15 min/day	3.933	1.32E-03		
	Medium	565	15 min/day	0.008	2.82E-06		
	Small	565	15 min/day	0.006	1.88E-06		

Specific weight of sediments assumed to be 1266 kg/m^3 (ASCE, 1975).

TABLE 5-7

Habitat Distribution of Commonly Occurring Mississippi River Fish Species in Selected Habitats in the Vicinity of Alton, Illinois (after Baker et al., 1991)

Species	Mainstream Channel	Nearshore Banks	Pool	Slough
Shovelnose sturgeon (*Scaphirhynchus platorynchus*)	C	C	U	R
Paddlefish (*Polyodon spathula*)	U	U	C	T
Longnose gar (*Lepisosteus osseus*)	C	C	A	T
Shortnose gar (*Lepisosteus platostomus*)	A	C	A	A
Bowfin (*Amia calva*)	--	R	R	A
American eel (*Anguilla rostrata*)	U	T	U	--
Skipjack herring (*Alosa chrysochloris*)	C	C	A	A
Gizzard shad (*Dorosoma cepedianum*)	U	C	A	A
Threadfin shad (*Dorosoma petenense*)	R	C	A	A
Goldeye (*Hiodon alosoides*)	U	T	C	T
Common carp (*Cyprinus carpio*)	C	A	C	A

Habitat Distribution of Commonly Occuring Mississippi River Fish Species in Selected Habitats in the Vicinity of Alton, Illinois (after Baker et al., 1991)

Species	Mainstream Channel	Nearshore Banks	Pool	Slough
Central silvery minnow (*Hybognathus nuchalis*)	P	C	C	U
Speckled chub (*Hybopsis aestivalis*)	C	C	U	--
Silver chub (*Hybopsis storeriana*)	P	C	C	--
Emerald Shiner (*Notropis atherinoides*)	P	C	A	U
River shiner (*Notropis blennius*)	P	C	C	R
Silverband shiner (*Notropis shumardi*)	P	C	C	R
Blacktail shiner (*Notropis venustus*)	R	T	C	--
Mimic shiner (*Notropis volucellus*)	P	C	C	R
Bullhead minnow (*Pimephales vigilax*)	--	R	T	R
River carpsucker (*Carpiodes carpio*)	C	A	A	A
Blue sucker (*Cycleptus elongatus*)	A	C	T	--
Smallmouth buffalo (*Ictiobus bubalus*)	A	C	C	C
Bigmouth buffalo (*Ictiobus cyprinellus*)	U	T	T	C
Spotted sucker (*Minytrema melanops*)	R	R	U	T

Habitat Distribution of Commonly Occuring Mississippi River Fish Species in Selected Habitats in the Vicinity of Alton, Illinois (after Baker et al., 1991)

Species	Mainstream Channel	Nearshore Banks	Pool	Slough
Blue catfish (*Ictalurus furcatus*)	A	A	C	T
Channel catfish (*Ictalurus punctatus*)	C	C	A	A
Flathead catfish (*Pylodictis olivaris*)	A	A	T	R
Pirate perch (*Aphredoderus sayanus*)	--	--	--	C
Blackstripe topminnow (*Fundulus notatus*)	--	R	R	C
Mosquitofish (*Gambusio affinis*)	--	R	R	C
Brook silverside (*Labidesthes sicculus*)	--	U	U	C
Inland silverside (*Menidia beryllina*)	P	C	C	R
White bass (*Morone crysops*)	U	C	A	U
Striped bass (*Morone saxatilis*)	T	T	T	R
Orangespotted sunfish (*Lepomis humilis*)	--	R	R	C
Bluegill (*Lepomis macrochirus*)	--	T	T	A
Largemouth bass (*Micropterus salmoides*)	--	U	U	C
White crappie (*Pomoxis annularis*)	P	T	C	A

Habitat Distribution of Commonly Occuring Mississippi River Fish Species in Selected Habitats in the Vicinity of Alton, Illinois (after Baker et al., 1991)

Species	Mainstream Channel	Nearshore Banks	Pool	Slough
Black crappie (*Pomoxis nigromaculatus*)	P	T	T	U
Sauger (*Stizostedion canadense*)	U	C	C	T
Freshwater drum (*Aplodinotus grunniens*)	C	A	A	A

Notes:

Source: Baker et al., 1991

A = abundant: usually found in high numbers
C = common: usually found in moderate numbers
T = typical: occurs regularly, but in low numbers
U = uncommon: irregularly found, usually, but not always, in low numbers
R = rare: seldom encountered, almost always in low numbers
P = probable: likely to occur, but records lacking or inconclusive
– = insufficient information

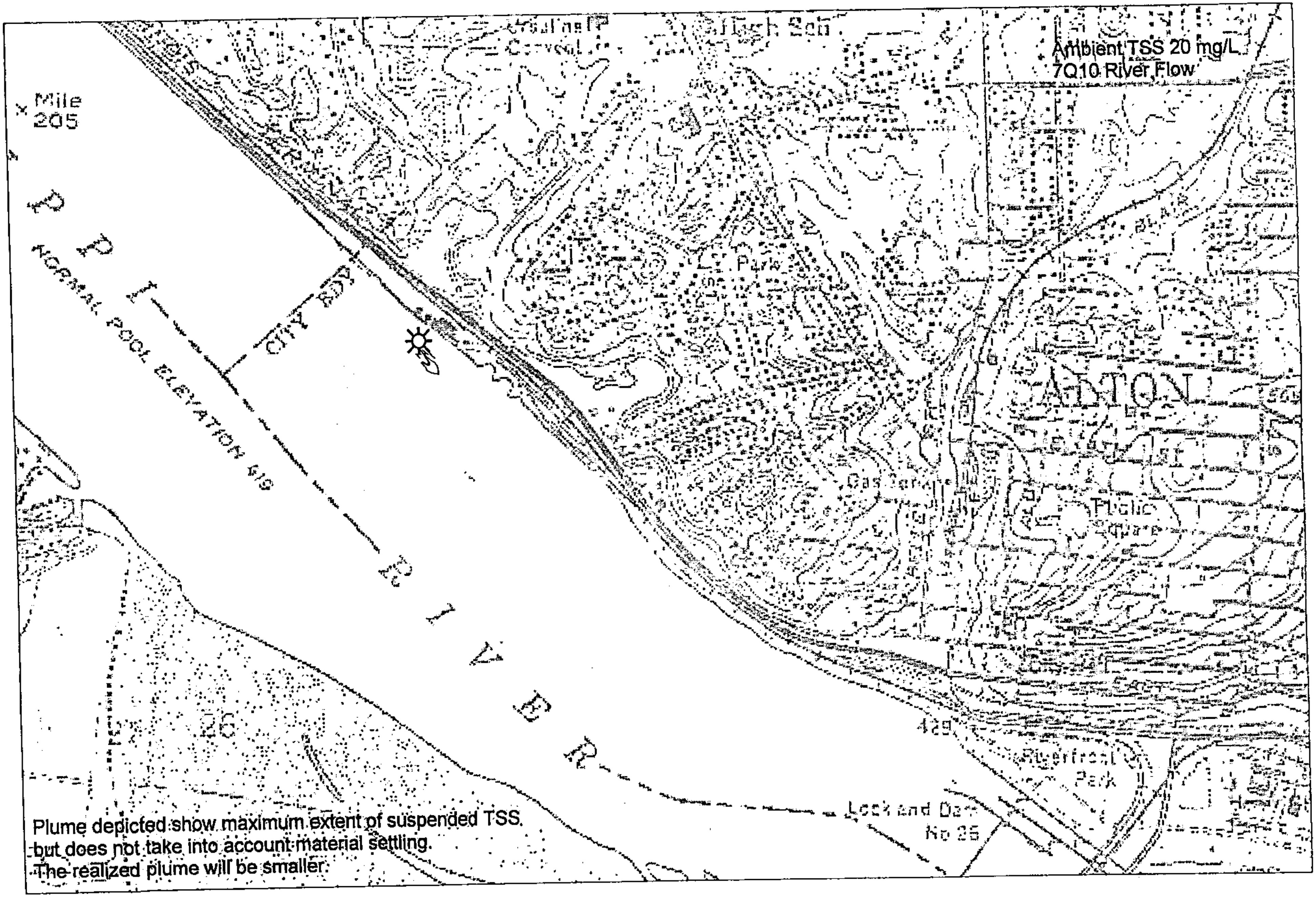
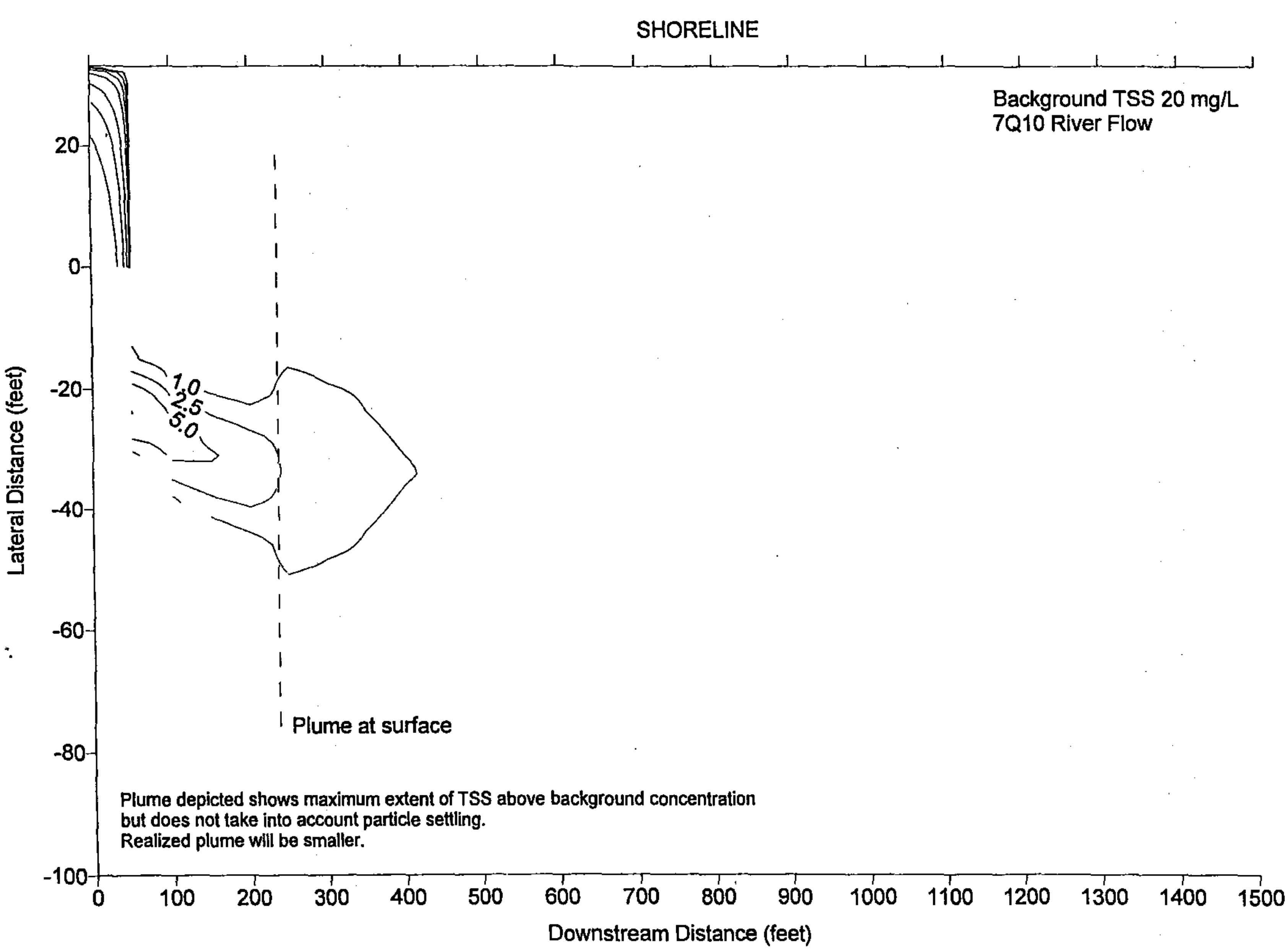


FIGURE 5-1 - Location of Plume 1 mg/L Above Background Concentration for Scenario 1.



Aerial View of Predicted TSS Plume (mg/L above background levels) - Scenario 1

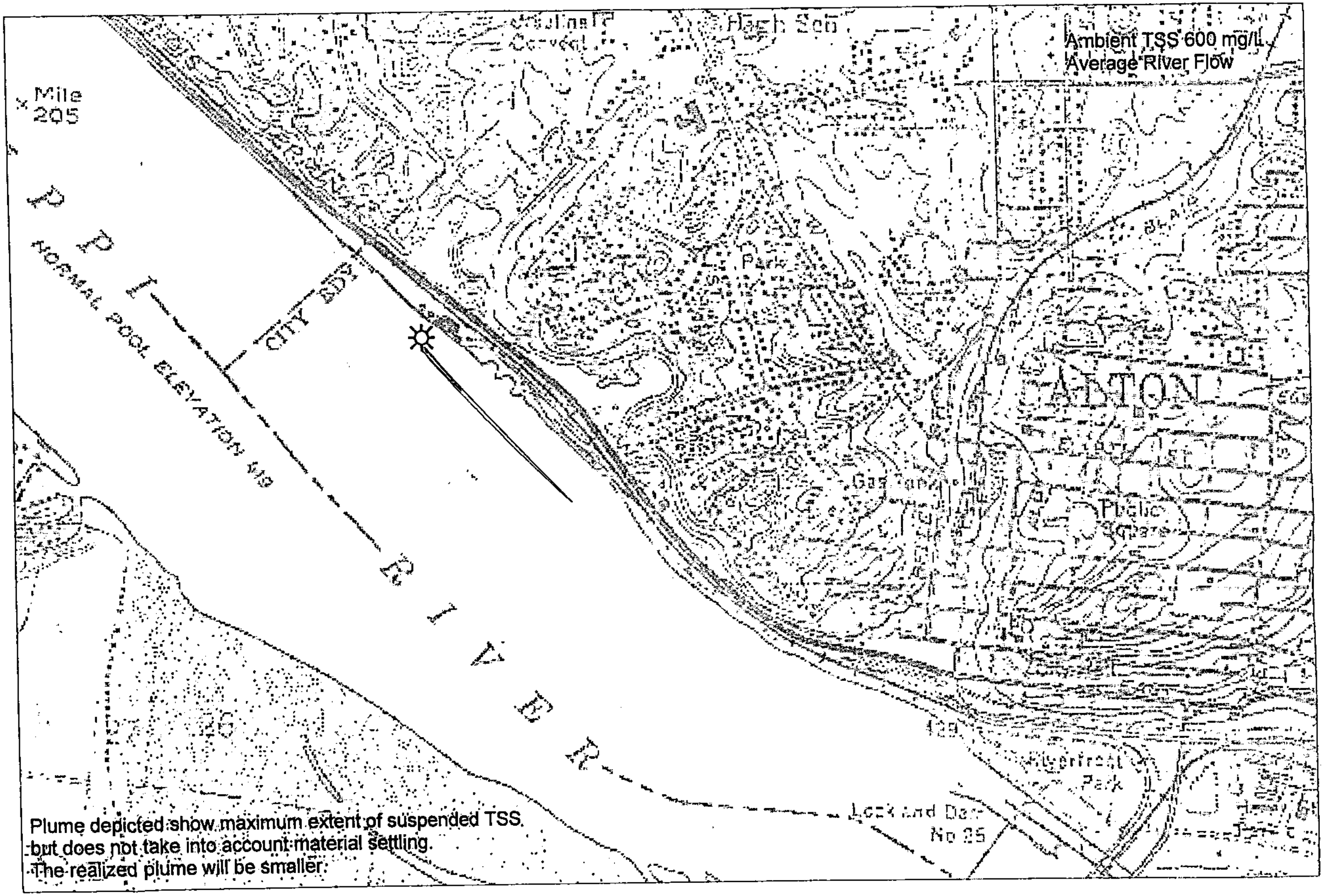


FIGURE 5-3: Location of Plume 25 mg/L Above Background Concentration for Scenario 2.

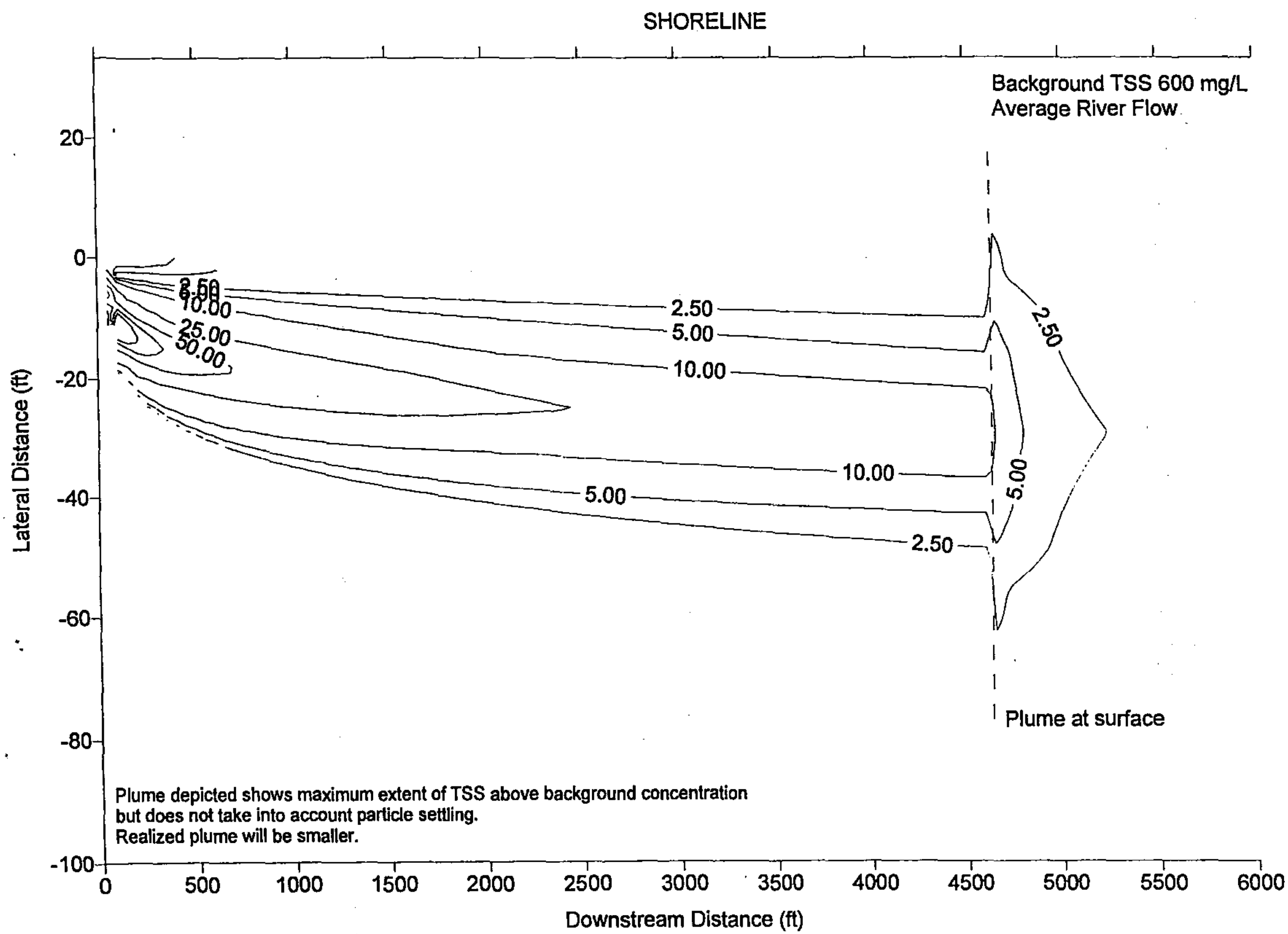


FIGURE 5-4: Aerial View of Predicted TSS Plume (mg/L above background levels) - Scenario 2

Figure 5-5
Clarifier Residuals Settling Curves
(Data from existing Alton plant)

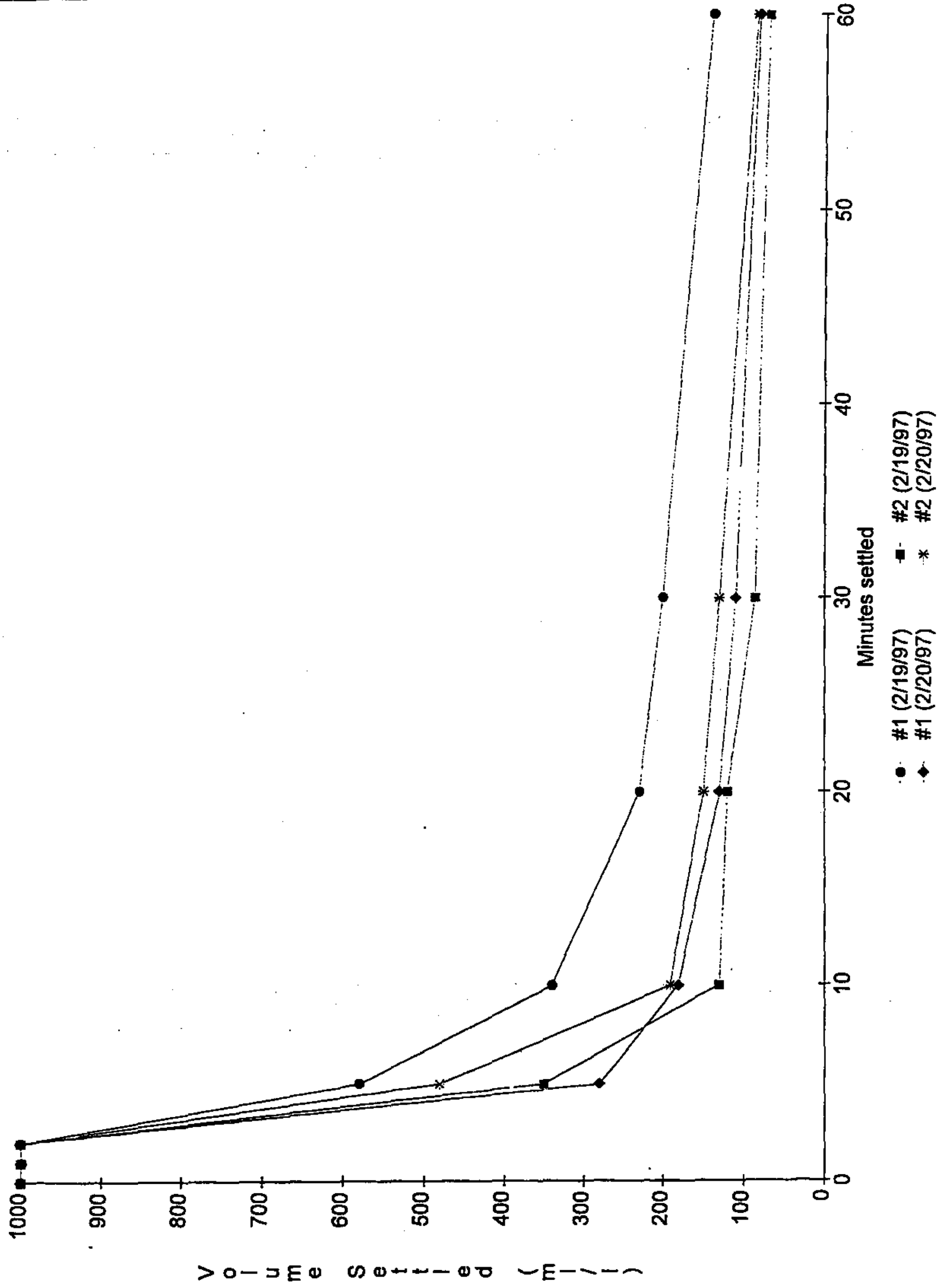
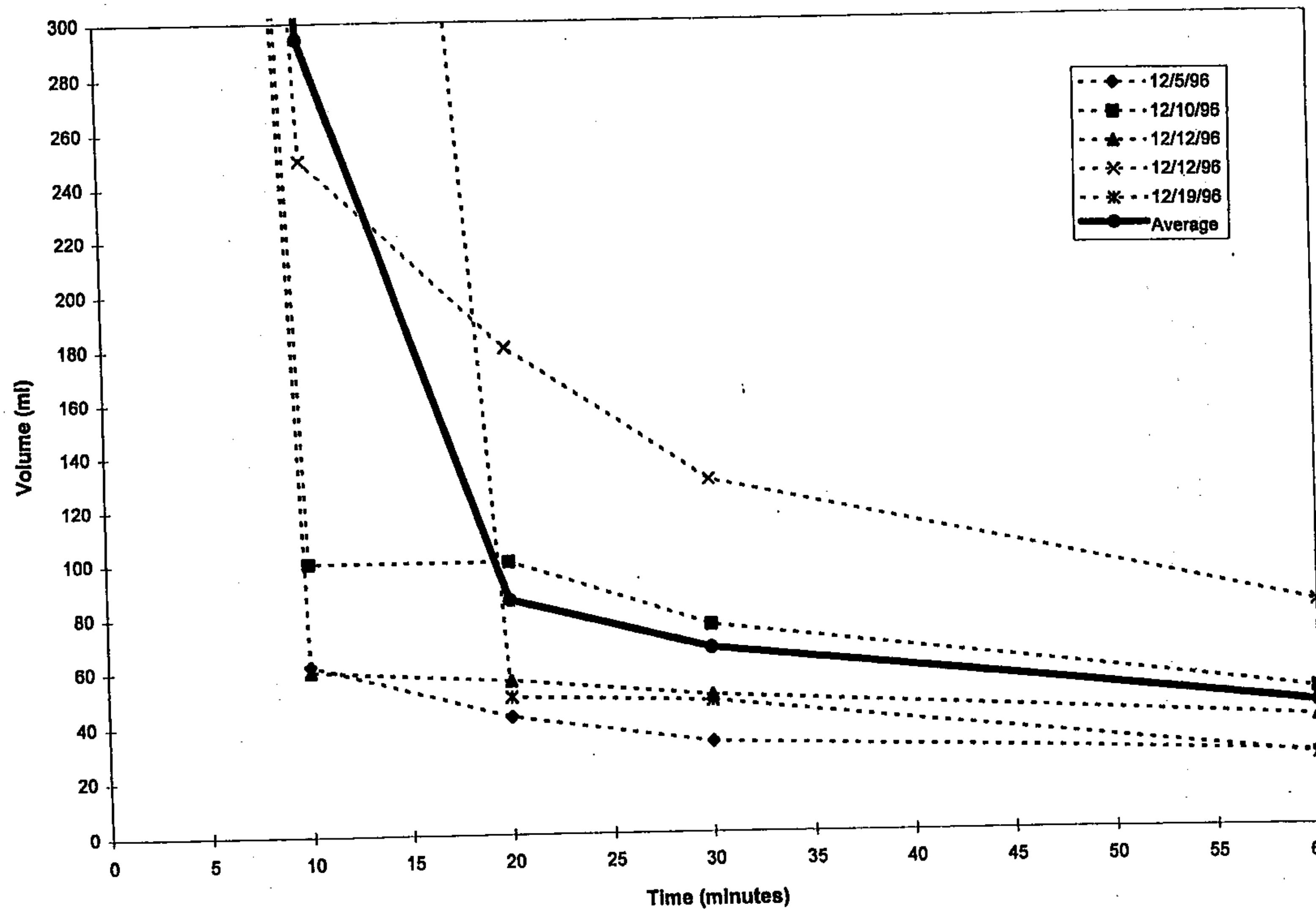


FIGURE 5-6
Filter Backwash Residuals Settling Curves
(data from existing Alton plant)



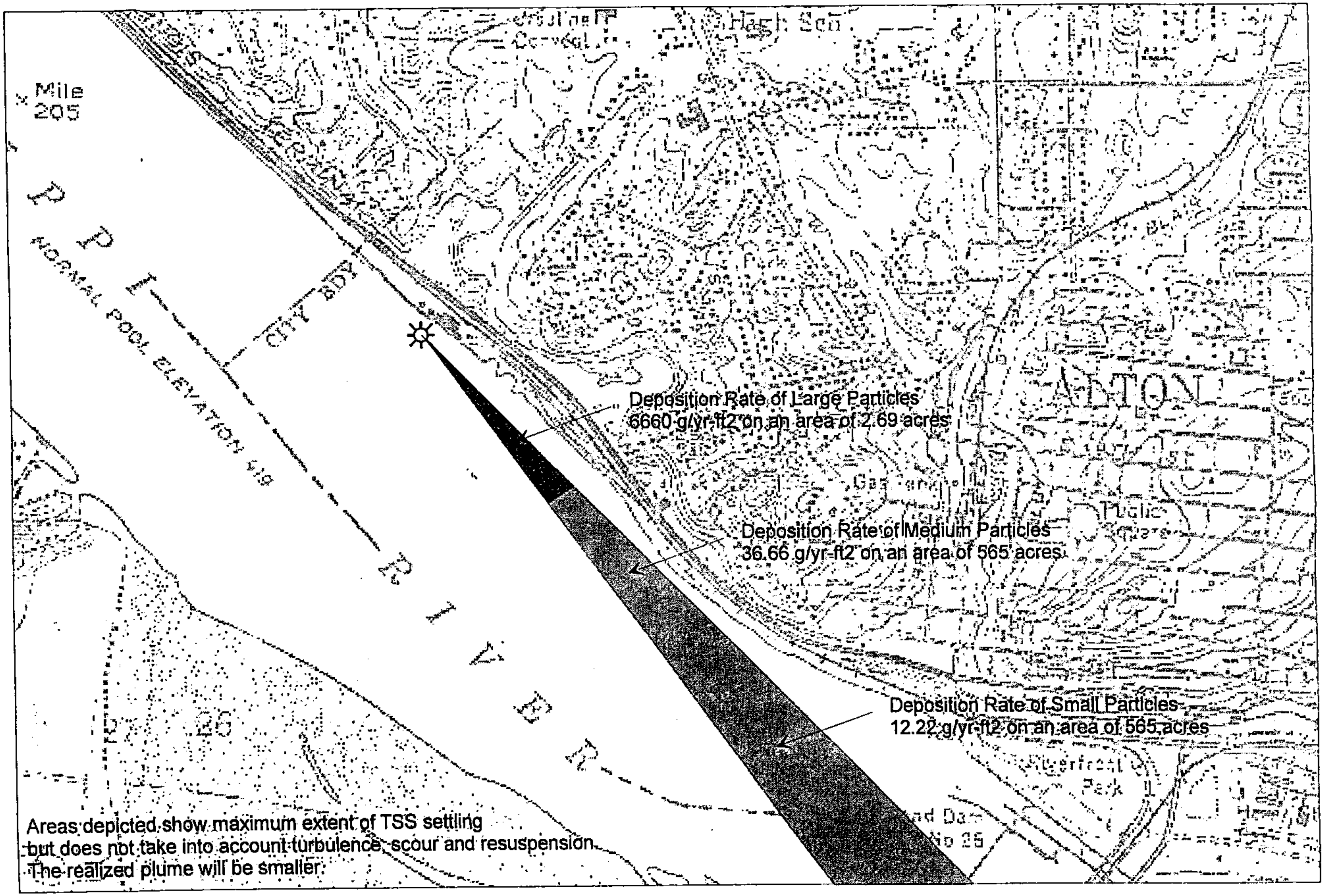


FIGURE 5-7: Location of Theoretical Maximum Deposition Areas (steady-state scenario, quantities above ambient level)

6.0 BEST DEGREE OF TREATMENT (BDT) ANALYSIS

As part of the site specific impact study (SSIS) for the proposed replacement water treatment plant, it is necessary to determine which treatment technology provides the best degree of treatment (BDT) for the Superpulsator® and filter residuals using the factors identified in 35 IAC 304.102. This is accomplished by consideration of the current plant's TSS control practice (discharge to the Mississippi River) and alternative TSS control technologies which were identified as technically feasible for the proposed replacement facility and integrating the information from other parts of the SSIS. The BDT is selected from among these options. A schematic flow diagram indicating the relationship of the various components of the SSIS to the BDT determination is depicted in Figure 6-1.

