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STATE OF ILLINOIS
Pollution Control Board

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
)
Petition of Noveon, Inc.)
) AS 02-5
)
for an Adjusted Standard from)
35 Ill. Adm. Code 304.122)

NOTICE OF FILING

TO: Dorothy M. Gunn, Clerk
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PLEASE TAKE NOTICE that on Wednesday, May 22, 2002, we filed the attached **Petition for Adjusted Standard** with the Illinois Pollution Control Board, a copy of which is herewith served upon you.

Respectfully submitted,

NOVEON, INC.

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THIS FILING IS SUBMITTED ON RECYCLED PAPER

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
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Petition of Noveon, Inc.	)	
	)	AS 02-5
	)	(Adjusted Standard)
for an Adjusted Standard from	)	
35 Ill. Adm. Code 304.122	)	

PETITION FOR ADJUSTED STANDARD

Noveon, Inc., f/k/a The BFGoodrich Company ("Noveon"), through its undersigned attorneys, respectfully petitions the Illinois Pollution Control Board ("Board") for an adjusted standard pursuant to 35 Ill. Adm. Code 104 and Section 28.1 of the Illinois Environmental Protection Act ("Act"). Specifically, Noveon requests an adjusted standard from 35 Ill. Adm. Code 304.122(b) for the effluent from Noveon's Henry, Illinois Plant.

PROCEDURAL BACKGROUND

On August 30, 1989, Noveon submitted a renewal application for NPDES Permit No. IL0001392, governing the wastewater discharge from the Noveon plant located in Henry, Illinois (the "Henry Plant"). By letter dated December 28, 1990, the Illinois Environmental Protection Agency ("Agency") re-issued a final NPDES permit for the Henry Plant. In response to the re-issued NPDES permit, on January 24, 1991, Noveon initiated a timely permit appeal (PCB 91-17).

Noveon filed the appeal based on, among other grounds, the inclusion of ammonia nitrogen effluent limitations that had not been included before in any of the previously issued Henry Plant NPDES permits. The Agency claimed that the inclusion of an ammonia nitrogen effluent limitation was based on the regulatory requirements of 35 Ill. Adm. Code 304.122(b). That provision of the Board's regulations states that:

> Sources discharging to [the Illinois River, the Des Plaines River downstream of its confluence with the Chicago River System or Calumet River System] and whose untreated waste load cannot be computed on a population equivalent basis comparable to that used for municipal waste treatment plants and whose ammonia nitrogen discharge exceeds 45.4 kg/day (100 pounds per day) shall not discharge an effluent of more than 3.0 mg/L of total ammonia nitrogen as N.

Id.

It was Noveon's position in the permit appeal that this provision was not applicable to the Henry Plant and that the Agency was without basis to include such a limitation in the NPDES Permit. Noveon contended that, since the Henry Plant's untreated waste load could be readily calculated under 35 Ill. Adm. Code 304.122(a) on a population equivalent ("PE") basis, 35 Ill. Adm. Code 304.122(b) was inapplicable because another provision of the Board's regulations, 35 Ill. Adm. Code 304.122(a), should be considered with regard to the Henry Plant's discharge. 35 Ill. Adm. Code 304.122(a) provides that:

> No effluent from any source which discharges to the Illinois River, the Des Plaines River downstream of its confluence with the Chicago River System or Calumet River System, and whose untreated waste load is 50,000 or more population equivalents shall contain more than 2.5 mg/L of total ammonia nitrogen as N during the months of April through October, or 4 mg/L at other times.

The untreated waste load for the Henry Plant is less than 32,000 PE. Thus, pursuant to Section 304.122(a), no effluent limitation for ammonia should apply to the Henry Plant because its untreated waste load can be calculated on a PE basis, and the PE is less than 50,000.

During the mid-1970's the Agency did raise the applicability of 35 Ill. Adm. Code 304.122(b) in a draft NPDES Permit for the Henry Plant, only to remove the proposed ammonia effluent limit and issue a permit without this condition. Nothing has changed with respect to the discharge from the Henry Plant that would warrant a change in that Agency decision regarding the applicability of this section.

Following initiation of the permit appeal proceeding and after two days of hearing were conducted, Noveon and the Agency entered into negotiations to resolve the issues raised in the permit appeal. After lengthy discussions with the Agency, the parties agreed that the appropriate course of action would be for Noveon to file a variance petition with the Board to enable Noveon to review and evaluate treatment alternatives that might allow the Henry Plant to reduce the levels of ammonia in its wastewater discharge. Consequently, the permit appeal proceeding was stayed by agreement of the parties through a series of decision deadline waivers, with periodic status reports to the Board, and a variance petition (PCB 92-167) was filed on October 30, 1992. By order dated November 19, 1992, the Board issued an order accepting the variance petition for hearing.

As discussed in detail later in this petition, as part of the "study variance" proceeding, Noveon and its consultants continued to review and evaluate different aspects of ammonia reduction and treatment technologies that would, perhaps, reduce the ammonia nitrogen in the wastewater from the Henry Plant. In addition, Noveon continued its internal studies focused on determining whether it could take any actions to eliminate, recover or recycle the precursors to ammonia contained in the Henry Plant wastewater. Because of the complexity of the various studies, they took longer to complete than was anticipated. A series of status reports were also filed with the Board as part of the variance proceeding, detailing the progress Noveon made in evaluating the ammonia issue at the Henry Plant. Noveon kept the Agency apprised of its efforts, and a series of progress meetings took place between representatives of Noveon and the Agency during the course of the various studies.

At the numerous meetings between the parties, the various reports detailing the potential source reduction options, pretreatment options and treatment alternatives were discussed. Based on those studies and the evaluation of the various options reviewed, Noveon and its consultants have concluded, and the evidence presented in this proceeding will show, that none of the available treatment technologies are both economically reasonable and technically feasible for Noveon to significantly reduce the ammonia in the wastewater from the Henry Plant to levels that would achieve compliance with 35 Ill. Adm. Code 304.122(b). Consequently, a variance would not be the appropriate vehicle for Noveon to obtain relief since that would require eventual compliance with the standard from which relief was requested. Accordingly, the Agency and Noveon agreed that it was appropriate to resolve the ammonia issue raised in the permit appeal by pursuing adjusted standard relief from the Board.

35 ILL. ADM. CODE 104.406 INFORMATIONAL REQUIREMENTS

I. Standard From Which Relief Is Sought -- Section 104.406(a)

Noveon does not believe that, for the reasons discussed earlier in this petition, 35 Ill. Adm. Code 304.122(b), effective 1972, is applicable to its wastewater discharge from the Henry Plant. Nonetheless, to resolve this issue with the Agency Noveon agreed to seek an adjusted standard from the ammonia effluent limit of 35 Ill. Adm. Code 304.122(b).

II. Nature of Regulation of General Applicability -- Section 104.406(b)

A. Ammonia Effluent Limitations

On January 6, 1972, the Board adopted Rule 406 of its water pollution rules, which limited the ammonia nitrogen level of certain dischargers to the Illinois River. That rule has since been amended and is now codified at 35 Ill. Adm. Code 304.122. The rule as promulgated was specifically intended to reduce the discharge of ammonia nitrogen to the Illinois River from limit, 35 Ill. Adm. Code 304.122 remained in the Board's regulations as ammonia nitrogen effluent limitations.

B. Ammonia Water Quality Standards

Noveon recognizes that as part of the triennial review of water quality standards the Agency performs under Section 303(c)(1) of the Clean Water Act, 33 U.S.C. § 1313(c)(1), significant amendments to the water quality standards for ammonia nitrogen were adopted by the Board toward the end of the 1996. In the Matter of: Triennial Water Quality Review Amendments, R94-1(B) (Dec. 19, 1996) (Final Order). As amended in 1996, the ammonia water quality standards consist of four separate un-ionized ammonia standards: an acute summer standard, a chronic summer standard, an acute winter standard and a chronic winter standard. 35 Ill. Adm. Code 302.212. The ammonia nitrogen water quality standards, as amended, have been approved by the U.S. EPA.

Noveon is also aware that the Board currently has pending before it a proposal to amend again the ammonia water quality standards. The proposed amendments, if adopted, will change the acute and general use water quality standards for un-ionized ammonia, among other proposed changes to the ammonia water quality standards. Noveon is not seeking an adjusted standard from the ammonia water quality standards, because as discussed below, Noveon meets those standards through use of a ZID and a mixing zone.

C. Mixing Zone and ZID

With an appropriately calculated zone of initial dilution ("ZID") and mixing zone, consistent with both Agency and U.S. EPA guidance on mixing zones, the discharge from the Henry Plant will meet the summer/winter acute and chronic limitations set forth in the amended ammonia water quality standards. See Exhibit 1. In Illinois water quality standards must be met at the 7Q10 low flow condition. Historical river data has been analyzed by Noveon from various monitoring stations, including the Agency's Hennepin, IL and United States Geological Survey ("USGS") Henry, IL monitoring stations to determine appropriate ambient river parameters to determine an appropriate mixing zone. See Exhibit 2.

Field studies have been conducted on the Henry Plant's discharge to analyze the in-river mixing taking place. According to the analysis arising from those field studies, based on a computed total cross-sectional area, and a maximum plume width of 160 feet in the river, the effluent plume will require less than 18% of the cross-sectional area of the total 875 foot width of the Illinois River in the vicinity of the Henry Plant for a mixing zone. In addition, the 26-acre limitation on mixing zones is easily met by the discharge from the Henry Plant. The size of the ZID calculated by Noveon's consultant is 66.5 feet, with a mixing zone of a 1,000 feet. See Exhibit 1. This ZID and mixing zone will allow the effluent from the Henry Plant to meet both the summer (April through October) and winter (November through March) acute and chronic water quality standards at total ammonia nitrogen effluent discharge limits of no greater than 189 mg/L for winter and for summer. See Exhibit 3 at Figure 1.

To ensure that maximum mixing continues to occur sufficient to meet the acute and chronic ammonia water quality standards, Noveon will agree to replace the current single-port diffuser with a multi-port diffuser, as part of the relief in this proceeding. Specifically, Noveon will install and maintain a high-rate multi-port diffuser that will immediately and rapidly disperse the treated effluent from Noveon into the Illinois River within a short distance from the diffuser (on the order of one diffuser length). The diffuser will be at least 15 ft. long and will be placed in the river so that the normal water depth over the diffuser will be about 13 ft. at low pool elevation of 440 feet above the National Geodetic Vertical Datum of 1929. There will be nine 2-in. ports set at an angle of 60 ° from horizontal, and the ports will be co-flowing with the river. The port exit velocities have been designed to achieve an exit velocity of 10 ft/sec, which will prevent habitation by biological species in the immediate vicinity of the diffuser. The diffuser has been designed, using accepted U.S. EPA diffuser models, to meet an effluent dispersion of 43:1 for an effluent flow of 1.3 mgd, and all water quality parameters will be met at the edge of the zone of initial dilution. The multi-port diffuser will be installed within a year of the granting by the Board of the adjusted standard requested herein. See Exhibit 3 for a detailed description of the multi-port diffuser.

Consequently, Noveon is not seeking adjusted standard relief from the ammonia water quality standards. Noveon is only seeking an adjusted standard from the ammonia effluent limit for discharges into the Illinois River as set forth in 35 Ill. Adm. Code 304.122(b). Noveon also seeks from the Board as part of this proceeding, a determination that the ammonia water quality standards will be met with the ZID and mixing zone calculated in Exhibit 1 and 3 and as discussed above for the Henry Plant discharge.

III. Specified Level of Justification – Section 104.406(c)

The regulation of general applicability from which Noveon seeks an adjusted standard does not specify a level of justification. Thus, the Board can grant the adjusted standard upon adequate evidence of the four criterion set forth in Section 28.1(c) of the Act, along with the information required by 35 Ill. Adm. Code 104.406. The four criterion required by Section 28.1(c) of the Act are discussed later in this petition.

IV. Facility and Process Description -- Section 104.406(d)

A. Facility and Process Description

The Henry Plant is located on 1550 County Road, 850 N., in Henry, Illinois in northwestern Marshall County. The facility was solely owned and operated by the BFGoodrich Company from its initial construction in 1958 until 1993. In 1993, the BFGoodrich Company divested the Geon Vinyl Division from the company and formed The Geon Company ("Geon"), a separate, publicly held company. In February 2001 the BFGoodrich Company sold all the assets of its chemical business, including the Henry Plant, and that former BFGoodrich division is now known as Noveon, Inc.

Today, both Geon (now known as PolyOne) and Noveon continue to operate facilities at the Henry site. The wastewater treatment system is owned and operated by Noveon, and the system continues to treat the wastewater from both PolyOne's and Noveon's Henry Plant processes. Approximately 360,000 gallons per day of effluent from the PolyOne operations are treated by the Henry Plant wastewater treatment system and the Noveon operations contribute approximately 180,000 gallons per day. The total daily discharge of process water and non-process water is approximately 800,000 gallons from the Henry Plant's wastewater treatment system. Noveon currently employs approximately 85 people and the PolyOne facility employs approximately 100 people at the site.

The Noveon Henry Plant produces rubber accelerators and antioxidants for the rubber, lubricant and plastic industries. The rubber accelerators are used in tires and other rubber goods to "accelerate" the curing process. The antioxidants are used to inhibit the oxidation process in materials such as rubber, jet fuel, greases, oils and polypropylene.

In the production of accelerators there are several key raw materials: sulfur, aniline, carbon disulfide and amines. The manufacture of accelerators is a multi-step process including the manufacture of an intermediate (sodium mercaptobenzothiazole). This intermediate is then reacted with an amine and other raw materials to form an accelerator product. The product is then isolated through filtration and drying.

There are various types of antioxidants manufactured by Noveon at the Henry Plant. In general, the antioxidant processes utilize either diphenylamine or one of several phenols as a starting material. The processes in which these products are manufactured consist of both batch and continuous reactors, filtration operations and solidification.

PolyOne produces polyvinyl chloride ("PVC") resins. These resins are sold to a variety of customers including those in the construction, household furnishings, consumer goods, electrical, packaging and transportation industries. While PolyOne is not a party to this proceeding, as noted earlier, its process wastewater is combined with the Noveon wastewater and treated in the Henry Plant's wastewater treatment system by Noveon.

Between 1985 and 1987, three major physical changes occurred at the Henry Plant. The first involved the installation of a fluidized bed coal-fired boiler, which became operational in 1985, and is now operated by PolyOne. The second involved the addition of facilities for a new rubber accelerator process building that became operational in 1986. In 1987 Noveon significantly upgraded its wastewater treatment system. This upgrade included installation of two above ground biotreators, two above ground equalization tanks and a tertiary filtration system. A third biotreator was added in 1989 and a fourth one was placed into service in 1998. Auxiliary equipment and pretreatment systems were also installed to facilitate the operation and effectiveness of the wastewater treatment system.

The levels of ammonia in the Henry Plant's wastewater were particularly puzzling and required significant investigation to discover the source, since ammonia is not a major raw material in any of the processes at either PolyOne or the Noveon Henry Plant. As an ingredient in the production processes, ammonia is only used in minor amounts in one low volume product manufactured by Noveon at the Henry Plant. The only other ammonia used by Noveon at the Henry Plant is in the ammonia cooling system, which utilizes ammonia in a closed-loop system from which no ammonia is released. PolyOne uses a small amount of ammonia as an ingredient to produce an emulsifier for use in one of the PVC processes. Ammonia, however, is not a primary ingredient in any of the processes carried out by either Noveon or PolyOne nor in the products either company produces.

Since ammonia is not used in any significant amount in the processes conducted by either Noveon or PolyOne that ultimately discharge to the Henry Plant's wastewater treatment plant, the levels of ammonia in the effluent required extensive investigation and analyses to determine why ammonia was in the effluent following treatment. As discussed later in this petition, it was ultimately discovered that the major source of ammonia is the degradation of amines that occurs in the wastewater treatment process at the Henry Plant. The efforts of Noveon to address the source of the ammonia is also fully discussed later in this petition.

B. The Henry Plant Wastewater Treatment System

The wastewater treatment system at the Henry Plant is a multi-process system that treats both process wastewater and non-process discharges including stormwater and non-contact cooling water. A block flow diagram of the system is included as Exhibit 4. The Henry wastewater treatment system has historically provided greater than 95% BOD reduction while discharging ammonia-nitrogen in an effluent concentration range of 23 mg/L to 150 mg/L. See Exhibit 5 and Exhibit 6 at 1-1.

Pretreatment of certain process wastewaters is the initial step in the treatment process. The Cure-Rite 18® wastewater is pretreated with hydrogen peroxide. Some of the PVC wastewater from PolyOne is pretreated by a wastewater stripping system that removes residual vinyl chloride. PolyOne also pretreats certain centrate waste streams prior to discharge to the Henry Plant's wastewater treatment system.

Following pretreatment, all process wastewater is collected in equalization tanks prior to transfer to the primary treatment system. Wastewater from the Henry Plant's production of accelerators and antioxidants discharge to either the polymer chemicals ("PC") equalization tank or to the Cure-Rite 18® equalization tank. PolyOne's wastewater and sidestreams from the combined wastewater treatment facility discharge to the PVC equalization tank. Site-wide stormwater runoff and sidestreams from the boilerhouse and water treatment facility discharge to two holding ponds.

In the primary treatment system, the wastewater is fed into the treatment process where pH is adjusted, coagulants are added, and a large settleable floc, a cluster of particles, is formed. The wastewater is then sent to the primary clarifier where the solids in the wastewater settle to the bottom. The solids that settle in the primary clarifier are pumped into a collection tank and processed through a filter press for dewatering before being sent off-site to a landfill as a non-hazardous special waste. The wastewater collected from the filter press is recycled back into the treatment system.

After primary clarification, the wastewater is sent to activated sludge treatment by the biotreatment system consisting of four "biotreators." The biotreators are tanks that range in size from 400,000 gal. to 1.3 million gal. and contain biomass to degrade the organic matter in the wastewater. The degradation process is augmented by the addition of air into the biotreators. The addition of air into the biotreators ensures that the biomass has sufficient oxygen to complete the degradation of organic materials and also ensures through agitation that the biomass comes into adequate contact with the organic matter contained in the wastewater.

After biological treatment in the biotreators, the wastewater flows into the secondary clarifier where more coagulants are added. The solids removed during secondary clarification are primarily biomass and are returned to the biotreators.

The wastewater from the secondary clarifier is then sent to tertiary treatment provided by a polishing filtration device called a traveling bridge sand filter. As the wastewater passes through the sand bed, additional solids removal occurs and the effluent flows into a concrete sump leading to the outfall. Any backwash from the sand filter is recycled back into the primary treatment system and is processed again.