Section 6.1 summarizes the available BDT technologies identified for control of residuals (primarily TSS) at the proposed replacement facility. All of the proposed technologies are expected to attain the effluent limits of 15 mg/L daily average TSS provided in the Illinois water quality standards. Brief descriptions and the feasibility of each of the leading candidate technologies for removal of the alum-associated solids are given. Section 6.2 identifies the treatment technologies selected for further evaluation.

In Section 6.3, engineering cost estimates for construction, operation, and possible land acquisition are provided for the two candidate BDT technologies. Section 6.4 presents the BDT determination for the proposed Alton replacement facility discharge residuals. Section 6.5 presents development of BPT and BCT for compliance with CWA requirements.

6.1 Identification of Treatment Technologies for Residuals Control

As a first step in the determination of BDT, it is necessary to identify available treatment technologies and select appropriate candidate technologies for application at the proposed replacement site. One major consideration in the selection of candidate technologies is the turbid and hydrologically variable nature of the Mississippi River near Alton. This variability is documented in Section 4.3, based on over 20 years of USGS data and available intake water turbidity of the current Alton facility. The intake data records indicate average TSS levels of 180 mg/L, average turbidity at 90 NTU and extremely dynamic variation on a daily, seasonal, and yearly basis. These environmental conditions constitute a scenario which had been recognized as problematic during the development of proposed national guidelines (U.S. EPA 1975). The fact that EPA never promulgated industry-wide effluent standards indicates that water supply plants and their source waters are too different for industry-wide standards to be useful. Consequently, ability to deal with a highly dynamic TSS load is an important selection factor.

A number of residuals management control technologies shown in Table 6-1 have been screened based on site specific factors including the nature and quantity of settled solids produced, climatic factors, land availability, and past performance history of various technologies. The following is a brief discussion of the respective control technologies.

1) Direct Discharge to River

Direct discharge of all residuals from the proposed replacement facility to the river will serve as the base case. It is predicted that an estimated average of 3,358 dry tons of solids will be discharged from the plant each year. Of the total solids discharged annually (based on a coagulant dosage rate of 40 ppm), approximately 8.7 percent, or 580,000 pounds, are coagulant residuals. That is, they are produced by the addition of the chemical coagulants themselves. Of this amount, metals only constitute a small fraction. For example, Clar+Ion® is approximately 20 percent organic polymer and about 80 percent alum, of which aluminum accounts for 5 percent (based on molecular weight). Therefore, the amount of coagulant-based aluminum in the effluent is 8.7 percent * 0.8 * 0.05 = 0.348 percent, which constitutes a very minor percentage (and is comparable to the East St. Louis drinking water facility). It should be noted that the production rates of total suspended solids are highly variable depending on river suspended solids as described in Section 3.3. The current practice of direct discharge to the Mississippi River provides operational flexibility when dealing with the wide variations expected in the rate of solids generation.

2) Land Application

The management of residuals by land application includes temporary storage of residuals at the proposal Alton site followed by transportation and application of residuals to local agricultural land. The residuals can be applied either as a liquid form or as dewatered residuals termed "cake". For the former application method, liquid residuals (say 5%) would be stored, loaded into 6000 gallon tanker trucks and hauled to the application area. The liquid residuals can then be injected into the soil (fallow or with crops) by specialized equipment or applied to the soil surface with spray equipment. Residuals applied to the soil surface would then be disked or plowed into the soil within 24 hours of application. Land application of liquid residuals (including hauling and application) can cost between $70 to $300 per dry ton (depending on the hauling distance). Since significant agricultural land is not available in the immediate vicinity of the facility and is less likely to be available in the future (as there is an increasing trend for residential growth in the area), the high end of the cost range was considered more appropriate. The total cost of land application of liquid residuals, including on-site holding facilities, was considered comparable to the cost of dewatering lagoons or belt press dewatering followed by landfilling (see Option 6B or 6C).

Application of dewatered cake was also considered. Dewatered residuals (say 25% solids) would be stored, loaded into lined dump trucks and hauled to the application area. Weather permitting (i.e., ground not frozen or saturated), the residuals could then be applied in thin layers to the soil directly from the truck or by using equipment like a manure spreader. Similar to the liquid form, the cake residuals would then be incorporated into the soil via disking or plowing. Land application of dewatered residuals (including hauling and application) can cost between $20 and $68 per dry ton. This method is very similar to that of Option 6C (i.e., landfill disposal after mechanical dewatering) except that the final destination is widespread application to farm fields rather than to a landfill facility.

For either method, weather, public acceptance, permit requirements, and land availability can limit the feasibility of the land application of residuals. In the Alton area inclement weather does not seriously limit land application, but application or injection to frozen soil may not be feasible for some winter months. Biosolids from the Godfrey wastewater treatment plant have been successfully applied to nearby land ten months of the year for the last 10 years. However, public acceptance of residuals may be considerably less than for biosolids (considered a soil enhancement due to carbon and nutrient content) since the residuals add little to (or detract from) soil fertility. Land application is further complicated by permit regulations concerning the content of applied materials.

Based on the estimated average annual mass of approximately 3,358 tons of residual solids from outfalls potentially containing coagulant residuals, and a representative drinking water facility residual metals content, an estimate of annual metals loading was made. Due to the manganese content of these solids, (1760 ppm) and the Illinois (35 IAC 391.420(c)) lifetime recommended cumulative mass loading of 900 pounds of manganese per acre, 263 acres acquired every twenty years for land application of these residuals to soils would be required. Potential concerns with other heavy metals and elements may also exist in a land application scenario. Due to the potentially large amount of land required for every twenty years of operation (based on the maximum potential manganese load), this technology would be less preference.

Thus, while land application of residuals is technically feasible, it is associated with considerable uncertainty due to factors discussed above. Further, the potential costs appear to be similar to other more conventional residuals management techniques. Given these factors and significant uncertainty, land application was eliminated from further consideration.

3) Temporary Storage and Dewatering in Lagoons, and Offsite Landfilling

This technology would involve the construction of onsite lagoons for dewatering of the water treatment residuals. Every year, residuals flow would be diverted into the dewatering lagoons. Residuals would be regularly dewatered in each lagoon to approximately 4% solids. Then, the residuals would be removed and further dewatered by a mechanical dewatering system to approximately 25% solids. Following the second dewatering the residuals would be shipped to an offsite landfill.

4) Permanent Storage in Monofills

This technology involves the construction of impoundments for permanent storage of the residual solids. The supernatant from the impoundment can either be recycled to the head of the treatment plant or it could be treated if necessary prior to discharge. Based on the average loading of 92 tons of wet residuals (10% solids) per day over a typical 20 year operating period, a 40-acre monofill (14 foot depth) would be required. The proposed Alton facility property is not large enough for such a facility. Additional farmland offsite would have to be purchased (at $6,000 to $10,000 per acre) to implement this option. However, the construction of a large, lined impoundment would cost at least $20 million based on preliminary estimates. Annual operation and maintenance costs would be approximately $1.3 million. Further drawbacks of this technology are that disposal in monofills will likely limit the future use of the land and replacement monofills will be continually required. Due to these factors, this technology has been eliminated from further consideration.

5) Discharge to Alton POTW

This option was investigated, since it is commonly used by many other potential NPDES dischargers. However, the estimated flow and mass of solids could not be treated at the relatively small POTW without POTW expansion. The flexibility of POTW future operations would be severely curtailed by accepting the water treatment plant residuals. This option has been explored on a preliminary basis with the Alton POTW staff who have indicated that it is not feasible based on potential hydraulic overload of the adjacent sewer system, inadequate slope of the inceptor sewer, elimination of the POTW's reserve capacity, and a quadrupling of the solids loading (see letter from James Blaine to Kim Gardner in Appendix A).

The cost and technical feasibility of expansion of the POTW would be similar to constructing an Illinois-American on-site treatment facility (such as lagoon or belt press systems described here). Based on consideration of the above factors, discharge of the untreated residuals to the Alton POTW has been eliminated from further consideration.

6) Sludge Dewatering and Subsequent Landfilling

In the screening of this family of technologies, non-mechanical and mechanical dewatering techniques were reviewed as methods to prepare the settled solids for offsite landfilling. While the proposed replacement facility will use a Clar⁺Ion® type alum-organic polymer coagulant, analysis of residuals handling methods was based on industry experiences with alum-based residuals. However, these methods are expected to be directly applicable for treatment of Clar⁺Ion®-based residuals.

6A) Non-Mechanical Dewatering Processes

Non-mechanical dewatering relies on drainage, decanting, evaporation, and freezing processes. It is commonly used for dewatering residuals because of their simplicity and low operational costs. However, non-mechanical processes are often subject to disruptions due to climatic perturbations. Also, non-mechanical processes, perhaps even more so than mechanical processes, could be plagued by having a low overload capacity in the event that the rate of solids production were to be higher than planned. Potential non-mechanical technologies include sand drying beds and natural freeze-thaw drying beds. The most efficient way to utilize a drying bed system is to combine the freeze-thaw operation and conventional sand drying operations during the course of the year. This option is similar in feasibility and cost to dewatering lagoons. However, because it requires more area than dewatering lagoons and construction costs are slightly higher (based on preliminary unit cost estimates), the drying beds were not considered further.

6B) Mechanical Dewatering Processes

A variety of mechanical dewatering methods have been screened. These processes are typically utilized in the water industry when insufficient space is available for non-mechanical processes, high solids concentrations are required for disposal, or when economics dictate their use. Mechanical processes are less susceptible than non-mechanical processes to inclement weather conditions. The mechanical processes included in this initial screening included vacuum filtration, filter pressing, and centrifugation.

In the vacuum filtration of residuals, a pre-coated rotating drum surface is subjected to a vacuum to dewater the solids and to form a cake. While vacuum filters have been routinely used in the wastewater treatment industry, they have been reportedly evaluated only on pilot scale for a sludge application due to the high amounts of conditioning chemicals and the poor cake yield. Therefore, no further consideration will be given to vacuum filtration.

The belt filter press utilizes a well known and reliable technology which has been used in the water industry for 25 years. Conditioning of residuals is required prior to press operations, and operational data indicate that a solids concentration of 15 to 25 percent is typically achieved. Despite the higher capital and operating costs associated with a filter press compared to certain non-mechanical means, the higher density sludge may translate into cost savings due to the lower volume of material to be landfilled. Because of its reliability and operational characteristics, an order of magnitude cost estimate was provided for the filter press dewatering process and subsequent landfilling of the dried cake. Land is available at the proposed water plant facility to house the required filter press units and associated tankage.

Centrifugation is another mechanical process worthy of consideration. Several different varieties of centrifuges are commercially available. However, the solid bowl centrifuge is the most common. These units can operate in either the co-current or counter-current flow modes. Centrifuges have become an acceptable mechanical dewatering technology and have proven to be capable of dewatering sludges. The centrifugation and filter press technologies would require similar auxiliary equipment and the resulting costs would likely be the same. However, due to the fact that mechanical belt filter presses are the more common technology, are in use at other public water supply facilities to which Illinois-American has direct technical access (i.e., "sister" operations in other locations in the U.S.) and centrifugation has had a poor success record in dealing with Mississippi River silts, the belt filter press technology was selected as the mechanical dewatering technique for which order of magnitude costs will be developed.

6C) <u>Landfilling of Dewatered Residuals</u>

The landfilling of dewatered water treatment plant residuals in Illinois is permissible. Provided that the dewatered solids are not hazardous waste under RCRA regulations, the dewatered solids can be landfilled in a permitted non-hazardous special waste landfill.

Preliminary discussions with the operator of the nearest landfill (Waste Management Inc.) which accepts water treatment plant residuals, located in Granite City, Illinois, indicate that there is sufficient landfill capacity to receive these residuals for 30 years. However, as landfill capacity diminishes and tipping fees escalate, it is likely that it may become more economical to construct dedicated landfills solely for the management of the water treatment plant residuals. As noted in the discussion of monofills, (i.e. Treatment Technology Number 4) the diminishment of existing landfill capacity and the high capital cost of constructing new landfill capacity are major drawbacks to landfill disposal.

6.2 Selection of Candidate Technologies

Based on the screening process described in Section 6.1, two candidate technologies were selected for further evaluation. The two selected technologies are:

- construction of onsite sludge storage lagoons for dewatering of the solids by non-mechanical means, and subsequent landfilling in a local landfill; and

- belt filter press dewatering at the facility and subsequent offsite landfilling of the dewatered residuals.

Temporary Storage and Dewatering in Lagoons was selected for the following reasons:

- Reliable operation with minimal maintenance requirements
- Site is large enough to construct lagoon system

Belt Filter Press Dewatering was selected for the following reasons:

- Reliable operation which produces consistently dense residuals
- Site is large enough for buildings required to house the press dewatering system

6.3 Order of Magnitude Cost Estimates for Selected BDT Options

Section 6.1 summarized various candidate technologies for management of residuals including the current (base case) direct discharge and what are considered two of the leading BDT technologies for treatment of solids to be discharged from the proposed facility. In addition to the base case two of the BDT technologies have been selected for feasibility, implementability, and reasonableness. Order of magnitude cost estimates are provided below to compare the costs of these options.

The design basis used in developing these costs is presented in Appendix D along with the tabulated cost breakdown for each of the two options. In order for the plant to produce an average of 10.5 MGD of potable water (forecasted demand in 15 years), 11.2 MGD of water must be withdrawn from the river. Under average river sediment conditions (TSS = 180 mg/L) at the flows described above the plant will produce approximately 3400 tons of dry solids per year from proposed discharges which will require treatment for removal of solids. Under these conditions, the average discharge flow rate of this effluent will be 1.0 MGD (see Table 3-1).

6.3.1 Dewatering Lagoons and Subsequent Landfilling Cost Estimate

As the proposed water treatment plant project has progressed, the non-mechanical dewatering alternative has been refined to meet the current site conditions. The cost estimate for the initial design (two 3-acre lagoons with subsequent landfilling) is included in Table D-1 in Appendix D for completeness. However, consideration of additional site information (i.e., required site preparation) led to a refined lagoon design which is the preferred alternative of the two dewatering lagoon designs. Therefore, the initial design will not be considered further. The refined lagoon alternative includes smaller lagoons and additional mechanical dewatering equipment. The four lagoons require less subsurface excavation and less land area than the previous design. The three belt presses and one thickener will dewater the lagoon residuals from 4% solids to 25% solids.

The cost estimate for the refined lagoon alternative (4 lagoons and additional mechanical dewatering) on an annual basis is $1,140,00 as detailed in Table D-1A of Appendix D. The major items associated with this refined option are:

- construction of one pumping station to transport residuals from the treatment plant to the lagoons;
- construction of four onsite lagoons (one acre each with dedicated dredge/pump system at 4% solids);
- installation of one thickener;
- installation of three filter presses, backup units and associated auxiliary facilities;
- collection of lagoon overflow and press filtrate/washwater in the thickener and subsequent discharge to the river; and
- landfilling of residuals at local landfill at a solids concentration of 25%

The estimated capital and operating and maintenance costs are summarized in Table 6-2 along with the annualized costs over 30 years at 9% interest.

6.3.2 Filter Press Dewatering and Subsequent Landfilling Cost Estimate

The cost estimate for belt filter press dewatering, thickener, and subsequent landfilling on an annual basis is $1,630,000 and is detailed in Table D-2 of Appendix D.

The major items associated with this are:

- installation of one equalization/storage tank;
- construction of onsite residual collection tanks and ancillary equipment;
- installation of one thickener;
- installation of large filter presses and back up units and associated auxiliary facilities sized to handle peak hydraulic conditions;
- collection of overflow and discharge to the river;
- collection of filtrate/washwater and return to the treatment plant; and
- landfilling of sludge at a local landfill at a solids concentration of 25% in the treated sludge.

The estimated capital, operating and maintenance, and annualized costs amortized over 30 years at 9% interest are tabulated in Table 6-2.

6.4 Development of BDT

To fully evaluate site specific impacts of the proposed Alton replacement facility, it is first necessary to consider what is considered BDT, as guided by the factors identified in 35 IAC 304.102. Each of these factors is considered in detail below.

6.4.1 Technological Feasibility

A review of candidate control technologies for TSS control is provided in Section 6.1. The various technologies assessed included direct discharge (current practice), land application, monofills, discharge to POTW, and various sludge dewatering methods with subsequent landfilling. From this evaluation (see Table 6-1) it was noted that:

- the two options initially identified as most technically feasible (in addition to direct discharge) are (1) use of dewatering lagoon/filter presses with later landfilling; and (2) filter press dewatering alone with later landfilling; and

- control technologies found to be not feasible on a long term basis include land application, monofills, and direct discharge to the Alton POTW. Vacuum filtration and centrifugation, while feasible, have been shown to be less desirable than filter belt presses (see Table 6-1 for summary).

6.4.2 Economic Reasonableness

6.4.2.1 Cost-Benefit Relationship

This factor examines the cost-benefit relationship between removal of effluent TSS to resulting effluent reduction benefits. Important considerations which a permit writer would take into account include:

- the unusually high, naturally-occurring level of silt and suspended solids indigenous to the Mississippi River near Alton;

- statements by EPA that natural conditions found in larger highly turbid rivers may result in unreasonable cost-benefit relationship (U.S. EPA, 1974; 1975);

- EPA's acknowledgement that returning raw waste sludge to a highly turbid source can result in an imperceptible increase in TSS above ambient levels. (U.S. EPA, 1975);

- The difficulty of handling alum-based residuals and its poor performance as landfill material (U.S. EPA, 1975);

- Identification of two candidate technologies which are potentially capable of treating large volumes of effluent TSS (see Section 6.1);

- Total capital cost estimates for candidate control technologies which range between approximately $7.38 to $10.8 million dollars (see Section 6.3); and

- Operation and maintenance costs, which represent a continuing and potentially escalating cost for future plant operation.

There are two technically feasible candidate technologies which have been identified for treating the residuals: dewatering lagoons with offsite landfilling and belt filter press dewatering followed by offsite landfilling. Application of these technologies would result in the estimated Alton effluent discharges meeting Illinois water quality standards for TSS.

A cost-benefit analysis demonstrates that considerable costs would be incurred by the proposed replacement facility to meet these effluent limitations without a clearly-defined improvement to the aquatic environment (as indicated by Section 5.0). In other words, application of candidate control technologies does not provide effluent reduction benefits with regard to receiving water quality.

The application of TSS treatment technology will not result in perceptible improvements in water quality (see Section 5.1) or sediment quality (see Section 5.2), will not enhance habitat quality (see Sections 4.3.3 and 5.3.1), and has no effect on local biota (see Section 5.3.2). These factors are controlled by the nature of the receiving water, the Mississippi River. Further the TSS treatment is not needed for control of sludge or bottom deposits, visible oil, odors, or plant or algal growth, has no effect on stream morphology, and de minimis effect on stream chemistry and sediment chemistry. Since the discharge is comprised (>91%) of river silts, it will exhibit little or no color difference to receiving water.

Turbidity was evaluated through water quality modeling (see Section 5.1). The results of the CORMIX model indicate small areas (<0.5 acres) where surface receiving water TSS is predicted to be >5% above ambient conditions (see Figures 5-2, 5-4). As discussed earlier, the level and spatial extent of these areas does not result in an "Offensive Condition" exceedance.

The operation and maintenance costs for residual management for the proposed candidate technologies (i.e., belt presses and lagoons) represent an increase of approximately 60 to 70%, respectively, of the current operational costs for potable water production at the existing Alton plant. In other words, for the same volume of potable water produced, the additional O&M costs of residual management will increase the facility's operational costs between 1.6 to 1.7 times their current level.

In considering the economic reasonableness of the BDT option, rate payer and community impacts must be considered. The costs of the control technology will be borne by water company rate payers. Annualized costs for the candidate technologies range from $1.14 to $1.63 million dollars per year. If these costs are divided by the number of households/businesses served (rounded to 17,500 people), the per unit cost ranges from $65 to $93 per year. In addition, some individual families could be adversely impacted.

6.4.2.2 Community Impacts

Socioeconomic costs may be incurred by the potential loss of real estate value due to the presence of a lagoon in a residential area. Neighborhood concerns regarding lagoons have already been identified in recent public meetings, namely, noise, odor and traffic problems. The potential number of truck trips necessary to dispose of the treated sludge is estimated at approximately 750 trips per year. Additional truck traffic results in potential noise, congestion, and increased traffic hazard. Some individual families could be adversely impacted (e.g., houses which potentially abut or overlook lagoons).

Additional community impacts may be incurred due to the effect of increased traffic to activities associated with the newly-authorized City of Alton Park located next to the proposed facility entrance road. The park contains the natural bluff area and will feature a cliff painting of the "Piasa Bird". Potential conflicts exist for trucks entering and exiting the site to park traffic, park visitors, and bike park traffic. Better delineation of potential conflicts will require finalization of the park design.

6.4.3 Waste Reduction

As part of the BDT determination, the potential for pollution prevention or waste minimization were considered. This has already been previously considered in Section 5.8. As required by 35 IAC 304.102, the following two factors must be considered to determine BDT:

- waste reduction opportunities by process change, improved housekeeping and recovery of waste components for reuse; and
- segregation or combining of process wastewater streams.

The type of process employed to make potable water is a critical factor which helps determine the nature, amount and treatability of residuals produced. In the "Draft Development Document For Effluent Limitations Guidelines and Standards of Performance, Water Supply Industry," subcategories for the water supply industry were based on the type of processes or combinations of processes used at a plant (US EPA, 1975). The proposed replacement facility will rely on coagulation of river silt by Clar⁺Ion® to achieve potable water. This type of process means that:

- the percentage of naturally-occurring material in the total solids returned to the River is typically 91% or greater;

- only a trace amount of the 8.7 percent discharge solids contributed by the coagulant is comprised of the metals of concern (i.e., only 0.348 percent of the total discharge volume is comprised of aluminum or iron);

- conversely, the residual solids contain a minor amount of process-derived chemicals; and

- use of an alum-organic polymer such as Clar⁺Ion® leads to potentially greater disposal costs due to its poor storage and handling characteristics (US EPA, 1975).

The possibility of incorporating a number of process changes to reduce the quantity of and to improve the quality of the effluent was considered for the proposed replacement facility. Evaluation of these process changes indicated that:

- stringent housekeeping measures (in effect at the existing facility) will be implemented at the proposed replacement facility;

- recovery of the small percentage of alum in the Clar⁺Ion® is not practicable at the proposed replacement facility due to the high silt content in the residuals; and

- segregation of waste streams will not reduce the treatment required nor improve the effluent quality.

Thus, no process design changes were identified to significantly reduce the quantity and improve the quality of the effluent.

6.4.4 Determination of BDT for Proposed Alton Facility

As part of the BDT determination, sound engineering judgement was applied to integrate the various site specific factors and technical elements. A review of the cost-benefit analysis of the factors considered above indicates that technologically feasible methods exist for reducing TSS in discharge effluent to Illinois Water Quality Standards (i.e., 15 mg/L daily average). The capital cost of these options could range from approximately $7.38 million to $10.8 million to implement. As discussed above, operating costs would be substantial.

The overriding unique factors in determining BDT for the proposed replacement facility are the large amounts of naturally-derived TSS in the discharge with only minor quantities of process-generated TSS, and the discharge's lack of discernable environmental impact. The lack of discernable environmental impact is significant because the economic reasonableness analysis on which BDT is based presumes the existence of such impacts. Conventional treatment of process-generated TSS typically contends with only a small fraction of silt in the process influent water. In contrast, the Mississippi River provides large volumes of silt in the intake water. This volume of silt translates into large residual volumes which must be potentially disposed of. Little environmental purpose is served in retaining these residuals and disposing of them on land at considerable economic cost to Illinois-American Water Company, and ultimately its rate-paying customers.

Based on a review of modeled physical, chemical and biological impacts to the Mississippi River, the large naturally-occurring volumes of TSS and the lack of discharge environmental impact make the technically feasible treatment options unwarranted under BDT. It appears that little, if any, tangible environment benefit will be derived from solids reduction. Water quality and biological communities will not be measurably enhanced by this solids reduction nor do they appear impacted by the cumulative impact of current discharges. These findings are similar to those reported from water treatment plants on similar large, turbid rivers (ORSANCO, 1978; Lin et al., 1984). Available aluminum and iron data indicates that dissolved concentrations of either are highly unlikely to impact biological communities in the Mississippi River.

Moreover, the Illinois water quality standard of 15 mg/L was probably based on considerations of what was achievable for POTWs under secondary treatment (Viessman and Hammer, 1985). Effluent concerns for these plants were based on the amount of organic matter (BOD concerns) and bacteria (waterborne diseases) being released to the aquatic environment. By placing effluent limits on POTWs for both TSS and BOD_5, reasonable control of the potential for environmental degradation was being exercised.

Such arguments are not applicable to the Alton water treatment facility situation. Application of TSS control is not linked to control of potential degradation. The Mississippi River is not adversely impacted by the re-introduction of concentrated river silts with a small amount of coagulant.

Benefits usually associated with solids reduction are improvement or enhancement of water quality of receiving waters. Solids reduction in this case will provide negligible improvement to the water quality parameters in question and no enhancement of existing biological communities or designated uses of the river. In addition, continuation of the return of effluent TSS from residuals does not result in degradation of the receiving water, as judged by potential impacts.

Application of the candidate control technologies appear to provide negligible reduction benefits. Based on a careful weighing of these factors, it can be concluded that a determination of no treatment of TSS in the discharge is BDT for the proposed replacement facility.

6.5 Compliance with Federal BPJ Evaluation

This section provides a BPJ evaluation of the effluent limitations at the proposed replacement facility. Development of BPT under BPJ is provided in Section 6.5.1, through consideration of regulatory factors contained in 40 CFR 125.3(d)(1). Development of Best Conventional Technology (BCT) under BPJ is provided in Section 6.5.2, through consideration of regulatory factors contained in 40 CFR 125.3(d)(2). As part of the BCT determination, a cost-reasonableness test as recommended previously by EPA for BPJ requirements of the Missouri-American St. Joseph facility) was performed and is discussed in Section 6.5.

6.5.1 Development of BPT Under Best Professional Judgement

To fully evaluate the BPJ demonstration for the proposed Alton replacement facility, it is first necessary to determine the Best Practicable Control Technology (BPT), as guided by the factors identified in 40 CFR 125.3(d)(1). Many of these factors have been previously considered during development of the BDT. Each of these factors is considered in detail below.

6.5.1.1 The Total Cost of Application of Technology in Relation to the Effluent Reduction Benefits to be Achieved from Such Application

This factor examines the cost-benefit relationship between removal of effluent TSS to resulting effluent reduction benefits and has been evaluated in Section 6.4.2, Economic Reasonableness.

6.5.1.2 The Age of Equipment and Facilities Involved

All equipment for the proposed replacement facility will be new so this factor is not a constraint for this facility.

6.5.1.3 The Process Employed

The type of process employed to make potable water is a critical factor which helps determine the nature, amount and treatability of residuals produced. Issues related to the process have already been discussed in Section 6.4.3, Waste Reduction.

6.5.1.4 The Engineering Aspects of the Application of Various Types of Control Techniques

Consideration of the engineering aspects of the candidate control technologies for TSS control is provided in Section 6.4.1, Technological Feasibility.

6.5.1.5 Process Changes

Process changes are discussed in Section 6.4.3, Waste Reduction and Section 5.8, Pollution Prevention.

6.5.1.6 Non-Water Quality Environmental Impact (including energy requirements)

Potential non-water quality environmental impacts were considered. The major ones identified included:

- landfill space requirements for the dewatering lagoon and mechanical filter press techniques;
- land acreage needed for storage lagoons;
- potential energy requirements for handling and pumping of sludges;
- loss of viable farmland during the foreseeable future (i.e., next 30 years);
- a high level of truck traffic necessary to transport and dispose of treated sludge (approximately 750 truckloads per year); and
- community stakeholder issues regarding noise, odor, and aesthetic concerns.

The use of available landfill space to store what is largely naturally-occurring river silt does not appear to represent wise environmental stewardship and conservation of land, particularly when landfill volume capacity is reaching crisis proportions in other parts of the United States.

Energy requirements for pumping of sludge material, handling of dried material, and transportation by truck to landfill represent recurring costs. The potential number of truck trips necessary to dispose of the treated sludge is estimated at approximately 750 trips per year. Additional truck traffic may result in potential noise, congestion, and increased traffic hazard. Finally, there is an unresolved issue of whether any future land use restrictions may be incurred by Illinois-American through sludge disposal at the landfill. Part of this uncertainty is associated with future or unforeseen changes in solid waste disposal regulations.

Socioeconomic costs may be incurred by the potential loss of real estate value due to the proximity of treatment processes for residual handling near abutting residential areas. Noise, odor and traffic problems have been identified as stakeholder concerns (as discussed above).

6.5.1.7 BPT Determination for the Proposed Alton Facility

The BPJ determination compels the permit writer to address the statutory factors listed in 40 CFR 125.3(d)(1), but does not limit his/her consideration to only those factors. The permit writer is also directed by 40 CFR 125.3(c)2(ii) to consider whether there are "any unique factors relating to the applicant" which may justify different effluent limitations. These unique factors and those identified above have been summarized in Section 6.4.4, as part of BDT determination. Based on consideration of the statutory and unique factors, it was determined through BPJ that BPT for the proposed Alton replacement facility is no treatment of TSS in the discharge.

6.5.2 Development of BCT under Best Professional Judgement

To complete the BPJ demonstration for the proposed Alton replacement facility, it is also necessary to determine the Best Conventional Treatment (BCT), as guided by the factors identified in 40 CFR 125.3(d)(2). Many of these factors are identical to those previously considered during development of BPT, with the exception of a cost-reasonableness test.

To conduct a cost-reasonableness test, the incremental cost of increasing treatment from conventional wastewater treatment (i.e., BPT) to advanced treatment (i.e., BCT) is a critical element. In cases when BPJ indicates that BPT is no treatment, EPA regional staff have directed that comparison of the costs of upgrading from no treatment to BCT is not appropriate. Rather the practitioner must assume a BPT of conventional treatment (even if no circumstances call for it) for use in calculating a cost-reasonableness. While Illinois-American has determined that both BDT and BPT are no treatment, they have assumed BPT treatment to follow this EPA guidance.

6.5.2.1 The Reasonableness of the Relationship Between the Costs of Attaining a Reduction in Effluent and the Effluent Benefits Derived

As indicated by the discussion in Sections 6.4.2 and 6.5.1.1, the costs of attaining the necessary reduction in effluent are unusually high due to:

- the high turbidity and silt content of the source water which affects post-clarification processes;
- the need to respond to a highly variable silt loading; and

- the lack of reliable alternative sources of water within a reasonable distance (this was more thoroughly investigated during the facility siting selection process).

The capital costs of the two candidate technologies range from approximately $7.38 million to $10,8 million. As summarized in Section 6.3 and Table 6-2, the estimated annualized costs of installation, permitting, operation, and maintenance of the two BDT technologies are approximately $1,140,000 to $1,630,000. These annualized costs have been calculated using the yearly operations and maintenance costs and by amortizing the capital costs over a 30 year period at 9 percent interest. These proposed treatment technologies rely on the basic concept of gravitational settling of the solids from the wastewater, or mechanical dewatering and offsite landfilling of the dewatered solids. The gravitational settling step, as in clarifiers or lagoons, is generally expected to provide a supernatant discharge stream of sufficient quality to meet Illinois water quality standards.

Under this BCT analysis, however, the focus is whether providing additional treatment beyond the level provided by conventional gravitational settling is warranted under the BCT POTW-based cost-benefit factors. Such treatment could be achieved through a variety of technologies including pressure filtration. This technology could be applied to final treatment of the supernatant from the residuals treatment prior to discharge to provide BCT.

6.5.2.2 The Comparison of the Cost and Level of Reduction of Such Pollutants from the Discharge from Publicly Owned Treatment Works to the Cost and Level of Reduction of Such Pollutants from a Class or Category of Industrial Sources

This section evaluates the reasonableness of costs associated with the cost reasonableness of the TSS control technology (i.e., pressure filtration) as it compares to the cost and level of reduction of TSS from the discharge from publicly owned treatment works (POTWs). As previously discussed, this comparison is part of the statutory BCT methodology.

The overall BCT methodology is designed to answer the question whether it is cost-reasonable for industry to control conventional pollutants at levels more stringent than BPT limitations. The candidate technology is evaluated by applying the BCT cost test, which is designed to allow evaluation of virtually all industries which produce process-generated TSS. The applicability of the results of this test to the Alton water treatment plant is examined in Section 6.5.2.8.

To "pass" the POTW portion of the cost test, the cost per pound of conventional pollutant removed by industrial dischargers in upgrading from BPT to the candidate BCT must be less than the cost per pound of conventional pollutant removed in upgrading POTWs from secondary treatment to advanced secondary treatment (51 FR 24974-25002, July 9, 1986). In general, the upgrade cost to industry must be less than EPA's POTW benchmark cost of $0.25 per pound of TSS (in 1976 dollars).

In the case of the proposed Alton replacement facility, a final unit operation process of pressure filtration will reduce the TSS concentration of the effluent from the conceptual BPT process of 15 mg/L TSS to essentially zero. The pressure filtration system has been sized based on an estimated hydraulic flow rate of the total residuals.

The annualized costs for a pressure filtration system have been calculated by amortizing the capital costs over 30 years at a 9 percent interest rate and adding the yearly operation and maintenance costs (see Table D-3 in Appendix D). These costs have then been indexed to 1976 dollars by using the Chemical Engineering Plant Cost Index Ratio of 388.1 in 1997 to 192.1 in 1976. In other words, 1997 dollars have been multiplied by 0.495 to convert to 1976 dollars.

The annualized costs (in 1976 dollars) per pound of TSS removed by each of the candidate technologies are shown in Table 6-3. This table also compares the cost per pound TSS removed to EPA's benchmark price of $0.25/lb TSS removed for the POTW test. As shown in the table, the costs per pound is more than the benchmark POTW cost. The candidate technology of pressure filtration would therefore fail the cost reasonableness test.

6.5.2.3 The Age of Equipment and Facilities Involved

All equipment for the proposed replacement facility will be new so this factor is not a constraint for this facility.

6.5.2.4 The Process Employed

The process employed was considered as part of the determination of BDT. The relevant information is contained in Section 6.4.3.

6.5.2.5 The Engineering Aspects of the Application of Various Types of Control Techniques

The engineering aspects of application of various types of control techniques were considered as part of the determination of BDT. The relevant information is contained in Section 6.4.1.

6.5.2.6 Process Changes

Process changes were considered as part of the determination of BDT. The relevant information is contained in Section 6.4.3.

6.5.2.7 Non-Water Quality Environmental Impact (including energy requirements)

Non-water quality environmental impacts were considered as part of the BPJ determination of BPT. The relevant information is contained in Section 6.5.6.

6.5.2.8 BCT Determination for Proposed Alton Facility

Analogous to the BPT determination and using the determination of BPJ, the appropriate BCT technology was determined. More precisely, it was considered whether the effluent limitation being developed under BCT should be made more stringent than BPT requirements.

For purposes of this analysis, the permit writer would have to determine if the removal of TSS at the proposed Alton replacement plant by candidate technologies are cost-reasonable with regard to analogous upgrades at a POTW. If these candidate technologies fail the cost-reasonableness test then they should not be applied. If the candidate technologies pass the cost-reasonableness test, then the permit writer will need to consider these candidate technologies as part of BPJ. The permit writer is not bound to accept the results of the cost-reasonableness test as the ultimate determinant of what BCT should be. That decision can only be arrived at after comprehensive review of statutory factors, including any relevant unique, site specific factors.

Application of the candidate BCT technology was not cost-reasonable based on the results of the test (see Table 6-3). Thus, adoption of BCT effluent limitations in lieu of the previously developed BPT effluent limitations is not warranted.

In summary, this BPJ evaluation of the existing NPDES effluent limitations concludes that the existing no effluent limitation is the appropriate control technology under both BPT and BCT.

TABLE 6-1

Initial Screening of Residuals Management Control Technologies
Illinois-American, Water Treatment Plant, Alton Illinois

Candidate Technology	Remarks
1) Direct Discharge to River	Current (Base Case)
2) Land Application	Removed from consideration due to: - uncertainty about long-term land availability (requires up to 260 acres every 20 years) - inconsistent operation (high metal content and inclement weather may limit ability to apply residuals)
3) Dewatering Lagoons	Retained for consideration due to: - reliable/understood technology and operation - economical
4) Monofill	Removed from consideration due to: - high capital costs (preliminary estimate) - high operation and maintenance costs (preliminary estimate)
5) Discharge to POTW	Removed from consideration due to: - rejection as infeasible by Alton POTW - similarity in costs to onsite treatment system
6A) Sand Drying/Freezing Beds (Non-Mechanical Dewatering)	Removed from consideration due to: - uncertainty about long-term reliability - large land requirements (compared to similar technology, e.g. dewatering lagoon) - high unit capital costs (compared to dewatering lagoon)
6B1) Vacuum Filtration (Mechanical Dewatering)	Removed from consideration due to: - infeasibility (cannot dewater WTP residuals)
6B2) Belt Filter Press (Mechanical Dewatering)	Retained for consideration due to: - reliable/understood technology and operation
6B3) Centrifugation (Mechanical Dewatering)	Removed from consideration due to: - similarity in feasibility to belt press - lack of familiarity within Illinois-American operations
6C) Landfilling of Dewatered Residuals	Retained as final step for selected candidate technologies

TABLE 6-2
Summary Table of Estimated Order of Magnitude Costs for Selected Candidate Technologies[1] Proposed Replacement Facility at Alton, Illinois

Technology	Total Capital Costs ($)	Annual O&M Costs ($)	Total Annualized[2] Costs ($)
Dewatering Lagoons[3] and Landfilling	7,380,000	419,000	1,140,000
Belt Press and Landfilling	10,800,000	572,000	1,630,000

(1) Current cost for base case situation involves direct discharge of solids to river.
(2) Annualized costs assume capital costs are amortized over 30 years at 9% interest rate.
(3) Refined option includes lagoons and belt presses.

TABLE 6-3

POTW Cost Reasonableness Comparison Test with Best Conventional Technology[1]

Candidate BCT[2] Technology	Candidate Technology $/lb. TSS Removed (1976 dollars)[3]	EPA Benchmark Technology $/lb. TSS Removed (1976 dollars)
Pressure Filtration of Clarified or Settled Water Prior to Discharge	$4.38 / lb. TSS	$0.25 / lb. TSS

(1) This table compares the annualized costs per pound of TSS removed for the selected technologies for the replacement WTP to EPA's 1976 Benchmark cost per pound TSS removal in going from secondary treatment to advanced treatment for a POTW. Candidate technologies whose cost per pound TSS removed is more than the EPA's 1976 cost of $0.25/lb. TSS would "fail" the POTW cost reasonableness comparison test (FR Vol. 51, No. 131, July 9, 1986).

(2) The candidate technology is assumed to remove all TSS from the discharge stream. Pounds TSS removed at the replacement WTP are based on an assumed TSS content of 15 mg/L in the supernatant stream from a well engineered and maintained settling operation. The flow rate of the stream to be treated from all the outfalls is 1.0 MGD.

(3) For the purposes of this table, all 1997 costs have been converted to 1976 costs by using Chemical Engineering Plant Cost Index ratio of 388.1 in 1997, to 192.1 in 1976, or 192.1/388.1 = 0.495. In other words, 1997 dollars have been multiplied by 0.495 to convert to 1976 dollars.

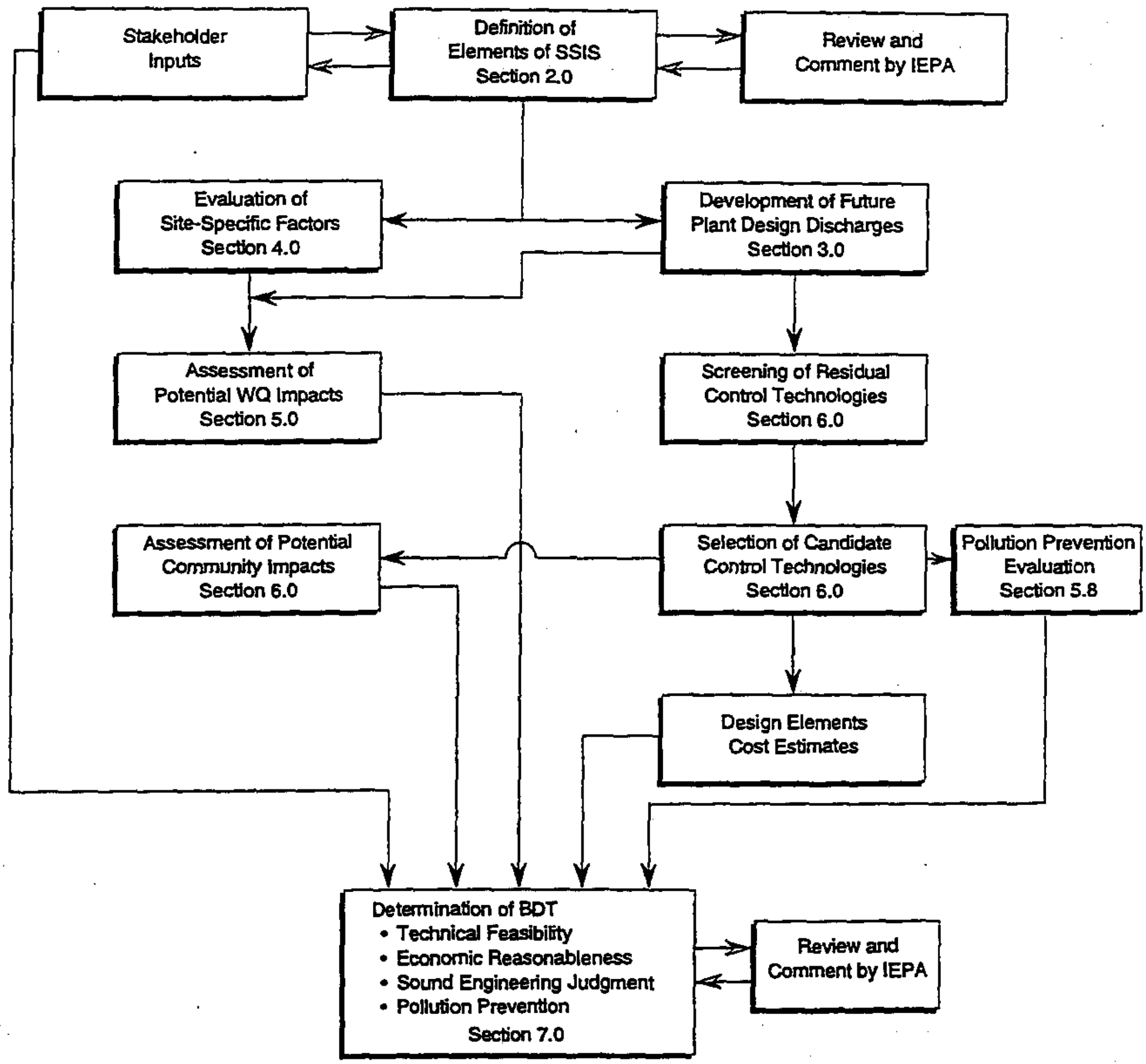


FIGURE 6-1
Determination of Best Degree of Treatment (BDT) for the Proposed Alton Drinking Water Facility

7.0 RESULTING DEFINITION OF SITE SPECIFIC EFFLUENT AND RELATED LIMITATIONS

A Site Specific Impact Study and BDT determination was conducted for residuals handling at the Water Company's proposed replacement facility located at Alton, Illinois. This evaluation was based on review of: background information on draft effluent guidelines, the predicted effluent discharges, the receiving water characteristics, potential impacts of the discharge, candidate treatment technologies and costs, development of BDT, and evaluation of the cost-reasonableness of BPT/BCT technology.

The components used to develop the SSIS and BDT evaluation for the proposed Alton replacement water treatment plant and the relevant sections of this report which address these factors are given below:

- the regulatory criteria and statutory factors needed for a BDT determination and BPT/BCT determination are given in Section 1.0;
- the elements of a site specific impact study are described in Section 2.0;
- the plant configuration, the nature of the clarification and coagulation processes, and effluent flows are described in Section 3.0;
- the proposed site physical and environmental setting hydrologic and water quality characteristics of the source receiving water and stakeholder concerns are detailed in Section 4.0;
- potential environmental impacts caused by the effluent discharge and/or disposal are evaluated in Section 5.0;
- determination of BDT for residual control is developed for the proposed Alton facility in Section 6.0. This action also includes development of BPT and BCT, including a cost-reasonableness test of the candidate technologies; and
- the findings of the SSIS and determination of effluent limitations by BPJ are summarized in Section 7.0.

This information was incorporated into a BDT evaluation which addressed the regulatory concerns identified at 35 IAC 304.102 and considered federal concerns as directed by 40 CFR

125 regulations, and additional information relevant to the case-by-case determination. Based on this evaluation, the major findings were:

- The proposed Alton replacement water treatment supply facility will have two effluent waste streams which will discharge (through a common discharge outfall) to the Mississippi River as part of operational and maintenance activities;

- The major operational discharges, associated with operation of the Superpulsator® and filter backwash, return accumulated river silts and sediments and small amounts of coagulant to the Mississippi River at loadings of about 16,500 lbs/day on an average annual basis. The percentage of the coagulant-associated metals in the discharge (0.35%)) constitutes a negligible amount;

- The average TSS concentration in the Mississippi River over the last 20 years is approximately 175-180 mg/L, other measures of suspended material (i.e, turbidity) are equally elevated;

- Modeling of potential effects due to settling or resuspension of cumulative TSS or coagulant (iron or aluminum) from facility discharges indicate negligible changes to the physical and chemical composition of the Mississippi River at Alton.

- Modeling of potential discharge-related turbidity indicates minor areas (<0.5 acres) of slightly elevated TSS conditions (i.e., ≤5% over average flow ambient levels). While these areas potentially represent introduction of turbidity of "unnatural origin" into the receiving water (as do all TSS-containing discharges to the waters of the State resulting from human activities), the location and spatial extent of these areas do not constitute an "Offensive Condition."

- Potential impacts associated with environmental changes associated with discharges were evaluated with regard to non-toxic and toxic effects to biota, including sensitive species and habitats and found to be negligible;

- Treatment technologies for residuals control were evaluated and two candidate technologies were identified - lagooning/belt presses with off-site landfilling and mechanical belt filter presses (alone) with off-site landfilling;

- Order of magnitude estimates of capital costs for the two candidate technologies were developed and ranged from $7.38 to $10.8 million dollars;

- Annualized costs for the candidate technologies range from $1.14 to $1.63 million dollars per year. If these costs are divided by the number of households/businesses of the service district, the per unit cost ranges from $65 to $93.

- The operation and maintenance costs for residual management for the two candidate technologies represent a 60% to 70% increase in the operational costs of the existing facility for the same amount of potable water production.

- Potential community impacts are associated with the candidate technologies and include: disposal site land requirements and/or landfill space, potential energy requirements, loss of farmland, potential noise and odor concerns, and traffic-related concerns;

- A determination of Best Degree of Treatment was conducted according to 35 IAC 304.102 and included technical feasibility, economic reasonableness, sound engineering judgement and pollution prevention;

- The BDT for the residual effluent discharge was determined to be no treatment, similar to the monitoring-only provision currently incorporated in the existing NPDES permit;

- A BPJ determination of Best Practicable Control Technology was conducted according to 40 CFR 125.3(d)(1) and as provided in 40 CFR 125.3(c) in consideration of unique factors and other available information. The resulting BPT was also determined to be no treatment;

- Similarly, a BPJ determination of Best Conventional Control Technology was conducted according to 40 CFR 125.3(d)2 and as provided in 40 CFR 125.3(c) in consideration of unique factors and other available information. A cost-reasonableness test was included as well;

- The candidate BCT technology failed the cost-reasonableness test and therefore imposition of BCT effluent limitations more stringent than BPT limitations is not warranted; and

- Based on this SSIS and BPJ evaluation, BDT for the proposed Alton replacement facility was considered to be direct discharge. Accordingly, no effluent limitations are warranted for TSS, iron or aluminum.

8.0 REFERENCES

Alton Zoning Office. 1997. Zoning Map of Alton, Illinois.

Baker, J.A., Kilgore, K.J. and R.L. Kasul. 1991. Aquatic Habitats and Fish Communities in the Lower Mississippi River. Reviews in Aquatic Sciences 3:313-56.

Banerji, S.K. and B. Brazos. 1990. Effects of Water Treatment Plant Residue Discharges on Missouri River Water Quality. Columbia, MO.

Beckett, D.C., Bingham C.R., Sanders L.G., Methis D.B., and McLemmore, 1983. Benthic Macroinvertebrates of Selected Aquatic Habitats of the Lower Mississippi River. Tech Rep. E-83-10. U.S. ACOE Waterway Experiment Station, Vicksburg, MS.

Campbell, P.G.C. and P.M. Stokes. 1985. Acidification and toxicity of metals to aquatic biota. Can. J. Fish. Aquat. Sci. 42:2034-2049.

Driscoll, C.T., J.P. Baker, J.J. Bisogni, and C.L. Schofield. 1980. Effect of aluminum speciation on fish in dilute acidified waters. Nature 284:161-64.

ENSR. 1992. Information in Support of the Petition of Illinois - American Water Company for an Adjusted Standard for Total Suspended Solids and Total Iron. ENSR Consulting and Engineering. Acton, MA.

George, D.B., Berk, S.G. and V.D. Adams et al. Sludge in the Aquatic Environment. Prepared for AWWA Research Foundation, Denver, CO.

Hall, W.S. and L.W. Hall, Jr. 1989. Toxicity of Sludge to Ceriodaphnia Dubia and Pimephales Promelas. Bull. Environ. Contam. Toxicol.; 42(5);791-8.

Hem, J.D. 1986. Study and Interpretation of the Chemical Characteristics of Natural Water. U.S. Geological Survey Water-Supply Paper 2254.

Illinois-American Water Company. 1996. Illinois-American Comprehensive Planning Study. Belleville, IL.

Illinois Environmental Protection Agency. 1996. Letter from Tom McSwiggin (IL EPA) to Illinois-American Water Company dated December 16, 1996.

Lee, D.S., Gilbert, C.R., Hocutt, C.H., Jenkins, R.E., McAllister, D.E., and J.R. Stauffer. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History and U.S. Fish and Wildlife Service.

Lin, S., R.L. Evans, D. Schnepper and T. Hill. 1984. Evaluation of wastes from the East St. Louis water treatment plant and their impact on the Mississippi River. Illinois Department of Energy and Natural Resources. State Water Survey Contract Report 338.

Muncy, R.J., C.J. Atchinson, R.V. Bulkeley, B.W. Menzel, L.G. Perry, and R.C. Summerfeldt. 1979. Effects of suspended solids and sediment or reproduction and early life of warm water fishes: a review. Office of Research and Development, U.S. EPA, EPA-600/3-79-042. Corvallis, Oregon. 100 pp.

Ohio River Valley Water Sanitation Commission (ORSANCO). 1978. Study of Wastewater Discharges from Water Treatment Plants.

Orlins, J. and Voigt, R. 1996. Conceptual Design of Raw Water Intake for New Alton Water Treatment Plant: Sverdrup Civil, Inc.

Ramamoorthy, S. 1988. Effect of pH on speciation and toxicity of aluminum to rainbow trout (Salmo gairdneri). Can. J. Fish. Aquat. Sci. 45:634.42.

Richards, K. 1982. Rivers, form and processes in alluvial channels. Methuen, New York, NY.

Sawyer, C.N. and P.L. McCarty. Chemistry for Environmental Planning. 1978. 3rd ed. McGraw Hill Publishers, New York, NY.

Skelton, J. 1976. Missouri Stream and Spring Flow Characteristics- Low Flow Frequency and Flow Duration: Rolla Missouri Division of Geology and Water Resources Report 32, p. 8.

Sorenson, D.L. M.M. McCarthy, E.J. Middlebrooks, and D.B. Porcella. 1977. Suspended and dissolved solids effects on freshwater biota: A review. U.S. EPA Office of Research and Development. Res. Report EPA-600/3-77-042, 64pp.

Sparling, D.W. and T.R. Lowe. 1996. Environmental Hazards of Aluminum to Plants, Invertebrates, Fish, and Wildlife. Reviews of Environmental Contamination and Toxicology 145:1-127.

U.S. Army Corps of Engineers. 1994. U.S. Army Engineer District, St. Louis- Upper Mississippi River Basin, mile 20-0.4 to mile 208.5, Hydrographic Survey Map (digitized version provided as diskette).

U.S. EPA. 1974. Permit Policy Statement Memorandum from Robert Schaffer to all Regional Enforcement Directors Regarding Disposal of Supply Water Treatment Sludges. Office of Enforcement and General Counsel. Washington, D.C.

U.S. EPA. 1975. Draft Development for Effluent Limitations Guidelines and Standards of Performance - Water Supply Industry. Draft Final Report to U.S. EPA Southern Research Institute, Birmingham, AL.

U.S. EPA. 1977. Memorandum from E.J. Stevenson dated March 1, 1977. Permit Limitations for Water Treatment Plant Discharges.

U.S. EPA. 1988. Ambient Water Quality Criteria for Aluminum. EPA Report 440/5-86-008 Office of Water Regulations and Standards. Washington, D.C.

U.S. EPA. 1991a. Technical Support Document for Water Quality-based Toxics Control. Office of Water. EPA/505/2-90-001.

U.S. EPA. 1991b. Memorandum from Don Toensing to Timothy Amsden dated June 13, 1991, U.S. EPA Region VII Kansas City, KA.

U.S. EPA. 1994. Amended Section 301(h) Technical Support Document. Office of Water. EPA Report 842-8-94-007.

U.S. Geological Survey. 1996. Personal communication with Lori Wood, Missouri District office in Rolla, Missouri. Information came from digital downloads from their databases sent electronically.

Viessman, W. and M.J. Hammer, 1985. Water Supply and Pollution Control. (4th ed.) Harper and Row, Publishers, New York.

Wells, F.C. and C. R. Demas. 1979. Benthic Invertebrates of the Lower Mississippi River. Water Resources Bull. 15:1865.

APPENDIX A

OFFICIAL CORRESPONDENCE

State of Illinois
ENVIRONMENTAL PROTECTION AGENCY

Mary A. Gade, Director 2200 Churchill Road, Springfield, IL 62794-9276
217/782-0610

December 16, 1996

Illinois - American Water Company
300 North Water Works Drive
Belleville, Illinois 62223

Re: Illinois - American Water Company
Illinois - American Water - Alton District
Proposed Water Treatment Facility

Gentlemen:

We received the draft work plan for the proposed water treatment plant on October 5, 1996. We have reviewed the data contained in your letter and supporting documents and have the following comments to make:

Section V of the draft work plan discusses the impacts of the effluent on sensitive species in the river. A similar discussion of the terrestrial impacts of the water treatment plant itself and related construction activities is also needed, as well as a discussion of any historical significance of the site. The Agency suggests that Illinois - American contact Illinois Historic Preservation Agency and the Illinois Department of Natural Resources for their input on these issues.

Section VI of the work plan addresses the treatment technology options. However, Section VI does not discuss identifying treatment technology and costs necessary to meet the effluent requirements of 35 IAC 304 and providing a reason for seeking an alternative. Compliance with the 35 IAC 304 effluent standards needs to be shown before BPJ standards can be developed. Illinois - American needs to discuss these issues prior to seeking an alternative standard. Because of the public nature of these proceedings, such a discussion is a necessary part of the documentation.

Furthermore, before a mixing zone can be granted, Illinois - American will need to show that BDT in accordance with 35 IAC 304.102 is being provided. All expected pollutants should be looked at in the mixing zone evaluation.

We thank you for submitting the draft work plan for the proposed water treatment plant. Should you have any further questions or comments, please contact Fred Rosenblum of the Agency at the telephone number indicated above.

Very truly yours,

Thomas G. McSwiggin, P.E.
Manager, Permit Section
Division of Water Pollution Control

TGM:SFN:FLR\96121101.PSJ

State of Illinois
ENVIRONMENTAL PROTECTION AGENCY

Mary A. Gade, Director 1021 N. Grand Ave., East, Spfld., IL 62794-

217-782-3362

October 16, 1997

Ms. Heidi L. Dunn
Ecological Specialists, Inc.
114 Algana Court
St. Peters, MO 63376

RE: Illinois American Mussel Survey Work Plan Approval

Dear ~~Ms. Dunn~~ Heidi:

The subject work plan was received via fax this morning. In our estimation, the plan is adequate to provide the information concerning mussel presence in the proposed construction, intake and discharge areas in the Mississippi River. The plan, if successfully fulfilled, should satisfy the criteria discussed with Illinois American and its consultants at a recent meeting held to discuss Adjusted Standards for the proposed water treatment plant.

While not specifically mentioned in the plan, any insight your study could provide to the impacts on mussels of an increased loading of water treatment plant solids and associated treatment chemicals to the river would certainly help in ascertaining the overall effects of the proposed facility. Predicting impacts is a difficult business and I understand that the primary function of this study is to document the existing conditions. However, should you have experience in the response of mussels (should they be present at this site) to pollutants of this nature or know of pertinent studies in the literature, this information would certainly be helpful.

As I mentioned during our phone conversation, if any useful ideas come to you while in the field, they should be reasonably pursued. The goal of this study should be to glean the most useful information concerning mussels as possible within the scope of the plan.

Should you have any questions, please feel free to call me at any time.

Sincerely,

Robert Mosher

Robert Mosher, Supervisor
Standards and Monitoring Support Unit
Planning Section
Division of Water Pollution Control

RGM:prh:iawmusel

cc: Karen Tsikteris, Illinois American Water Company

ENSR

Consulting • Engineering • Remediation

35 Nagog Park
Acton, MA 01720
(508) 635-9500
FAX (508) 635-9180
http://www.ensr.com

September 22, 1997

Dr. Joyce A. Collins
Assisstant Field Supervisor
U.S. Fish and Wildlife Service - MISO
8588 Route 148
Marion, IL 62959

RE: Endangered, Threatened, Rare and Candidate Species in the Vicinity of the proposed Alton Water Treatment Plant, Alton, Illinois.

Dear Dr. Glosser:

On behalf of the Illinois-American Water Company, ENSR hereby requests information regarding the occurrence and distribution of federally-listed endangered, threatened, rare, or candidate floral and faunal species in the vicinity of the new plant site and the proposed intake. This information is sought in support of site investigation activities. A copy of the applicable USGS topographic quadrangle showing the proposed site outlined has been provided for your use. ENSR requested similar information for another site for this project in a letter dated January 9, 1997, and a reply was received in a letter dated March 24, 1997. However, since that time, the site location has changed by about two miles downstream, closer to River Mile 204.5.

If you have any questions, please do not hesitate to contact me at (508) 635-9500 X3061. Thank you for your attention to this request.

Very truly yours,
ENSR

Kelly A. Sullivan

Kelly A. Sullivan
Risk Assessment Specialist

Attachment
cc: D. Mitchell, ENSR

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Consulting • Engineering • Remediation

35 Nagog Park
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Very truly yours,
ENSR

Kelly A. Sullivan

Kelly A. Sullivan
Risk Assessment Specialist

Attachment
cc: D. Mitchell, ENSR

NO OBJECTION
U.S. Fish & Wildlife Service
Marion, Illinois
Joyce A. Collins 10/16/97
Asst. Supervisor **Date**

SEP 25 1997

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http://www.ensr.com

September 22, 1997

Kim M. Roman
Project Manager
Endangered Species Consultation Program
Illinois Department of Natural Resources
524 South Second Street
Springfield, Illinois 62701-1787

RE: IDNR Project #37855, Madison Co.
Alton Water Treatment Plant, Near Youngblood Hollow

Dear Ms. Roman:

On behalf of the Illinois-American Water Company, ENSR hereby requests information regarding the occurrence and distribution of state listed endangered, threatened, rare, or special status floral and faunal species in the vicinity of the new plant site and the proposed intake. This information is sought in support of site investigation activities. A copy of the applicable USGS topographic quadrangle showing the proposed site outlined has been provided for your use. ENSR requested similar information for another site for this project in a letter dated January 9, 1997, and a reply was received in a letter dated February, 1997. However, since that time, the site location has changed by about two miles downstream, closer to River Mile 204.5.