The non-process wastewater, including non-contact cooling water, stormwater, water from the boilerhouse demineralizer and water treatment works, is discharged to a holding pond. The non-process wastewater is then either pumped into the primary treatment system or pumped directly to the sand filter to remove solids prior to discharge through the outfall.

The City of Henry operates a municipal wastewater treatment system adjacent to the Henry Plant and also contributes flow to the Henry Plant's outfall. The City of Henry municipal treatment system consists of an aerated lagoon followed by a sedimentation basin and effluent disinfection. The treated discharge from the City of Henry municipal wastewater treatment system combines with the treated Henry Plant effluent and is discharged together through the Henry Plant's outfall into the Illinois River. Compliance sampling of the Henry Plant and City of Henry waste streams is performed before the waste streams are combined. It also should be noted that the Agency has determined that the Henry Plant wastewater treatment system achieves "best degree of treatment" for all pollutants except for ammonia.

C. Description of Area Affected

Following treatment, the wastewater is discharged through Outfall 001 to the Illinois River pursuant to NPDES Permit No. IL0001392. The Illinois River is formed at the junction of the Kankakee and Des Plaines Rivers near Joliet, Illinois and runs 273 miles west, southeast and south to the Mississippi River, near Grafton, Illinois, which is a few miles upstream from St. Louis. The Henry Plant is located on the right edge of the water (when looking downstream) between river mile 198 and 199.

The Illinois River at Henry is approximately 875 feet wide, with an approximate 18 foot maximum depth. The average depth of the river is 11 feet, and it has a drainage area of approximately 13,543 square miles at Henry, IL. The USGS has operated a gauging station at Henry, Illinois since October 1981. The available USGS data for this gage indicate that the Illinois River at this location has an annual mean flow of 15,340 cfs. The Illinois State Water Survey reports an annual 7-day, 10-year low flow for the river at Henry of 3,400 cfs.

D. Description of Discharge

The effluent from the Henry Plant is discharged through an 18-inch, single-port submerged diffuser into the main channel of the Illinois River. Since the Henry Plant sits 40 to 50 feet above the Illinois River, the effluent enters the river with a great deal of velocity. This velocity causes rapid and immediate mixing, resulting in maximum effluent concentration reductions and is of sufficient turbulence to discourage habitation by aquatic organisms in the area of the diffuser. As mentioned earlier, Noveon will agree to replace the current single-port diffuser with a multi-port diffuser, as part of the relief in this proceeding.

The effluent from the Henry Plant historically has had an ammonia nitrogen concentration ranging from 23 to 150 mg/L. See Exhibit 5 and Exhibit 6 at 1-1. Based on an analysis of the Henry Plant discharge, up to 189 mg/L total ammonia can be discharged from the existing single-port diffuser during summer and winter conditions, respectively, and still achieve the applicable acute and chronic ammonia water quality standards. See Exhibit 3 at Figure 1. The replacement of the single-port diffuser with a multi-port diffuser will ensure that the discharge from the Noveon Henry Plant continues to meet applicable water quality standards. Exhibit 5 contains the most recent summary of the types and quantities of other substances present in the treated Henry Plant effluent.

Over the years Noveon expended significant resources in evaluating its production processes and wastewater treatment system in an effort to determine what was contributing to the ammonia levels in its wastewater. As noted earlier, the levels did not correspond to the small amount of ammonia used by Noveon or PolyOne in their respective processes. As a result of the various studies conducted by and on behalf of Noveon, it has been determined that ammonia is generated as a degradation product of the Henry Plant's wastewater treatment system. In particular, the degradation of amines in the wastewater treatment process produces the ammonia found in Noveon's effluent. The efforts of Noveon to evaluate various compliance alternatives are discussed in the next section of this petition.

V. Cost of Compliance and Compliance Alternatives -- Section 104.406(e)

As detailed below, Noveon has examined a variety of methods to reduce the level of ammonia in its effluent. Initially, the Henry Plant evaluated the existing treatment system's ability to nitrify, or oxidize ammonia to nitrates. These preliminary nitrification studies led Noveon to retain Brown and Caldwell, f/k/a Eckenfelder Inc., to perform treatability studies concerning the ability of the Henry Plant to nitrify. The proposal for the Brown and Caldwell nitrification work was shared with the Agency, and the Agency's comments and suggestions resulted in a revised proposal to examine the potential of the Henry Plant to operate as a single-stage nitrifying unit.

Noveon originally had Brown and Caldwell examine the ability to reduce ammonia through single-state biological nitrification in the late 1980's. This early study concluded that single-stage biological nitrification was not achievable in the existing activated sludge system. The Agency requested a more extensive study of single-stage nitrification as a means to reduce ammonia. The requested additional treatability study was completed in December 1995, and a report was prepared and submitted to the Agency. The results of the treatability study conclusively demonstrated that the Henry Plant could not achieve single-stage nitrification under existing waste loads and optimum conditions of mixed liquor pH, D.O., temperature, alkalinity, F/M ratio and mean cell residency time. See Exhibit 6 at 1-1. The study also showed that the addition of a commercially provided "nitrifier-rich" biomass to the wastewater treatment plant would not prompt the initiation of nitrification due to the wasteload characteristics and not the operating conditions. The inability of the Henry Plant wastewater treatment system to nitrify was due to inhibition of nitrifying bacteria by the PC tank and C-18 tank contents flows.

Noveon did not simply stop its efforts toward finding a solution for the ammonia issue once it was determined that nitrification would not work. Noveon has investigated various other technologies for the control and/or reduction of ammonia in its discharge. In general, Noveon examined three areas for institution of possible technology-based ammonia reduction measures:

1) in-process reductions; 2) pretreatment of the wastestream; and 3) post-treatment of the wastestream. The options that Noveon explored in each of these three categories are discussed below.

A. In-Process Reductions

Noveon explored whether it could eliminate the use of amines in the various processes or whether it could recover and/or recycle the precursors to ammonia for reuse in the system. Both of these methods were rejected as feasible compliance alternatives following analysis by a research and development team from Noveon. Amines are an essential element in many of the products that Noveon produces at the Henry Plant, and elimination of amines would essentially require the complete elimination of the affected product lines, if not closing the entire plant. The recycling option was also rejected on the basis that the recycled material was of inferior quality and would not guarantee production of the standard, high quality product Noveon's customers demand. In addition, the waste material generated in the recycling process would likely be classified as a hazardous waste, which raises concerns about cross-media impact associated with this alternative. Excess amines are, however, currently recovered from processes where recovery methods provide reusable quality materials and are not cost prohibitive.

B. Pretreatment

The second option, additional pretreatment of the wastewater, involved the removal of certain constituents before the water was sent to the wastewater treatment system. Noveon investigated a variety of pretreatment options, including morpholine recovery, TBA recovery and a liquid extraction process in which a solvent is passed counter-current to the wastewater removing the amines from the water. None of the pretreatment options would achieve reduction that would result in compliance with the ammonia effluent standard of 35 Ill. Adm. Code

304.122(b). The pretreatment options also raised various technical issues including plant personnel safety issues.

C. Post-treatment

Once it became clear that the Henry Plant could not achieve compliance through single-stage nitrification, in process reductions or pretreatment options Noveon retained Brown and Caldwell to develop preliminary process designs and cost estimates to evaluate other post-treatment alternatives that could reduce the ammonia in the effluent from the Henry Plant. The report prepared by Brown and Caldwell is attached as Exhibit 6.

The alternatives considered by Brown and Caldwell included:

1. Alkaline air stripping at different points in the wastewater treatment system (e.g., PC tank, PVC tank and secondary clarifier).
2. Struvite precipitation from the combined wastestream influent.
3. Effluent breakpoint chlorination.
4. Single-stage biological nitrification of non-PC wastestream combined with separate biological treatment of the PC tank discharge.
5. Biological nitrification of combined influent wastestream.
6. Ion exchange treatment of final effluent.

Ozonation and tertiary nitrification are two other potential compliance alternatives evaluated after Brown and Caldwell completed the evaluation of compliance alternatives discussed in Exhibit 6. Each of these post-treatment alternatives that were evaluated and the conclusions reached by Brown and Caldwell are summarized below. Flow diagrams of each these ammonia reduction alternatives are included in the figures to Exhibit 6 and in Attachment A to Exhibit 7.

1. Alkaline Air Stripping

Ammonia exists in two forms, aqueous and gaseous, and as pH increases the aqueous form becomes a gas. Thus, by increasing the pH of a wastewater stream it is possible to strip or remove the ammonia gas. This alternative as investigated involved the use of air stripping at three separate portions of the treatment system as a means of ammonia removal: 1) within the PC tank; 2) within the PVC tank and 3) the secondary clarifier effluent. See Exhibit 6 at 2-1 to 2-2.

Because samples of the PC tank and PVC tank discharges contained greater than 500 mg/L TSS, a packed tower air stripper or horizontal tray stripper would require frequent maintenance due to fouling. Thus, diffused air stripping and surface aeration processes were both selected for evaluation in both the PC tank and PVC tank. Due to the slow rate of these stripping processes, the small amount of ammonia available in these tanks, and the large flow rates of the wastewater into the PC tank and PVC tank, only stripping within existing tankage was considered. Building additional tankage and aeration equipment to address ammonia removal from these wastestreams would have offered little additional benefit since the bulk of the ammonia discharged from the Henry Plant is generated as a by-product in the downstream wastewater treatment facility. Conventional packed tower air stripping was selected for evaluation of the wastewater treatment facility effluent downstream of the secondary clarifier wastewater since this is a well-established stripping technology.

The batch air stripping test results from 1996 for the PC tank, PVC tank and secondary clarifier wastewater indicated that some ammonia reduction in those wastestreams could be achieved. A combined removal of ammonia from the wastewater, however, of less than 20% would be achieved by treatment of either the PC tank or PVC tank wastewater using surface aeration stripping technology. See Exhibit 6 at 2-1 to 2-2. This low level of ammonia reduction means air stripping from the PC tank and PVC tank would not achieve sufficient ammonia reduction that would allow the Henry Plant meet the effluent limitation of 35 Ill. Adm. Code 304.122(b). Further, given the present worth costs (capital, operation and maintenance costs) of $2.3 million for PC tank treatment and $14.1 million for PVC tank treatment, this alternative was also deemed economically unreasonable in light of the high costs and low ammonia reduction obtained. See Exhibit 7 at pgs. 2-3.

The ammonia removal achieved from the secondary clarifier was greater than 95% using packed tower air stripping technology. This technology was evaluated again in 2000. One difficulty with this alternative is that it would increase TDS by more than 20%, which could lead to aquatic toxicity of the effluent. The most important difficulty with this treatment alternative is its high operation, maintenance and installation costs, which makes it an economically unreasonable one with present worth costs of over $14 million. See Exhibit 7 at pgs. 2-3. The costs associated with this alternative are so high because additional equipment is required to remove the ammonia from the off-gases.

2. Struvite Precipitation

This alternative involved an analysis of the ammonia reduction achieved by the precipitation of struvite ($NH_4MgPO_4.6H_2O$) from the combined Noveon Henry Plant and PolyOne wastestream. See Exhibit 6 at 2-2 to 2-4. The results of the batch treatability studies indicate that under certain operating conditions the combined wastestream ammonia concentration can be reduced to approximately 25 mg/L in the treatment plant influent. This treatment process, however, would provide only a 24% reduction in the average final *effluent* ammonia level at a present worth cost of $5.1 million. See Exhibit 7 at 2-3. This alternative also would increase TDS in the Henry Plant effluent.

In sum, struvite precipitation would not result in compliance with the ammonia effluent limit. Because only a small portion of the wastewater nitrogen load would be removed from the Henry Plant treatment system by struvite precipitation, combined with its high costs, this is not a feasible compliance alternative.

3. Effluent Breakpoint Chlorination

Brown and Caldwell also evaluated the use of chlorine to achieve ammonia reduction. This alternative involved gravity discharge of the secondary clarifier wastewater to a reaction tank where chlorine gas would be sparged into the tank and caustic soda added to maintain a pH of approximately 6.9. See Exhibit 6 at 3-3 to 3-4. Following the addition of chlorine, the wastewater would be discharged to the existing sand filters.

This alternative could meet the ammonia standard set forth in 35 Ill. Adm. Code 304.122(b). See Exhibit 6 at 3-4. The problem it presents, however, is that breakpoint chlorination is prohibitively expensive, at a present worth cost of $9.7 million, which makes it economically unreasonable. See Exhibit 7 at pgs. 2-3. Thus, this alternative is economically unreasonable. This alternative will also dramatically increase effluent TDS and may likely result in the formation of chlorinated organics in the effluent.

4. Single-stage Biological Nitrification of Non-PC Wastewater

Noveon's consultant also examined what level of ammonia reduction would occur by first-stage nitrification of the non-PC wastewater followed by second-stage biological treatment of the PC tank wastewater after combination with effluent from the first-stage reactor. It was determined after the batch treatability study that this was not a feasible compliance alternative because of the low level of ammonia reduction that was achieved. The percentage of ammonia reduction was only 47% and yet had a present worth cost of $4.9 million. See Exhibit 6 at 2-4 to 2-7 and Exhibit 7 at pgs. 2-3.

5. Biological Nitrification of Combined Wastewater

This alternative required pH reduction to 2 of the PC tank discharge, followed by river water addition and combined single-stage nitrification with non-PC wastestreams. The results of the analysis by Noveon's consultant, Brown and Caldwell, showed that biological nitrification of the combined wastewater stream was a technically feasible compliance alternative. See Exhibit 6 at 4-1. This alternative suffers from a lack of reliability, which is necessary for consistent compliance, since it is sensitive to the variable characteristics inherent in the wastewater produced by the different batch processes at the Henry Plant.

Further, biological nitrification is a very costly alternative. Brown and Caldwell estimated that the present worth costs of this alternative at $11.7 million. See Exhibit 7 at pgs. 2-3. Those costs make this an economically unreasonable alternative, particularly in light of the reliability concerns associated with it.

6. Ion Exchange

One other compliance alternative analyzed by Brown and Caldwell was ion exchange treatment of the secondary clarifier effluent using clinoptilolite, an ammonia selective ion exchange resin. See Exhibit 6 at 2-9 to 2-10; 3-4. This alternative could meet the ammonia effluent standard of 35 Ill. Adm. Code 304.122(b). The batch treatability test results demonstrated that approximately 50 lbs. of clinoptilolite would be required to remove each pound of ammonia. This poor removal efficiency was presumed to be due to the large concentration of competing ions in the effluent. Id. at 3-4. The poor selectivity of this alternative for removing ammonia precluded further consideration of ion exchange as a compliance alternative. This alternative had a present worth cost of $5.1 million. See Exhibit 7 at pgs. 2-3.

7. Ozonotion

This ammonia treatment alternative was evaluated recently by Noveon's consultant as a compliance alternative. This alternative could meet the ammonia standard set forth in 35 Ill. Adm. Code 304.122(b). It was rejected as an alternative due to its high present worth costs of $20.3 million. See Exhibit 7 at pgs. 2-3. Further, it would significantly increase the effluent TDS concentrations. This alternative would likely also convert some of the effluent non-degradable COD into BOD, which could cause BOD effluent limit violations.

8. Tertiary Nitrification

This alternative would involve pumping the secondary clarifier effluent through a separate aeration basin containing fixed film media that nitrifying bacteria would grow on. Alkalinity and D.O. would be controlled in this basin to meet the demands associated with nitrification. Effluent from this tank would be directed to the existing tertiary filtration process that would be expanded to accommodate the additional solids loading. Results of analyses dating back to the late 1980s and confirmed during the 1990s indicate this process is a technically feasible compliance alternative. The difficulty with this alternative is that it lacks reliability, which is necessary to achieve compliance, due to its great sensitivity to variations in wastewater characteristics that occur with the Henry Plant's batch processes.

Further, tertiary nitrification is a very costly alternative. Brown and Caldwell estimated that the present worth costs of tertiary nitrification is $11.4 million. See Exhibit 7 at pgs. 2-3.

Those costs make this an economically unreasonable alternative, particularly in light of the reliability concerns associated with it.

In sum, Noveon evaluated a number of in-process reductions, pretreatment measures and post-treatment measures as methods to achieve compliance with the effluent limits of 35 Ill. Adm. Code 304.122. The results of its evaluation demonstrate that there is no alternative that is both technically feasible and economically reasonable that would allow the Henry Plant to achieve compliance with the ammonia effluent limit of 35 Ill. Adm. Code 304.122(b).

VI. Proposed Adjusted Standard -- Section 104.406(f)

Noveon proposes the adoption by the Board of one of the following alternatives as the adjusted standard language:

Alternative #1

> Noveon, Inc. ("Noveon") is hereby granted an adjusted standard from 35 Ill. Adm. Code 304.122. Pursuant to this adjusted standard, 35 Ill. Adm. Code 304.122 shall not apply to the discharge of effluent into the Illinois River from the Noveon plant located at 1550 County Road, 850 N., in Henry, Illinois as regards ammonia nitrogen. The granting of this adjusted standard is contingent upon the following conditions:
>
> A. Noveon shall not discharge calculated un-ionized ammonia at concentrations greater than 3.5 mg/l during the months of April through October and 7.9 mg/l during the months of November through March from its Henry, Illinois plant into the Illinois River.
>
> B. Discharge into the Illinois River shall occur through a diffuser that is at least 15 ft. in length, with 9 two-inch ports, angled at 60 degrees from horizontal, co-flowing with the river, designed to achieve an effluent dispersion of 43:1.

Alternative #2

> Noveon, Inc. ("Noveon") is hereby granted an adjusted standard from 35 Ill. Adm. Code 304.122. Pursuant to this adjusted standard, 35 Ill. Adm. Code 304.122 shall not apply to the

discharge of effluent into the Illinois River from the Noveon plant located at 1550 County Road, 850 N., in Henry, Illinois as regards ammonia nitrogen. The granting of this adjusted standard is contingent upon the following conditions:

A. The water quality standards will be met by the Noveon Henry plant limiting its total ammonia nitrogen discharge to 1200 pounds per day during the months of April through October and 1735 pounds per day during the months of November through March.

B. Discharge into the Illinois River shall occur through a diffuser that is at least 15 ft. in length, with 9 two-inch ports, angled at 60 degrees from horizontal, co-flowing with the river, designed to achieve an effluent dispersion of 43:1.

Alternative #3

Noveon, Inc. ("Noveon") is hereby granted an adjusted standard from 35 Ill. Adm. Code 304.122. Pursuant to this adjusted standard, 35 Ill. Adm. Code 304.122 shall not apply to the discharge of effluent into the Illinois River from the Noveon plant located at 1550 County Road, 850 N., in Henry, Illinois as regards ammonia nitrogen. The granting of this adjusted standard is contingent upon the following conditions:

A. Noveon shall not discharge total ammonia nitrogen at concentrations greater than 155 mg/l during the months of April through October and 225 mg/l during the months of November through March from its Henry, Illinois plant into the Illinois River.