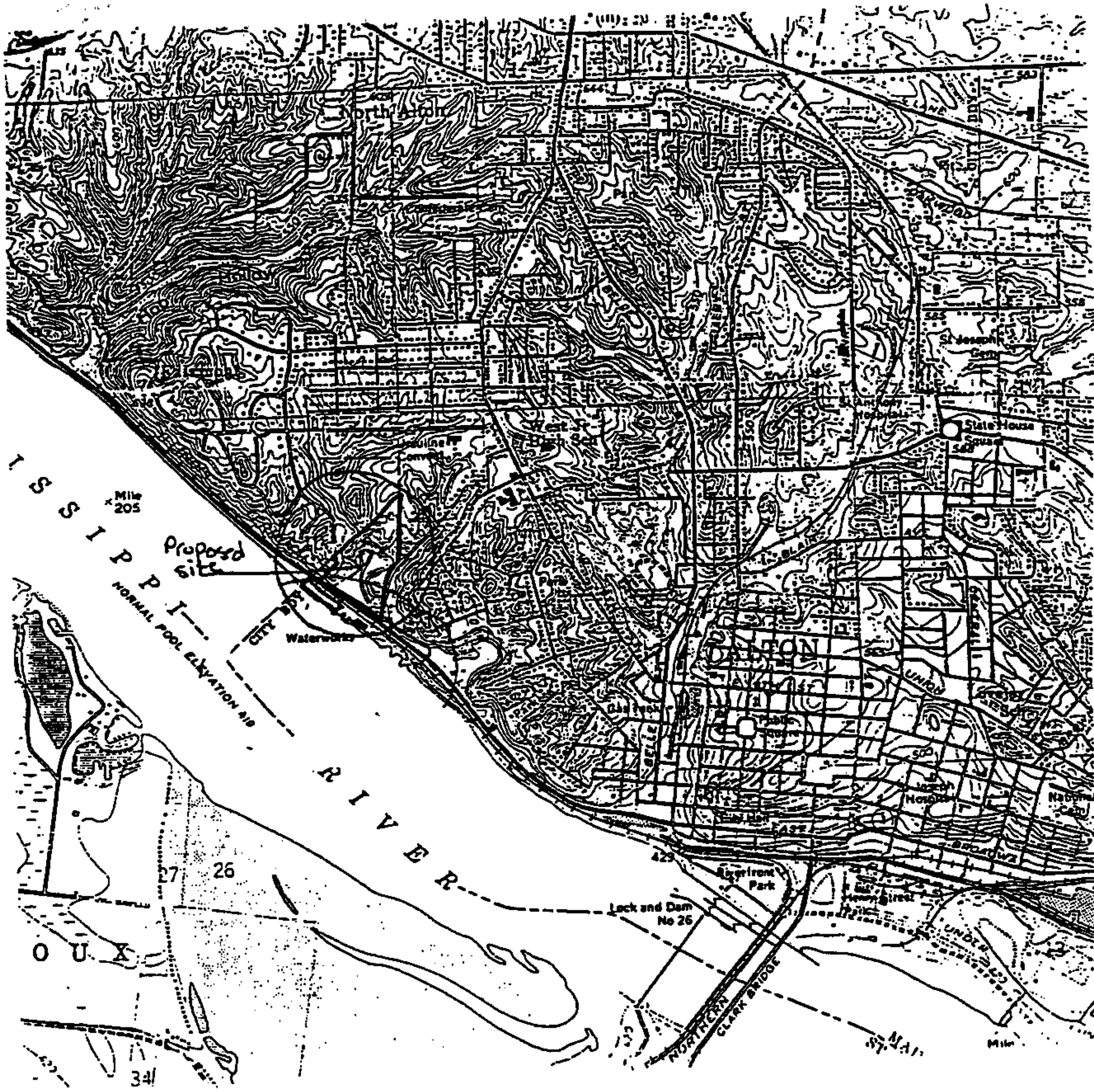
If you have any questions, please do not hesitate to contact me at (508) 635-9500 X3061. Thank you for your attention to this request.

Very truly yours,
ENSR

Kelly A. Sullivan

Kelly A. Sullivan
Risk Assessment Specialist

Attachment
cc: D. Mitchell, ENSR



SOURCE: USGS 7½ Minute Topographic Quadrangle.

SCALE

0 1/4 1/2 1 MILE

N

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ENSR Consulting and Engineering

FIGURE 1

PROJECT LOCATION

Proposed Drinking Water Plant
Alton, IL

DRAWN:	DATE: September 22, 1997	PROJECT NO.:	RE
FILE NO.:	CHECKED: Kelly Sullivan	3995-007	1

ILLINOIS
DEPARTMENT OF
NATURAL RESOURCES

524 South Second Street, Springfield 62701-1787

Jim Edgar, Governor ● Brent Manning, Director

October 6, 1997

Kelly A. Sullivan
Risk Assessment Specialist
ENSR
35 Nagog Park
Acton, MA 01720

Re: **Information Request for Alton Water Treatment Plant, Madison County, Illinois**

Dear Ms. Sullivan:

I have reviewed the Natural Heritage Database for the presence of threatened and endangered species, Illinois Natural Area Inventory (INAI) sites, and dedicated Illinois Nature Preserves in the vicinity of the proposed site. Following are the results of that review:

Alton Geological Area INAI site is located in Township 5N, Range 10W, Sections 10, 11, and 14. This site is part of the inventory for its outstanding example of St. Louis limestone.

Olin Tract INAI and John M. Olin Nature Preserve is located in Township 5N, Range 10W, Sections 3 and 4. **Oblate Father's Woods** Nature Preserve is also located in Township 5N, Range 10W, Section 4.

According to the Database, there are no known occurrences of state listed threatened and endangered species at these natural areas and nature preserves.

Please be aware that the Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of significant features in any part of Illinois. The reports only summarize the existing information regarding the natural features or locations in question known to the Division of Natural Heritage at the time of the inquiry. This response should not be regarded as a final statement on the site being considered, nor should it be a substitute for field surveys required for environmental assessments.

Though we cannot charge you for the request, we do urge you to support the Database with a donation to the Illinois Wildlife Preservation Fund. Your request costs approximately $50 in staff time and resources to complete. Donations can be made to:

Illinois Wildlife Preservation Fund
Illinois Department of Natural Resources
Division of Natural Heritage
524 South Second Street
Springfield, Illinois 62701-1787

If you need additional information or have any questions, please do not hesitate to contact me at 217-785-5500.

Sincerely,

Heather C. Hostetler
Heather C. Hostetler
Environmental Database Specialist
Division of Natural Resource Review & Coordination

[printed on recycled and recyclable paper]

Illinois-American Water Company

100 No. Water Works Dr. • P.O. Box 24040 • Belleville, IL 62223-9040 • (618) 277-7450 • FAX (618) 277-7498

August 13, 1997

Ms. Anne E. Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capital
Springfield, IL 62701

RE: New Water Treatment Plant in Alton

Dear Ms. Haaker:

Illinois-American Water Company is preparing to construct a new water treatment plant at a site within the city limits of alton. The site for the plant is an abandoned quarry and the site for the intake is land formed by fill material along the river side of the Great River Road.

We would appreciate your review of the proposed site, identified on the attached drawing, to determine whether a Phase I Archaeological Reconnaissance Survey for the above referenced project will be required.

Thank you for your cooperation in this matter. If you have any questions, please contact me at 618-239-3250.

Sincerely,

ILLINOIS-AMERICAN WATER COMPANY

Kim E. Gardner
Director- Engineering

KEG/jes

enc.- map

Illinois Historic Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1507 • (217) 782-4836 • TTY (217) 524-7128

MADISON COUNTY
Alton
New Water Treatment Plant

PLEASE REFER TO:
IHPA LOG #970814004PMS

Quarry Site

October 4, 1997

Mr. Kim E. Gardner, P.E.
Illinois-American Water Company
100 North Water Works Drive
Post Office Box 24040
Belleville, Illinois 62223-9040

Dear Sir:

The Illinois Historic Preservation Agency is required by the Illinois State Agency Historic Resources Preservation Act (20 ILCS 3420, as amended, 17 IAC 4180) to review all state funded, permitted or licensed undertakings for their effect on cultural resources. Pursuant to this, we have received information regarding the referenced project for our comment.

Our staff has reviewed the specifications under the state law and assessed the impact of the project as submitted by your office. We have determined, based on the available information, that no significant historic, architectural or archaeological resources are located within the proposed project area.

According to the information you have provided concerning your proposed project, apparently there is no federal involvement in your project. However, please note that the state law is less restrictive than the federal cultural resource laws concerning archaeology. If your project will use federal loans or grants, need federal agency permits, use federal property, or involve assistance from a federal agency, then your project must be reviewed under the National Historic Preservation Act of 1966, as amended. Please notify us immediately if such is the case.

Please retain this letter in your files as evidence of compliance with the Illinois State Agency Historic Resources Preservation Act.

Sincerely,

Anne E. Haaker
Deputy State Historic
Preservation Officer

AEH:JSP:bb

CITY OF ALTON, ILLINOIS

DEPARTMENT OF PUBLIC WORKS
ALTON. ILLINOIS 62002
618-463-3530

August 20, 1997

Mr. Kim E. Gardner, P.E.
Illinois American Water Co.
100 No. Water Works Dr.
P.O. Box 24040
Belleville, IL 62223-9040

Re: New Water Treatment Plant Discharge to AltonWastewater Treatment Plant

Dear Mr. Gardner:

The following is a response to your letter dated August 14, 1997 in regard to discharge of Water Treatment Plant wastewater to the Alton sewer system. The City of Alton would be unable to accept the waste stream from your proposed new water treatment plant for the following reasons:

- The Sewer system in the immediate area would be hydraulically overloaded.

- The interceptor to the treatment plant is on minimum grade and deposition of sludge is likely.

- Accepting 1.25 MGD would almost eliminate the Treatment Plant's reserve capacity.

- The solids loading to the Treatment Plant would quadruple. Our current dewatering process would be grossly inadequate. Storage of sludge and the land application program would also be grossly inadequate.

- Costs to Illlinois-American Water for treatment would be approximately $1.35 million per year <u>if</u> Alton was able to treat the waste stream. This does not include costs of expansion to be able to accept the waste stream.

If you have any questions, please contact me at 463-3560.

Sincerely,

James M. Blaine

James M. Blaine
Operator-in-Charge
Alton Wastewater Treatment Plant

cc: Mayor Donald Sandidge
Jim Hernandez, Public Works Director

APPENDIX B

UNIONID SURVEY

Unionid Survey at a Proposed Water Intake on the Mississippi River, near Alton, Illinois

Prepared for:

ENSR
Acton, Massachusetts

under contract with:

Illinois-American Water Co.
Bellville, Illinois

Prepared by:
Ecological Specialists, Inc.
St. Peters, Missouri

November 1997

(ESI Project # 97-023)

Acknowledgments

This survey was completed for Illinois-American Water Co. Mr. Dave Mitchell was project manager for ENSR, and Ms. Heidi Dunn was project manager for Ecological Specialists, Inc. Mr. Bernard Sietman supervised the survey, and he was assisted by Ms. Melissa Moore. Mr. Sietman and Ms. Dunn were the primary authors of this report. Mr. James Duckworth of Ducktrail Ecological Services provided diving services, and he was assisted by Mr. Daniel Kelner.

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1.0 Introduction

Illinois-American Water Co. proposes installing a water intake system upstream of the current facility on the Mississippi River (Approximate River Mile 204.3), Madison County, Illinois. The construction will involve both in-stream and riverbank disturbance. Additionally, effluent from the new water treatment plant will be discharged from either the current intake pipe, or from a pipe to be constructed approximately 200m downstream of the existing intake.

Historically at least 28 unionid species occurred in this reach of the Mississippi River, including the Federally endangered *Potamilus capax*, and Illinois protected *Ellipsaria lineolata*, *Elliptio crassidens*, *Elliptio dilatata*, and *Simpsonaias ambigua* (Table 1-1). If unionids occur in the area, in-stream and riverbank disturbance could affect them in several ways. Unionids living in the area of direct impact may be crushed, dislodged, or buried during construction. Construction can also result in downstream sedimentation, possibly smothering unionids (Ellis, 1936); and/or substrate instability, rendering habitat unsuitable for unionids (Hartfield, 1993). Additionally, fish host activity in a unionid bed may be altered by habitat changes.

Because unionids may be affected by water intake construction and treatment discharge, the purpose of this study is to characterize the unionid community near the proposed construction location and downstream, and determine if protected unionids occur in the area.

Table 1-1. Unionids previously recorded[1] from the Mississippi River near Alton, Illinois.

Species[2]	Status
Amblema p. plicata	
Anodonta suborbiculata	
Arcidens confragosus	
Cyclonaias tuberculata	
Ellipsaria lineolata	IT
Elliptio crassidens	IT
Elliptio dilatata	IT
Fusconaia flava	
Lampsilis cardium	
Lampsilis teres	
Leptodea fragilis	
Ligumia recta	
Megalonaias nervosa	
Obliquaria reflexa	
Obovaria olivaria	
Potamilus alatus	
Potamilus capax	FE, IE
Potamilus ohiensis	
Pyganodon grandis	
Quadrula metanevra	
Quadrula nodulata	
Quadrula p. pustulosa	
Quadrula quadrula	
Simpsonaias ambigua	C2, IE
Tritogonia verrucosa	
Truncilla donaciformis	
Truncilla truncata	
Utterbackia imbecillis	
Total species	

[1]Unpublished data from the Illinois Natural History Survey

[2]Nomenclature follows Turgeon *et al.* (1988) and Hoeh (1990)

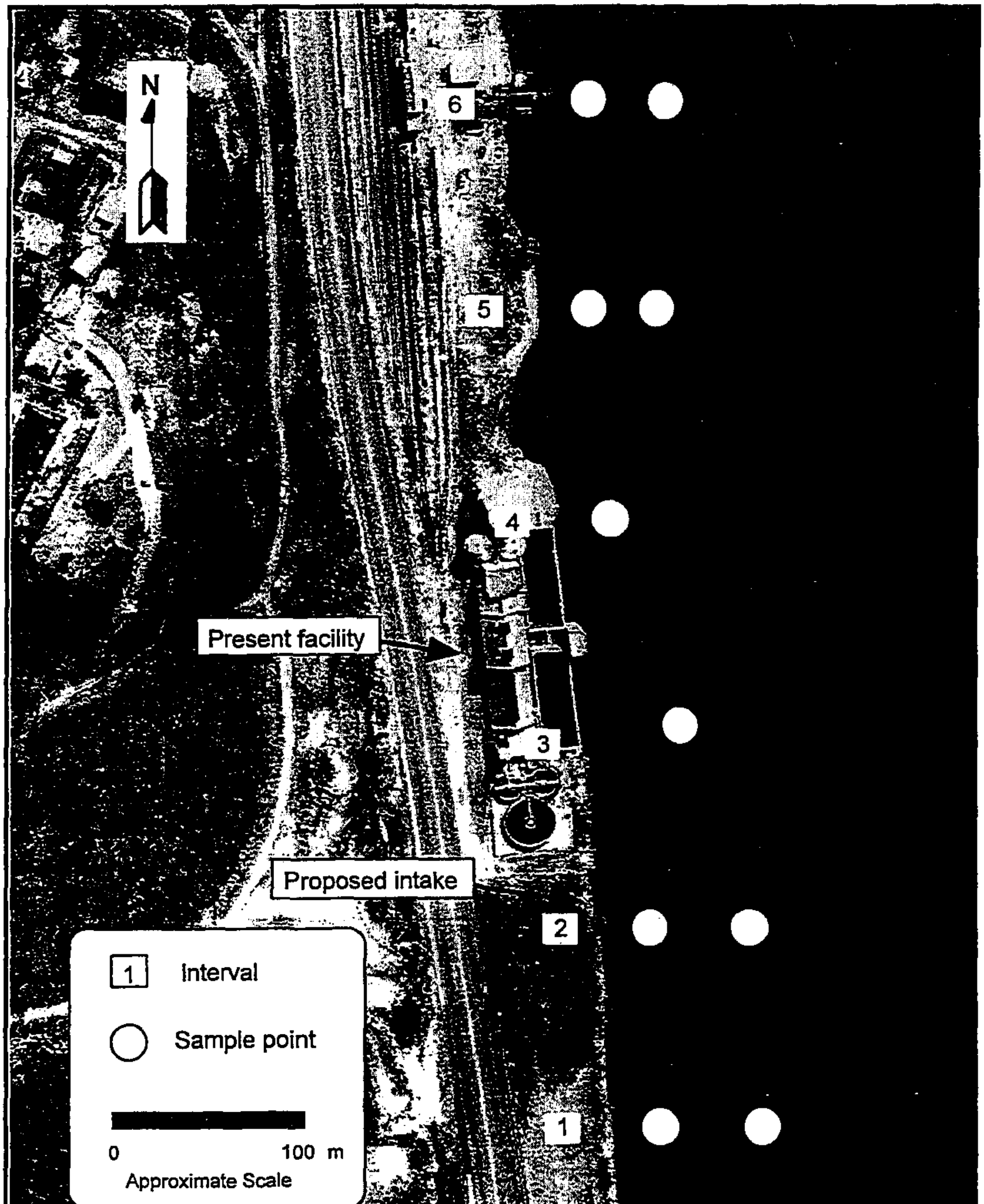
[3]FE = Federally endangered, C2=formerly Federal Category 2 species (USFWS, 1995 and 1996) IE = Illinois endangered, IT = Illinois threatened (Illinois Endangered Species Protection Board, 1994)

2.0 Methods

Unionids were sampled at the proposed construction site on 27 and 28 October 1997 using both qualitative and quantitative collection methods (Kovalak *et al.*, 1986). Six sample areas were established at 100m intervals, from approximately 100m upstream of the proposed construction site to 400m downstream (Figure 2-1). Initial plans were to sample along transects established perpendicular to the riverbank, between the bank and the navigation channel. However, the study site occurs within the navigation channel, and bottom debris, as well as commercial traffic, precluded the diver from safely following transects. Therefore, two sample points were established at each interval between the bank and a depth of 9.2m (the distance from the bank where samples were collected was limited by water depth due to diving safety concerns). The two sample points were marked by placing weighted buoys between 25 and 75m from the bank, except at Intervals 3 and 4, where only one point was sampled due to underwater debris and unsafe diving conditions (see Figure 2-1).

At each sample point, five 1/4m^2 whole substrate quadrat samples were randomly collected within approximately a 10m area around the buoy. Due to the unsafe conditions at Intervals 3 and 4, ten quadrats were collected 35m from the bank at Interval 3, and only five quantitative samples were collected 25m from the bank at Interval 4. However, an additional five samples were collected 55m from the bank at Interval 5. All substrate within the 1/4m^2 quadrat was excavated to a depth of 15cm and placed into a 20L bucket. The bucket was retrieved and the contents sieved through a series of nested sieves (mesh size 12mm and 6mm). Substrate composition of each sample was visually estimated, and depth and distance from the riverbank were recorded. After quantitative samples were collected, the area within 20m of each sample point was qualitatively searched for five minutes, and all unionids were collected.

All live unionids were identified, measured (length in mm), and aged (external annuli count). Empty shells were also collected, identified, and categorized as fresh (nacre still lustrous), weathered (nacre chalky), or subfossil (periostracum eroded or shell fragmented).



ECOLOGICAL SPECIALISTS, INC.

Figure 2-1. Sample points at intervals on the Mississippi River near Alton, Illinois.

ESI

3.0 Results and Discussion

Substrate composition has apparently limited unionid distribution in the study area, as no living unionids were found. Substrate throughout the area consisted of deep silt (up to 0.75m deep) from the bank to approximately 50-60m riverward, and then gradually changed to unstable sand farther into the navigation channel (Table 3-1). Silt was deeper at Intervals 4 to 6 than Intervals 1 to 3. The study area is upstream of Melvin Price Locks and Dam, and depositional substrate such as this commonly results from the lack of flow upstream of navigational dams.

This area currently does not appear to support a unionid community, as only the shells of eight species were collected (Table 3-2). *Leptodea fragilis* was the only species represented by freshly dead shells; the remaining species were weathered or subfossil. None of the species were Federal or Illinois protected. These shells may be remnants of a historical unionid community that occurred before the area was impounded, or they may have washed into the area from upstream. The greater majority of shells were collected at Intervals 1 and 2 (see Table 3-2), suggesting the historic community was more abundant upstream of the present facility, or perhaps the deep silt hampered detection of shells at downstream intervals. Regardless, a unionid community no longer persists at the study site. However, live zebra mussels (*Dreissena polymorpha*) (67 individuals) were collected at Interval 1, 16 of which were attached to a freshly dead *L. fragilis*, and zebra mussel infestation should be considered during intake design.

Consistent flow and stable substrate are general requirements for riverine unionid communities. The influence of impoundment on these variables, and its negative effects on unionids are well documented (Ellis, 1936; Bates, 1962; Isom, 1969; Stansbery, 1970 and 1971; Suloway *et al.*, 1981; Parmalee and Hughes, 1993). Substrate composition is viewed as a primary factor affecting unionid distribution, and although they may be collected in a variety of substrates (Coker *et al.*, 1921), unionids are commonly found in areas with stable sand, gravel, and cobble substrate. Conversely, unionids are rarely found in unstable sediments (Coker *et al.*, 1921; Baker, 1928, Cvancara, 1970; Strayer and Ralley, 1991) such as deep silt and shifting sand, because they are unable to maintain their natural position and may be buried or displaced during fluvial events. Silt deposition is probably the most detrimental result of impoundment. Silt can clog a unionid's gills and filtration system, preventing respiration and causing nutritive stress. Although minor amounts of silt can be tolerated, heavier shelled species may not be able to emerge from a thick layer of silt and will suffocate. Imlay (1972) found that *Fusconaia flava* and *Ligumia recta* could not emerge from 75mm of silt cover, and nearly 50% of the *F. flava* died after seven days. Marking and Bills (1979) found *F. flava* was unable to emerge from 10cm of silt, however, 17.5cm was required to prevent *Lampsilis siliquoidea* and *Lampsilis cardium* from emerging.

Table 3-1. Substrate composition at intervals on the Mississippi River near Alton, Illinois.

Distance from bank (m)	Interval[1]					
	1	2	3	4	5	6
20-30	4.6% Gravel 0.8% Sand 94.6% Mud	0.2% Gravel 12.8% Sand 85.8% Mud 0.2% Detritus		100% Mud	100% Mud	100% Mud
30-45			100% Mud			
50-60					100% Mud	
60-70						20.4% Sand 79.6% Mud
70-80	1.0% Gravel 94.6% Sand 3.6% Mud 0.8% Detritus	1.0% Gravel 98.8% Sand 0.2% Mud				

[1]Distances and sample intervals correspond to Figure 2-1

Table 3-2 . Species composition of unionids at intervals on the Mississippi River near Alton, Illinois.

	Interval[1]					
Species	1	2	3	4	5	6
Lampsilis teres	WD					
Leptodea fragilis	FD	FD	SF			
Obliquaria reflexa	WD	SF				
Obovaria olivaria	WD					
Quadrula nodulata	WD					
Quadrula quadrula		WD				
Truncilla donaciformis	WD	WD				SF
Truncilla truncata	WD	WD				
Total no. individuals	0	0	0	0	0	0
Total species	7	5	1	0	0	1

[1]Sample intervals correspond to Figure 2-1
FD=freshly dead, WD=weathered dead, SF=subfossil

Given that habitat conditions within the study area are unsuitable for unionid colonization, and no unionids were found, construction and operation of the water intake and treatment discharge should not impact unionids.

4.0 Literature Cited

Bates, J. M. 1962. The impact of impoundment on the mussel fauna of Kentucky Lake, Reservoir, Tennessee River. *American Midland Naturalist* 68:232-236.

Baker, F. C. 1928. The freshwater mollusca of Wisconsin: part II. Pelecypoda. *Bulletin of the Wisconsin Geological and Natural History Survey* 70:1-495.

Coker, R. E., A. F. Shira, H. W. Clark, and A. D. Howard. 1921. Natural history and propagation of fresh-water mussels. *Bulletin of the Bureau of Fisheries* [Document No. 893] 37:77-181.

Cvancara, A. M. 1970. Mussels (Unionidae) of the Red River Valley in North Dakota and Minnesota, U. S. A. *Malacologia* 10:57-92.

Ellis, M. M. 1936. Erosion silt as a factor in aquatic environments. *Ecology* 17:29-42.

Hartfield, P. 1993. Headcuts and their effects on freshwater mussels. Pages 131-141 *in* K. S. Cummings, A. C. Buchanan, and L. M. Koch (eds.). *Conservation and management of freshwater mussels.* Proceedings of a UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Hoeh, W. R. 1990. Phylogenetic relationships among eastern North American *Anodonta* (Bivalvia: Unionidae). *Malacological Review* 23:63-82.

Illinois Endangered Species Protection Board. 1994. *Checklist of endangered and threatened animals and plants of Illinois.* Illinois Department of Conservation. Springfield, Illinois. 20pp.

Imlay, M. J. 1972. Greater adaptability of fresh-water mussels to natural than artificial displacement. *Bulletin of the American Malacological Union* 1972:43-44.

Isom, B. G. 1969. The mussel resource of the Tennessee River. *Malacologia* 7:397-425.

Kovalak, W. P., S. D. Dennis, and J. M. Bates. 1986. Sampling effort required to find rare species of freshwater mussels. *In* B. G. Isom (ed.). *Rationale for sampling and interpretation of ecological data in the assessment of freshwater ecosystems. ASTM STP 894.*

Marking, L. L. and T. D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pages 204-211 *in* J.L. Rasmussen (ed.). *Proceedings of the UMRCC Symposium on Upper*

Mississippi River Bivalve Mollusks, 3-4 May 1979, Rock Island, Illinois. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Parmalee, P. W. and M. H. Hughes. 1993. Freshwater mussels (Mollusca: Pelecypoda: Unionidae) of Tellico Lake: twelve years after impoundment of the Little Tennessee River. *Annals of Carnegie Museum* 62:81-93.

Stansbery, D. H. 1970. Eastern freshwater mollusks. (I) The Mississippi and St. Lawrence River systems. Pages 9-20 *in* A. H. Clarke (ed.). Proceedings of the American Malacological Union symposium on rare and endangered mollusks. *Malacologia* 10:1-56.

Stansbery, D. H. 1971. Rare and endangered mollusks in the eastern United States. Pages 5-18 *in* Jorgensen, S. E. and R. W. Sharp (eds.). *Proceedings of a symposium on rare and endangered mollusks (Naiads) of the U.S.* U.S. Dept. of Interior, Twin Cities, Minnesota. 79pp.

Strayer, D. L. and J. Ralley. 1991. The freshwater mussels (Bivalvia: Unionidae) of the upper Delaware River Drainage. *American Malacological Bulletin* 9:21-25.

Suloway, L., J. J. Suloway and E. E. Herricks. 1981. Changes in the freshwater mussel (Mollusca: Pelecypoda: Unionidae) fauna of the Kaskaskia River, Illinois, with emphasis on the effects of impoundment. *Transactions of the Illinois State Academy of Science* 74:79-90.

Turgeon, D. D., A. E. Bogan, E. V. Coan, W. K. Emerson, W. G. Lyons, W. L. Pratt, C. F. E. Roper, A. Scheltema, F. G. Thompson, and J. D. Williams. 1988. *Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks.* American Fisheries Society Special Publication 16. 277pp.

U. S. Fish and Wildlife Service. 1995. Endangered and threatened wildlife and plants. *50 CFR 17.11 and 17.12.* 44pp.

U. S. Fish and Wildlife Service. 1996. Endangered and threatened wildlife and plants; review of plant and animal taxa that are candidates for listing as endangered or threatened. Proposed Rule. 28 February 1996. *Federal Register 61(40): 7596-7613. FR Doc. 96-4412.*

APPENDIX C

WATER QUALITY DATA AND IMPACT CALCULATIONS

TABLE C-TSS.1

ESTIMATED TSS CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	7Q10Flow			
River Flow Value (RFV) =	13895	mgd or	5.26E+10	l/day
Mixing Zone Flow Value (MZFV) =	3474	mgd or	1.31E+10	l/day
River TSS Condition =	Minimum Daily Value			
River TSS Concentration (RTSS) =	20	mg/l		
Coagulent Type =	Clarion			
Superpulsator Flow Value (SFV) =	0.433	mgd or	1.64E+06	l/day
Superpulsator TSS Conc. (STSS) =	726.2	mg/l		
Filter Backwash Flow Value (FSV) =	0.620	mgd or	2.35E+06	l/day
Filter Backwash TSS Conc. (FTSS) =	7.2	mg/l		

RESULTS:

Estimated TSS Concentration At Edge of Mixing Zone (ETSS) :

$$\frac{((SFV)*(STSS)) + ((FSV)*(FTSS)) + ((MZFV)*(RTSS))}{(SFV + FSV + MZFV)}$$

$$ETSS = \frac{2.64E+11 \text{ mg/l2/day}}{1.32E+10 \text{ l/day}}$$

ETSS = 20.1 mg/l

or 0.43 % increase over ambient river conditions

TABLE C-TSS.2

ESTIMATED TSS CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	Average Flow			
River Flow Value (RFV) =	69059	mgd or	2.61E+11	l/day
Mixing Zone Flow Value (MZFV) =	17265	mgd or	6.53E+10	l/day
River TSS Condition =	Maximum Monthly Value			
River TSS Concentration (RTSS) =	600	mg/l		
Coagulent Type =	Clarion			
Superpulsator Flow Value (SFV) =	0.68755	mgd or	2.60E+06	l/day
Superpulsator TSS Conc. (STSS) =	10000	mg/l		
Filter Backwash Flow Value (FSV) =	0.931	mgd or	3.52E+06	l/day
Filter Backwash TSS Conc. (FTSS) =	144.4	mg/l		

RESULTS:

Estimated TSS Concentration At Edge of Mixing Zone (ETSS) :

$$\frac{((SFV)*(STSS)) + ((FSV)*(FTSS)) + ((MZFV)*(RTSS))}{(SFV + FSV + MZFV)}$$

ETSS = 3.92E+13 mg/l2/day / 6.54E+10 l/day

ETSS = 600.3 mg/l

or 0.06 % increase over ambient river conditions

a:\feb99\XQ-Max.wk4 RN: 1

TABLE C-AL.1

ESTIMATED DISSOLVED ALUMINUM CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	7Q10 Flow			
River Flow Value (RFV) =	13895	mgd or	5.26E+10	l/day
Mixing Zone Flow Value (MZFV) =	3474	mgd or	1.31E+10	l/day
River Dissolved Al Condition =	Minimum Daily Value			
River Dissol. Al Concentration (RDA) =	0.026	mg/l		
Coagulent Type =	Clarion			
Superpulsator Flow Value (SFV) =	0.433	mgd or	1.64E+06	l/day
Superpulsator Diss. Al Conc. (SDA) =	17.67	mg/l	assumed to be all dissolved	
Filter Backwash Flow Value (FSV) =	0.620	mgd or	2.35E+06	l/day
Filter Backwash Diss. Al Conc. (FDA) =	2.59	mg/l		

RESULTS:

Estimated Dissolved Aluminum Concentration At Edge of Mixing Zone (EDA) :

$$\frac{((SFV)*(SDA)) + ((FSV)*(FDA)) + ((MZFV)*(RDA))}{(SFV + FSV + MZFV)}$$

$$EDA = \frac{3.77E+08 \text{ mg/liters2/day}}{1.32E+10 \text{ l/day}}$$

EDA = 0.029 mg/l

or 10.22 % increase over ambient river conditions

a:/feb99/7QDC-avg RN: 1

TABLE C-AL.2

ESTIMATED DISSOLVED ALUMINUM CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	Average Annual Flow			
River Flow Value (RFV) =	69059	mgd or	2.61E+11	l/day
Mixing Zone Flow Value (MZFV) =	17265	mgd or	6.53E+10	l/day
River Dissolved Al Condition =	Maximum Monthly Value			
River Dissol. Al Concentration (RDA) =	0.220	mg/l		
Coagulent Type =	Clarion			

Superpulsator Flow Value (SFV) =	0.688	mgd or	2.60E+06	l/day
Superpulsator Diss. Al Conc. (SDA) =	16.69	mg/l	assumed to be all dissolved	
Filter Backwash Flow Value (FSV) =	0.931	mgd or	3.52E+06	l/day
Filter Backwash Diss. Al Conc. (FDA) =	8.25	mg/l		

RESULTS:

Estimated Dissolved Aluminum Concentration At Edge of Mixing Zone (EDA) :

$$\frac{((SFV)*(SDA)) + ((FSV)*(FDA)) + ((MZFV)*(RDA))}{(SFV + FSV + MZFV)}$$

EDA = 1.44E+10 mg/liters2/day / 6.54E+10 l/day

EDA = 0.221 mg/l

or 0.49 % increase over ambient river conditions

a:/feb99/XDC-max.wk4 RN: 3

TABLE C-Fe.1

ESTIMATED DISSOLVED FE CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	7Q10 Flow			
River Flow Value (RFV) =	13895	mgd or	5.26E+10	l/day
Mixing Zone Flow Value (MZFV) =	3474	mgd or	1.31E+10	l/day
River Dissolved Fe Condition =	Minimum Daily Value			
River Dissol. Fe Concentration (RDF) =	0.036	mg/l		
Coagulent Type =	Clarion			
Superpulsator Flow Value (SFV) =	0.433	mgd or	1.64E+06	l/day
Superpulsator Diss. Fe Conc. (SDF) =	0.04	mg/l		
Filter Backwash Flow Value (FSV) =	0.620	mgd or	2.35E+06	l/day
Filter Backwash Diss. Fe Conc. (FDF) =	0.005	mg/l		

RESULTS:

Estimated Dissolved Iron Concentration At Edge of Mixing Zone (EDF) :

$$\frac{((SFV)*(SDF)) + ((FSV)*(FDF)) + ((MZFV)*(RDF))}{(SFV + FSV + MZFV)}$$

$$EDF = \frac{4.73E+08 \text{ mg/liters2/day}}{1.32E+10 \text{ l/day}}$$

EDF = 0.036 mg/l

or -0.01 % increase over ambient river conditions

Note: Value is below iron AWQC value of 1.0 mg/l

a:\feb99\7Qdf-avg.wk4 RN: 1

TABLE C-Fe.2

ESTIMATED DISSOLVED FE CONCENTRATION AT EDGE OF MIXING ZONE

TEST CONDITIONS:

River Flow Condition =	Average Annual Flow			
River Flow Value (RFV) =	69059	mgd or	2.61E+11	l/day
Mixing Zone Flow Value (MZFV) =	17265	mgd or	6.53E+10	l/day
River Dissolved Fe Condition =	Maximum Monthly Value			
River Dissol. Fe Concentration (RDF) =	0.710	mg/l		
Coagulent Type =	Clarion			
Superpulsator Flow Value (SFV) =	0.688	mgd or	2.60E+06	l/day
Superpulsator Diss. Fe Conc. (SDF) =	0.04	mg/l		
Filter Backwash Flow Value (FSV) =	0.931	mgd or	3.52E+06	l/day
Filter Backwash Diss. Fe Conc. (FDF) =	0.005	mg/l		

RESULTS:

Estimated Dissolved Iron Concentration At Edge of Mixing Zone (EDF) :

$$\frac{((SFV)*(SDF)) + ((FSV)*(FDF)) + ((MZFV)*(RDF))}{(SFV + FSV + MZFV)}$$

EDF = 4.64E+10 mg/liters2/day / 6.54E+10 l/day

EDF = 0.710 mg/l

or -0.01 % increase over ambient river conditions

Note: Value is below iron AWQC value of 1.0 mg/l.

General Chemical Corporation
Product Data Sheet

CLAR+ION® A405P

Characteristics

Clar+Ion® A405P is a clear to amber colored liquid and is an advanced coagulant and flocculant suitable for industrial and potable water treatment. It is especially recommended where rapid settling is desired.

U. S. EPA APPROVED FOR THE TREATMENT OF POTABLE WATER:
FILE NUMBER 02-021.01-AEB-87

Typical Properties

Formula: Aqueous solution of aluminum sulfate and approved flocculating agent.

C.A.S. :	10043-01-3 (Aluminum sulfate)	
	pH (neat)	2 - 3
	Specific Gravity @ 70°F	1.30 - 1.32
	Freezing Point, °F	10 (Approx.)
	Density, lbs/gal.	10.8 - 11.0
	Aluminum as Al, %	4.0 - 4.2
	Aluminum as Al_2O_3, %	7.60 - 7.89

Product Uses

Municipal and industrial water and wastewater treatment for the removal of turbidity, color, suspended solids and phosphorus. Sludge compaction and volume reduction. Lagoon treatment. Oily wastewater clarification and dissolved air flotation. Emulsion breaking.

Shipping Containers

Bulk transport.
Bulk car.
55 gal. plastic drum.
275 gal. one way containers.

Shipping Regulations

DOT Classification: ORM-B
Corrosive liquid n.o.s. (Contains aluminum sulfate)
DOT ID Number: UN 1760 RQ = 18000 lbs

Product Safety Information

Clar+Ion® products require care in handling. Anyone procuring, using or disposing of these products or their containers must be familiar with the appropriate safety and handling precautions. Such information may be found in the **PRODUCT SAFETY DATA SHEETS, (PSDS)** for these products or you may contact General Chemical Corporation Technical Service. In the event of an emergency with these products, call the 24 hour **General Chemical Emergency Number: 800-631-8050**. For additional information contact:

General Chemical Corporation
Syracuse Technical Center
344 West Genesee St.
Syracuse, NY 13202
(315) 478-2323 or
(800) 255-7589 Outside NY

General Chemical Corporation
Water Chemicals Group
90 East Halsey Rd
Parsippany, N.J. 07045
(201) 515-0900 or
(800) 631-8050 Customer Service

Illinois-American Water Company

4436 Industrial Drive • P.O. Box 186 • Alton, Illinois 62002 • (800) 422-2782 • FAX (618) 466-9247

December 30, 1996

ENSR Consulting and Engineering
ATTN: Jim Jolley
35 Nagog Park
Acton, MA 01720

Dear Mr. Jolley,

Here are the chemical analyses for the last two settling samples. If there are any questions please call me at (618) 465-6736.

Sincerely,

ILLINOIS AMERICAN WATER COMPANY

Dwayne E. Lowry
Water Quality Supervisor

cc: K. Tsikteris

Illinois-American Water Company

800 N. Front St. • East St. Louis, IL 62201-1202 • (618) 874-0523 • FAX (618) 874-0319

SUMMARY OF LAB RESULTS, ALTON SPECIAL SAMPLES
Sample Location: Alton Discharge

All results reported in mg/Liter

Sample Collector: Dwayne Lowry

Date Sampled	12/18/96			12/19/96		
Time Sampled Lab Sample #	08:35 522	09:10 523	10:50 524	08:35 525	09:10 526	10:50 527
Total Suspended Solids by Method SM 2540 B	5	332	9	4	226	159
Total Dissolved Solids by Method SM 2540 C	366	354	341	381	360	347
Total Recoverable Iron by EPA Method 200.9 rev. 2	0.288	6.719	0.370	0.253	7.062	5.991
Dissolved Iron by EPA Method 200.9 rev. 2	0.006	0.006	<0.005	0.006	<0.005	<0.005
Total Recoverable Aluminum by EPA Method 200.9 rev. 2	0.71	24.17	1.18	0.72	21.94	12.06
Dissolved Aluminum by EPA Method 200.9 rev. 2	0.19	0.27	0.19	0.18	0.22	0.21

ANALYST: JOHN A SCHIERMANN
ILLINOIS AMERICAN WATER COMPANY
INTERURBAN LABORATORY
800 NORTH FRONT STREET
E. ST. LOUIS, IL 62201
618/874-2460
CERTIFICATION NO. 100259

John Schiermann
JOHN SCHIERMANN, ANALYST

Illinois-American Water Company

4436 Industrial Drive • P.O. Box 186 • Alton, Illinois 62002 • (800) 422-2782 • FAX (618) 466-9247

December 20, 1996

ENSR Consulting and Engineering
ATTN: Jim Jolley
35 Nagog Park
Acton, MA 01720

Dear Mr. Jolley,

The Imhoff cone studies for Illinois American Water Company Alton discharge is enclosed. Samples were taken over five different days. Sampling was done prior to backwashing the filters, during the backwash of the filters, and after backwashing filters. The times were kept consistent to avoid any variables. The first two days the samples were run at the same time causing some warming up of the water. The last three days the samples were analyzed immediately to prevent the warming of the water. Duplicate samples were sent to our East St. Louis laboratory for chemical analysis. These samples were analyzed for total suspended solids, total dissolved solids, total recoverable iron, dissolved iron, total recoverable aluminum, and dissolved aluminum. The first three days are included and the remaining two days will follow. If there are any questions please call me at (618) 465-6736.

Sincerely,

ILLINOIS AMERICAN WATER COMPANY

Dwayne E. Lowry
Water Quality Supervisor

cc: K. Tsikteris

ILLINOIS AMERICAN WATER COMPANY
ALTON, ILLINOIS
IMHOFF CONE STUDY OF ALTON'S DISCHARGE

SAMPLE DATE	SAMPLE TIME	VOLUME OF SETTLED MATERIAL AT SELECTED ELAPSED TIMES							CONE LENGTH IN INCHES	SETTLED VOLUME IN INCHES	TEMPERATURE F (C)	TIME SAMPLE RELATIVELY CLEAR	TURBIDITY NTU
		1 MIN	2 MIN	5 MIN	10 MIN	20 MIN	30 MIN	60 MIN					
DEC 5, 1996	8:35 AM	0 ml	0 ml	0.05 ml	0.1 ml	0.1 ml	0.1 ml	0.1 ml	15.5	0 0625	77 (25)	22 hrs 35 mins later	4.8
DEC 5, 1996	9:10 AM	0 ml	0 ml	0 2 ml	62 ml	43 ml	33 ml	27 ml	15 5	3 825	77 (25)	8 hrs 55 mins later	3.3
DEC 5, 1996	10:50 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	74 (23.3)	7 hrs 15 mins later	4.8
DEC 10, 1996	8:35 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0.25	62 (16.7)	22 hrs 40 mins later	2.7
DEC 10, 1996	9:10 AM	0 ml	0 ml	0.5 ml	100 ml	100 ml	78 ml	50 ml	15.5	4.5	60 (15.5)	11 hrs 5 mins later	3 2
DEC 10, 1996	10:50 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15 5	1.1875	47 (8.3)	20 hrs 25 mins later	1.4
DEC 12, 1996	8:35 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	42 (5.6)	43 mins later	4 0
DEC 12, 1996	9:10 AM	0 ml	0 ml	0 ml	60 ml	56 ml	50 ml	40 ml	15.5	4.375	41 (5)	22 hrs 20 mins later	4.5
DEC 12, 1996	10:50 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	42 (5.6)	1 hr later	4.7
DEC 18, 1996	8 35 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	43 (6.1)	45 mins later	1 9
DEC 18, 1996	9:10 AM	0 ml	0 ml	0.1 ml	250 ml	180 ml	130 ml	82 ml	15.5	5.375	43 (6.1)	23 hrs 30 mins later	17.0
DEC 18, 1996	10 50 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	43 (6.1)	2 hrs later	2.1
DEC 19, 1996	8:35 AM	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	0 ml	15.5	0	42 (5.6)	1 min later	4 3
DEC 19, 1996	9:10 AM	0 ml	0 ml	0 ml	0.1 ml	50 ml	48 ml	28 ml	15.5	3.625	39 (3.9)	2 hrs 27 mins later	5.8
DEC 19, 1996	10:50 AM	0 ml	0 ml	0 ml	0 ml	1 ml	4 ml	4 ml	15.5	1 4375	40 (4.4)	16 hrs 25 mins later	4.8

Illinois-American Water Company

800 N. Front St. • East St. Louis, IL 62201-1202 • (618) 874-0523 • FAX (618) 874-0319

SUMMARY OF LAB RESULTS, ALTON SPECIAL SAMPLES
Sample Location: Alton Discharge

All results reported in mg/Liter

Sample Collector: Dwayne Lowry

Date Sampled	12/05/96			12/10/96			12/12/96		
Time Sampled Lab Sample #	08:35 *507*	09:00 *508*	10:50 *509*	08:35 *514*	09:10 *515*	10:50 *516*	08:35 *518*	09:10 *519*	10:50 *520*
Total Suspended Solids by Method SM 2540 B	43	97	173	4	165	16	7	180	9
Total Dissolved Solids by Method SM 2540 C	232	288	294	298	287	259	310	293	279
Total Recoverable Iron by EPA Method 200.9 rev. 2	1.893	2.182	4.053	0.283	3.902	0.567	0.293	3.535	0.287
Dissolved Iron by EPA Method 200.9 rev. 2	<0.005	<0.005	<0.005	<0.005	0.026	<0.005	<0.005	<0.005	<0.005
Total Recoverable Aluminum by EPA Method 200.9 rev. 2	2.01	7.41	12.80	0.95	12.71	1.53	0.69	14.65	0.78
Dissolved Aluminum by EPA Method 200.9 rev. 2	0.28	0.32	0.30	0.28	0.36	0.30	0.26	0.30	0.24

↑ ↑ ↑

ANALYST: JOHN A SCHIERMANN
ILLINOIS AMERICAN WATER COMPANY
INTERURBAN LABORATORY
800 NORTH FRONT STREET
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618/874-2460
CERTIFICATION NO. 100259

John Schiermann
JOHN SCHIERMANN, ANALYST

Data for Figure 5-1

Description	Filter Backwash Discharge	Filter Backwash Discharge	Filter Backwash Discharge	Filter Backwash Discharge	Filter Backwash Discharge	Average
Date Collected	12/5/96	12/10/96	12/12/96	12/18/96	12/19/96	
Time Collected	9:10 AM	9:10 AM	9:10 AM	9:10 AM	9:10 AM	
TSS (mg/l)	97	165	180	354	360	231.2
Time (min)	**Settled Solids**					
0	1000	1000	1000	1000	1000	1000
1	1000	1000	1000	1000	1000	1000
2	1000	1000	1000	1000	1000	1000
5	1000	1000	1000	1000	1000	1000
10	62	100	60	250	1000	294.4
20	43	100	56	180	50	85.8
30	33	76	50	130	48	67.4
60	27	50	40	82	26	45
Superficial Turbidity (NTU)	3.3	3.2	4.5	17.0	5.6	

Clarifier Sludge Settling Data
(data from existing Alton facility)

Minutes Settled	#1 (2/19/97)	#2 (2/19/97)	#1 (2/20/97)	#2 (2/20/97)	Average
0	1000	1000	1000	1000	1000
1	1000	1000	1000	1000	1000
2	1000	1000	1000	1000	1000
5	580	350	280	480	423
10	340	130	180	190	210
20	230	120	130	150	158
30	200	86	110	130	132
60	140	70	82	85	94

Notes: #1 and #2 refer to #1 and #2 Claricone at Alton Facility

File = IAsettle.wks

APPENDIX D

TREATMENT TECHNOLOGY ASSUMPTIONS AND SPREADSHEETS

DOCUMENTATION FOR COST ESTIMATES IN ALTON SSIS REPORT

This document is provided to Illinois Environmental Protection Agency (IEPA) for details and clarification of the assumptions and project experience used to develop costs for residual treatment alternatives for the proposed Alton water treatment facility contained in the Site-Specific Impact Study (SSIS) Report. Based on discussion with IEPA we have provided a general approach, description of relevant projects considered, and a detailed description of the source of the major components of the two alternatives (Non-Mechanical Dewatering with Lagoon (Table D-1) and Mechanical Watering using Belt Presses (Table D-2)). A refinement to the Non-Mechanical Dewatering alternative (Table D-1A) has been developed (by Hazen and Sawyer) since the original submittal to IEPA. For clarity the major components in Table D-1, D-1A, and D-2 (attached) are given a number which corresponds to the appropriate documentation text.

A. General Purpose and Approach of Cost Estimates

As discussed at the IL EPA meeting on 12/3/98, the purpose of the cost estimates developed in the Alton facility Site-Specific Impact Study (SSIS) Report was to provide representative costs to distinguish between various alternative effluent discharge treatment options. ENSR's purpose was to describe and cost a representative treatment option, using site-specific factors or Illinois-American cost experience where available; venders quotes, where available; and assumptions based on other similar projects which formed a database for remaining costs (see below). Treatment options were evaluated using relatively simple schematic engineering designs and volume estimates. Flow and volume estimates were based on appropriate hydrologic characteristics (e.g., average annual flow, monthly maximum intake TSS, etc). Cost details for the estimates were developed commensurate with this purpose and not to the degree typically necessary to provide cost and specification sufficient for the design/bid process. This level of uncertainty was accounted for in using a robust contingency estimate (30%). (Note that in the cost estimate for alternative D-1A, Hazen and Sawyer uses a contingency of 20%)

B. Background on Water Supply Facility Experience

Due to the specialized nature of processes and residuals associated with water treatment plants on large turbid rivers, the most useful information comes from similar plants around the U.S. Several individual cost and assumptions in Table D-1 or D-2 (see attachments) for the Proposed Illinois-American Alton Water Treatment Plant refer to best professional judgment or past experience. The past experience includes project work by ENSR, Hazen and Sawyer (D-1A), the Illinois-American Water Company (IAWC) or American Water Works Service Company (AWWSC) staff on other water treatment plants in the American Water Works System including:

- Illinois-American – East St. Louis Water Treatment Facility;
- Connecticut-American – Putnam Lake Dredging and Residual Dewatering Analysis;
- Missouri-American- St Joseph Water Treatment Facility;
- Iowa-American - Davenport Water Treatment Facility;
- Pennsylvania-American Plant (unidentified facility);
- West Virginia-American - Weston Water Treatment Facility; and,
- West Virginia-American - Bluestone Water Treatment Facility.

This project-specific experience provided many of ENSR's and Hazen and Sawyer's costs and assumptions. Using water treatment plants for this guidance is important since effluent limitations for water treatment plants are not generic (i.e., no industry-wide guidelines were ever promulgated), the residuals of concern are somewhat specialized, and most water treatment plants do not contend with as turbid a raw water source. These specific projects are described below.

Illinois-American, East St. Louis Water Treatment Facility

This 43.5 MGD facility is located in East St. Louis, uses Mississippi River as the raw water source, and discharges a portion of the residuals back to the River. In 1992 ENSR conducted an Engineering Analysis and Discharge Evaluation for support of a petition to the Illinois Water Pollution Control Board for relief of effluent standards for TSS and iron. Other tasks included: engineering analysis of the current and past plant configurations; feasibility study proposed diffuser system; water quality modeling to determine quantitative impact of suspended and particulate solids on receiving water, toxicity testing on outfall discharge; and assessment of potential non-toxicological environmental impacts to aquatic ecosystem.

During the course of the project, Illinois-American project staff provided costs for disposal options, dechlorination costs, and other improvements, which were considered in evaluation of the costs for the proposed Alton facility. During the course of preparation of testimony for the WPCB petition, extensive additional technical information was also developed on many aspects of water plant operation.

Connecticut-American, Putnam Lake Reservoir and Water Treatment Facility
ENSR conducted an engineering study of water treatment residuals deposits in Putnam Lake, a water supply reservoir in Greenwich, Connecticut, owned and managed by the Connecticut-American Water Company. ENSR confirmed the nature and extent of the residuals deposit, evaluated removal alternatives, and recommended the most effective method of removal, storage, transportation and disposal of the residuals. Tasks included a field investigation using sediment profile imaging to define the extent of "impacted native sediments" and physical probing to determine the residuals deposit thickness; evaluation of removal alternatives including conventional excavation, hydraulic dredging, and mechanical dredging; evaluation of dewatering methods including belt filter presses, centrifuge, and drying beds; evaluation of disposal methods including composting, landfilling, monofil and reuse of sediment material in land application or building materials,

This project provided information on the removal and disposal of alum-containing sludges, which could be applied (with site-specific cost factors) to the proposed disposal options at Alton.

Missouri-American, St. Joseph Water Treatment Facility
This is a 62.5 MGD plant located immediately adjacent to the Missouri River, which is its raw water source. Since the Missouri River is extremely turbid at this point (average TSS = 1016 mg/l) removal of river silts was essential. Missouri-American had proposed a new facility design when, in 1993, the plant was flooded out for several days. Another plan design (using groundwater as a source) was eventually adopted at an inland site. During 1993-96, ENSR supplied technical services and regulatory strategy to Missouri-American in NPDES permit negotiations with US EPA (Region VII). ENSR produced a Best Professional Judgement (BPJ) Demonstration in support of the existing effluent limitations on the public water treatment plant's discharges to the Missouri River.

In the course of designing the new facility, AWWSC developed many cost estimates for the individual components of the Missouri-American. These cost estimates incorporated the current knowledge of their staff as to state-of-the-art treatment options and representative prices.

Iowa-American Water Treatment Facility, Davenport. IA
This 16 MGD facility, which uses the Mississippi River for its raw water source, provided information regarding the characteristics, operation, efficiency, and reliability of the superpulsator treatment units. This was important in determining potential sludge flows and volume from this type of treatment. This information was used in both the Missouri-American BPJ study and the Illinois-American SSIS.

Pennsylvania-American Water Treatment Facility
An unidentified facility along a major river in Pennsylvania was used by AWWSC for much of the technical information regarding the operation, efficiency, and reliability of belt filter presses. This information was used in both the Missouri-American BPJ study and the Illinois-American SSIS.

West Virginia-American, Weston Water Treatment Facility
The design and construction of this 2 MGD facility (expandable to 4 MGD), which uses the West Fork River for its raw water source, was the basis for the components of the dewatering building, and residuals thickener in the cost estimate for the D1-A alternative.

West Virginia-American, Bluestone Water Treatment Facility
The design and construction of this 5 MGD facility (expandable to 15 MGD), which uses the New River for its raw water source, was the basis for the components of the lagoons in the cost estimate for the D1-A alternative.

C. Description of Cost Estimation Process for Proposed Alton Water Treatment Plant

At Illinois EPA's request, a general description of the process by which costs were estimated for the most important components of the residuals disposal alternatives is provided below. The most important components are those items that cost at least $100,000 and are not simply a straight percentage of other total costs. This description should be considered in conjunction with a review of the cost estimates and lists of assumptions provided in Appendix D of the report.

General Design Approach

The design flows and volumes selected the appropriate solids loading from Table 3-1 of SSIS Report, using the following guidelines:

1) Use loading during average annual turbidity conditions to size long term equipment (e.g., lagoons) and estimate operation and maintenance efforts
2) Use loading during maximum monthly turbidity conditions to size residuals handling equipment (e.g., belt presses)
3) Use loading during maximum daily conditions to size equalization basin

Non-Mechanical Dewatering with Lagoons, Numbers Refer to Items in Cost Estimate Table D-1 [Non-preferred alternative; Costs and Justifications provided for comparison only]

(1) Dewatering Lagoons:

Lagoon Construction:

1) Selected small deep lagoon design due to site area constraints; two 3-acre lagoons, 8 feet deep, average solids concentration of 7%, one year storage time.
2) Estimated construction cost using Means and verified by Hazen and Sawyer; $6/cy for berm construction/earthwork; add 50% for difficult subsurface conditions for the following reasons. The Mississippi Lime site is a former quarry. As a result, the site has a combination of fissures and rubble overburden. There is evidence that this has created a condition where water does not run off from the site but, instead, permeates through the overburden and into the fissures and, thus into the groundwater. Construction of lagoons will require mitigating this condition to prevent groundwater contamination. The additional cost of mitigation is anticipated to cause lagoon construction to be approximately 50% greater than typical construction costs. These mitigation costs include a clay liner system or extensive grouting.

Pumping System:

Illinois-American provided the cost of 1 MGD booster pump which transports water from plant to lagoons. Cost based on actual construction cost estimate. The cost for the 1.0 MGD booster pump station was extrapolated from water pumps from previous Illinois-American projects listed below.

Joywood - 0.3 MGD pump station = $120,000
Principia - 1.0 MGD pump station = $350,000
Route 162 - 1.2 MGD pump station = $500,000

The cost was adjusted to account for the pumping medium, site conditions and control requirements. The pumping medium consists of a slurry, which requires heavy duty pumps to withstand the abrasion caused by the silt and sand. Site conditions may require special foundation treatment to prevent settlement. Other additional costs included supervisory control and data acquisition (SCADA) control and variable frequency drives to accurately link clarifier discharge to pumping rate of the pump station, and low head/ high flow pumps to match the on-site conditions.

(2) Overflow Collection/Transfer to River:

Collection System/Pipeline/Transfer Pumps:
1) Developed conceptual design for collecting lagoon overflow of 1 MGD as follows:

- 2000 lineal feet of 18 inch pipe for collection system and discharge pipeline
- 4 transfer pumps and associated valves
- 9000 cubic feet of excavation/backfill for pipeline

2) Retrieved costs from Means for all items except pumps
3) Determined cost of pumps from professional judgement and consultation with Illinois-American. This phrase should have been better written. The pump costs were determined from professional judgement and not from consultation with Illinois-American. Four pumps were estimated to cost $8,000 based on sizing for similar flows. This constitutes a minor component of the total cost ($140,000) of the overflow collection/transfer system.

(3) Non-Component Costs:

Piping: Illinois-American provided the cost of piping based on construction experience. It is estimated that the total length of on-site piping will be approximately 2000 feet. The projected flow of 1 MGD will require a minimum 12 inch diameter pipe. Based on previous pipeline projects in Illinois, it is estimated that the average cost per foot to install 12 inch diameter pipe will be $50 per foot including special pipe material which would be compatible with the abrasive materials.

(4A) Non-Construction Costs:

Permits: ENSR estimated these costs based on experience. After further review of permitting needs and assuming no additional public meetings. The $100,000 permit cost was revised down to $50,000. This would include development of the initial NPDES discharge permit, limited water quality modeling, treatment plant operating permit and landfill disposal manifesting. ENSR has developed these types of permits for many projects, which exceed $100,000, but usually these are more industrial applications.

(4B) Engineering/Construction Supervision: a value of 10% of the Subtotal was selected from the typical range of 10 to 30%. This is a conservative estimate since this includes design, but the lower end of the range was selected because some costs may be saved if the design/construction of the site buildings and treatment units occurs concurrently with the construction of the residuals handling system.

(4C) Contingencies: 30% of the Subtotal was selected from a typical range of 10 to 50% to account for certain uncertainties including potential changes in residual volumes and unit costs or unforeseen construction difficulties/delays. This order-of-magnitude cost estimate is based on a fairly well developed conceptual design with a level of accuracy of ±30%; however, the estimates of residual volumes are based on limited data with the unit costs based on assumptions described in this document.

(5) Supplemental Cost Consideration

Hauling and Disposal of Spoils:
1) Identified supplemental item to be included in cost (Illinois-American)
2) Determined amount of earth to be excavated (Burns and McDonnell)
3) Contacted vendors (Heimkamp and Baxmeyer) to determine cost of hauling and disposing of material

(6) Dewatering Residuals from Two Dewatering Lagoons:

Contacted dewatering contractor (Wheelabrator) to conduct additional dewatering from 7 to 20% because dewatering lagoons could only dewater residuals to 7%. Dewatering operation based on permanent installation (belt presses in small building) in which residuals pumped from one lagoon through presses to the second lagoon).

(7) Dredge and Landfill Residuals from Two Dewatering Lagoons:

1) Obtained cost from local contractor (PDC Response, Inc) for dredging lagoons every year and hauling to local landfill (Milam landfill, East St. Louis); dredging at $9/ton, loading into trucks at $6/ton, hauling at $7.5/ton, and mobilization/demobilization at $2500 per event.
2) Obtained landfill fees from landfill operator at $12/ton (Waste Management Inc.)
3) Calculated total cost by multiplying cost ($34.5/ton) by residual weight at 25% solids from each lagoon (13,400 wet tons) and adding demobilization/mobilization cost ($5000).

Refined Alternative - Dewatering with Lagoons/Presses, Numbers Refer to Items in Cost Estimate Table D-1A [Preferred Alternative]

(The cost estimate for this alternative was developed by Hazen and Sawyer based on a preliminary design and layout as shown on the attached Site Plan, Figure D-1A)

(8) Residual Pumping Station

Pumping Station :

1) The pumping station is designed to pump the residuals from the plant to the lagoons. The pumping station is designed with three vertical turbine pumps, where each pump will have a design pumping capacity of 3 MGD.
2) The residual pumps will be controlled using variable frequency drives and ultrasonic level control in the wetwell. Pumps would come on automatically and ramp up to maintain a selected liquid level in the wetwell.
3) Estimated construction cost from 95% design cost estimate for new Alton Water Treatment Facility. The cost includes instrumentation, electrical, and heating and ventilation.