B. Discharge into the Illinois River shall occur through a diffuser that is at least 15 ft. in length, with 9 two-inch ports, angled at 60 degrees from horizontal, co-flowing with the river, designed to achieve an effluent dispersion of 43:1.

VII. Environmental Impact -- Section 104.406(g)

The granting of the adjusted standard will not result in any adverse environmental impact. As noted earlier, the Board's rationale at the time 35 Ill. Adm. Code 304.122 was adopted was premised upon the belief that larger dischargers were contributing to D.O. sags. The study underlying that belief was later refuted by its authors when it was discovered that the D.O. sags were occurring not as a result of larger dischargers but primarily because of sediment oxygen demand. The discharge from the Henry Plant will not have a measurable effect on the D.O. in the Illinois River.

Further, under the Board's mixing zone regulations, it is appropriate to allow the mixing of effluent with the receiving stream before determining compliance with water quality standards. See, e.g., 35 Ill. Adm. Code 302.102. No adverse environmental impact will occur because at the edge of the ZID and mixing zone calculated by Noveon's consultant, consistent with Agency and U.S. EPA guidance, both the winter (November through March) and summer (April through October) acute and chronic water quality standards for ammonia will be readily met. See Section II C. of this Petition.

The regulations set forth at 35 Ill. Adm. Code 302.102 govern allowed mixing, mixing zones and zones of initial dilution. The calculated ZID and mixing zone proposed as a part of this adjusted standard will meet each of the requirements of 35 Ill. Adm. Code 302.102(b), in that:

A. Mixing will be confined in an area or volume of the Illinois River no larger than the area or volume which would result after incorporation of a multi-port diffuser, engineered location and configuration of discharge points to attain optimal mixing efficiency of effluent and the Illinois River.

B. Mixing will not occlude any tributary mouth or otherwise restrict the movement of aquatic life into or out of the tributary.

C. Mixing will not occur in waters adjacent to bathing beaches, bank fishing areas, boat ramps or dockages, or any other public areas.

D. Mixing will not occur in waters containing mussel beds, endangered species habitat, fish spawning areas, areas of important aquatic life habitat, or any other natural features vital to the well being of aquatic life in such a manner that the maintenance of aquatic life in the body of water as a whole is adversely affected.

E. Mixing will not occur in waters which contain intake structures of public or food processing water supplies, points of withdrawal of water for irrigation, or watering areas accessed by wild or domestic animals.

F. Mixing will allow for a zone of passage for aquatic life in which water quality standards are met.

G. The area and volume in which mixing occurs, alone or in combination with other areas and volumes of mixing, will not intersect any area or volume of any body of water in such a manner that the maintenance of aquatic life in the body of water as a whole is adversely affected.

H. The area and volume in which mixing occurs, alone or in combination with other areas and volumes of mixing, will not contain more than 25 percent of the cross-sectional area or volume of flow of the Illinois River including areas where the dilution ratio is less than 3:1. Mixing will not occur in an area of the Illinois River having a zero minimum 7Q10.

I. Mixing will not occur where the water quality standard for ammonia is already violated in the Illinois River.

J. The total Illinois River flow is not used for mixing.

K. The source of effluent is limited to a total area and volume of mixing no larger than that allowable for a single outfall.

L. The area and volume in which mixing will occur is as small as is practicable under the limitations prescribed in 35 Ill. Adm. Code 302.102, and in no circumstances does the mixing encompass a surface area larger than 26 acres.

Thus no adverse environmental impact, including harm to aquatic life, will result from the granting of the requested adjusted standard, and the mixing, zone of initial dilution and mixing zone that are an integral part of the relief Noveon seeks meet the requirements of 35 Ill. Adm. Code 302.102.

VIII. Justification for Adjusted Standard – 104.406(h)

As noted previously, the regulation of general applicability from which Noveen seeks an adjusted standard does not specify a level of justification for such a standard. Section 28.1(c) of the Act, however, allows the Board to grant an adjusted standard in the absence of a specified level of justification if the Board determines based upon adequate proof by the petitioner that:

> A. Factors relating to the petitioner are substantially different from the factors relied upon by the Board in adopting the general regulation;
>
> B. The existence of those factors justifies an adjusted standard;
>
> C. 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
>
> D. The adjusted standard is consistent with federal law.

415 ILCS 5/28.1(c). Each of these factors is discussed below.

1. Substantially Different Factors -- Section 28.1(c)(1)

The existing ammonia effluent regulation in 35 Ill. Adm. Code 304.122 is premised upon two factors: the ability to treat ammonia and the desire to address D.O. concerns in the Illinois River. Regarding the ability to treat ammonia, in amending the generally applicable rule the Board expressly noted that "present technology is capable of meeting this limit and should result in the removal of much ammonia nitrification oxygen demand ... from these stressed waterways." In the Matter of Water Quality Standards Revisions, R72-4 (Nov. 8, 1973) (Final Opinion). In general, there is technology capable of meeting the ammonia nitrogen limitation set forth in 35 Ill. Adm. Code 304.122. Specifically as applied to the Henry Plant wastewater, however, the numerous investigations and studies conducted by and on behalf of Noveon have established that there are no alternatives that are both technologically feasible and economically reasonable to achieve the ammonia reduction necessary to comply with 35 Ill. Adm. Code 304.122(b).

Secondly, the underlying technical justification that led the Board to adopt the general rule, a concern about D.O. sags in, among other rivers, the Illinois River was later refuted as being caused primarily by the discharge of ammonia nitrogen. Rather, the D.O. sags were later determined to be primarily caused by sediment oxygen demand. Ammonia discharged at the level requested by Noveon will thus have minimal, if any, impact upon the level of D.O. in the Illinois River. See Exhibit 2. Nor will it contribute to any water quality violations or harm to aquatic life as discussed in Section VII. above. In sum, the factors relied upon by the Board in adopting what is now 35 Ill. Adm. Code 304.122 were substantially different than those applicable to the Noveon Henry Plant.

2. Adjusted Standard Justification -- Section 28.1(c)(2)

One factor that must be taken into consideration when adopting environmental regulations in the State of Illinois is economic reasonableness. 415 ILCS 5/27. The ammonia nitrogen effluent limit from which Noveon seeks relief was adopted based upon balancing the potential adverse impact upon D.O. against the cost and ease of control. On both of these latter points, adverse impact and cost, the balance weighs heavily towards the requested adjusted standard relief. The beneficial impact, if any, to the Illinois River would be minimal if Noveon were required to meet the ammonia nitrogen limitation of 35 Ill. Adm. 304.122(b). Further, given the lack of any discernible environmental benefit, the high cost of the technically feasible control technology makes it economically unreasonable for Noveon to meet the ammonia effluent limitation and warrants the requested adjusted standard relief.

3. Environmental or Health Impacts -- Section 28.1(c)(3)

There is no measurable impact upon the environment or human health that would result from the granting of this adjusted standard. As discussed thoroughly in Section VII. in this petition, the discharge from the Henry Plant will meet the winter and summer acute water quality standards for ammonia at the edge of an appropriately calculated ZID. The winter and summer acute and chronic standards will also be met at the edge of an appropriately calculated mixing zone. Thus, the impact will not be significantly more adverse than that contemplated by the regulation of general applicability.

4. Consistency With Federal Law -- Section 28.1(c)(4)

The requested adjusted standard is consistent with federal law. The requested relief applies only to ammonia discharges from the Henry Plant. There are no applicable federal numeric effluent standards or water quality standards for ammonia. Under federal regulations:

> A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. States adopt water quality standards to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act (the Act). "Serve the purposes of the Act" (as defined in sections 101(a)(2) and 303(c) of the Act) means that water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation.

40 C.F.R. 131.2. Under 40 C.F.R. 131.4(a) "states are responsible for reviewing, establishing and revising water quality standards." In turn, pursuant to 40 C.F.R. 131.5(a), "EPA is to review and to approve or disapprove the State-adopted water quality standards." These standards are to be protective of the designated uses (§131.5(b)) and, where those uses are not protected, this must be supported by "appropriate technical and scientific data and analyses." (§131.5(b)(4)). A state is allowed to remove a designated use, which is not an existing use, if it "can demonstrate

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
Petition of Noveon, Inc.	)	
	)	AS 02-_____
	)	(Adjusted Standard)
for an Adjusted Standard from	)	
35 Ill. Adm. Code 304.122	)	

Exhibit List

1. AquAeTer June 4, 2001 memorandum "Review of Dispersion Achievable for Meeting Water Quality Limits at the PMD Group, Inc. [Noveon] Henry Facility."
2. AquAeTer October 3, 2000 memorandum "Analysis of DO in the Illinois River Downstream from Henry, Illinois."
3. AquAeTer June 22, 2001 report "Mixing Zone/ZID Issues, Illinois River at Henry, Illinois."
4. Wastewater Treatment Plant Block Flow Diagram.
5. 2001 Discharge Data Summary.
6. Eckenfelder Inc. June 1996 "Evaluation of Treatment Alternatives for Reducing Final Effluent Ammonia Load."
7. Brown and Caldwell May 17, 2002 memorandum.
8. Affidavit of David E. Giffin.

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optimizing environmental resources ♦ water, air, earth **AquAeTer**

MEMORANDUM

TO: Richard Kissel and Mark Latham, Gardner, Carton & Douglas
FROM: Mike Corn, P.E., **AquAeTer**
DATE: June 4, 2001
JOB NO: 001105
RE: **Review of Dispersion Achievable for Meeting Water Quality Limits at the PMD Group, Inc., Henry Facility**

In 1989, a dispersion study of the existing single port diffuser was conducted using specific conductance at 25 °C (conductivity) as the tracer. From this information, dispersion from the existing diffuser and physical dimensions of the zone of initial dilution (ZID) and the total mixing zone were estimated. Based on this tracer study, the diffuser was found to have a ZID that extended a total distance of 66.5 ft downstream, based on the discharge length scale, defined as the centerline of the plume in the downstream direction, and the flux average dispersion (FAD) at the end of the ZID. This distance was based on the in situ measurements of conductivity and also on the minimum distance prescribed by the Illinois Environmental Protection Agency (IEPA) for ZIDs, which in this case is based on 50 * the square root of the cross-sectional area. The dispersion achieved at the edge of the ZID based on the tracer study results of 13.2:1.

Additionally, in 1994 and 1995, as assessment of the Illinois River background water quality conditions at Marseilles, Illinois were as follows:

Parameter	Units	Summer	Winter
Total Ammonia	mg/L	0.297	0.8
NH_3, 75th percentile	mg/L	0.011	0.005
Temperature, 75th percentile	°C	26.0	6.5
pH, calculated 75th percentile	S.U.	7.77	7.63

Based on the above data, the critical period for meeting water quality numeric effluent limits was during summer periods. Meeting the numeric water quality limits during winter conditions were not an issue with this discharge based on the ZID described above and under the specified winter time conditions.

A multiport high-rate diffuser was also conceptually designed to maximize the dispersion from the combined PMD Group and City of Henry discharge. Based on a flow of 1.0 million gallons be low compared to the upstream stations that were taken in the early to mid-afternoon. Typically, DO in systems influenced by algae reflect average DO concentrations in the diurnal cycle around noon to about 1400. Therefore, the period average DO concentrations may be more reflective of River DO conditions. Regardless, the DO concentrations are not reflective of a stressed system, although there have been instances (grab samples) of DO concentrations less than the 5 milligrams per liter (mg/L) standard.

3. Nitrogen concentrations at these four stations are around 0.75 to 1.7 mg/L total kjeldahl nitrogen (organic plus ammonia-nitrogen). These are not excessive nitrogen levels. It is unclear from the data how much of the TKN is ammonia, but it appears to be on the order of 0.05 to 0.3 mg/L for September.

4. Nitrate concentrations are high in the River upstream from Henry (i.e., 3 to 4 mg/L at Marseilles) and this is reflective of nitrification in the River upstream.

5. Phosphorous is very high in the Illinois River with total phosphorous recorded in September around 0.5 mg/L. Phosphorous would control this system, because it is in excess of what is required by the algae. Total phosphorous in the range of 0.05 to 0.15 mg/L is a typical range. The BF Goodrich wastewaters are phosphorous limited and the facility adds phosphorous to aid in the biological process. The River phosphorous is most likely controlled by nonpoint sources (i.e., farming and most likely the City of Chicago effluent discharges).

6. The nitrogen to phosphorous ratio for healthy algae populations ranges from 60:1 to 10:1. Phosphorous at 100 ug/L for free-flowing streams and 50 ug/L for lake-like settings is considered adequate for preventing nuisance algae blooms. For the Illinois River, the N:P ratio is around 3:1, which would indicate that phosphorus is in excess.

The U.S. Environmental Protection Agency (USEPA) wasteload allocation model, QUAL2e, was utilized to project impacts of the BF Goodrich effluent to the Illinois River. Model inputs were projected from USGS and IEPA synoptic water quality data and from deoxygenation and reaeration/algae productivity rates based on similar rivers where specific wasteload allocation data have been collected. No specific assimilative capacity study data were available from the agencies, although the Illinois Water Survey may have these data that may be obtained through a Freedom of Information Act (FOIA) request.

The Henry discharge included both the BF Goodrich effluent and the Henry publicly owned treatment works (POTW) discharge through the BF Goodrich effluent diffuser. The ultimate carbonaceous biochemical oxygen demand ($CBOD_u$) was estimated at $CBOD_u/BOD_5$ ratio of 4:1. The following input parameters were used for the combined BF Goodrich and Henry POTW discharge.

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October 3, 2000 001105/3

Mr. Richard Kissel
Gardner, Carton & Douglas
Quaker Tower, Suite 3400
321 N. Clark Street
Chicago, Illinois 60610-4795

RE: **Analysis of DO in the Illinois River Downstream from Henry, Illinois**

Dear Mr. Kissel:

AquAeTer, Inc. (AquAeTer) has conducted screening level dissolved oxygen (DO) modeling of the Illinois River from about Illinois River mile (IRM) 200 to IRM 170. The BF Goodrich treated effluent diffuser discharges to the River at about IRM 198. Data obtained form the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) were used to develop an input data set for the River which is presented in Attachment 1. Stream hydraulic characteristics were estimated based on other similar river/lake settings at similar river depths and widths. Specific points of interest from the available data are listed below.

1. The critical low-flow high-temperature month has been assumed to be September when the 7-day 10-year low flow (7Q10) is around 2,900 cubic feet per second (cfs) (at Marseilles) and the critical temperature is around 77.7 degrees Farenheit (°F).

2. DO saturation in the River ranges as follows:

Location	Period Average (% of Saturation)	September Average (% of Saturation)
Illinois R. @ Marseilles	109.9	101.8
Illinois R. @ Hennepin	104.31	108.8
Illinois R. @ Lacon	97.60	96.4
Illinois R. @ Peoria	106.52	94.2

Normally, 85 percent DO saturation is considered typical stream conditions. These DO saturations are reflective of a stream that is primarily reoxygenated by the resident algae populations. It is important to note that the DO measurements at the Water Intake at Peoria were taken around 10 am and would be expected to

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per day (mgd) from the PMD Group effluent discharge and 0.3 mgd from the City of Henry for a total flow of 1.3 mgd, a 15 ft long diffuser with 4 4-in ports placed in 13 ft of water and with ports at a 60 ° angle from the bottom and parallel to the ambient current, a dispersion of 43:1 can be achieved on the order of one diffuser length downstream or from 7.5 to 22.5 ft downstream (½ to 1 ½ diffuser lengths). The dispersion modeling was completed for a 7-day 10-year low flow (7Q10) that occurs in September. The CORMIX model was used to project the diffuser dispersion. The diffuser would result in all numeric water quality limits being met in the shortest distance from the diffuser pipe and in the smallest area.

The information presented in this report has been developed using available IEPA, USEPA or other governmental agencies and using published dispersion models and guidance on mixing zones. If you should have questions or comments concerning this information, please call me at (615) 373-8532 or by FAX at (615) 373-8512 or by e-mail at mcorn@aquaeter.com.

MIXING ZONE/ZID ISSUES

ILLINOIS RIVER AT HENRY, ILLINOIS

NOVEON, INC.
HENRY, ILLINOIS

BF GOODRICH
BRECKSVILLE, OHIO

AquAeTer

215 JAMESTOWN PARK, SUITE 100
BRENTWOOD, TN 37027
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7340 EAST CALEY AVE., SUITE 200
CENTENNIAL, CO 80111
(303) 771-9150

JUNE 22, 2001

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If you should have questions or comments concerning these analyses, please contact us at (615) 373-8532, or by FAX at (615-373-8512, or by email at mcorn@aquaeter.com or smccormick@aquaeter.com.

Sincerely,

AquAeTer, Inc.

smccormick
Shaleen T. McCormick
Project Scientist

Michael R. Corn
Michael R. Corn
President

cc: Mark Latham, Gardner, Carton & Douglas
Dave Giffin, BF Goodrich, Henry, Illinois
Ken Willings, BF Goodrich, Cleveland, Ohio

SOURCE	FLOW (mgd)	BOD_5 (mg/L)	$CBOD_u$ (mg/L)	ORG N (mg/L)	NH_3+NH_4-N (mg/L)
BFG	0.8	40	160	46	137
BFG	0.8	20	80	46	137
BFG	0.8	20	80	3	3
Henry POTW	0.4	30	45	12	8

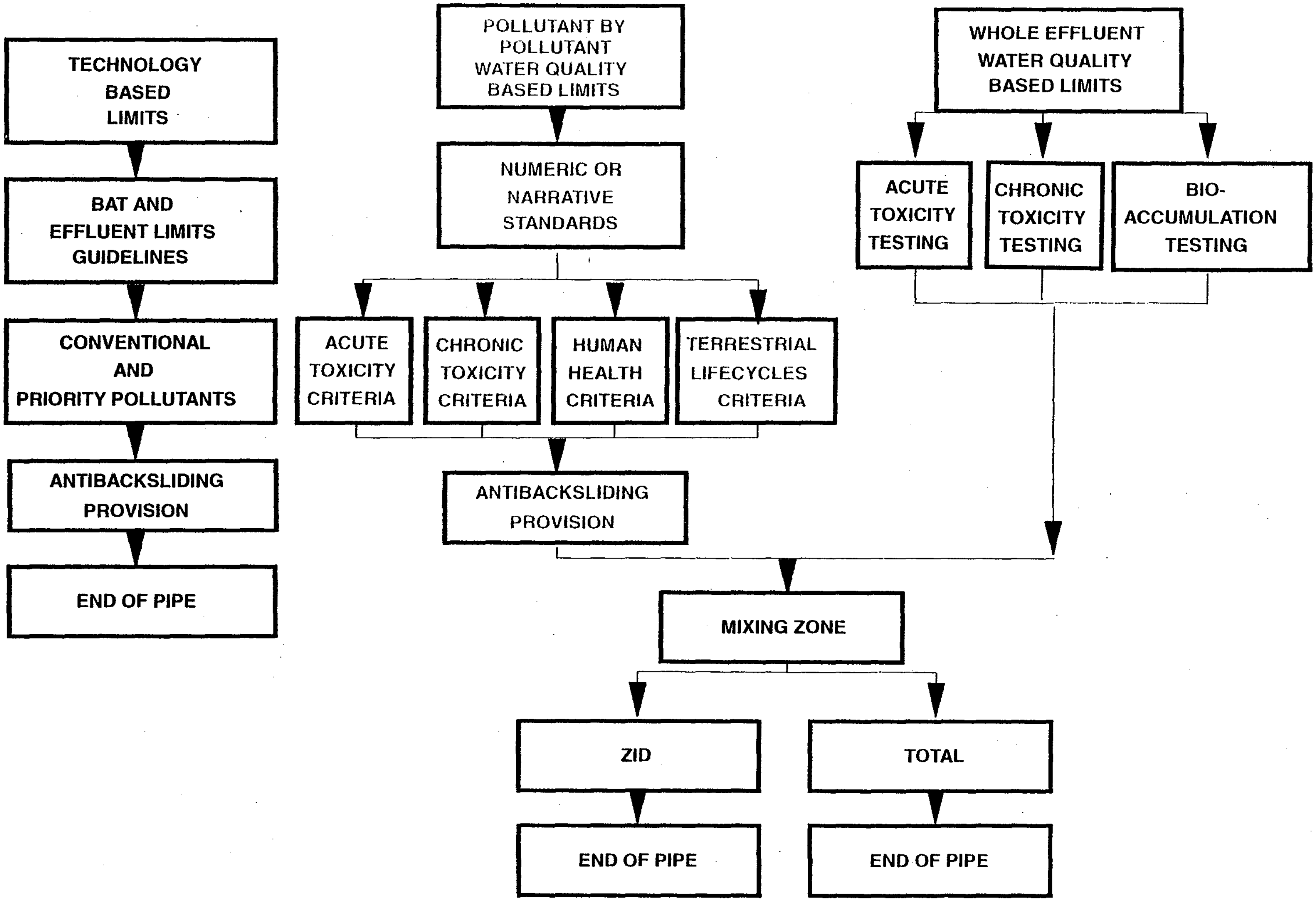
The values used for the BF Goodrich effluent have been input into the model using maximum concentrations or upper ranges of concentrations. For example, the BOD_5 concentration of 40 mg/L is a daily maximum permit limit and the daily average value is 20 mg/L. Monthly averages are used for projecting wasteload allocations. The $CBOD_u/BOD_5$ ratio of 4:1 for the Henry plant is estimated from past time-series BOD's conducted on organic chemical plants, which indicate this ratio is much higher than that traditionally estimated for domestic effluents (1.5 to 2:1).

Model results for dissolved oxygen are presented in Figures 1 and 2. Model inputs and outputs are presented in Attachment 2. The results include four model runs:

1. The BOD_5 in the BFG/Henry effluent discharge was set at 40 mg/L (daily maximum);
2. The BOD_5 in the BFG/Henry effluent discharge was set at 20 mg/L (monthly average – this is the allocation scenario that the allocation would be based on in the discharge);
3. The organic and ammonia nitrogen load from BFG was set at 6 mg/L; and
4. The BFG/Henry effluent discharge was removed from the River.

Based on the input parameters used, the model indicated that the BFG/Henry discharge reduced the DO in the River for the critical September 7Q10 condition from a DO sag low point of 7.74 mg/L without the BFG/Henry discharge to 7.58 mg/L with the BFG/Henry discharge or an impact of about 0.16 mg/L. The impact appears to occur between about IRM 178.75 to about 174.5, which is at the head of the Peoria pool. Without the BFG/Henry discharge, this sag occurs from about IRM 179 to about IRM 175.25, or approximately in the same general area. There is still a DO sag in the area downstream from Henry even without the Henry plant. This appears to be reflected in the DO saturations recorded at Lacon, although firm conclusions should not be drawn from grab samples.

The nitrogen load from BFG does not appear to be impacting algal productivity (i.e., not impacting nutrient enrichment), but it does impact the DO resources in the River. Since the BFG effluent has a minimal impact, less than 0.2 mg/L or within the accuracy of our ability to measure DO (+/- 0.1 mg/L), the nitrogen load from BFG is not having an adverse effect on the Illinois River.



CLEAN WATER ACT OF 1987
WATER-QUALITY BASED TOXICS CONTROL

TABLE 1. EFFLUENT AND RIVER DATA

GENERAL CONDITIONS

Effluent Characteristics

Single-port submerged discharge pipe located
~ 25 ft offshore at IRM 198.0

Average Effluent Flow = 1.43 cfs or 0.92 mgd

Average Effluent TDS~ 6,500 mg/L (typical)

Average Effluent Conductivity = 9,000-10,000 umhos/cm

River Characteristics

7Q10 = 3,400 cfs

Average = 16,500 cfs

Conductivity = 740 umhos/cm

OCTOBER 25, 1989 DISPERSION STUDY

Effluent

Q = 1.7 cfs or 1.1 mgd

TDS = 7,000 mg/L

Conductivity = 10,000 to 12,000 umhos/cm

River

Q = 6,550 cfs

Conductivity = 775 umhos/cm

Plume

ZID = 5:1 to 9:1
400 to 800 ft achieved complete vertical mixing
800 ft ~100:1

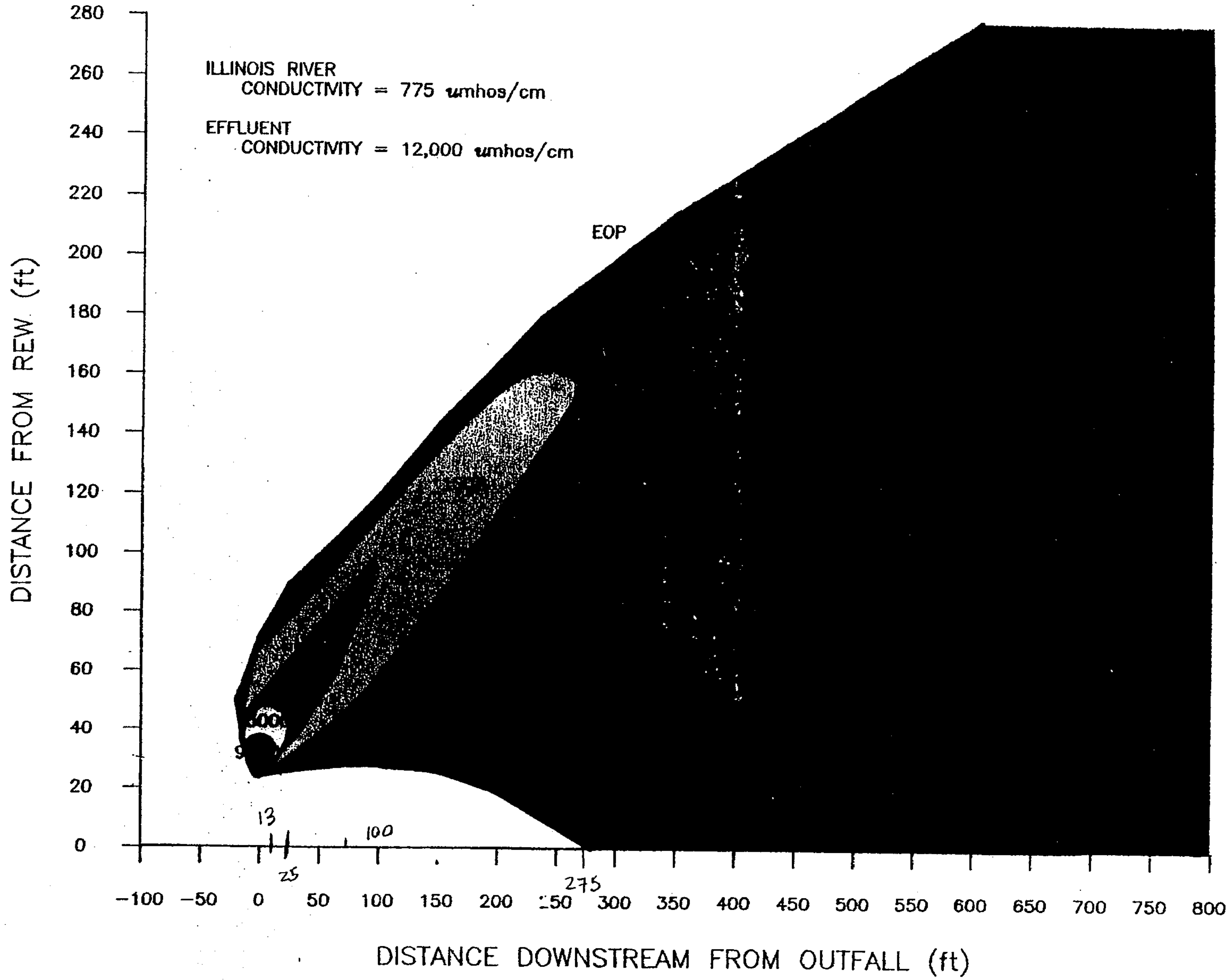


FIGURE 2
LATERAL AND LONGITUDINAL ISOPLETHS FOR BOTTOM SPECIFIC CONDUCTANCE

TABLE 2. DISPERSION ACHIEVED FOR THE EXISTING SINGLE-PORT DIFFUSER

CONDUCTIVITY ISOPLETH (umhos/cm)	EFFLUENT (%)	DISPERSION RATIO (_:1)
9,000	73.3	1.4
3,000	19.8	5.0
2,000	10.9	9.2
1,000	2.0	49.9
900	1.1	89.8
880	0.94	106.9

Table 3. Calculation of Allowable Total Ammonia in ZID

USEPA Equation ("1999 Update of Ambient Water Quality Criteria for Ammonia", USEPA, Office of Water, September 1999):

$$\text{CMC} = \frac{0.411}{1 + 10^{7.204 - \text{pH}}} + \frac{58.4}{1 + 10^{\text{pH} - 7.204}} \qquad (1)$$

where:

CMC = criterion maximum concentration (acute criterion)
pH = pH at edge of ZID

Calculating for CMC for Total ammonia or $NH_3 + NH_4$

where:

pH = 7.77 standard units (S.U.)

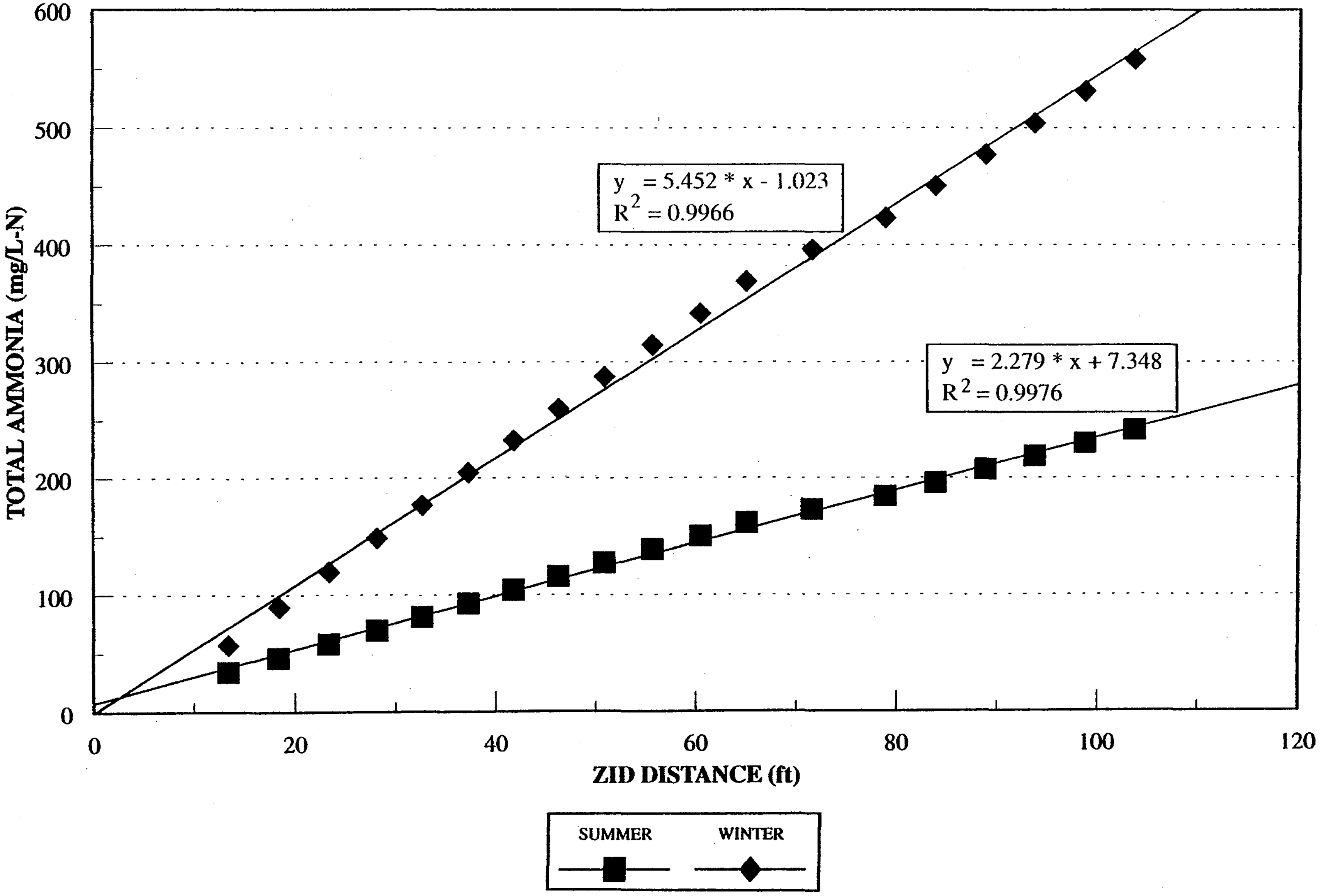
$$\text{CMC} = \frac{0.411}{1 + 10^{7.204 - 7.77}} + \frac{58.4}{1 + 10^{7.77 - 7.204}}$$

$$\text{CMC} = (0.411/1.272) + (58.4/4.681) = 0.323 + 12.475$$

$$\boxed{\textbf{CMC} = \textbf{12.8 mg/L Total Ammonia}}$$

Note: The 1998 and 1999 CMC equations for streams absent salmonids are equivalent.

FIGURE 1
TOTAL AMMONIA vs ZID DISTANCE DOWNSTREAM
SUMMER and WINTER



CALCULATION OF ALLOWABLE EFFLUENT AMMONIA CONCENTRATIONS FOR THE SINGLE PORT DIFFUSER (BF GOODRICH PROPOSED ZID)

The BF Goodrich effluent characteristics are assumed to be as follows:

Effluent Q	=	0.8 mgd or 556 gpm
Effluent TDS	=	10,361 mg/L
Effluent NH_3+ NH_4	=	Variable depending upon dispersion
BFG Effluent pH	=	7.00 S.U.
ZID pH	=	7.77 S.U.
Background River NH_3+ NH_4	=	0.297 mg/L (summer conditions)
ZID NH_3+ NH_4 CMC	=	12.80 mg/L (see Table 1)
ZID TDS WET Conc.	=	1,500 mg/L (to meet WET)

The effluent concentration can be calculated from the ZID required CMC or WET value as follows.

Assume: S = 13.2
S = 13.2 = 12.2 parts background river water and 1 part effluent

Therefore:

(13.2 total parts at edge of ZID * 12.80 mg/L NH_3+ NH_4 CMC) =

(1 part effluent * x mg/L NH_3+ NH_4) + (12.2 parts river * 0.297 mg/L NH_3+ NH_4)

x = (168.96 mg/L * parts – 3.62 mg/L * parts)/(1 part)

x = 165.3 mg/L effluent Total NH_3+ NH_4 allowable for S = 13.2:1

CONSIDERATION OF BF GOODRICH AND CITY OF HENRY POTW COMBINED EFFLUENT

1,516.5 lbs/day = (0.3 mgd * 20 mg/L * 8.34) + (0.8 mgd * x * 8.34)

x = (1,516.5 lbs/day – 50.04 lbs/day)/6.67 (mgd * lbs/day)/(mg/L * mgd)

x = 219.8 mg/L total ammonia that can be discharged from BF Goodrich

MINIMUM DISPERSION REQUIRED TO MEET ACUTE TOXICITY DUE TO TOTAL DISSOLVED SOLIDS (TDS)

(x + 1)(1,500mg/L TDS) = (x)(481 mg/L TDS) + (1)(10,361 mg/L TDS)

1,500 mg/L x + 1,500 mg/L = 481 mg/L x + 10,361 mg/L

1,500 mg/L x - 481 mg/L x = 10,361 mg/L

1,019 mg/L x = 8,861 mg/L

x = 8,861 mg/L/1,019 mg/L = 8.7:1
to meet 1,500 mg/L TDS at edge of ZID

With Henry POTW x = 8.2:1
to meet 1,500 mg/L TDS at edge of ZID

AquAeTer

ENGINEERS
ARCHITECTS
PLANNERS

Diffusion Requirements

The above assumptions and conceptual plan and profile layouts were discussed with AquAeTer's Mike Corn. AquAeTer recommends use of the following design parameters as it relates to the diffusion header. As recommended by AquAeTer, the port size, length of diffusion header, angle of ports and port spacing as shown below, will provide a dispersion of about 43:1 at one diffuser length downstream at 7Q10 flow (low pool) conditions.

Length of Diffusion Header:	15 ft.
Design Flow Rate:	1.3 MGD
Port Velocity at Avg. Design Flow Rate:	10 FPS
No. of Ports:	9
Port Diameter:	2 inches
Port Angle (from horizontal):	60 degrees
Centerline Distance Between Ports:	1.67 ft.
Dispersion:	43:1

Other Hydraulic Determinations

As previously discussed, flows above the average design flow would cause higher velocities and associated greater head loss through the diffusion system. The following outlines various port exit velocities and the corresponding total hydraulic headloss through the diffusion system at various flows.