(9) Dewatering Lagoons:

Lagoon Construction:

3) Selected small deep lagoon design due to site area constraints; 4 one-acre lagoons, with 15 feet side water depth, and average solids concentration of 4%. The lagoons are designed to continuously receive residuals from the pumping station. The lagoons will be continusoly dredged of solids and pumped to the residuals thickener. The components are similar to lagoons at West Virginia-American Bluestone Water Treatment Facility.
4) Estimated construction unit costs from estimate for 100% design of new Alton Water Treatment Plant Rough Grading Contract. The invert elevation at 490.00 MSL serves as the bottom of the residuals lagoons for this option. The lagoons would be constructed using a berm type construction/earthwork. The lagoons were designed with access roads around the perimeter of each lagoons
5) Each lagoon will be equipped with a dedicated dredge system for pumping the solids to the thickener tank. The piping system associated with each dredge is sized to dewater the lagoons at average monthly conditions.

(10) Thickener

1) The 120 foot diameter residuals thickener will receive an average solids concentration flow of 4% from the lagoons. The solids will be conditioned with polymer in the tank prior to the belt filter presses. Components are based on design and construction of similar thickener at West Virginia-American Weston Water Treatment Facility.
2) Estimated construction unit costs from 95% design cost estimate for new Alton Water Treatment Facility.

(11) Residuals Dewatering Building

1) Included two level building, 10,000 square feet area with reinforced concrete floor, and drainage system for filtrate and washwater. Building cost also includes a heating and ventilation system and platforms for each press (structural steel with grating). Other equipment includes polymer feed system and dechlorination system. The components are based on the design and construction of the West Virginia-American Weston Water Treatment Plant.
2) Estimated construction unit costs from 95% design cost estimate for new Alton Water Treatment Facility.

(12) Belt Presses

1) Contacted several vendors including Komline Sanderson (KS) and U.S. Filter. KS responded with complete cost for belt presses and associated items; checked quote for completeness by consulting with American Water Works Service Corporation. AWWSC reviewed the list of items to ensure all the equipment was included. For example, the building had initially not been included in the equipment needed for the belt press operation.
2) Checked cost information by comparing to cost estimates completed for Missouri-American work
3) Determined installation cost based on professional judgement and consultation with Illinois-American.

(13A) Non-Construction Costs:

Permits: ENSR estimated these costs based on experience. After further review of permitting needs and assuming no additional public meetings. The $100,000 permit cost was revised down to $50,000. This would include development of the initial NPDES discharge permit, limited water quality modeling, treatment plant operating permit and landfill disposal manifesting. ENSR has developed these types of permits for many projects, which exceed $100,000, but usually these are more industrial applications.

(13B) Engineering/Construction Supervision: a value of 10% of the Subtotal was selected from the typical range of 10 to 30%. This is a conservative estimate since this includes design, but the lower end of the range was selected because some costs may be saved if the design/construction of the site buildings and treatment units occurs concurrently with the construction of the residuals handling system.

(13C) Contingencies: 20% of the Subtotal was selected from a typical range of 10 to 50% to account for certain uncertainties including potential changes in residual volumes and unit costs or unforeseen construction difficulties/delays. This cost estimate is based on a preliminary design with a level of accuracy of ±20%; however, the estimates of residual volumes are based on limited data.

(14) Landfill Residuals from Belt Presses

1) Obtained cost from local contractor (PDC Response, Inc) for hauling dewatered residuals to local landfill (Milam landfill, East St. Louis) at $7.5/ton.
2) Obtained landfill fees from landfill operator at $12/ton (Waste Management Inc)
3) Calculated total cost by multiplying cost ($19.5/ton) by residual weight at 25% solids from each lagoon (13,400 wet tons).

Mechanical Dewatering Using Belt Presses, Numbers Refer to Items in Cost Estimate Table D-2

Major Mechanical Dewatering Components:

(15) Equalization/Storage Tank

1) Selected volume based on working volume (500,000 gallons) and differences between max daily and max monthly volume (880,000 gallons) for total of 1.38 MG. As stated the tank is sized to equalize the extreme loading condition i.e. loading during maximum daily conditions at TSS of 1928 mg/l. This tank protects the downstream mechanical units from surcharge conditions.
2) Obtained costs from Preload Inc., and Aquastore Tank Systems
3) Adjusted cost by proportion from price of 4.0 MG tank provided by Preload, Inc.

(16) Thickener

3) Selected diameter at 120 feet based on Illinois-American experience. Cost estimate for 120 foot diameter thickener is from a draft evaluation of residual handling alternatives provided by AWWSC to Illinois-American in December of 1995. Thickener sized to handle three days of residuals production.
4) Determined cost from similar equalization/storage tank at AWWSC facility.

(17) Belt Presses

4) Contacted several vendors including Komline Sanderson (KS) and U.S. Filter. KS responded with complete cost for belt presses and associated items; checked quote for completeness by consulting with American Water Works Service Corporation. AWWSC reviewed the list of items to ensure all the equipment was included. For example, the building had initially not been included in the equipment needed for the belt press operation.
5) Checked cost information by comparing to cost estimates completed for Missouri-American work
6) Determined installation cost based on professional judgement and consultation with Illinois-American.

(18) Building

3) Identified item in consultation with AWWSC
4) Included install two level building, 20,000 square feet area with reinforced concrete floor, and drainage system for filtrate and washwater. Building cost also includes a ventilation system and platforms for each press (structural steel with grating). Other equipment includes system for lifting heavy equipment for repairs (e.g., overhead rail mounted lift or crane).
5) Estimated cost from professional experience at AWWSC.

(19) Pumping System

1) Identified item in consultation with Illinois-American.
2) Includes 1 MGD pump station plus piping to deliver residuals to dewatering building from plant.
3) Estimated cost based on Illinois-American experience.

(20) Other Equipment

1) Identified item in consultation with AWWSC.
2) Includes system for returning washwater to equalization basin at head of process which includes pumps and holding tanks for washwater (approximately 1000 gpm washwater flow). Includes system for return 1.0 MGD filtrate to river. Also includes sludge pumps and instrumentation.
3) Estimate cost from professional experience at AWWSC.

(21) Dredge and Landfill Residuals from Belt Presses

4) Obtained cost from local contractor (PDC Response, Inc) for hauling dewatered residuals to local landfill (Milam landfill, East St. Louis); loading into trucks at $6/ton, and hauling at $7.5/ton.
5) Obtained landfill fees from landfill operator at $12/ton (Waste Management Inc)
6) Calculated total cost by multiplying cost ($25.5/ton) by residual weight at 25% solids from each lagoon (13,400 wet tons) and adding demobilization/mobilization cost ($5000).

TABLE D-1
Non-Mechanical Dewatering with Lagoons

Component	Base Cost	Note
Dewatering Lagoons		
Lagoons Construction (Two 3 acre)*	$700,000	(1)
Pumping System*	$500,000	(1)
Overflow Collection/Transfer to River		
Collection System/Pipeline/Transfer Pumps*	$140,000	(2)
Total of Component Costs (TCC)	$1,340,000	
Non-Component Costs		
Site Preparation (6 acres)	$16,200	
Piping*	$100,000	(3)
Electrical	$20,000	
Instrumentation	$20,000	
Total of Non-Component Costs (TNCC)	$156,200	
Subtotal (TCC + TNCC)	$1,496,200	
Non-Construction Costs		
Permits*	$50,000	(4A)
Engineering/Construction Supervision (10% Subtotal)	$149,620	(4B)
Taxes and Insurance (2% Subtotal)	$29,924	
Contingencies (30% Subtotal)	$448,860	(4C)
Total of Non-Construction Costs	$678,404	
Supplemental Cost Consideration		
Hauling & Disposal of Spoils* (240,000 cubic yards)	$2,400,000	(5)
Total Capital Costs (Subtotal + Non-Construction Costs + Supplemental Cost)	$4,574,604	
Annual Operation and Maintenance Costs		
Administration	$10,000	
Maintenance	$30,000	
Electricity	$10,000	
Total of Operation and Maintenance Costs	$50,000	
Dewater Residuals from Two Dewatering Lagoons Per Year*	$615,000	(6)
Dredge and Landfill Residuals from Two Dewatering Lagoons Per Year* (16,800 wet tons of residuals @25% solids for 2 lagoons)	$467,300	(7)
Total Annual Costs		
Capital Costs Amortized over 30 Years @ 9% Interest [(TCC + TNCC + Total of Non-Construction Costs + Supplemental Cost) x 0.0973]	$445,109	
Annual Operation and Maintenance Costs	$1,132,300	
Annualized Cost	$1,577,409	

**spoils hauling and disposal cost associated with selection of alternative D1 or D2 only; not for comparison with the base case alternative (i.e. direct discharge of solids).*

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Table D-1A
Non-Mechanical Dewatering with Lagoons – Preferred Alternative

Residual Pumping Station			
	Structural	$ 500,000	(8)
	Mechanical	$ 500,000	
	Electrical	$ 50,000	
	Instrumentation	$ 50,000	
Lagoons			
	Lagoon Construction (4 acre)	$ 500,000	(9)
	Access Roadways	$ 50,000	
	Dredge Systems (4)	$ 200,000	
	Piping System	$ 100,000	
Thickener			
	Structural	$ 600,000	(10)
	Mechanical	$ 400,000	
	Electrical	$ 25,000	
	Instrumentation	$ 25,000	
Dewatering Building			
	Architectural	$ 250,000	(11)
	Structural	$ 750,000	
	Electrical	$ 150,000	
	Instrumentation	$ 50,000	
Dewatering Building - Process			
	Belt Filter Presses - (Three presses two meters each)	$ 1,300,000	(12)
	Polymer Feed System	$ 50,000	
Total of Treatment System Component Costs (TSCC)		**$ 5,550,000**	
Non-Construction Costs			
	Permits	$ 50,000	(13)
	Engineering Construction Supervision (10% Subtotal)	$ 555,000	
	Taxes/Insurance (2% Subtotal)	$ 111,000	
	Contingencies (20% Subtotal)	$ 1,110,000	
Total of Non Construction Costs (TNCC)		**$ 1,826,000**	
Annual Operation and Maintenance Costs			
	One Operator at Site	$ 50,000	
	Maintenance (3% Belt Presses)	$ 39,000	
	Equipment Repair/Part Replacement (3% Belt Presses)	$ 39,000	
	Electricity	$ 30,000	
Total of Operation and Maintenance Costs		**$ 158,000**	
Haul/Dispose of Sludge at Local Landfill (per year)			
	13,400 wet tons of residuals @ 25 % solids) @ $20 / ton	**$ 261,300**	(14)
Total Annual Costs			
	Capital Costs Amortized over 30 Years @ 9% Interest	**$ 717,685**	
	[(TSCC + TSNCC + TNCC) x 0.0973]		
	Annual Operation and Maintenance (and Disposal) Costs	**$ 419,300**	
Annualized Cost		**$ 1,136,985**	

Non-Mechanical Dewatering with Lagoons – Preferred Alternative

Figure D1-A

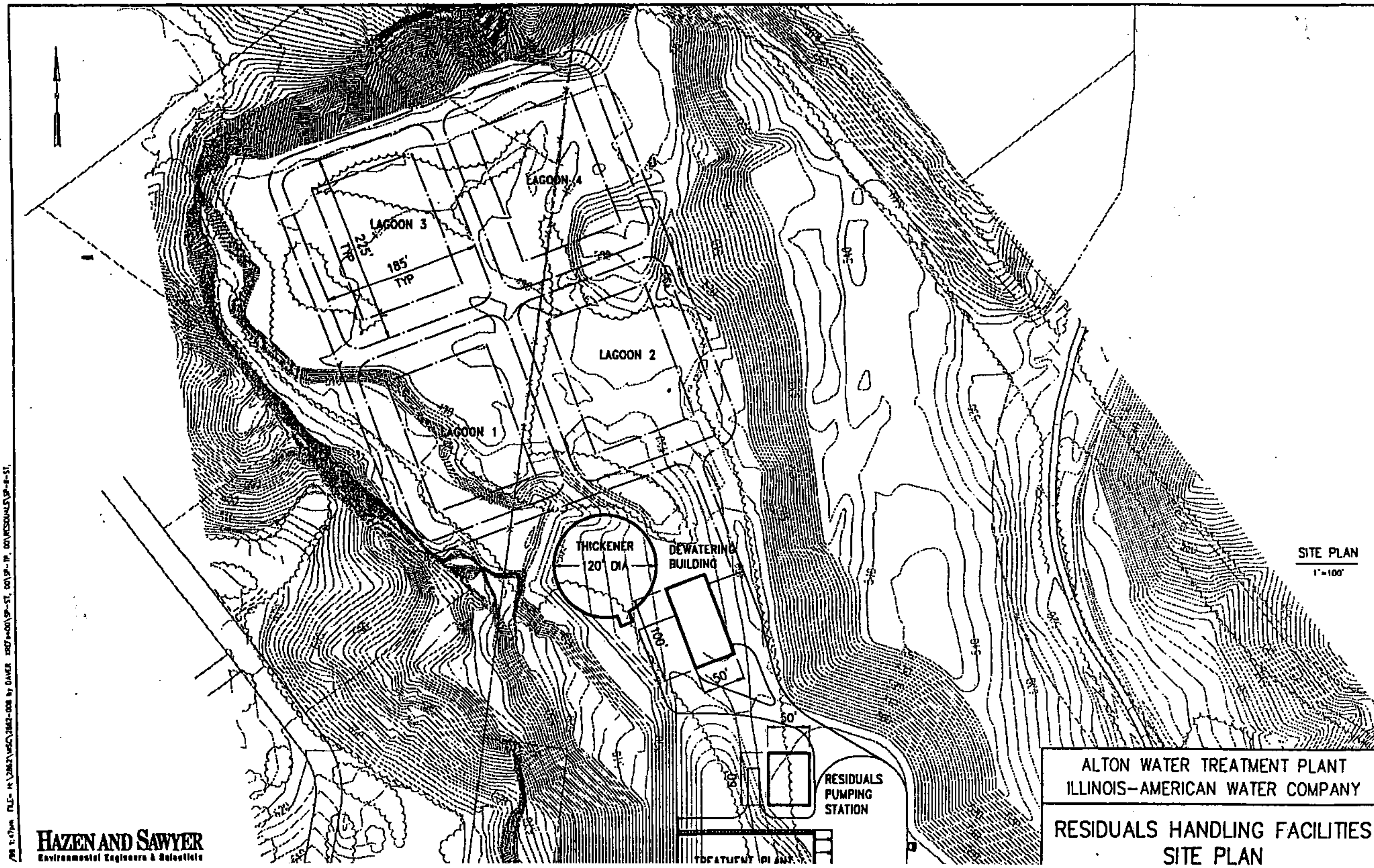

TABLE D-2
Mechanical Dewatering using Belt Presses

Component	Base Cost	Notes
Major Mechanical Dewatering Components		
Equalization/Storage Tank (2.9 Million Gallon)*	$1,020,000	(15)
Thickner (120 foot Diameter)*	$1,500,000	(16)
Belt Presses (6)*	$2,529,000	(17)
Building (20,000 sf)*	$1,500,000	(18)
Pumping System*	$500,000	(19)
Other Equipment*	$400,000	(20)
Sludge Storage (280,000 Gallon)	$38,400	
Total of Treatment System Component Costs (TSCC)	$7,487,400	
Treatment System Non-Component Costs		
Site Preparation(5 acres)	$13,500	
Piping (3% TSCC)	$224,622	
Electrical (3% TSCC)	$224,622	
Instrumentation (3% TSCC)	$224,622	
Total of Treatment System Non-Component Costs (TSNCC)	$687,366	
Subtotal (TSCC + TSNCC)	$8,174,766	
Non-Construction Costs		
Permits	$50,000	(4A)
Engineering/Construction Supervision (10% Subtotal)	$817,477	
Taxes and Insurance (2% Subtotal)	$163,495	
Contingencies (30% Subtotal)	$2,452,430	
Total of Non-Construction Costs	$3,483,402	
Annual Operation and Maintenance Costs		
One Operator at Site	$50,000	
Maintenance (5% Belt Presses))	$75,000	
Equipment Repair/Part Replacement (5% Belt Presses)	$75,000	
Electricity	$30,000	
Total of Operation and Maintenance Costs	$230,000	
Haul/Dispose of Sludge at Local Landfill (per year)* (13,400 wet tons of residuals @25% solids)	$341,700	(21)
Total Annual Costs		
Capital Costs Amortized over 30 Years @ 9% Interest [(TSCC + TSNCC + Total of Non-Construction Costs) x 0.0973]	$1,134,340	
Annual Operation and Maintenance Costs	$571,700	
Annualized Cost	$1,706,040	

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Option D-3

Assumptions - Hypothetical BPT for Derivation of Cost-Reasonableness
Pressure Filtration Followed by Discharge to River

References: Means
American Water Works facility in New Jersey 1992 Construction Costs

(1) All treatment system component installed capital costs and non-component costs retrieved from actual costs of constructing inline pressure filtration system at 3 MGD facility in New Jersey provided by American Water Works, S.Creel, 1993. Costs adjusted to 1997 costs using Chemical Engineering Plant Cost Index. Costs adjusted from 3 MGD to 1.0 MGD using 6/10ths rule.

(2) Haul/Dispose of Sludge at Local Landfill - Cost determined by proportional adjustment from Missouri-American cost estimate for 0.3 MGD Pressure Filtration system (February 1995).

(3) All other costs based on experience and professional judgement.

Table D-3
Hypothetical BPT for Derivation of Cost Reasonableness
Pressure Filtration Followed by Discharge to River
(1.0 MGD Flow and 0 mg/l in Effluent)

Component	Base Cost
Treatment System Component Installed Capital Costs	
Building	$180,000
Equipment and Piping	$490,000
Equalization Tank	$110,000
Total of Treatment System Component Costs (TSCC)	$780,000
Treatment System Non-Component Costs	
Site Work and Yard Piping	$90,000
Electrical and Instrumentation	$120,000
General Conditions	$30,000
Total of Treatment System Non-Component Costs (TSNCC)	$240,000
Subtotal (TSCC + TSNCC)	$1,020,000
Non-Construction Costs	
Engineering/Construction Supervision (10% Subtotal)	$102,000
Taxes and Insurance (2% Subtotal)	$20,400
Contractor Fees (7.5% Subtotal)	$76,500
Contingencies (30% Subtotal)	$306,000
Total of Non-Construction Costs	$504,900
Annual Operation and Maintenance Costs	
Labor (10 hrs/wk @ $30/hr)	$15,600
Maintenance (5% TSCC)	$39,000
Equipment Repair/Part Replacement (5% TSCC)	$39,000
Electricity	$25,000
Total of Operation and Maintenance Costs	$118,600
Haul/Dispose of Sludge at Local Landfill (per year)	$137,500
Total Annual Costs	
Capital Costs Amortized over 30 Years @ 9% Interest [(TSCC + TSNCC + Total of Non-Construction Costs) x 0.0973]	$148,373
Annual Operation and Maintenance Costs	$256,100
Annualized Cost	$404,473
Solids Removed per year (@ 15 mg/l and 1.0 MGD)	45662 lb/yr
Cost per pound removed($1997)	$8.86 per pound TSS remove
Cost per pound removed($1976)	$4.38

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APPENDIX E

FUTURE WATER DEMAND IN ALTON SERVICE AREA

SECTION 2
ALTON SERVICE AREA

2.1 DEMAND PROJECTIONS

Population projections are prepared by several planning entities in the Illinois region, including five that cover the Alton area. These planning groups include: Riverbend Growth Association, Southwestern Illinois Metropolitan and Regional Planning Commission, East-West Gateway Coordinating Council, Southern Illinois University at Edwardsville and the West Central Illinois Valley Planning Commission. The authorized planning agency for Madison County, which includes the Alton area, is the Southwestern Illinois Metropolitan and Regional Planning Commission. Applicable population projection data was obtained from these agencies for use in preparing water system demand projections.

Population projections available from the East-West Gateway Coordinating Council incorporated the 1990 census data and show an estimated population increase of 3.9% in Madison County over the next 15 years, ending in the year 2010. For adjoining St. Clair County, just south of Madison County, a 5.1% increase is predicted. These projected growth rates represent an average, county-wide increase of 600 persons per year in Madison County and 840 persons per year in St. Clair County. This represents an increase of approximately 245 and 335 households or potential new customers, respectively, based on the estimated population per household ratio in the area. The other available population projections have their basis in the 1980 census data, and show only a very slight increase or a slight decrease in the expected future population of Madison County.

A comparison of data from the 1980 and 1990 census reports show a past decline of 1266 persons in the City of Alton and an overall gain of 1547 persons in Madison County. Although area population projections indicate only moderate future growth, there are several factors which are expected to result in a modest increase in the growth rate for the Alton region over the 15 year planning horizon of the Comprehensive Planning Study.

A new multi-lane highway bridge has recently been completed across the Mississippi River at Alton. A new highway bypass, from south of Alton to Route 267 near Godfrey, is scheduled for completion sometime within the next ten years, according to the Illinois Department of Transportation. These highway improvements are expected to stimulate new home construction in the general Alton region, mostly to the north of Alton, at or beyond Godfrey, where Alton sells water to other water purveyors. There is a genera consensus that there will be an increase in new home construction in the areas north of Alton, but the planning agencies have not yet made any new population projections to indicate what the amount of the residential increase might be or the location of any new home construction that may result from the highway improvements.

The City of Alton and the Riverbend Growth Association are promoting downtown redevelopment for tourism, shopping and waterfront renewal. Plans exist for parks, bike trails, boat ramps and a marina on the waterfront, where the land has been cleared and improved by the recent construction of the Mississippi River bridge. Long range plans would add athletic fields, an amphitheater, hotel and convention center, as financing becomes available. Riverboat gambling, which operates from the Alton waterfront, has been in existence for several years and is expected to attract more visitors now that the new bridge will give better vehicular access from St. Louis.

The Illinois Department of Transportation has indicated that traffic is expected to increase at a rate of about 1-2% per year in the future as a result of better access over the new bridge. Traffic peaks other than those related to rush hour are generally attributable to river boat gambling, tourism, boating on summer weekends or October weekend trips to view the autumn leaves. The Illinois Department of Transportation did not conduct any origin-destination traffic surveys, nor did they have access to any population projections other than from the agencies mentioned above. The need for the new bridge was justified on the basis of the existing traffic congestion created by the old bridge. Thus, no specific data is available from the Department of Transportation reflecting any projected area housing growth that can be attributed to the influence of the new bridge.

At the end of 1995 there were a total of 17,482 customers being served in the Alton system. The number of residential customers grew by an average of 40 customers per year over the ten year period from 1984 to 1994 despite a temporary loss of 39 customers in 1993 due to the devastating flood. Commercial demand in Alton has exhibited modest growth over the past ten years, probably due to the local downtown renewal efforts. Modest increases in the number of residential and commercial customers and demands are expected from continuing downtown renewal efforts, waterfront area improvements and the influence of the new bridge and connecting highway improvements. The largest future increase in residential construction is expected to take place North of Alton in the Jerseyville and Brighton areas. Desirable, rural land is available in this region for new home construction. Housing costs in the Jerseyville vicinity are said to be two-thirds the cost of equivalent homes in the St. Louis vicinity. Lower costs plus the much improved bridge access to the Jerseyville region from St. Louis are expected to result in construction of 200, 300 or possibly more new homes per year over the 15 year CPS planning horizon.

While most of these homes will be constructed outside the current Water Company service area, the territories involved are served indirectly by Alton District through sales to other water purveyors. Therefore, the projected demand increases for these areas have been incorporated into the "Other" category for Illinois American Water Company which includes sales for resale. The nearby purveyors include the Jersey County Rural Water District, Brighton Water Company and the Fosterburg Water District. The Jersey County system is the largest of the three and the one expected to experience most of the growth. This system is wholly supplied by Alton District.

Demand projections have been made which include the above growth indicators. Demand projection scenarios evaluated growth in Alton varying from the past trend of 46 customers per year up to 125 customers per year. Consideration was given to the fact that part of the future Water Company growth will come from areas outside of the City through service extensions to new developments plus extensions to areas of existing homes where public water supplies are not currently available. In addition, increased sales were projected in the Other category of water sales for the anticipated new home construction in the Jersey County Rural Water District. Three scenarios, described below, were used to develop average day projections for the 15 year planning period, a low, a medium and a high demand scenario.

The low growth scenario represents a continuation of current trends in the Alton service area, with modest growth in the residential and commercial sectors. The residential, commercial and other demands are based on a linear regression of the last 10 year trend, omitting the earlier declining period of record. The increase in residential customers is 48 per year taken from the regression analysis. The industrial demand category has been reduced to 1.5 MGD to reflect recent experience in industrial consumption.

The medium growth scenario reflects a residential customer increase of 125 per year in Alton, a small increase in commercial demand plus an increase in the "Other" category of consumption to reflect an estimated 200 new residential customers per year in rural areas North of Alton, primarily in the Jerseyville vicinity. The per customer demand for the Northern rural area customers has been estimated at 200 gpcd, compared to 170 gpcd in the Alton system. This reflects the larger, more modern type homes, with mor extensive landscaping which are expected to be constructed in the new developments.

The high growth scenario is the same as the medium growth scenario except that the "Other" category o: consumption has been increased to reflect 300 new residential customers per year in the Jerseyville vicinity, instead of 200 per year. The high demand scenario is included to indicate trends that may become prevalent in the later years of the planning period when highway improvements are more fully completed, facilitating access to the Jerseyville area and increasing its desirability as a bedroom community for the region.

One additional scenario of 500 new homes per year in Jersey County was considered as an upper limit of growth, primarily as a sensitivity analysis to determine the effect of a rapid growth rate on the incremental needs for source of supply and treatment facilities. Details of this projection are not included in the average day tabulations, but the average and maximum days predicted by this scenario exceeded the high growth scenario values by only 3 to 7 percent over the 15 year projection range of this report. This would require an incremental increase of only 0.7 mgd in source and treatment facilities by the year 2010 if the growth in Jersey County were 500 new homes per year. This is not a significant factor in the long range plan.

Each of the demand projection scenarios includes allowances for non-revenue usage and unaccounted for water at a combined rate of 10 percent of the average day based on past experience and estimated usage rates in these categories.

Tabular summaries of the average day and maximum day demand projections are presented immediately hereafter, followed by more detailed discussions of the components of projected demand in each Water Company demand classification. The middle range average day demand projection was adopted as the planning scenario for this report. As shown by Table 2.1-1, the projected average day demands for the planning scenario range from 9.16 mgd in the year 2000 to 10.09 mgd in the year 2010.

A review of Alton area regionalization prospects is contained in the following regionalization summary section and in the overall regionalization discussion in Section 1.0 of this report. Most of the likely prospects for regional growth beyond the existing Alton system are included in the Jersey County Rural Water District projections which are part of the "Other" customer category of consumption. Any added regionalization growth is expected to be relatively minor and will not materially affect the demand

Table 2.1-1

Alton Demand Summary

YEAR		RESIDENTIAL	COMMERCIAL	INDUSTRIAL	OTHER	NON REVENUE	UAF WATER	AVG DAY	MAX DAY	MAX/AVG RATIO
HISTORIC DEMAND (mgd)										
	1985	2.44	1.24	2.23	1.69	0.16	0.62	8.38	10.40	1.24
	1986	2.47	1.26	2.39	1.66	0.09	0.78	8.65	10.66	1.23
	1987	2.67	1.33	2.48	1.76	0.10	0.51	8.86	10.95	1.24
	1988	2.76	1.34	2.41	1.83	0.06	0.71	9.11	12.61	1.38
	1989	2.59	1.31	2.44	1.80	0.07	0.70	8.91	11.94	1.34
	1990	2.55	1.33	2.27	1.84	0.06	0.83	8.90	11.65	1.31
	1991	2.64	1.37	2.16	1.94	0.09	0.64	8.85	11.19	1.26
	1992	2.57	1.35	1.90	1.97	0.07	0.56	8.41	11.39	1.35
	1993	2.41	1.34	1.82	1.84	0.09	0.52	8.02	11.54	1.44
	1994	2.53	1.44	1.85	2.14	0.08	0.78	8.62	11.40	1.29
	1995	2.52	1.45	1.69	2.07	0.05	0.77	8.55	11.64	1.36
PROJECTED DEMAND (mgd)										
Low	2000	2.64	1.37	1.50	2.25	0.17	0.69	8.63		
	2005	2.66	1.39	1.50	2.35	0.18	0.70	8.80		
	2010	2.72	1.41	1.50	2.45	0.18	0.72	8.98		
Most Likely	2000	2.77	1.55	1.50	2.43	0.18	0.73	9.16	13.20	1.44
	2005	2.87	1.61	1.50	2.68	0.19	0.77	9.63	14.16	1.47
	2010	2.98	1.67	1.50	2.93	0.20	0.81	10.09	15.13	1.50
High	2000	2.77	1.55	1.50	2.55	0.19	0.74	9.30		
	2005	2.87	1.61	1.50	2.90	0.20	0.79	9.87		
	2010	2.98	1.67	1.50	3.25	0.21	0.84	10.44		

projections. If unexpected regionalization growth materializes, the proposed treatment plant can be expanded in the future to meet such needs.

Maximum day demand projections were derived by factoring the planning scenario average day demands. The factors for estimating the planning scenario maximum days were developed from the 95 percent confidence level of the least squares trended ratio between the maximum and average day over the past 10 years.

The ratios were developed from the upward trend of the past 10 years because decreasing industrial demands, coupled with increasing residential consumption will alter the overall demand base. Water systems with significant industrial users exhibit lower peaking ratios and systems with a majority of residential users have higher maximum day to average day ratios. Future industrial demand is projected to decrease to 15 percent of the average day whereas in the past industrial consumption has exceeded 30 percent of the average day demand. The maximum day to average day ratios estimated for the planning scenario projections are reasonable for the anticipated customer composition of the Alton system based on published data.

The 95 percent confidence level criteria provides a maximum day demand projection that should be exceeded only once in 20 years. Maximum day demands were also calculated for two additional confidence levels, a 99 percent reliability (one in 100 years exceedence) and a 50 percent reliability (one in two years exceedence). Table 2.1-2 lists the various maximum day to average day ratios for the three confidence levels and three projection years. The maximum day demand values resulting from these additional confidence level projections establish a projected maximum day band which will account for all but the most extreme weather and demand variations that can be expected in the Alton water system during the report planning horizon.