Flow (MGD)	Port Exit Velocity (FPS)	Hydraulic Headloss (Feet)
1.3	9.9	2.9
1.6	12.1	4.4
2.1	15.9	7.6
2.4	18.2	9.9
4.7	35.6	37.8
5.0	37.9	42.7

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B.F. Goodrich - Henry, Illinois Facility
Multiport Diffusion System

Estimate of Probable Construction Costs

Item	Cost
Land mobilization	$15,000
River Mobilization	13,000
Bonds and Insurance	8,000
Excavation for Manholes	15,000
Excavation for Piping	45,000
Backfill	15,000
Rip Rap	20,000
Concrete Cast-in-Place Outfall Manhole	40,000
Handrail, Ladders and Fall Prevention System	15,000
Sheet Pile for Outfall Manhole	30,000
Foundation Piling for Outfall Manhole	3,000
Dewatering	10,000
Set-Over Precast Concrete Manhole	8,000
Closure Gates	30,000
Connection to Existing Manhole	3,000
Connection to Existing Pipe Line	2,000
Interconnecting Pipe, Fittings and Appurtenances	12,000
Outfall Pipe Line	125,000
Diffusion Header and Ports	20,000
Pile Bent Placement and Support System	140,000
Miscellaneous	10,000
Subtotal	$579,000
Contingencies (15%)	87,000
Total Construction Cost	$666,000

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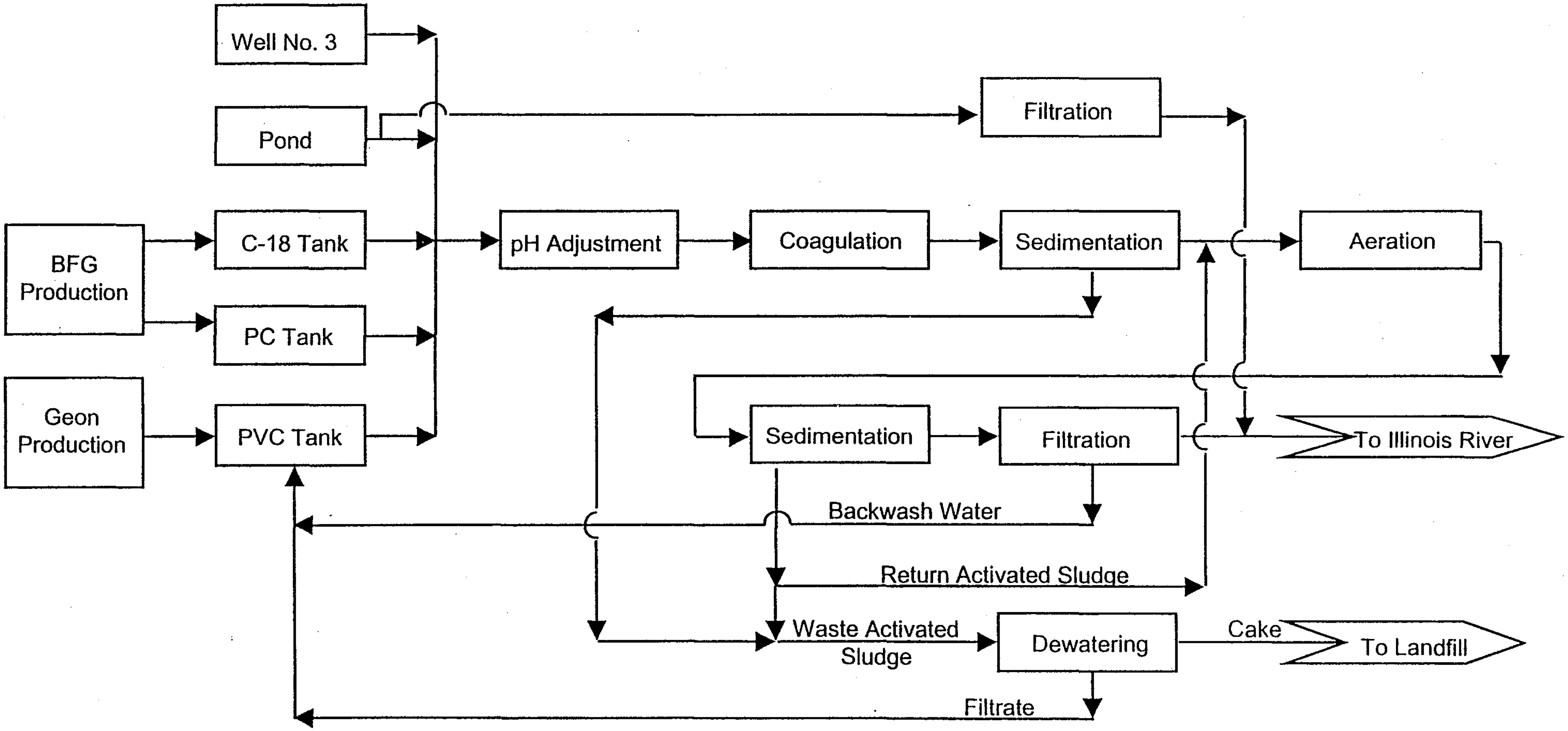

FIGURE 1

BLOCK FLOW DIAGRAM OF WASTESTREAM SOURCES AND WWTF

BROWN AND CALDWELL

Nashville, Tennessee

P:/PROJ/21522/Fig 1

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DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Jan						12	8	539.09	77.63	51.75	7.5	70
2-Jan						12	7	434.98	62.64	36.54	7.5	68
3-Jan						12	49	211.00	30.38	124.07	7.6	64
4-Jan						6	11	561.24	40.41	74.08	6.3	77
5-Jan								609.07			7.3	80
6-Jan								738.33			7	78
7-Jan						6	10	653.49	47.05	78.42	7.5	78
8-Jan						10	9	685.71	82.29	74.06	7.6	66
9-Jan						38	9	524.84	239.33	56.68	7.5	72
10-Jan						8	8	492.62	47.29	47.29	7.5	70
11-Jan						4	6	511.02	24.53	36.79	7.5	73
12-Jan								472.49			7.5	72
13-Jan								648.18			7.9	73
14-Jan						4	6	632.08	30.34	45.51	7.3	72
15-Jan <	10	10	110	0.054	0.09	6	3	501.83	36.13	18.07	7	66
16-Jan						5	4	401.13	24.07	19.25	7.2	73
17-Jan						5	4	503.21	30.19	24.15	7	63
18-Jan						3	3	549.00	19.76	19.76	7.3	66
19-Jan								457.22			7.8	70
20-Jan								278.02			7.7	70
21-Jan						11	7	462.33	61.03	38.84	7.8	70
22-Jan						4	2	587.03	28.18	14.09	6.5	74
23-Jan						5	3	533.10	31.99	19.19	6.2	78
24-Jan						8	6	512.90	49.24	36.93	6.7	78
25-Jan						6	5	499.33	35.95	29.96	6.5	78
26-Jan								502.47			6.6	70
27-Jan								544.23			6.7	73
28-Jan						4	4	547.12	26.26	26.26	6.7	64
29-Jan						6	6	604.60	43.53	43.53	6.7	73
30-Jan						5	8	697.49	41.85	66.96	6.8	70
31-Jan						7	6.4	624.62	52.47	47.97	6.9	73
Average	10.000	10.000	110.000	0.054	0.090	8.130	8.017	532.896	50.545	44.790	7.148	71.677
Maximum	10.000	10.000	110.000	0.054	0.090	38.000	49.000	738.330	239.327	124.068	7.900	80.000
Minimum	10.000	10.000	110.000	0.054	0.090	3.000	2.000	211.000	19.764	14.089	6.200	63.000

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Feb						4	16	503.81	24.18	96.73	6.9	70
2-Feb								367.63			6.9	66
3-Feb								363.40			6.9	70
4-Feb						4	2.4	491.11	23.57	14.14	6.9	75
5-Feb						4	3.2	587.66	28.21	22.57	7.3	73
6-Feb						6	5.2	300.00	21.60	18.72	7.3	66
7-Feb						5	7.6	494.97	29.70	45.14	7.4	70
8-Feb						5	13	730.47	43.83	113.95	7.3	73
9-Feb								608.08			7.4	78
10-Feb								702.58			6.7	80
11-Feb						7	6.4	455.51	38.26	34.98	6.8	72
12-Feb						10	5.6	504.81	60.58	33.92	7	68
13-Feb						21	8	642.72	161.97	61.70	6.9	72
14-Feb						15	21	636.33	114.54	160.36	6.9	75
15-Feb						32	24	639.73	245.66	184.24	7	73
16-Feb								501.79			7.6	75
17-Feb								498.53			7.4	57
18-Feb						22	30	495.49	130.81	178.38	7.3	68
19-Feb						28	21	664.23	223.18	167.39	7.3	73
20-Feb						24	25	651.30	187.57	195.39	7.5	73
21-Feb <	10	0	140	0.068	0.344	15	16	608.38	109.51	116.81	7.6	66
22-Feb						21	49	553.56	139.50	325.49	7.2	70
23-Feb								629.09			8.3	64
24-Feb								634.60			7.4	68
25-Feb						32	14	653.04	250.77	109.71	7.1	70
26-Feb						14	10	501.26	84.21	60.15	7.3	79
27-Feb						16	8.4	554.22	106.41	55.87	7	78
28-Feb						13	5.2	518.41	80.87	32.35	7	78
Average	10.000	0.000	140.000	0.068	0.344	14.900	14.550	553.311	105.246	101.400	7.200	71.429
Maximum	10.000	0.000	140.000	0.068	0.344	32.000	49.000	730.470	250.767	325.493	8.300	80.000
Minimum	10.000	0.000	140.000	0.068	0.344	4.000	2.400	300.000	21.600	14.144	6.700	57.000

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Mar						6.1	5.2	493.66	36.14	30.80	6.8	79
2-Mar								569.01			6.9	68
3-Mar								600.80			7	72
4-Mar						13	7.6	581.66	90.74	53.05	7.3	64
5-Mar						8	5.6	415.74	39.91	27.94	7	70
6-Mar						10	5.6	463.61	55.63	31.15	6.8	68
7-Mar <						7	7.6	418.28	35.14	38.15	6.8	79
8-Mar						14	8	506.11	85.03	48.59	6.7	68
9-Mar								514.14			6.7	70
10-Mar								433.90			6.3	72
11-Mar						11	11	487.18	64.31	64.31	6.4	73
12-Mar						6	9.6	633.74	45.63	73.01	6.9	78
13-Mar <	10	0	120	0.11		17	16	665.01	135.66	127.68	7	72
14-Mar					0.196	15	6	670.57	120.70	48.28	7.2	72
15-Mar						9	6.4	619.60	66.92	47.59	7	
16-Mar								637.14			7	68
17-Mar								626.87			7.2	66
18-Mar						7	4.8	647.50	54.39	37.30	7.1	70
19-Mar						11	4.4	595.87	78.65	31.46	7.1	72
20-Mar						9	7.2	563.66	60.88	48.70	7.2	70
21-Mar						9	7.6	528.79	57.11	48.23	7	70
22-Mar						11	8.4	519.49	68.57	52.36	7.1	71
23-Mar								507.06			7.2	70
24-Mar								488.70			7	70
25-Mar						5	8	487.76	29.27	46.82	7.1	66
26-Mar						7	2.8	392.56	32.98	13.19	7	71
27-Mar						8	5.2	431.69	41.44	26.94	7.3	71
28-Mar						16	8	379.69	72.90	36.45	7.2	71
29-Mar						16	3.6	430.44	82.64	18.60	7.6	72
30-Mar								425.12			6.8	73
31-Mar								445.81			7.7	74
Average	10.000	0.000	120.000	0.110	0.196	10.243	7.076	521.973	64.506	45.266	7.013	71.000
Maximum	10.000	0.000	120.000	0.110	0.196	17.000	16.000	670.570	135.662	127.682	7.700	79.000
Minimum	10.000	0.000	120.000	0.110	0.196	5.000	2.800	379.690	29.266	13.190	6.300	64.000

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Apr						9	5.6	577.47	62.37	38.81	7.5	72
2-Apr						25	18	510.17	153.05	110.20	7.5	70
3-Apr						21	20	447.16	112.68	107.32	7.4	72
4-Apr						12	19	541.42	77.96	123.44	7.2	74
5-Apr						15	24	540.00	97.20	155.52	7.2	73
6-Apr								575.02			7.2	75
7-Apr								657.02			7.2	75
8-Apr						14	21	625.63	105.11	157.66	7.4	75
9-Apr						11	6.4	610.51	80.59	46.89	7.4	72
10-Apr <	10	0	130	0.08		20	15	600.82	144.20	108.15	7.3	77
11-Apr						15	26	629.01	113.22	196.25	7.3	75
12-Apr					0.213	15	10	297.29	53.51	35.67	7.3	75
13-Apr								524.93			7.3	71
14-Apr								606.28			7	72
15-Apr						7	4	621.76	52.23	29.84	7.4	71
16-Apr						10	5.2	500.54	60.06	31.23	7.3	73
17-Apr						11	16	511.07	67.46	98.13	7.2	72
18-Apr						15	21	512.59	92.27	129.17	7.2	74
19-Apr						11	10	626.82	82.74	75.22	7.2	75
20-Apr								516.97			7.4	73
21-Apr								539.63			7.7	74
22-Apr						10	12	545.40	65.45	78.54	7.3	73
23-Apr						12	10	623.27	89.75	74.79	7.3	75
24-Apr						13	19	554.26	86.46	126.37	7.2	73
25-Apr						10	18	499.50	59.94	107.89	7.2	72
26-Apr						12	12	466.23	67.14	67.14	7.1	72
27-Apr								359.08			7.4	73
28-Apr								323.91			7.3	73
29-Apr						12	10	365.23	52.59	43.83	7.2	72
30-Apr						12	14	417.91	60.18	70.21	7.2	75
Average	10.000	0.000	130.000	0.080	0.213	13.273	14.373	524.230	83.462	91.467	7.293	73.267
Maximum	10.000	0.000	130.000	0.080	0.213	25.000	26.000	657.020	153.051	196.251	7.700	77.000
Minimum	10.000	0.000	130.000	0.080	0.213	7.000	4.000	297.290	52.228	29.844	7.000	70.000

Wwt2001 Apr
5/22/02 11:07 AM

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Jun								440.50			7.1	70
2-Jun								609.21			7.1	70
3-Jun						6	6	544.06	39.17	39.17	7.2	70
4-Jun						6	13	424.52	30.57	66.23	7.3	72
5-Jun						4	27	477.14	22.90	154.59	7.3	70
6-Jun						4	10	507.63	24.37	60.92	7.3	75
7-Jun <						5	6	540.92	32.46	38.95	7.3	76
8-Jun								476.53			7.3	77
9-Jun								436.44			7.3	77
10-Jun						5	7	462.43	27.75	38.84	7.4	77
11-Jun <	10	10	100	0.11	0.187	6	19	475.06	34.20	108.31	7.2	75
12-Jun						7	7	563.24	47.31	47.31	7.2	74
13-Jun						8	6	No Data			7.1	75
14-Jun						9	9	569.84	61.54	61.54	7.1	76
15-Jun								616.74			7.3	81
16-Jun								580.42			7.2	79
17-Jun						19	36	484.49	110.46	209.30	7	81
18-Jun						5	16	490.60	29.44	94.20	7.3	82
19-Jun						11	28	565.22	74.61	189.91	7.1	82
20-Jun						11	32	647.21	85.43	248.53	7.1	82
21-Jun						11	42	602.44	79.52	303.63	7.5	78
22-Jun								533.94			7	78
23-Jun								634.64			6.9	77
24-Jun						3	17	617.77	22.24	126.03	7	80
25-Jun						6	15	664.29	47.83	119.57	7.3	82
26-Jun						25	33	597.46	179.24	236.59	7.1	80
27-Jun						13	27	568.40	88.67	184.16	7.1	78
28-Jun						12	20	649.22	93.49	155.81	7.1	82
29-Jun								631.81			7.2	80
30-Jun								630.63			7.1	81
Average	10.000	10.000	100.000	0.110	0.187	8.800	18.800	553.200	59.537	130.716	7.183	77.233
Maximum	10.000	10.000	100.000	0.110	0.187	25.000	42.000	664.290	179.238	303.630	7.500	82.000
Minimum	10.000	10.000	100.000	0.110	0.187	3.000	6.000	424.520	22.240	38.844	6.900	70.000

Wwt2001 June
5/22/02 11:07 AM

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Jul						3	19	584.87	21.06	133.35	7.1	82
2-Jul						8	14	460.51	44.21	77.37	7.2	77
3-Jul						4	3	669.34	32.13	24.10	7.3	80
4-Jul						5	3	616.73	37.00	22.20	6.8	83
5-Jul						3	2	536.26	19.31	12.87	7.1	80
6-Jul								602.67			6.4	81
7-Jul <								637.07			6.9	79
8-Jul						3	3	625.00	22.50	22.50	6.9	82
9-Jul						4	5	546.52	26.23	32.79	6.8	81
10-Jul <	10	80	96	0.088		6	9	718.98	51.77	77.65	6.8	80
11-Jul						9	15	775.62	83.77	139.61	7.3	77
12-Jul						9	27	728.89	78.72	236.16	7.2	81
13-Jul								666.09			7.4	82
14-Jul								633.08			7.4	81
15-Jul						3	11	583.43	21.00	77.01	6.9	82
16-Jul						5	6	586.56	35.19	42.23	7.3	80
17-Jul						9	15	589.83	63.70	106.17	7	80
18-Jul						6	13	674.00	48.53	105.14	7.4	82
19-Jul						7	18	679.06	57.04	146.68	7.1	80
20-Jul								721.81			7.2	82
21-Jul								692.31			7.4	88
22-Jul						6	18	670.24	48.26	144.77	7.3	83
23-Jul					0.363	9	18	678.44	73.27	146.54	7.4	85
24-Jul						6	21	748.13	53.87	188.53	7.5	82
25-Jul						10	30	701.43	84.17	252.51	7.6	81
26-Jul						4	17	711.94	34.17	145.24	7.5	80
27-Jul								669.36			7.7	82
28-Jul								671.39			7.5	80
29-Jul						3	6	639.49	23.02	46.04	7.3	82
30-Jul						4	4	549.88	26.39	26.39	7.4	83
31-Jul						4	5	643.63	30.89	38.62	7.3	83
Average	10.000	80.000	96.000	0.088	0.363	5.652	12.261	645.566	44.183	97.586	7.206	81.323
Maximum	10.000	80.000	96.000	0.088	0.363	10.000	30.000	775.620	84.172	252.515	7.700	88.000
Minimum	10.000	80.000	96.000	0.088	0.363	3.000	2.000	460.510	19.305	12.870	6.400	77.000

Wwt2001 July
5/22/02 11:07 AM

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Aug						5	12	767.71	46.06	110.55	7.4	83
2-Aug						11	6	834.40	110.14	60.08	7.3	81
3-Aug								781.00			7.1	81
4-Aug						5	72	778.07	46.68	672.25	7.4	82
5-Aug						9	29	766.51	82.78	266.75	7.5	80
6-Aug						*		751.20			7.3	80
7-Aug						*		No Data				
8-Aug						15	26	No Data				
9-Aug						13	100	123.38	19.25	148.06	7.4	82
10-Aug								642.79			7.2	80
11-Aug								812.18			7.6	77
12-Aug						5	12	603.76	36.23	86.94	6.7	78
13-Aug						7	25	471.12	39.57	141.34	7.3	80
14-Aug <	10	30	110	0.084	0.24	6	15	474.07	34.13	85.33	7.5	77
15-Aug						11	13	504.01	66.53	78.63	7.3	78
16-Aug						5	4	599.26	35.96	28.76	7.2	72
17-Aug								537.78			7.3	72
18-Aug								501.98			7.7	72
19-Aug						6	16	560.87	40.38	107.69	7.3	75
20-Aug						11	10	569.69	75.20	68.36	7.3	80
21-Aug						8	20	680.96	65.37	163.43	7.5	79
22-Aug						8	12	683.12	65.58	98.37	7.4	77
23-Aug						13	12	550.96	85.95	79.34	7.5	77
24-Aug								672.83			7.5	77
25-Aug								634.53			7.6	77
26-Aug						5	27	625.36	37.52	202.62	7.6	80
27-Aug						3	17	608.31	21.90	124.10	7.7	77
28-Aug						12	38	537.47	77.40	245.09	7.6	76
29-Aug						12	36	535.01	77.04	231.12	7.8	78
30-Aug						14	14	556.98	93.57	93.57	7.8	80
31-Aug								420.29			7.6	85
Average	10.000	30.000	110.000	0.084	0.240	8.762	24.571	606.400	57.862	154.618	7.428	78.379
Maximum	10.000	30.000	110.000	0.084	0.240	15.000	100.000	834.400	110.141	672.252	7.800	85.000
Minimum	10.000	30.000	110.000	0.084	0.240	3.000	4.000	123.380	19.247	28.764	6.700	72.000

* No Data due to Plant Shutdown

Wwt2001 Aug
5/22/02 11:07 AM

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Sep								594.99			7.6	84
2-Sep						7	20	533.58	44.82	128.06	7.4	86
3-Sep						6	20	548.92	39.52	131.74	7.5	88
4-Sep						8	10	516.52	49.59	61.98	7.5	88
5-Sep						12	10	559.53	80.57	67.14	7.5	86
6-Sep						10	31	578.06	69.37	215.04	7.5	86
7-Sep <								658.01			7.5	80
8-Sep								725.20			7.5	80
9-Sep						6	14	698.70	50.31	117.38	7.5	80
10-Sep						6	9	578.60	41.66	62.49	7.3	86
11-Sep						8	8	570.18	54.74	54.74	7.3	85
12-Sep						11	12	583.73	77.05	84.06	7.3	77
13-Sep						4	23	552.36	26.51	152.45	7.4	79
14-Sep								472.39			7.4	82
15-Sep								458.39			7.4	78
16-Sep						15	36	594.80	107.06	256.95	7.2	76
17-Sep	<10	10	150	0.1	0.7	14	33	547.29	91.94	216.73	7.4	83
18-Sep						15	22	537.03	96.67	141.78	7.4	84
19-Sep						16	37	556.23	106.80	246.97	7.3	83
20-Sep						13	31	531.63	82.93	197.77	7.5	77
21-Sep								618.67			7.4	78
22-Sep								765.58			7.4	76
23-Sep						7	44	668.17	56.13	352.79	7.6	84
24-Sep						12	44	562.74	81.03	297.13	7.4	74
25-Sep						13	42	479.71	74.83	241.77	7.9	80
26-Sep						8	22	478.18	45.91	126.24	7.2	76
27-Sep						9	13	554.79	59.92	86.55	7.5	78
28-Sep								582.08			7.4	70
29-Sep								433.97			7.1	70
30-Sep						22	30	481.14	127.02	173.21	7.3	70
Average	#DIV/0!	10.000	150.000	0.100	0.700	10.571	24.333	567.372	69.732	162.522	7.420	80.133
Maximum	0.000	10.000	150.000	0.100	0.700	22.000	44.000	765.580	127.021	352.794	7.900	88.000
Minimum	0.000	10.000	150.000	0.100	0.700	4.000	8.000	433.970	26.513	54.737	7.100	70.000

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Oct						16	15	537.71	103.24	96.79	7.2	80
2-Oct						11	38	536.67	70.84	244.72	7.0	78
3-Oct						13	16	573.01	89.39	110.02	7.0	82
4-Oct						10	42	540.48	64.86	272.40	7.0	80
5-Oct								632.27			7.6	78
6-Oct								674.20			7.6	76
7-Oct						19	34	690.77	157.50	281.83	7.3	77
8-Oct						9	26	553.06	59.73	172.55	7.5	76
9-Oct						12	12	495.79	71.39	71.39	7.2	77
10-Oct						13	14	547.23	85.37	91.93	7.1	84
11-Oct						12	21	684.88	98.62	172.59	7.1	79
12-Oct								675.28			6.9	78
13-Oct								693.32			7.0	76
14-Oct						23	23	623.73	172.15	172.15	7.1	72
15-Oct						40	46	489.76	235.08	270.35	6.8	75
16-Oct <	10	0	100	0.079	0.461	23	18	648.44	178.97	140.06	6.8	70
17-Oct						13	15	596.18	93.00	107.31	6.9	70
18-Oct						10	11	493.31	59.20	65.12	6.6	74
19-Oct								429.39			6.7	76
20-Oct								535.18			6.7	77
21-Oct						9	4	568.39	61.39	27.28	6.9	73
22-Oct						11	6	559.59	73.87	40.29	7.0	75
23-Oct						12	21	432.28	62.25	108.93	7.1	70
24-Oct						10	19	402.41	48.29	91.75	7.0	79
25-Oct						10	10	424.56	50.95	50.95	7.4	72
26-Oct								421.70			7.1	66
27-Oct								589.66			6.9	63
28-Oct						12	12	614.08	88.43	88.43	7.0	64
29-Oct						8	10	432.18	41.49	51.86	7.0	73
30-Oct						13	6.8	423.16	66.01	34.53	6.7	78
31-Oct						20	9	427.16	102.52	46.13	6.9	76
Average	10.000	0.000	100.000	0.079	0.461	14.304	18.643	546.640	92.806	122.147	7.035	74.968
Maximum	10.000	0.000	100.000	0.079	0.461	40.000	46.000	693.320	235.085	281.834	7.600	84.000
Minimum	10.000	0.000	100.000	0.079	0.461	8.000	4.000	402.410	41.489	27.283	6.600	63.000

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Nov						9	6	477.08	51.52	34.35	6.9	75
2-Nov								620.56			6.9	77
3-Nov								523.24			7.2	77
4-Nov						20	11	484.02	116.16	63.89	7	79
5-Nov						20	10	462.67	111.04	55.52	7.3	73
6-Nov						33	2	407.17	161.24	9.77	7.3	72
7-Nov <						22	11	436.79	115.31	57.66	7.3	73
8-Nov						10	11	571.82	68.62	75.48	7.2	77
9-Nov								536.97			7.3	73
10-Nov								635.73			7.1	72
11-Nov						8	5	542.86	52.11	32.57	7.2	72
12-Nov						10	14	432.28	51.87	72.62	7.4	75
13-Nov						10	23	464.84	55.78	128.30	7.2	77
14-Nov <	10	0	100	0.051	0.344	17	18	516.90	105.45	111.65	7.4	81
15-Nov						13	16	464.14	72.41	89.11	7.5	81
16-Nov								474.67			7.4	80
17-Nov								470.73			7.1	79
18-Nov						14	13	449.29	75.48	70.09	7.4	80
19-Nov						27	17	487.48	157.94	99.45	7.4	68
20-Nov						35	22	547.01	229.74	144.41	7.5	68
21-Nov						29	17	434.63	151.25	88.66	7.3	72
22-Nov						36	23	315.34	136.23	87.03	7	72
23-Nov								411.74			6.9	73
24-Nov								457.19			6.8	70
25-Nov						26	24	404.78	126.29	116.58	6.9	72
26-Nov						17	28	305.81	62.39	102.75	6.5	73
27-Nov						23	30	395.98	109.29	142.55	6.8	72
28-Nov						▨ 44	47	486.34	256.79	274.30	7	78
29-Nov						15	34	383.46	69.02	156.45	6.8	79
30-Nov								462.80			6.8	73
Average	10.000	0.000	100.000	0.051	0.344	20.857	18.190	468.811	111.236	95.867	7.127	74.767
Maximum	10.000	0.000	100.000	0.051	0.344	44.000	47.000	635.730	256.788	274.296	7.500	81.000
Minimum	10.000	0.000	100.000	0.051	0.344	8.000	2.000	305.810	51.525	9.772	6.500	68.000

▨ Non-Compliance

DMR Support Data - 2001
Plant Effluent

Date	Vinyl Chloride (ug/L)	Fecal Coliform (#/100 mL)	Ammonia (mg/L)	Phenol (mg/L)	Residual Chlorine (parts/MM)	tBOD (mg/l)	TSS (mg/l)	Flow (gpm)	tBOD Load (#/day)	TSS Load (#/day)	pH	Temp. (F)
1-Dec								484.51			6.7	73
2-Dec						23	69	482.63	133.21	399.62	7.2	77
3-Dec						19	43	421.99	96.21	217.75	7.1	75
4-Dec						20	40	454.23	109.02	218.03	7.0	79
5-Dec						23	44	433.10	119.54	228.68	7.0	80
6-Dec						24	30	445.52	128.31	160.39	7.1	77
7-Dec								425.00			7.3	75
8-Dec								463.17			7.5	73
9-Dec						31	18	483.96	180.03	104.54	7.3	70
10-Dec						17	24	487.51	99.45	140.40	7.4	75
11-Dec						26	18	563.61	175.85	121.74	7.1	73
12-Dec						43	51	587.48	303.14	359.54	7.1	73
13-Dec						17	37	236.34	48.21	104.93	7.9	72
14-Dec								563.48			7.8	73
15-Dec								687.21			7.2	72
16-Dec	< 10	0	120	0.062		29	24	565.32	196.73	162.81	7.0	73
17-Dec						16	32	506.44	97.24	194.47	7.3	75
18-Dec					0.537	15	16	536.98	96.66	103.10	7.1	72
19-Dec						12	7	597.00	85.97	50.15	7.0	70
20-Dec						10	11	636.27	76.35	83.99	6.9	66
21-Dec								600.88			7.1	72
22-Dec								379.59			6.6	70
23-Dec						14	16	421.04	70.73	80.84	6.8	68
24-Dec						16	21	420.54	80.74	105.98	7.0	66
25-Dec						16	27	216.78	41.62	70.24	6.6	64
26-Dec						15	48	329.40	59.29	189.73	6.5	63
27-Dec						14	22	294.05	49.40	77.63	6.8	64
28-Dec								410.46			6.8	68
29-Dec								480.82			6.6	61
30-Dec						15	23	119.16	21.45	32.89	6.2	55
31-Dec						11	25	210.13	27.74	63.04	6.5	58
Average	10.000	0.000	120.000	0.062	0.537	19.364	29.364	449.826	104.404	148.658	7.016	70.387
Maximum	10.000	0.000	120.000	0.062	0.537	43.000	69.000	687.210	303.140	399.618	7.900	80.000
Minimum	10.000	0.000	120.000	0.062	0.537	10.000	7.000	119.160	21.449	32.888	6.200	55.000

6

DRAFT

EVALUATION OF TREATMENT ALTERNATIVES FOR REDUCING FINAL EFFLUENT AMMONIA LOAD

Prepared for:

BF GOODRICH
Henry, Illinois

Prepared by:

ECKENFELDER INC.®
227 French Landing Drive
Nashville, Tennessee 37228
(615) 255-2288

February 1997

9387.01

ECKENFELDER INC.®

February 18, 1997 9387.01

Mr. Dave Giffin
Health, Safety and Environmental Manager
BF Goodrich
R.R. 1, Box 15
Henry, IL 61537

RE: Evaluation of Treatment Alternatives for
Reducing Final Effluent Ammonia Load

Dear Mr. Giffin:

We are pleased to submit our Draft Report, "Evaluation of Treatment Alternatives for Reducing Final Effluent Ammonia Load." This Report presents the background, methods and materials, and results of our work. We will prepare a Final Report that addresses your review comments.

If you have any questions or need additional information, please contact me.

Sincerely,

ECKENFELDER INC.®

T. Houston Flippin

T. Houston Flippin, P.E.
Project Manager

cc: Richard Kissel, Esquire - Gardner, Carton & Douglas
Ken Willings - BF Goodrich
W. Wesley Eckenfelder, Jr., D.Sc., P.E.

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227 French Landing Drive
Nashville, Tennessee 37228
615.255.2288
FAX 615.256.8332

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1.0 BACKGROUND

1.1 DESCRIPTION OF WASTEWATER TREATMENT FACILITY AND HISTORICAL PERFORMANCE

BF Goodrich Company (BFG) and The Geon Company (Geon) own and operate adjoining manufacturing facilities in Henry, Illinois. Wastewaters from the BFG manufacturing processes discharge to either the Polymer & Chemicals (PC) equalization tank or the Cure Rite® (C-18) equalization tank. Wastewaters from the Geon manufacturing processes and sidestreams from the combined wastewater treatment facility (WWTF) discharge to the Polyvinyl Chloride (PVC) equalization tank. Site-wide stormwater runoff and sidestreams from the boiler house and water treatment facility (WTF) discharge to a holding pond (Pond). Wastewaters from the PC Tank, C-18 Tank, and PVC Tank are fed at controlled rates to the WWTF along with discharge from a groundwater recovery well (Well No. 3). Pond water is discharged at a controlled rate to either the WWTF or through a sand filter into the channel transporting WWTF effluent to the Illinois River. The WWTF consists of chemical coagulation, sedimentation, activated sludge treatment, and sand filtration prior to discharge to the Illinois River. The discharge is regulated by a NPDES permit issued by the Illinois Environmental Protection Agency (IEPA). A summary of the 1996 wasteloads is presented in Table 1-1. A block flow diagram of the wastestream sources and WWTF is presented in Figure 1-1.

The WWTF has historically provided greater than 95 percent BOD reduction while discharging an effluent ammonia-nitrogen concentration of 23 to 120 mg/L.[1] The IEPA has proposed a monthly average effluent limit of 3 mg/L for ammonia (as N). A previous study conducted by ECKENFELDER INC. in 1995 indicated that single-stage biological nitrification was not feasible in the existing activated sludge system due to inhibition of nitrifying bacteria caused by the PC Tank discharge. The PC Tank discharge is also inhibitory to BOD removal by the activated sludge process. This effect has been controlled by adjusting its flow contribution to less than 23 percent of the combined wastestream flow and its TCOD contribution to 1,100 mg/L in the combined wastestream.

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[1] Based on once monthly analysis of effluent NH_3-N concentrations during the period of January 1994 through December 1996.

TABLE 1-1

SUMMARY OF 1996 WASTELOAD

Wastestream	Flow Rate (gpm)		SCOD (lb/day)[b]		TKN (lb/day)		NH_3-N (lb/day)	
	Average[a]	Peak	Average	Peak	Average	Peak	Average	Peak
PVC Tank Discharge	401	499	2,650	4,330	335	485	215	300
PC Tank Discharge	107	150	8,280	10,840	360	525	45	75
C-18 Tank Discharge	6	15	1,320	2,940	60	150	20	50
Pond Water & Well No. 3 Discharges	46	105	50	50	2	5	1	2
Total Wastestream	560	670	12,300	14,500	757	1,165	281	427

[a] The average 1995 flow rates for the PVC Tank, PC Tank, C-18 Tank, and Pond Water & Well No. 3 Discharges were 414, 107, 7, and 51 gpm, respectively.

[b] Soluble COD defined as COD of filtrate following 1.5 µm filtration.