Table 2.1-2
Maximum Day to Average Day Ratio for Various Confidence Levels

Confidence Interval (CI)	2000 Ratio	2005 Ratio	2010 Ratio	Years Exceeding CI
99%	1.47	1.50	1.53	1 in 100
95%	1.44	1.47	1.50	1 in 20
50%	1.35	1.38	1.41	1 in 2

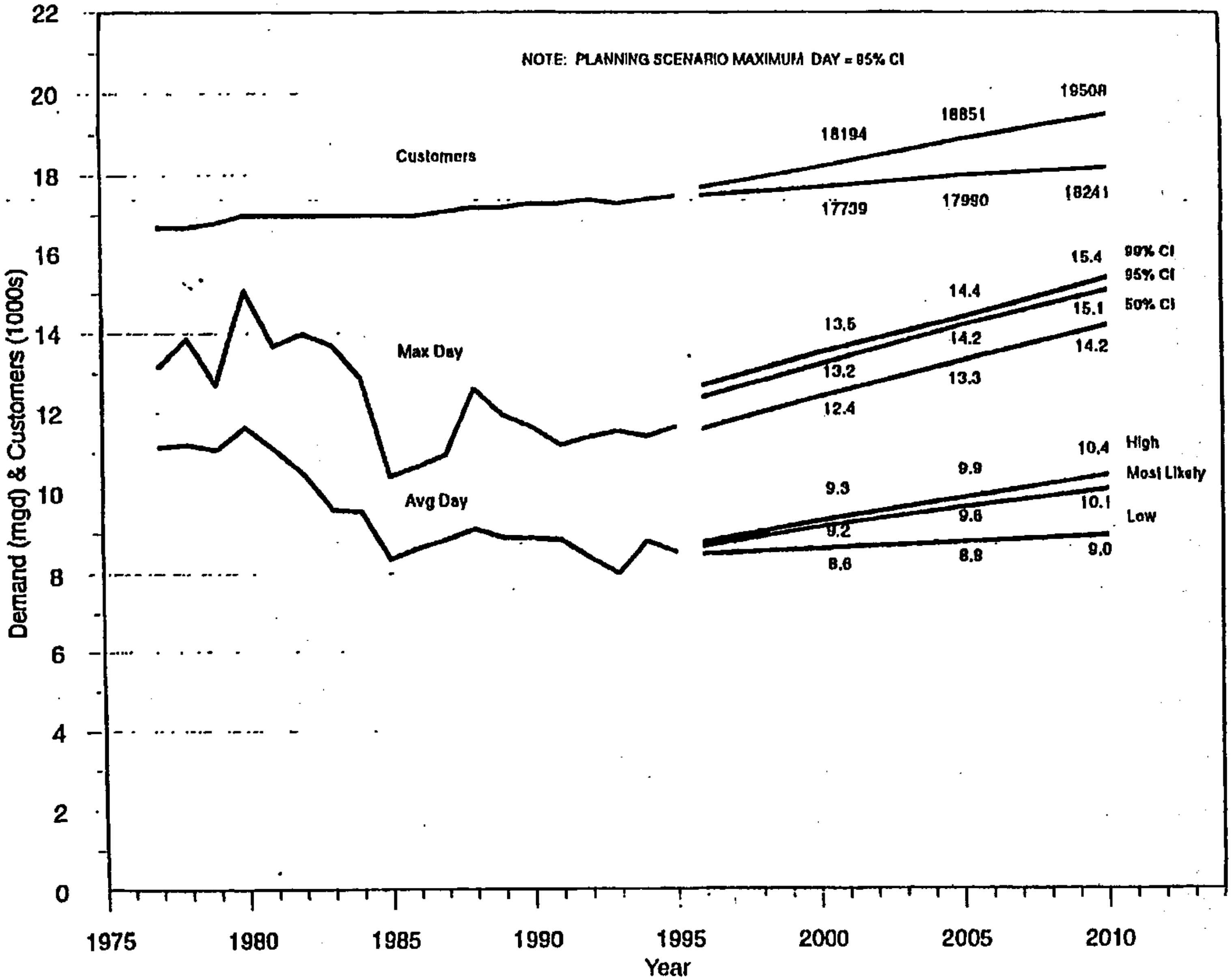
The maximum day demands projected for these three reliability conditions are listed in Table 2.1-3 and graphed on Figure 2.1-1. The three maximum day scenarios provide a range of expected maximum demands from an average year to a one in one hundred year dry weather occurrence. Future improven needs are based on the planning scenario maximum day (one in 20 year exceedence). If extreme weather conditions cause a maximum day demand in excess of the planning scenario, customer restrictions may need to be imposed depending on the capacity of available and treatment facilities at time of the drought conditions.

Table 2.1-3
Alton Maximum Day Demand Summary

	2000	2005	2010
Planning Scenario Average Day	9.16	9.63	10.09
99% Confidence Level			
Ratio	1.47	1.50	1.53
Maximum Day	13.47	14.44	15.44
95% Confidence Interval *			
Ratio	1.44	1.47	1.50
Maximum Day	13.19	14.16	15.14
50% Confidence Interval			
Ratio	1.35	1.38	1.41
Maximum Day	12.37	13.29	14.23

* Planning Scenario = 95% Confidence Interval

Figure 2.1-1
Alton Demand and Customers



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APPENDIX F

DISCHARGE TSS MODELING EVALUATION

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1.0 INTRODUCTION

This appendix describes a screening level modeling performed to evaluate potential impacts of the proposed Alton replacement water supply facility discharge on the Mississippi River (Figure F-1). The modeling evaluation focused on potential impacts of discharge total suspended solids (TSS) on ambient surface water and on the riverbed of the Mississippi River. The modeling evaluation resulted in predicted discharge TSS contours in surface water and discharge particle deposition rate contours on the riverbed. The predicted discharge TSS contours were compared to ambient TSS concentrations in the Mississippi River in order to evaluate potential impacts.

The screening level modeling evaluation consisted of two major components; a surface water mixing zone model and a particle deposition model. The modeling evaluation was designed to provide conservative predictions of TSS impacts associated with the proposed discharge. Conservative predictions are predictions that overestimate actual discharge TSS concentrations in the river. Discharge TSS impacts were predicted under several different scenarios including low ambient river flow (i.e. the 7Q10 flow) and high discharge TSS concentrations. The screening level modeling evaluation is described in detail below.

2.0 METHODS

Methods applied to the surface water mixing zone modeling and particle deposition modeling evaluations are described below. A key assumption of the modeling methods is that all discharge TSS mass is applied to both the surface water and the riverbed. Thus, the method is conservative in that all discharge TSS mass is counted twice; once assuming all mass remains in the water column and once assuming all mass settles on the riverbed. This is not realistic in that particulate material will either be in the water column or on the riverbed, but this approach was used to evaluate worst-case conditions. As a result, predictions of discharge TSS concentration in both media (i.e., surface water TSS or deposited residuals) will overestimate actual discharge mass present.

2.1 Surface Water Mixing Zone Model

The objective of surface water mixing zone modeling was to obtain predictions of discharge surface water dilution contours to allow prediction of the potential plume dimensions and to obtain predictions of horizontal particle velocity, required as input to the particle deposition model. CORMIX, the Cornell Mixing Zone Expert System (Jirka, et al, 1996), was selected for this application. CORMIX is a widely accepted mixing zone model capable of predicting discharge dilution contours in surface waters under a variety of different receiving waters and submerged discharge scenarios. The selection of CORMIX for this application was approved by Illinois EPA (letter from Mr. Robert Mosher to Mr. Ken Hickey, dated May 13, 1998). The CORMIX model relies on the following simplifying assumptions:

- Steady state ambient conditions, including constant river flow, velocity, water temperature, and density; uniform, flat river bathymetry; and
- Steady state discharge conditions, including constant discharge flowrate, constituent concentration, water temperature, and, density.

Specification of input parameter values for surface water mixing zone modeling is described in Section 3.1.

2.2 Particle Deposition Model

The objective of particle deposition modeling was to predict rates of particle deposition on the riverbed as a result of the proposed outfall. A particle deposition model, based on the equations and methodologies presented in the U.S. EPA Section 301(h) Technical Support Document (US EPA, 1994), was selected and applied. This model is recommended by US EPA for screening level particle deposition evaluations. The particle deposition model results in predictions of particle mass per area per time (e.g., $g/m^2/yr$) deposited onto the riverbed. Again, the complete mass of the discharge was settled out unto the riverbed. In reality, a large fraction of this discharge is likely to remain suspended. Therefore the rates of particle deposition will be overestimated. The particle deposition model relies on the following assumptions:

- All simplifying assumptions of the discharge dilution model apply,
- All total suspended solids are settleable solids,
- All particle settling is unhindered, and
- All particles are spherical in shape.

The particle deposition model relies on the input parameter values applied to the CORMIX model and a set of additional input parameter values, such as specification of particle size distributions. Specification of input parameter values for particle deposition modeling is described in Section 4.2.

3.0 APPLICATION OF SURFACE WATER MIXING ZONE MODEL

3.1 Specification of Model Scenarios

Figure F-1 shows the location of the proposed outfall in Alton, Illinois. The numerical models described above were applied to a set of worst-case conditions in order to obtain overly conservative predictions of discharge TSS concentrations in the river. Numerous sets of conditions or scenarios were considered in selecting a set of worst-case scenarios. The following factors were critical in selecting scenarios:

- Ambient river flowrate,
- Ambient river TSS concentration,
- Facility Discharge flowrate, and
- Facility Discharge TSS concentration,

ENSR reviewed available ambient Mississippi River flow data and TSS concentration data. Figure F-2 contains a plot of flow vs. TSS concentration data measured in the Mississippi River at Alton and Grafton, Illinois (USGS Gage Numbers 05587500 and 05587450, respectively) from January 1, 1981 through December 31, 1992. Each point on the figure represents a measurement of Mississippi River flowrate and corresponding TSS concentration. This figure illustrates that TSS concentrations tend to increase with increased flow. Also, low flows are well correlated with relatively low TSS concentrations.

Plant operating conditions are described in detail in Section 3 of the SSIS report and are summarized in Table 3-1. As described in Section 3, discharge flowrates and discharge TSS concentrations are related to ambient river TSS concentrations. Based on Figure F-2 and the description of plant operating conditions presented the body of the SSIS report, two scenarios were selected to represent worst-case conditions in terms of potential TSS impacts from the proposed discharge. These scenarios were selected in consultation with Illinois EPA (Robert Mosher pers. comm) to represent daily minimum (20 mg/L) and monthly maximum (600 mg/L) TSS conditions in the river.

<u>Scenario #1: Average River Flow, High TSS Concentration</u>

- River flowrate at average value of 106,589 cfs,
- Ambient river at high TSS concentration of 600 mg/L,
- Discharge flowrate of 2.5 cfs (0.071 m^3/sec), and

- Discharge TSS concentration of 4,332.5 mg/L.

Scenario #2: Low River Flow, Average TSS Concentration

- River flowrate at the seven-day, 10-year low flow (7Q10), value of 21,500 cfs,
- Ambient river at average TSS concentration of 20 mg/L,
- Discharge flowrate of 1.6 cfs (0.046 m^3/sec), and
- Discharge TSS concentration of 295.9 mg/L.

A complete set of input parameter values applied to the modeling evaluation is provided below.

3.2 Specification of Input Parameter Values

Input parameter values required to specify the characteristics of the river and of the discharge in the CORMIX model are specified below.

3.2.1 River Input Parameters

Flowrate - Two values of river flow were used in the analysis, the average flow of 106,589 cfs (Scenario 1) and the seven-day, 10-year low flow (7Q10), of 21,500 cfs (Scenario 2).

Channel Dimensions - Average channel width (2600 ft) and depth (25.4 ft) were determined for the reach between the proposed facility discharge and the Melvin Price Lock and Dam at River Mile 200.78 from the hydrographic survey chart (USACE, 1994). The depths on the source chart are referenced to a low water datum of elevation 414 feet National Geodetic Vertical Datum (NGVD), and were assumed to correspond to the levels at the 7Q10 flow. Since the river depth will be greater at higher flows, a stage-discharge relationship for the Alton gage was used to determine that the river depth would be expected to be 5.1 feet greater, or 30.5 feet, during average flow conditions.

CORMIX will allow specification of a different depth at the discharge location. The maximum channel depth along the cross-section at the proposed discharge is 30 feet, but this occurs 437 feet offshore and would entail crossing the barge navigation channel; therefore it was not considered feasible to locate the discharge in deeper than average water.

River TSS Concentration - Two river TSS concentrations were applied:

For Scenario 1: An average TSS value of 20 mg/L corresponding to the predicted TSS concentration for the minimum daily flow (see Tables 4-3 and 4-4 and Figure F-2). Note that Scenario 1 assumes the 7Q10 flow. Due to the rare nature of a 7Q10 flow, little or no information is available about the corresponding TSS concentrations. Selection of a minimum daily TSS value is appropriate, since low flows are correlated with low TSS concentration (see Figure F-2). Thus, it would be inappropriate to apply a high river TSS concentration to a low river flow scenario.

For Scenario 2: A high TSS value of 600 mg/L corresponding to the predicted TSS concentration for the maximum monthly flow (see Tables 4-3 and 4-4 and Figure F-2).

Temperature and Density - The river was assumed to be fully mixed, therefore of uniform density with respect to depth. The average of the mean monthly temperatures, 15.3 °C, calculated from data reported at the USGS Alton gage (05587500) from 1975 to 1981, was used to specify the density.

3.2.2 Facility Discharge Input Parameters

Discharge Location - Various discharge scenarios were investigated using the CORMIX model to determine an optimal discharge location. The selected discharge configuration was located 10 meters (32.8 feet) from the riverbank and at a depth of 5 meters (16.4 feet) above the river bottom. This depth corresponds to the maximum allowable elevation of 409 feet NGVD.

Discharge Port Size – A discharge port diameter of 0.305 meters (12 inches) was selected.

Discharge Flowrate - Two discharge flow rates were applied:

For Scenario 1 A low flow value of 1.6 cfs (0.046 m^3/s or 1.1 mgd) corresponding to the predicted average annual flow (see Table 3-1).

For Scenario 2: A high flow value of 2.5 cfs (0.071 m^3/s or 1.6 mgd) corresponding to the predicted maximum daily flow (see Table 3-1).

Discharge TSS Concentration – The discharge TSS concentration was determined by dividing the total predicted solids load by the total flow for each discharge using values in Table 3-1 of the SSIS Report and converting the units. For example, the high TSS concentration was calculated from the maximum daily flow of 1.6 mgd and predicted solid loadings of 29.6 tons/day to derive at a TSS concentration of 4,332 mg/L. Two discharge TSS concentrations were applied:

For Scenario 1: A low TSS value of 295.9 mg/L corresponding to the predicted TSS concentration for the minimum daily flow (see Table 3-1).

For Scenario 2: A high TSS value of 4,332 mg/L corresponding to the predicted TSS concentration for the maximum monthly flow (see Table 3-1).

Temperature and Density - Discharge water from the plant was assumed to have the same temperature as the river, 15.3 °C. Therefore the discharge plume is assumed to be neutrally buoyant.

3.3 Surface Water Mixing Zone Results

Scenario 1

Results of the Scenario 1 surface water mixing zone modeling are presented in far-field and near-field aerial views in Figures F-3 and F-4, respectively. Figure F-3 presents an aerial view of the location of the predicted TSS plume resulting from the proposed discharge. The contours represent concentrations above background TSS concentrations in the Mississippi River. The outermost contour represents a TSS concentration of 1 mg/L above background TSS concentration or approximately 5% above ambient conditions of 20 mg/L.

Figure F-4 presents a more detailed aerial view of the same predicted TSS plume as presented in Figure F-3. Contours are plotted for 1, 2.5 and 5 mg/L of discharge TSS concentration. This figure shows that the river velocity (parallel to the shoreline from left to right) quickly overcomes the initial discharge momentum (perpendicular and away from the shoreline). The plume, represented by the 1 mg/L contour, reaches approximately 400 feet downstream and achieves a maximum width of approximately 30 feet. The distance at which the plume reaches the surface, approximately 200 feet, is marked on Figure F-4. Once the plume reaches the surface, all predicted concentrations are below 2.5 mg/L.

Scenario 2

Results of the Scenario 2 surface water mixing zone modeling are presented in far-field and near-field aerial views in Figures F-5 and F-6, respectively. Figure F-5 presents an aerial view of the location of the predicted TSS plume resulting from the proposed discharge. The contours represent concentrations above background TSS concentrations in the Mississippi River. The outermost contour represents a TSS concentration of 2.5 mg/L above background TSS concentration or about 0.4% above ambient water conditions of 600 mg/L.

Figure F-6 presents a more detailed aerial view of the same predicted TSS plume as presented in Figure F-5. Contours are plotted for 2.5, 5, 10, 25, 50, 100, and 200 of discharge TSS concentration. This figure shows that the river velocity (parallel to the shoreline from left to right) quickly overcomes the initial discharge momentum (perpendicular and away from the shoreline). The plume, represented by the 2.5 mg/L contour, reaches approximately 5250 feet downstream and achieves a maximum width of approximately 75 feet. The distance at which the plume reaches the surface, approximately 4,600 feet downstream, is marked on Figure F-6. Once the plume reaches the surface, all predicted concentrations are below 10 mg/L.

4.0 APPLICATION OF PARTICLE DEPOSITION MODEL

4.1 Specification of Model Scenarios

Particle deposition modeling was focused on predicting long-term rates of particle deposition and accumulation resulting from the proposed outfall. Also, predictions of deposition and accumulation resulting from transient events, such as low river flows and filter backwashing, were required. Thus, a steady-state particle deposition scenario and two transient particle deposition scenarios were developed to evaluate particle deposition resulting from the proposed discharge. The steady-state scenario applied average values for river flowrate, river TSS concentration, discharge flowrate, and discharge TSS concentration because the objective of the steady-state evaluation was to predict the long-term average rate of deposition. The transient scenarios specify extreme conditions (e.g., high TSS or low flow) with the goal of predicting the impacts of worst-case transient events. Particle deposition modeling scenarios are specified below.

Steady-State Scenario

- River flowrate at average value of 106,589 cfs,
- Average annual discharge flowrate of 1.6 cfs (0.046 m^3/sec), and
- Average daily discharge TSS concentration of 2,092 mg/L.

Transient Scenario #1: 7Q10 River Flowrate

- River flowrate at the seven-day, 10-year low flow (7Q10) value of 21,500 cfs,
- Discharge flowrate of 1.6 cfs (0.046 m^3/sec),
- Minimum daily discharge TSS concentration of 295.86 mg/L, and
- Duration of event: 7 days in every 10 years.

Transient Scenario #2: Filter Backwash

- River flowrate at average value of 106,589 cfs,
- Discharge flowrate of 2.5 cfs (0.071 m^3/sec),
- Maximum monthly discharge TSS concentration of 4,332.5 mg/L, and
- Duration of event: 15 minutes every 24 hours.

The particle deposition modeling evaluation was based on several very conservative assumptions. Firstly, it is assumed that all particles settle out of the water column and onto the riverbed. The presence of large TSS concentrations (e.g. up to 2,000 mg/L) in the ambient Mississippi River clearly indicates that all suspended solids do not settle out of the water column in this waterway. In addition, according to US Army Corps of Engineers (US ACOE) personnel, suspended solids that are settleable generally settle in harbors or backwater areas, rather than in the main channel of the river (Mr. Jerry Rapp, US ACOE, personnel correspondence, 6/10/98). The proposed outfall is located near the main channel of the Mississippi River. Thus, the modeling evaluation results in overpredictions of the mass of particles settling on the riverbed.

The particle deposition modeling evaluation is also conservative in that it assumes average river flows. As a result, the model simulations neglect above average river flows. Above average river flows and especially very large river flows are known to transport particles more effectively than smaller flows. Also, large river flows are known to produce scour of the riverbed, picking up deposited materials and transporting them downstream. The net result of sediment scour is that more particles are deposited in areas with lower water velocities (e.g., backwater areas) and less particles are deposited in the main channel. The particle deposition modeling evaluation assumes that no sediment scour occurs, and therefore, results in overprediction of long-term sediment accumulation.

4.2 Specification of Input Parameter Values

In order to quantify predictions of particle settling behavior resulting from the discharge of residual-associated TSS, three discrete particle sizes were chosen. These three representative particle size groups were then evaluated to determine settling rates, deposition areas and accumulation rates for the three scenarios described above.

4.2.1 Particle Size Groups

The following three particle size ranges were assumed to characterize discharge TSS:

Large particle size: 25% of discharge TSS, particle size > 0.062 mm in diameter.

Medium particle size: 50% of discharge TSS, particle size between 0.062 mm and 0.039 mm in diameter.

Small particle size: 25% of discharge TSS, particle size between 0.039 mm and 0.0039 mm in diameter.

Particle size groups were assigned based on Imhoff Cone settling measurements collected from the present discharge waters and presented in Section 5 of the SSIS Report and sieve tests performed by the USGS on Mississippi River water in Alton. Particle size groups selections are conservative in that all particles are assumed to be settleable. Also, the particle sizes listed above were validated using US EPA guidance documents (US EPA, 1985) and were found to be typical of fine sand, silty sand, silt, silty clay, and clay that would be expected to be found in the discharge waters.

4.2.2 Additional Input Parameter Values

The Stoke's Law equation was applied to the three particle sizes to determine vertical particle velocities. Particle diameter ranges are provided above. Additional input parameter values are provided below.

Specific gravity of particles: 2.65

Channel width: 790 meters

Channel length: 5,867 meters, representing the distance to the lock and dam.

All particles were conservatively assumed to settle prior to reaching the downstream lock and dam structure. Thus, the downstream lock and dam location served as a downstream boundary for the model.

4.3 Particle Deposition Modeling Results

Steady-State Scenario

Results of the steady-state particle deposition modeling scenario are presented in aerial view in Figure F-7. Table F-1 contains the areas, deposition rates, accumulation rates predicted in the steady-state modeling scenario. Particle deposition rates of 4.38 kg/ft^2/yr, 0.037 kg/ft^2/yr, and 0.012 kg/ft^2/yr were obtained for the three particle size groups, respectively. The large size particle were predicted to settle over an area of 2.69 acres and to accumulate 2.2 in/yr. Medium and small size particles were predicted to accumulate very little (less than 0.015 in/yr) over a larger area (565 acres). Due to the overlap of settling zones for the two smaller particle classes, only two zones of deposition are indicated on Figure F-7.

Transient Scenario #1: 7Q10 River Flow

Results of the transient scenario #1 particle deposition modeling are in Table F-1. Particle deposition rates of 82.1 g/ft^2 and accumulation of 0.0275 inch per event were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible.

Transient Scenario #2: Filter Backwash

Results of the transient scenario #2 particle deposition modeling are in Table F-1. Particle deposition rates of 3.93 g/ft^2 and accumulation of 0.0013 inch per event were predicted for large size particles. Deposition of medium and small size particles was predicted to be negligible.

5.0 DISCUSSION OF RESULTS

Surface water mixing zone model predictions indicate minimal impacts of the proposed discharge in surface water in the Mississippi River. Even under worst-case conditions (i.e., Scenarios #1 and #2), the maximum TSS concentration above background was predicted to be less than 10 mg/L at the water surface. In the subsurface, the maximum TSS concentrations are greater than 50 mg/L above background levels for a distance of less than 600 feet from the outfall location.

Particle deposition model predictions indicate minimal impacts of the proposed discharge on the riverbed in the Mississippi River. Steady-state particle deposition from the proposed discharge is predicted to be less than 2.3 in/yr. The steady-state particle deposition modeling evaluation contained very conservative assumptions (e.g., all particles settle) that overestimate potential deposition. Thus, the actual particle deposition rate is less than 2.3 in/yr. Based on these results, it may be concluded that TSS from the proposed discharge will not result in significant impacts on the riverbed.

The discharge TSS modeling evaluation was based on conservative assumptions regarding the potential for discharge TSS impacts to the Mississippi River. In addition, worst-case scenarios, designed to overpredict average or normal impacts were developed and applied. Conservative, worst-case model predictions indicate minimal impacts to the water column and riverbed in the Mississippi River from the proposed discharge.

6.0 REFERENCES

ASCE. 1975. Sedimentation Engineering. ASCE Manuals and Reports in Engineering Practice – No. 54. American Society of Civil Engineers. New York NY.

Doneker, Robert L. and Gerhard H. Jirka. 1990. Expert System for Hydrodynamic Mixing Zone Analysis of Conventional and Toxic Submerged Single Port Discharges (CORMIX1). Environmental Research Laboratory, U.S. Environmental Protection Agency, Athens, GA. EPA/600/3-90/012.

Jirka, G. H., R. L. Doneker, and S. W. Hinton. 1996. User's Manual for CORMIX, A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges Into Surface Water. Office of Science and Technology, U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants (Revised 1985), Part II. Environmental Research Laboratory, Athens, GA. EPA/600/6-85/002b.

U.S. EPA. 1994. Amended Section 301(h) Technical Support Document. Office of Water. EPA 842-B-94-007. p B8-13.

Table F-1: Summary of Particle Deposition Results

Scenario & Event	Particle Group	Area (acres)	Event Duration	Deposition Rate (g/ft^2)	Accumulation (in)	Deposition Rate ($g/yr{\cdot}ft^2$)	Accumulation Rate (in/yr)
Steady-State	Large	2.69				6660	2.229
	Medium	565				36.66	0.012
	Small	565				12.22	0.004
Scenario #1 7Q10	Large	0.06	7 day/10 yr	82.1	2.75E-02		
	Medium	356	7 day/10 yr	0.014	4.71E-06		
	Small	565	7 day/10 yr	0.003	1.13E-06		
Scenario #2 Filter Backwash	Large	1.04	15 min/day	3.933	1.32E-03		
	Medium	565	15 min/day	0.008	2.82E-06		
	Small	565	15 min/day	0.006	1.88E-06		
Specific weight of sediments assumed to be 1266 kg/m^3 (ASCE, 1975)							