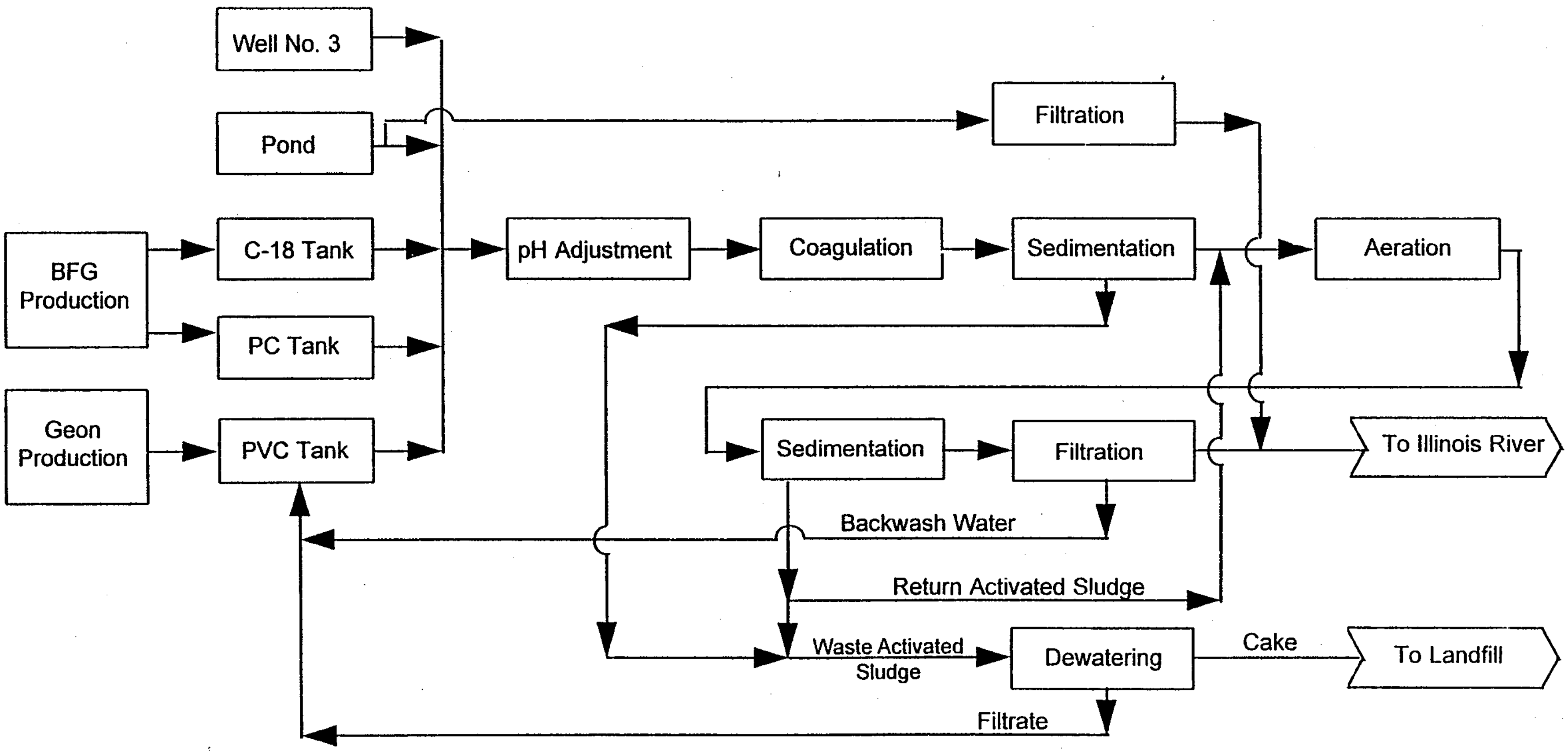

FIGURE 1-1

BLOCK FLOW DIAGRAM OF WASTESTREAM SOURCES AND WWTF

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

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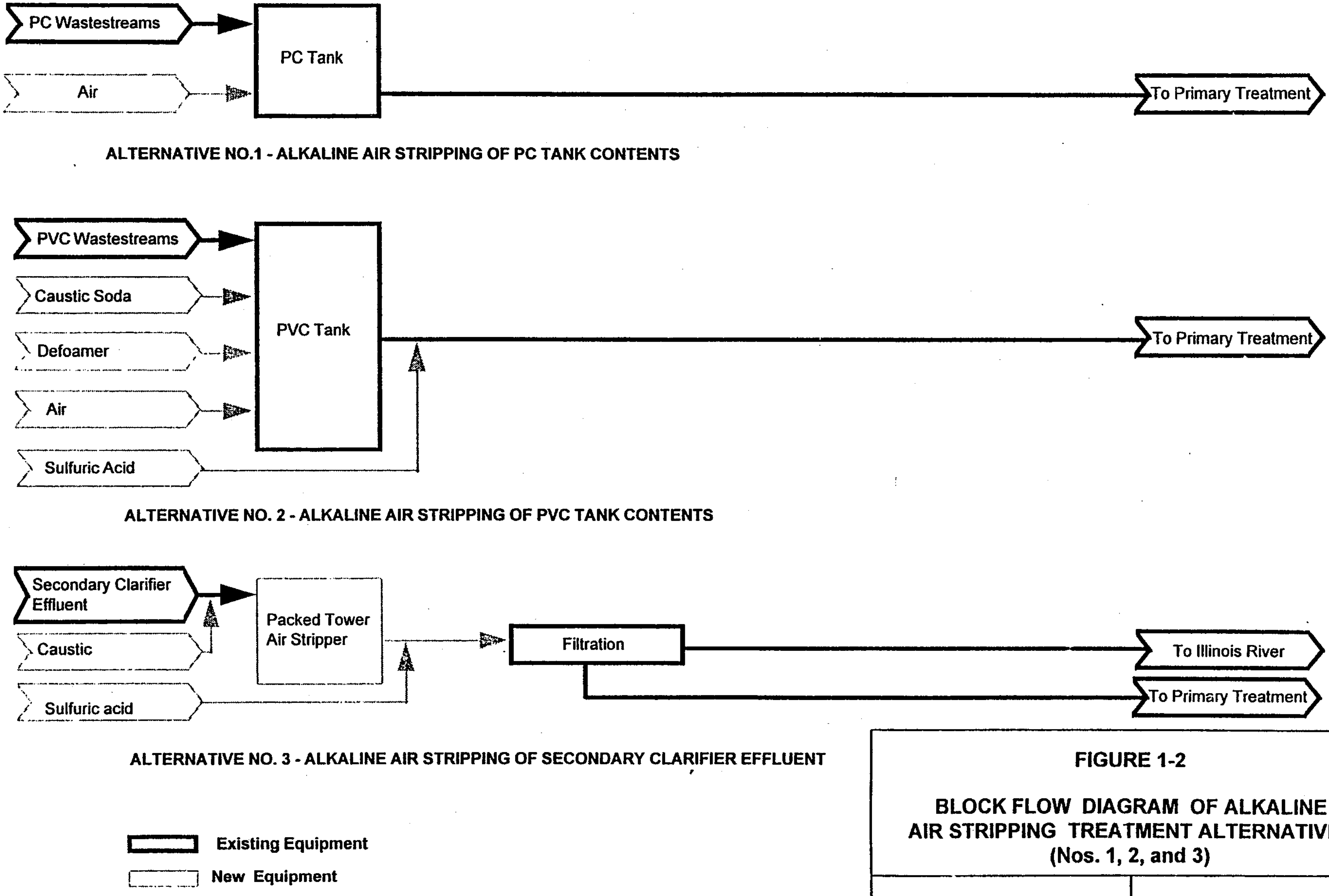
1.2 SCOPE OF WORK

BF Goodrich retained ECKENFELDER INC. to develop preliminary process designs and budget level cost estimates for alternative treatment processes which would reduce the ammonia load in the final effluent from the WWTF. The alternatives considered are summarized below and illustrated in Figures 1-2 through 1-7.

- Alternative No. 1 - Alkaline air stripping of PC Tank contents
- Alternative No. 2 - Alkaline air stripping of PVC Tank contents
- Alternative No. 3 - Alkaline air stripping of secondary clarifier effluent
- Alternative No. 4 - Struvite (NH_4MgPO_4) precipitation from combined wastestream influent
- Alternative No. 5 - Single-stage biological nitrification of non-PC wastestreams combined with separate biological treatment of the PC Tank discharge.
- Alternative No. 6 - Biological nitrification of combined influent wastestream
- Alternative No. 7 - Breakpoint chlorination of secondary clarifier effluent
- Alternative No. 8 - Ion exchange treatment of final effluent

Preliminary process designs were developed for each Alternative based on batch treatability testing and wastestream characterization data gathered in previous studies by ECKENFELDER INC., and additional treatability testing and wastestream characterization data presented in this report. Average and maximum daily effluent ammonia loads were projected under each alternative for the 1996 wasteload. Preliminary cost estimates for the treatment alternatives were developed using preliminary process designs and information provided by vendors, BF Goodrich, a cost estimating software program, and ECKENFELDER INC.

The methods, results, conclusions, and recommendations of this evaluation are presented in the following sections.



ALTERNATIVE NO.1 - ALKALINE AIR STRIPPING OF PC TANK CONTENTS

ALTERNATIVE NO. 2 - ALKALINE AIR STRIPPING OF PVC TANK CONTENTS

ALTERNATIVE NO. 3 - ALKALINE AIR STRIPPING OF SECONDARY CLARIFIER EFFLUENT

FIGURE 1-2

BLOCK FLOW DIAGRAM OF ALKALINE AIR STRIPPING TREATMENT ALTERNATIVES (Nos. 1, 2, and 3)

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

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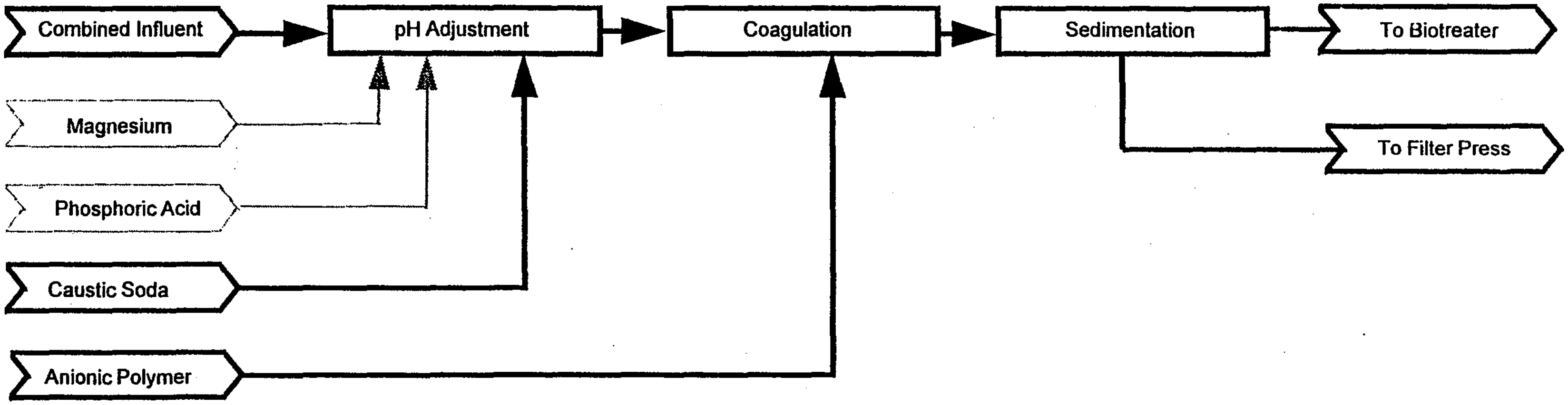
Combined Influent

pH Adjustment

Coagulation

Sedimentation

To Biotreater

To Filter Press

Magnesium

Phosphoric Acid

Caustic Soda

Anionic Polymer

NOTE: Existing $FeCl_3$ Addition would be discontinued

▬ Existing Equipment

▭ New Equipment

FIGURE 1-3

BLOCK FLOW DIAGRAM OF STRUVITE PRECIPITATION TREATMENT ALTERNATIVE (No. 4)

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

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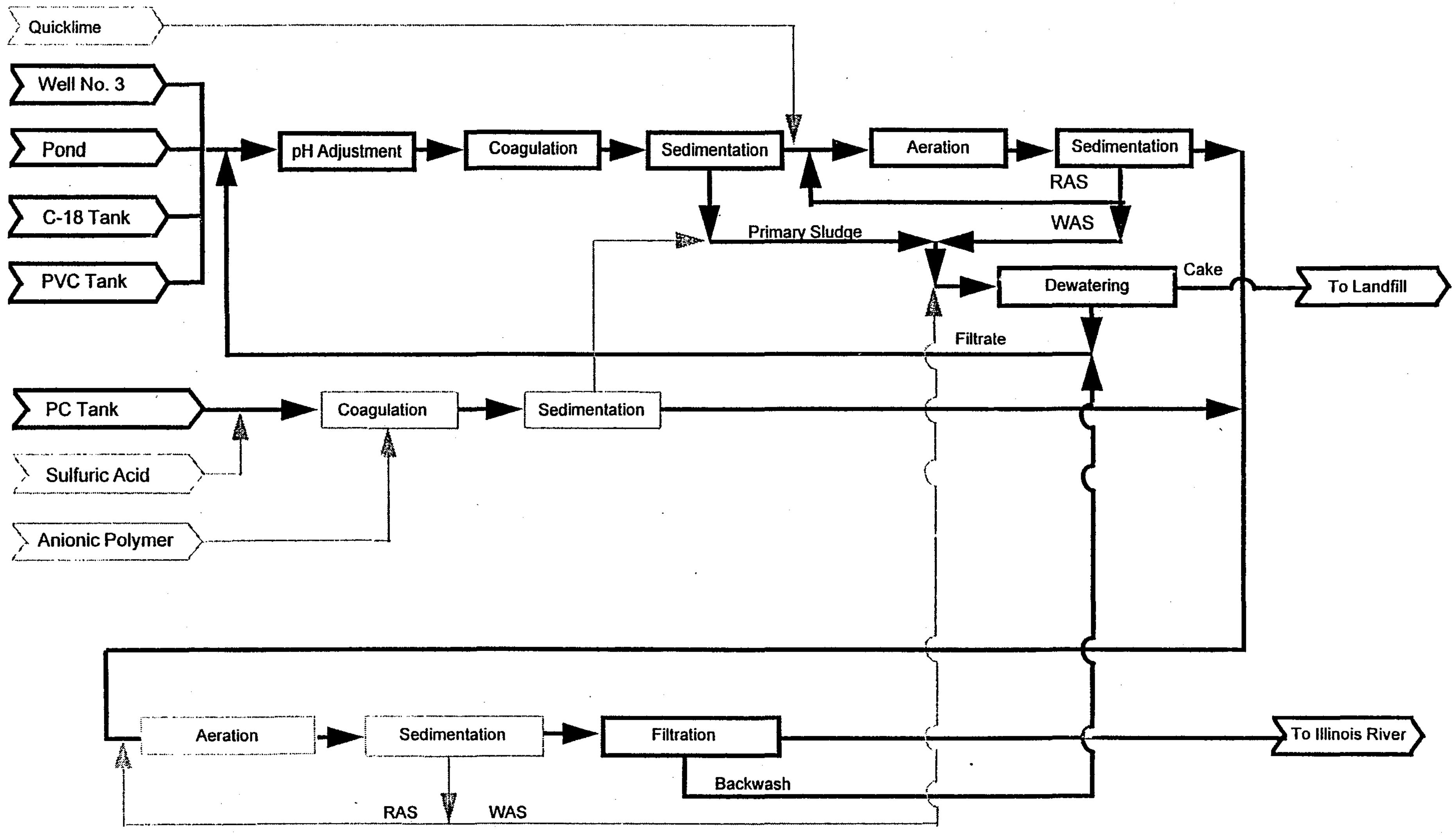

▭ Existing Equipment

⬚ New Equipment

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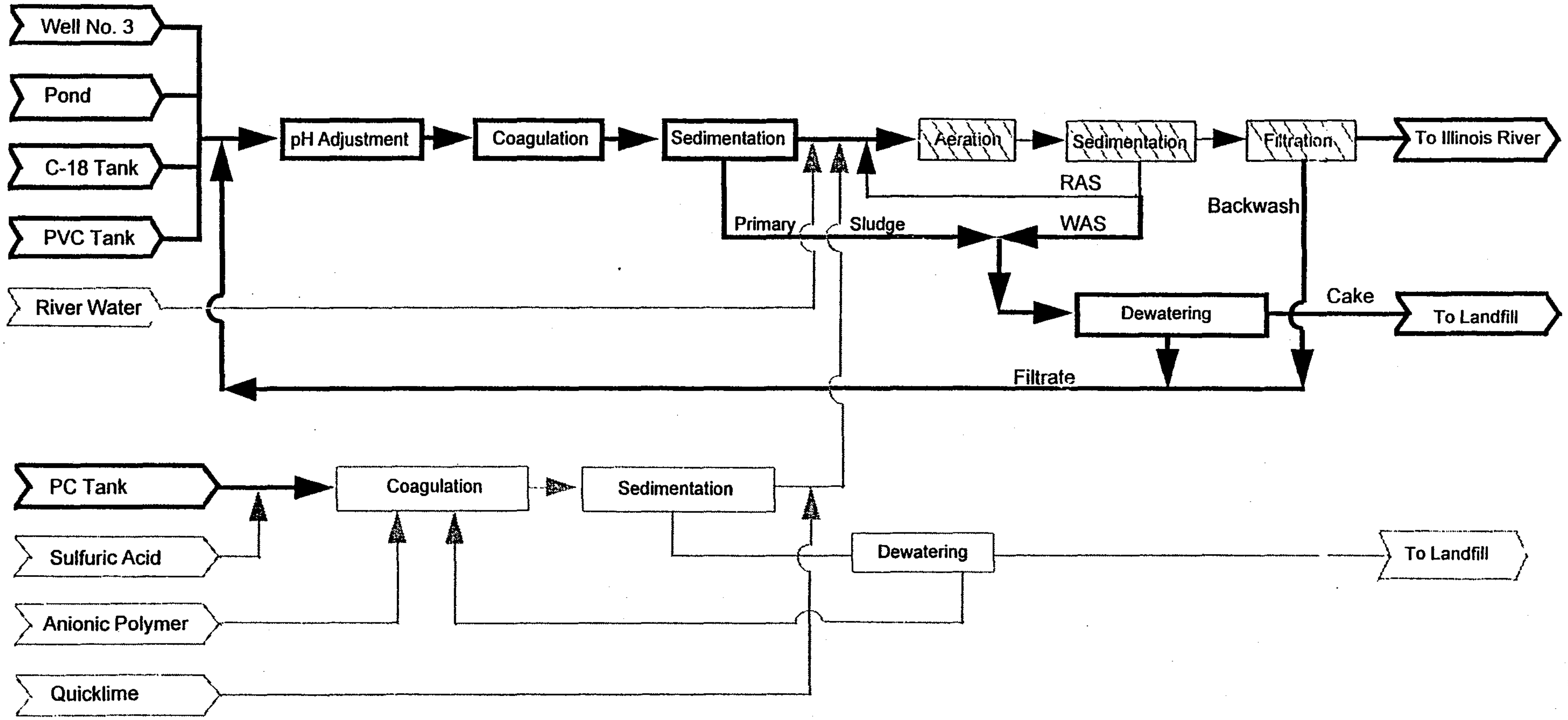
FIGURE 1-4

BLOCK FLOW DIAGRAM OF BIOLOGICAL NITRIFICATION TREATMENT ALTERNATIVE (No. 5)

ECKENFELDER
INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina



▭ Existing Equipment

⬚ New Equipment

▨ Upgraded Equipmemt

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FIGURE 1-5

BLOCK FLOW DIAGRAM OF BIOLOGICAL NITRIFICATION TREATMENT ALTERNATIVE (No. 6)

ECKENFELDER
INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

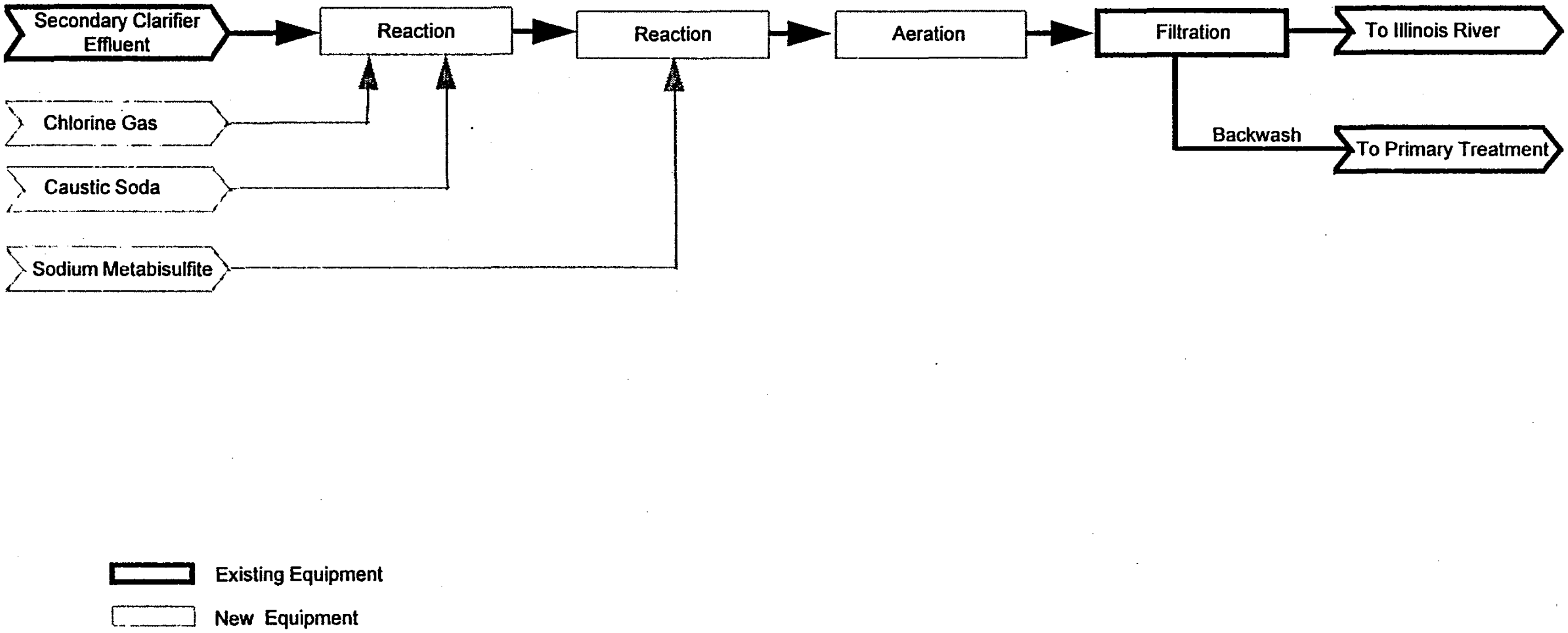

FIGURE 1-6

BLOCK FLOW DIAGRAM OF BREAKPOINT CHLORINATION ALTERNATIVE
(No. 7)