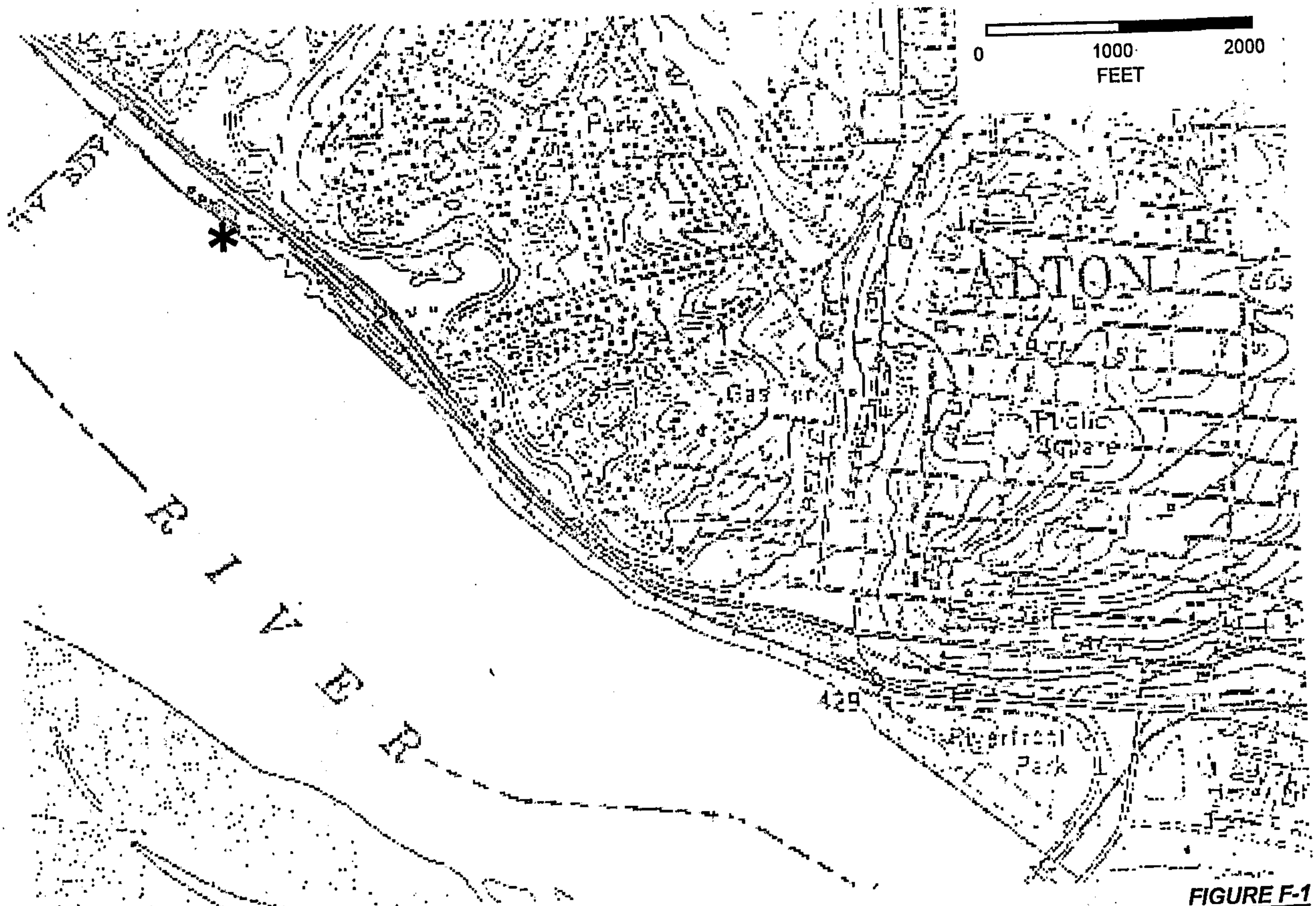

FIGURE F-1
Location of Proposed New Discharge

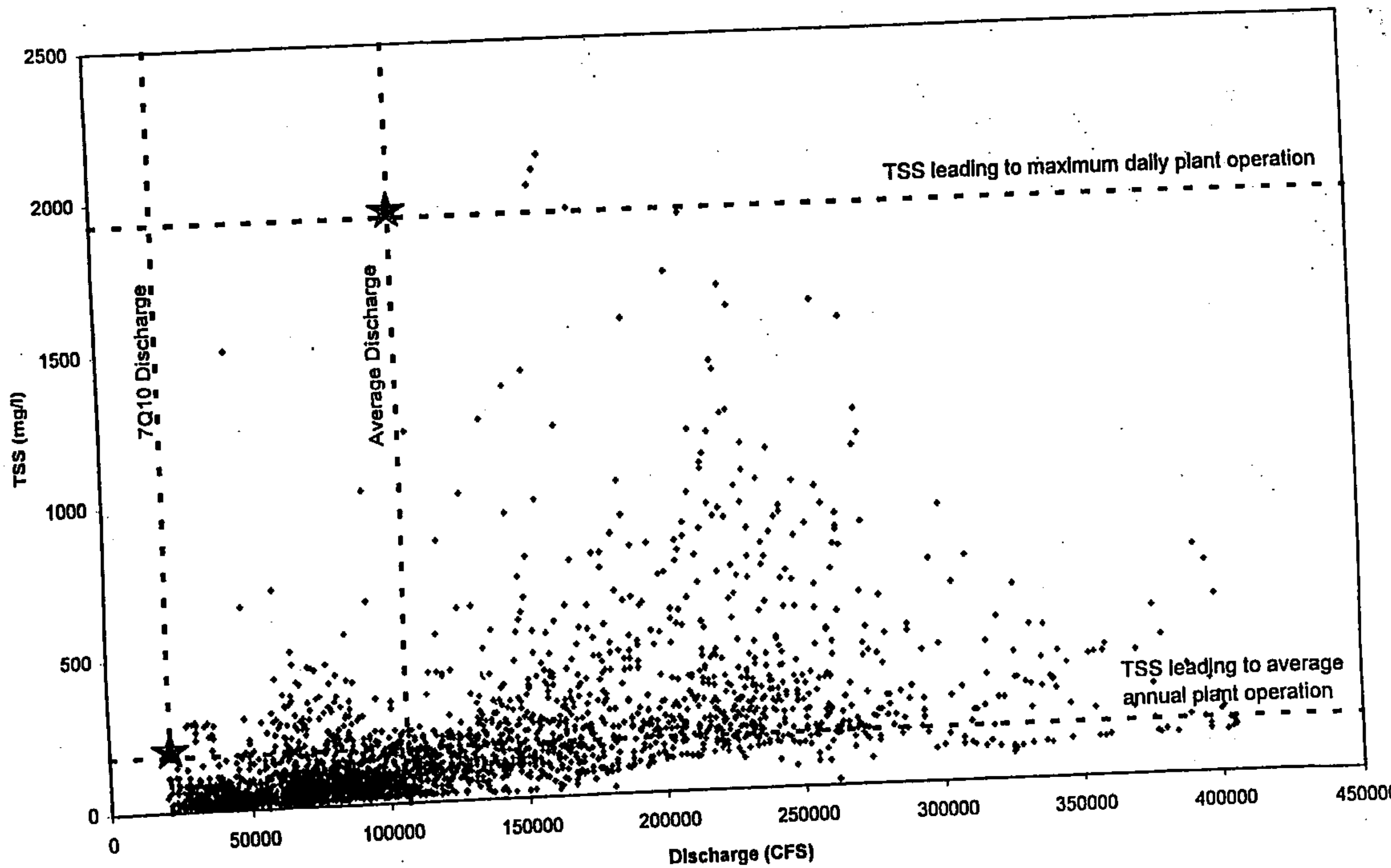

FIGURE F-2

TSS vs Flow For Mississippi River at Alton (Grafton), IL: 1/1/81 - 12/31/92

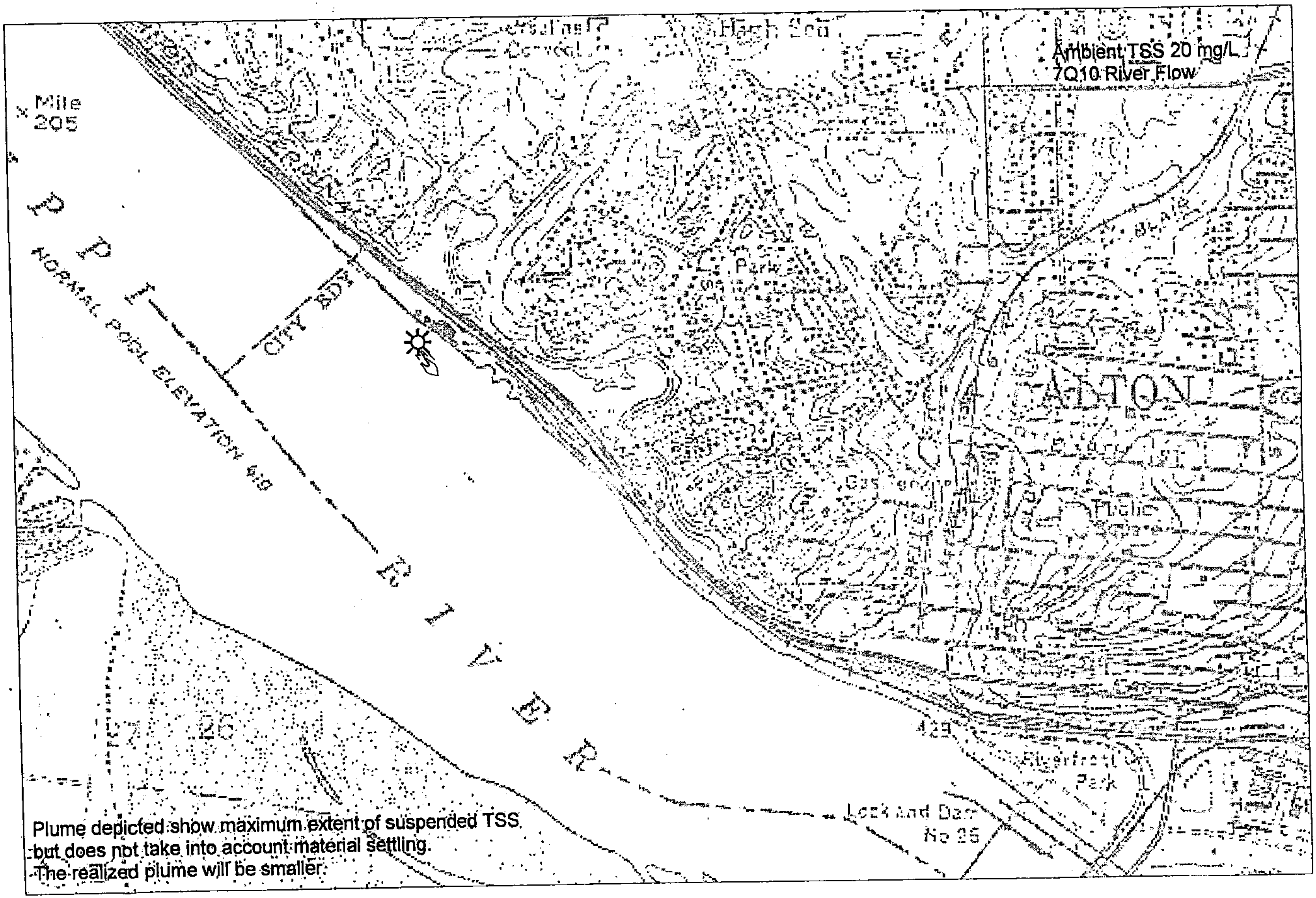

FIGURE F-3: Location of Plume 1 mg/L Above Background Concentration for Scenario 1.

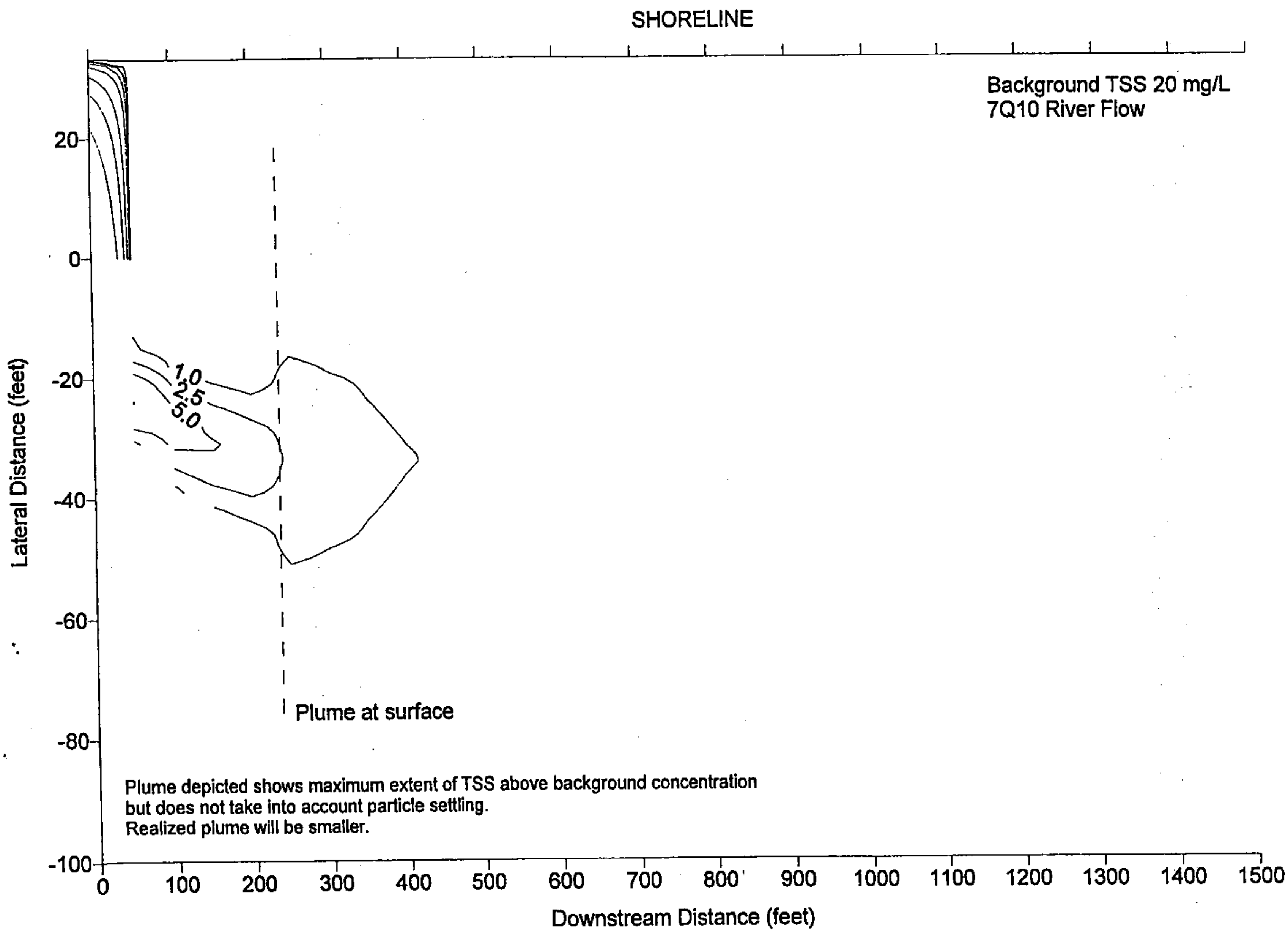

FIGURE F-4: Aerial View of Predicted TSS Plume (mg/L above background levels) - Scenario 1

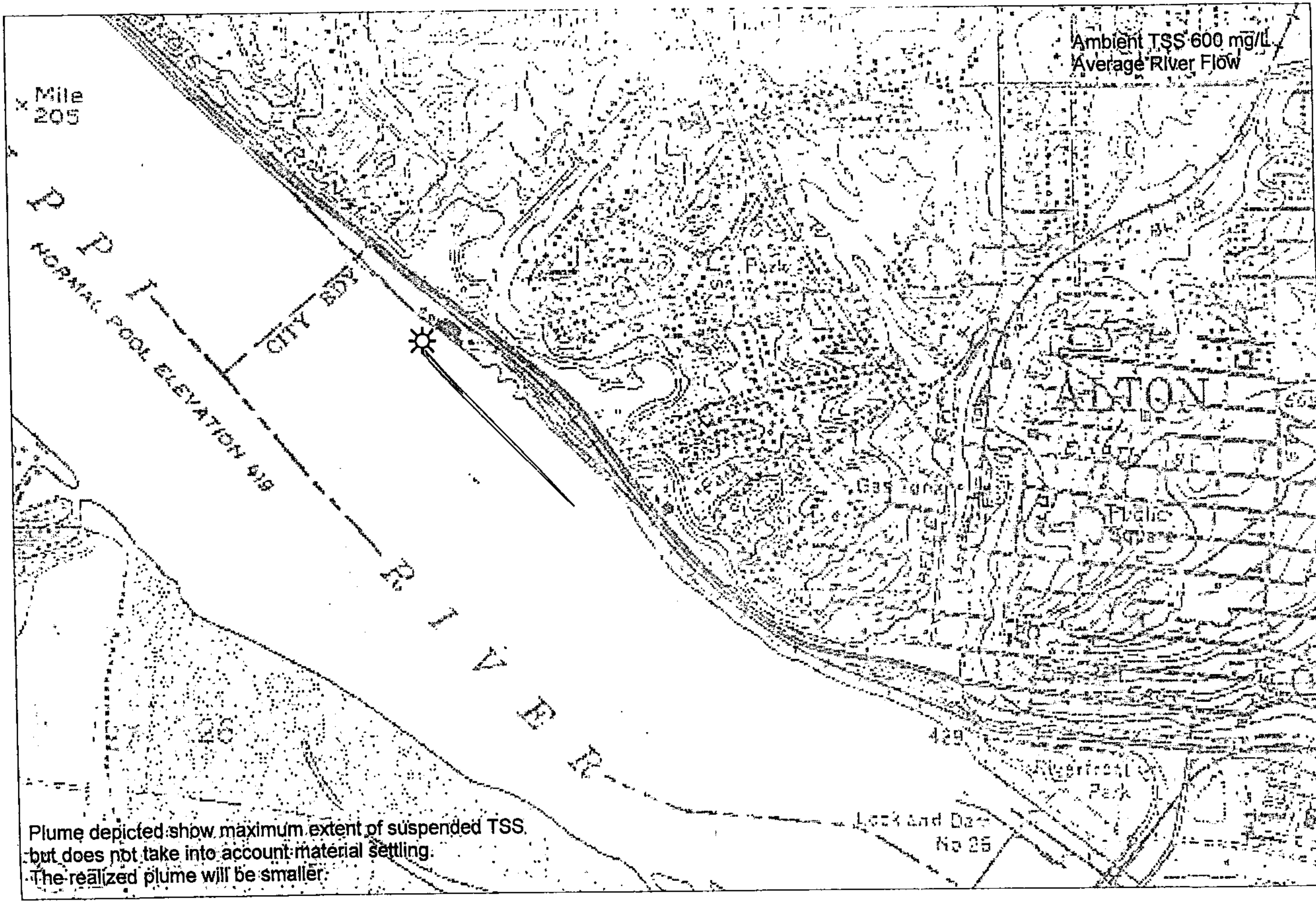

FIGURE F-5: Location of Plume 25 mg/L Above Background Concentration for Scenario 2.

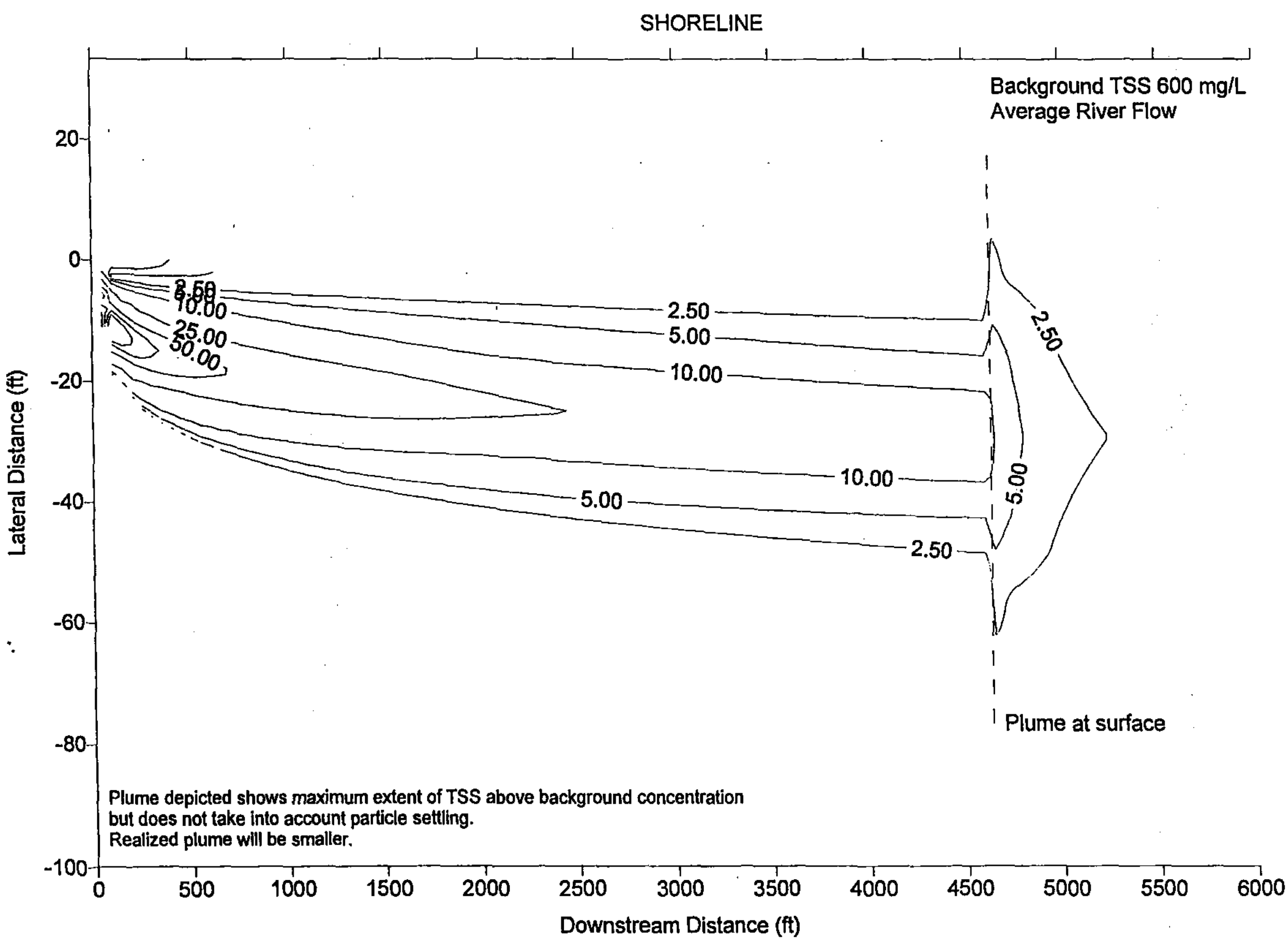

FIGURE F-6: Aerial View of Predicted TSS Plume (mg/L above background levels) - Scenario 2

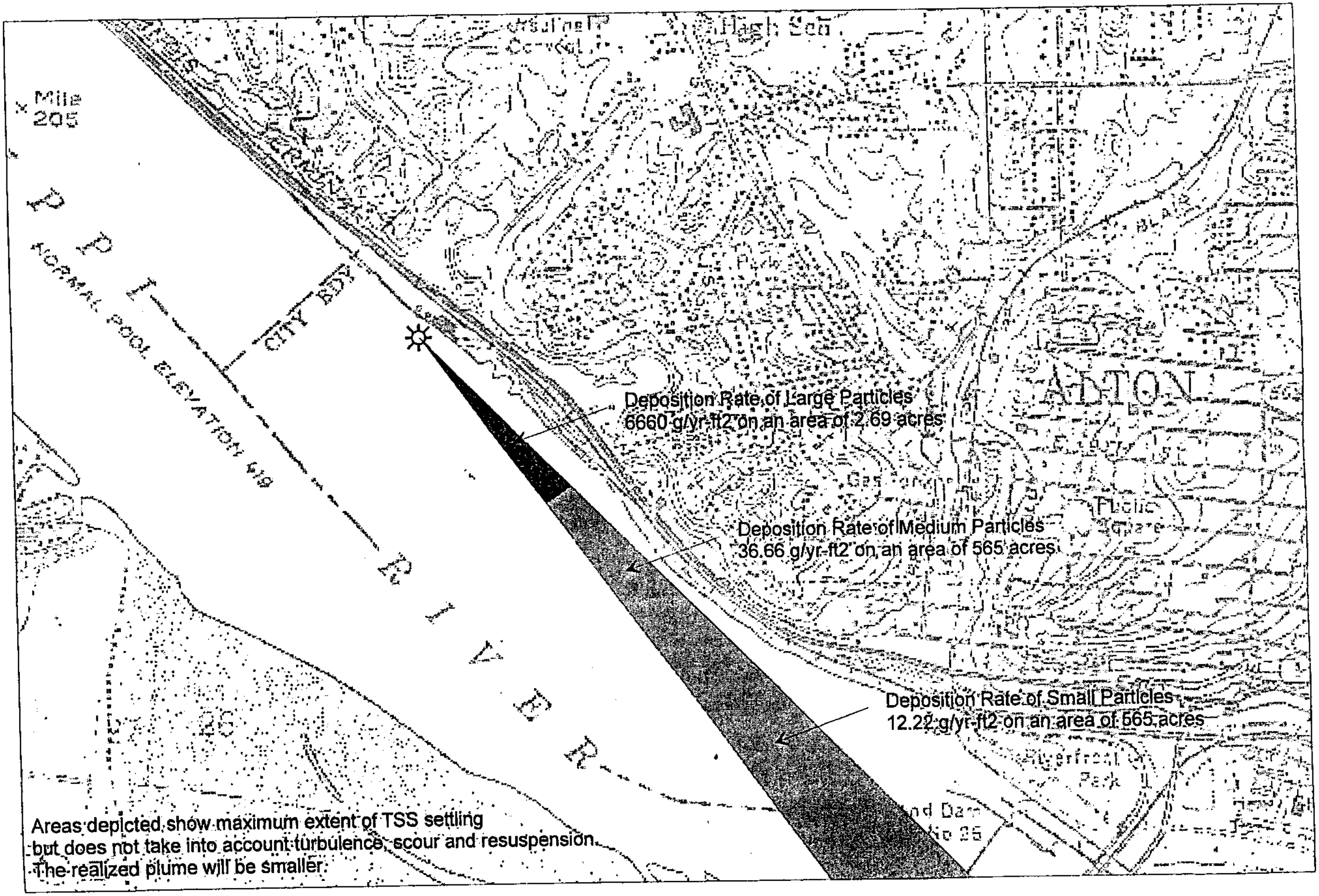

FIGURE F-7: Location of Theoretical Maximum Deposition Areas (steady-state scenario, quantities above ambient level)

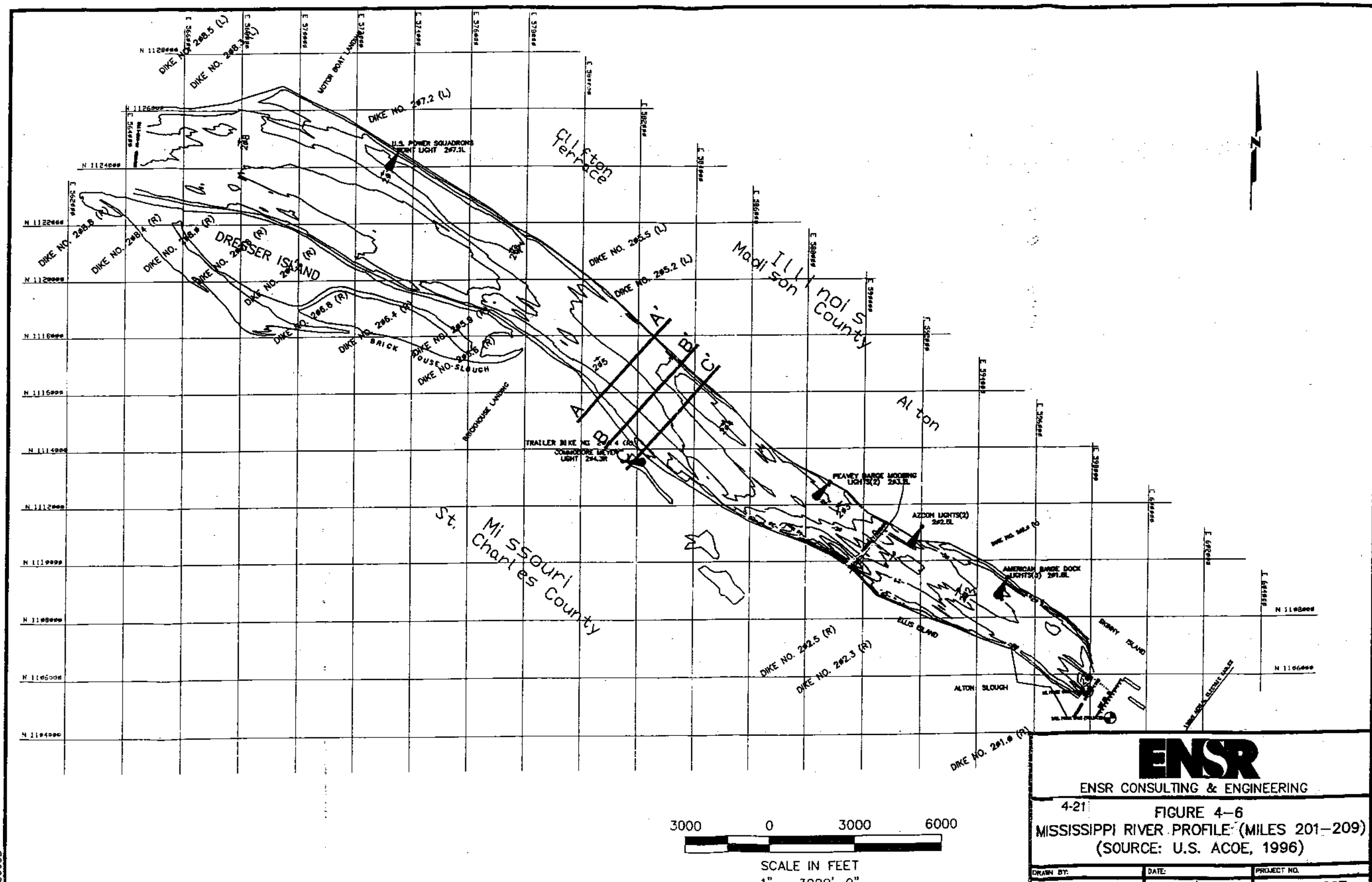

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FIGURE 4–6
MISSISSIPPI RIVER PROFILE (MILES 201–209)
(SOURCE: U.S. ACOE, 1996)

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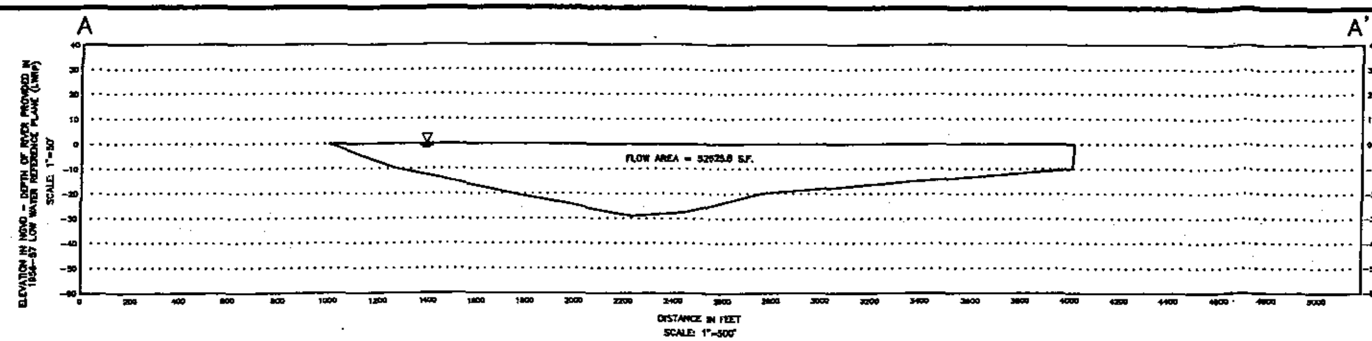
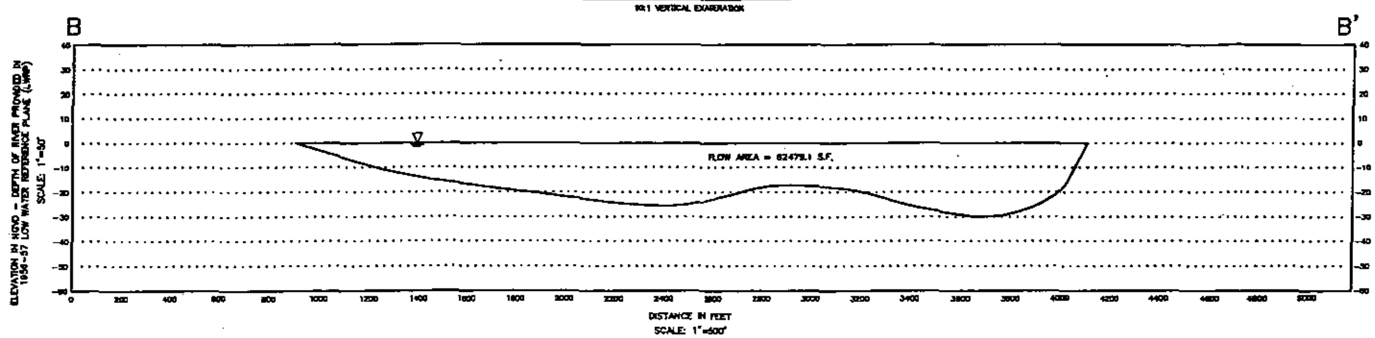


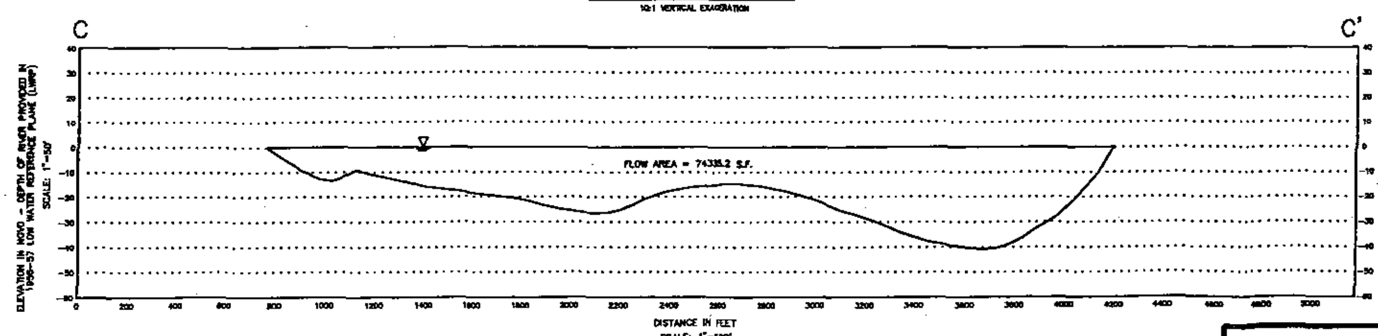
CROSS SECTION A–A'

10:1 VERTICAL EXAGERATION



CROSS SECTION B–B'

10:1 VERTICAL EXAGERATION



CROSS SECTION C–C'

10:1 VERTICAL EXAGERATION

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FIGURE 4–7
CROSS SECTIONAL AREAS
MISSISSIPPI RIVER NEAR RIVER MILE 204

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