ECKENFELDER
INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

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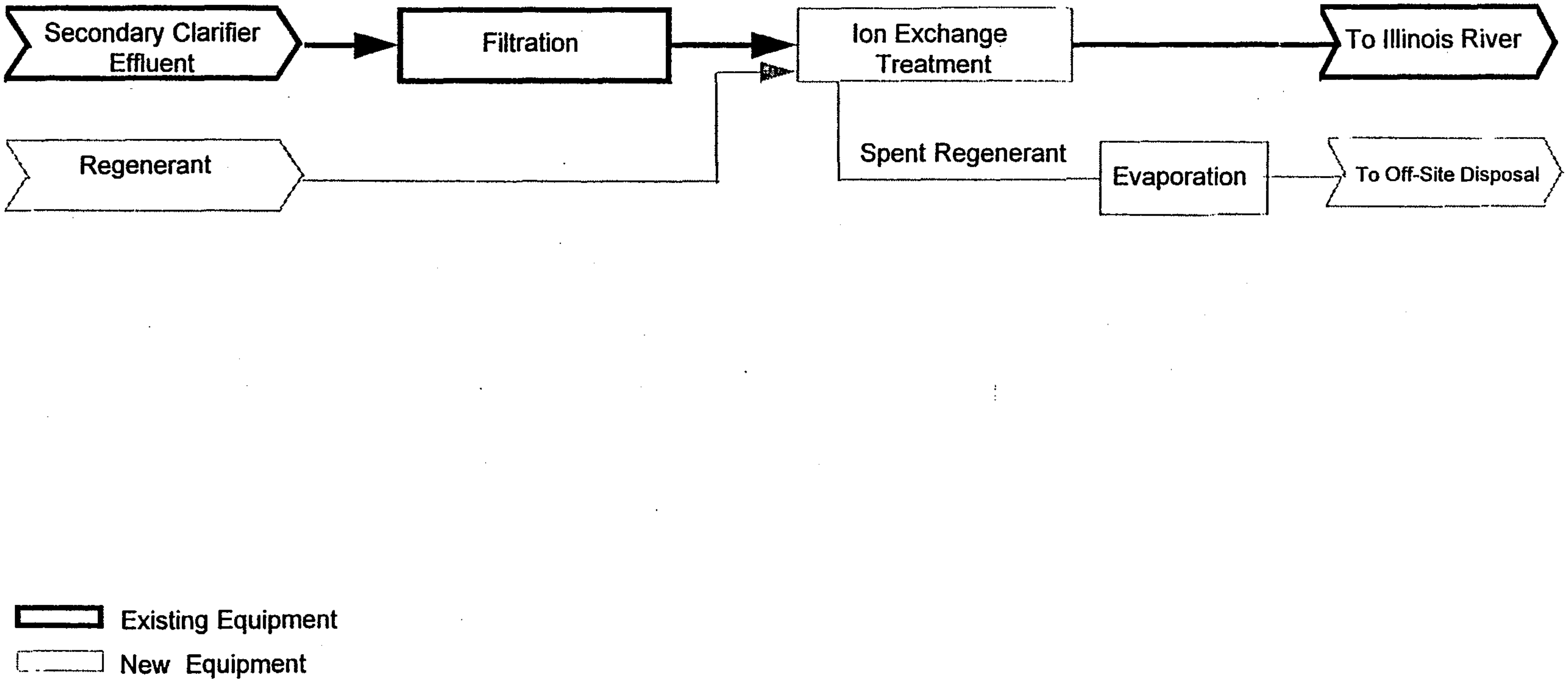

FIGURE 1-7

BLOCK FLOW DIAGRAM OF ION EXCHANGE TREATMENT ALTERNATIVE (No. 8)

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey
Greenville, South Carolina

q:\9387.01\ts\tsf0107.ppt

2.0 METHODS AND MATERIALS

2.1 DEVELOPMENT OF PRELIMINARY PROCESS DESIGN

Preliminary process designs were developed based on treatment of the 1996 wasteload as described in Table 1-1. Treatment process sizing and performance assessment assumed complete biohydrolysis of the influent TKN load to ammonia through the activated sludge process, an influent TCBOD/TCOD ratio of 0.30 lb/lb, and a TCBOD removal requirement of 0.035 lb NH_3-N/lb TCBOD. These assumptions yielded average and peak effluent ammonia loads for 1996 of 628 lb/day and 1,013 lb/day, respectively.

The BF Goodrich WWTF has historically exhibited 50 percent to 100 percent biohydrolysis of the influent TKN load. It is anticipated that this same variation in biohydrolysis of the influent TKN load occurred in 1996.

2.1.1 Alkaline Air Stripping

"Grab type" samples of the PC Tank discharge, PVC Tank discharge, and Secondary Clarifier Effluent were collected on April 22, 1996 and shipped via overnight delivery to ECKENFELDER INC.'s Laboratory in Nashville, Tennessee. The samples were analyzed for pH, total suspended solids (TSS), and ammonia-nitrogen (NH_3-N). Following these analyses, the samples were refrigerated until used for subsequent testing.

The pH of the PC Tank discharge, PVC Tank discharge, and Secondary Clarifier effluent were 12.5 s.u., 8.7 s.u., and 7.2 s.u., respectively. Alkaline air stripping of ammonia requires an operating pH of >10 s.u. to be effective.[2] The BF Goodrich activated sludge system requires an influent pH of 9.0 to 9.5 s.u. to ensure an operating pH of 6.5 to 7.5 s.u. The BF Goodrich effluent permit requires a discharge pH of 6.0 to 9.0 s.u. Consequently, the pH of PVC Tank discharge and Secondary Clarifier effluent required an increase prior to stripping and all three wastestreams required a pH reduction following stripping. The caustic soda (NaOH) and sulfuric

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[2] "Process Design Manual for Nitrogen Control," USEPA Technology Transfer, Washington, DC (1975).

acid (H_2SO_4) addition requirements to achieve the necessary pH adjustments were determined by development of titration curves presented in Section 3.1.

Samples of the PC Tank and PVC Tank discharges contained greater than 500 mg/L TSS which would foul a packed tower air stripper or horizontal tray stripper. Consequently, these wastestreams were considered for stripping by diffused aeration. Due to the poor efficiency of the diffused air stripping process and the large flow rates of these wastestreams, only stripping within the existing tankage was considered. Construction of additional tankage to achieve improved ammonia removal would not be cost effective. Conventional packed tower air stripping of the secondary clarifier effluent was considered since this is the most cost-effective and demonstrated stripping technology. The preliminary process designs of the diffused aeration stripping processes were based on modeling by ECKENFELDER INC. The preliminary process design of the packed tower air stripping process was developed based on modeling by Delta Cooling Towers.[3]

Samples of the PC Tank discharge, PVC Tank discharge, and Secondary Clarifier Effluent were subjected to batch diffused aeration stripping tests to confirm the ammonia in these wastestreams was "strippable." An aliquot (1,300 mL) of each sample was placed in a 2,000-mL graduated cylinder and aerated using a 1-inch porous stone diffuser at a rate of 1,000 cfm/1,000 cu ft (maximum design aeration rate) and pH >10 s.u. The NH_3-N concentration was monitored with time during these tests and water lost to evaporation was made up with distilled water. Results of these tests indicated the ammonia was strippable and progressed at a rate consistent with conventional theory (i.e., Henry's Constant).

In all cases, it was assumed that the off-gas would not require collection and treatment.

2.1.2 Struvite Precipitation

Grab type samples of the PC, PVC, and C-18 Tank discharges were collected on April 22, 1996 and shipped via overnight delivery to ECKENFELDER INC.'s

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[3] Keith Kay of Delta Cooling Towers, Inc., 134 Clinton Road, P.O. Box 952, Fairfield, New Jersey 07004, (201) 227-0300.

Laboratory in Nashville, Tennessee. The samples were blended to form combined wastestreams to simulate the average combined influent flow rate ratio for 1995 and a combined influent containing the peak 1996 PC Tank discharge COD load (see Table 1-1). The combined 1995 influent was analyzed for NH_3-N and subjected to three Batteries (I, II, and III) of batch treatability tests to evaluate NH_3-N removal by precipitation as struvite (NH_4MgPO_4). The combined peak 1996 influent was analyzed for NH_3-N and subjected to Battery IV batch treatability tests to demonstrate the impact of PC Tank discharge contribution on test results.

Battery I, II, III, and IV batch treatability tests consisted of placing aliquots (500 mL) of the wastestream in 1,000-mL beakers. The beaker contents were rapidly mixed, spiked with a magnesium sulfate solution containing 10,000 mg/L Mg^{++}, spiked with a phosphoric acid solution containing 10,000 mg/L PO_4-P, adjusted to the desired pH using NaOH, and mixed for 60 minutes. Samples were removed after 60 minutes, subjected to 0.45 μm filtration, and the filtrate analyzed for NH_3-N.

Battery I tests evaluated the impact of pH on ammonia removal while maintaining a Mg^{++} dose equal to 118 percent of the stoichiometric amount required to precipitate struvite (2.0 mg Mg^{++} per mg N versus 1.7 mg Mg^{++} per mg N) and a PO_4-P dose equal to 168 percent of the stoichiometric amount required to precipitate struvite (3.7 mg P per mg N versus 2.2 mg P per mg N). Work by Arnold and Wolfram[4] indicated that excess P addition increased NH_3-N removal while excess Mg^{++} addition did not improve NH_3-N removal. Battery II tests evaluated the impact of increased Mg^{++} addition (3.9 mg Mg^{++}/mg N) and PO_4-P addition (7.3 mg P/mg N) on NH_3-N removal while operating at a perceived optimum pH (12 to 12.5 s.u.). Battery III tests evaluated whether increased Mg^{++} addition (2.0, 2.9, and 3.9 mg Mg^{++}/mg N) at a pH 9.5 s.u. would provide comparable NH_3-N reduction to that experienced at pH of 12 s.u. and 2.0 mg Mg^{++}/mg N while maintaining a constant PO_4-P addition of 3.7 mg P/mg N. Lastly, Battery IV tests evaluated the effect of operating pH on NH_3-N removal from the combined peak 1996 influent while providing the Mg^{++} addition (3.9 mg Mg^{++}/mg N) and PO_4-P addition (3.7 mg P/mg N) deemed most favorable from Battery I, II, and III tests.

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[4] "Ammonia Removal and Recovery from Fertilizer Complex Wastewaters," D.W. Arnold and W.E. Wolfram, *Proceedings of 30th Industrial Waste Conference*, Purdue University, 1975.

In full-scale application, magnesium would be added as Sul-PO-Mag,[5] and phosphorus would be added as 85 percent (by weight, w/w) phosphoric acid (H_3PO_4). Primary clarifier effluent pH would continue to be maintained by addition of 50 percent (w/w) NaOH.

2.1.3 Single-Stage Biological Nitrification of Non-PC Wastestreams Combined with Separate Biological Treatment of the PC Wastestream

Previous work by ECKENFELDER INC. in 1995 indicated that all wastestreams at the BF Goodrich Henry Plant (excluding the PC Tank discharge) will support biological nitrification at their respective 1995 loads and peak 1996 loads. Further work in 1996 and 1997 indicated that the combined wastestream was treatable for BOD removal under the peak 1996 loads. Consequently, one alternative for effluent ammonia reduction would be first-stage nitrification of the non-PC wastestreams followed by a second-stage biological treatment of the PC Tank discharge after dilution with effluent from the first-stage reactor.

Development of the preliminary process design for this treatment alternative is described in the following subsections.

2.1.3.1 Clarification Requirements. The peak solids loading rate (SLR) on the secondary clarifier which the BF Goodrich WWTF has operated successfully for weeks at a time is 29 lb MLSS/day•sq ft calculated from Equation (2-1). This was considered to be the peak allowable SLR in sizing clarification area for first-stage and second-stage biological treatment processes.

$$\mathrm{SLR} = \frac{(Q_{in} + Q_{RAS}) \times 8.34 \times \mathrm{MLSS}}{A} \qquad (2\text{-}1)$$

where:

SLR = solids loading rate, lb/day•sq ft
= 29 lb/day•sq ft (peak)

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[5] Sul-PO-Mag (11 percent w/w Mg), distributed by IMC Global, One Nelson C. White Parkway, Mundelein, Illinois 60060, (847) 970-3000.

Q_{in} = peak influent flow rate, MGD
Q_{RAS} = peak return activated sludge flow rate, MGD
MLSS = mixed liquor suspended solids concentration in biotreater, mg/L
A = clarification area, sq ft
= 2,826 sq ft for existing secondary clarifier

2.1.3.2 BOD Removal Requirements. The required operating MLVSS concentration for first-stage and second-stage BOD removal was calculated from Equation (2-2)

$$\frac{So\,(So - Se)}{X_v\ HRT} = K\ Se \tag{2-2}$$

where:

So = biotreater influent total carbonaceous biochemical oxygen demand (TCBOD) concentration, mg/L
= assumed equal to 0.30 x influent soluble chemical oxygen demand (SCOD) concentration, mg/L
Se = final effluent SCBOD concentration, mg/L
X_v = biomass concentration in biotreaters, mg/L MLVSS
= assumed equal to 0.7 x MLSS concentration
HRT = hydraulic residence time in biotreaters, days
K = CBOD removal rate constant, 5.2 day^{-1} at the winter mixed liquor temperature of 27°C based on 1996 treatability data

The primary clarifier effluent BOD load (S_o for first stage) was calculated by multiplying the non-PC wastestream SCOD load (4,020 lb/day average and 7,320 lb/day peak) by the 1995 observed ratio of 0.30 lb TCBOD/lb TCOD for these wastestreams. The second stage BOD load was calculated by multiplying the PC wastestream SCOD load (8,280 lb/day average and 10,840 lb/day peak) by the 1995 observed ratio of 0.30 lb TCBOD/lb TCOD. Lastly, the required HRT while operating at the peak MLSS defined in Equation (2-1) was calculated based on discharging effluent filtered BOD concentrations (Se) of 16 mg/L (monthly average) and 36 mg/L (daily maximum) to comply with the monthly average and daily maximum permit limits for effluent BOD of 20 mg/L and 40 mg/L, respectively.

This assumes that the filter effluent TSS concentration is 16 mg/L and exhibits a BOD contribution of 0.25 mg TCBOD/mg TSS.

2.1.3.3 Biotreater Tankage and Oxygenation Requirements. Oxygen requirements for first-stage and second-stage treatment were calculated based on an observed 1996 consumption of 0.4 lb O_2/lb TCOD applied plus 4.6 lb O_2/lb NH_3-N removed through nitrification. The existing aeration system is capable of transferring 4,310 lb O_2/day at a 2 mg/L dissolved oxygen (DO) concentration and 31°C and 5,050 lb O_2/day at a 1 mg/L DO concentration and 31°C. Additional oxygen requirements beyond this capacity will be provided by addition of biotreater tankage which is equally oxygenated since this oxygenation rate is within 14 percent of the maximum achievable with the existing diffuser type and sidewall depth.[6]

2.1.3.4 Alkalinity Requirements. Approximately 7.1 mg total alkalinity (as $CaCO_3$) is consumed per mg NH_3-N removed during biological nitrification. BF Goodrich currently adds NaOH to the combined influent wastestream to maintain a minimum effluent pH of 6.5 s.u. However, quicklime rather than NaOH would be added to the primary clarifier effluent to support the alkalinity demands of biological nitrification due to its lower cost ($40 vs $560 per ton of alkalinity added).

2.1.3.5 Sludge Handling Requirements. An additional same-sized filter press (75 cu ft) is currently needed at the BF Goodrich-Henry, Illinois Plant. This need will become more acute with the increased sludge production associated with biological nitrification.

The required operating MLVSS concentration for nitrification was calculated using Equations (2-3) and (2-4). The MLVSS calculated in Equation (2-4) was used to calculate the clarification area required in first-stage treatment, assuming a 0.70 mg MLVSS/mg MLSS.

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[6] Greg Wendzicki of Roediger Pittsburgh, Inc., 3812 Route 8, Allison Park, PA 15101, 412-487-6010.

$$q_{max} = \frac{1}{MCRT\ Y} \qquad (2\text{-}3)$$

where:

q_{max} = maximum nitrification rate which can be achieved treating the specific wastestream, 0.25 mg NH_3-N/mg $MLVSS_{nitrifiers}$•day at 27°C based on 1997 treatability data

MCRT = mean cell residence time, days

Y = nitrifying biomass net yield, assumed 0.1 m $MLVSS_{nitrifiers}$/mg NH_3-N oxidized

$$MCRT = (a\ (COD_R) - bXdXv + fS\mathit{i} + Y(NH_3\text{-}N_R))\ \frac{1}{X_v} \qquad (2\text{-}4)$$

where:

a = heterotrophic biomass growth yield, 0.30 mg MLVSS/mg COD_R based on 1996 treatability data

COD_R = COD removal through activated sludge system, mg/day

b = endogenous decay term, assumed 0.15 mg MLVSS/mg degradable MLVSS•day at winter mixed liquor temperature of 27°C

Xd = fraction of MLVSS which is degradable, assumed equal to 0.8/(1 + 0.2 b MCRT), dimensionless

Xv = MLVSS mass in biotreaters, mg

f = fraction of primary clarifier effluent VSS which is non-degradable, assumed 0.5 mg/mg

Si = mass loading of primary clarifier effluent VSS assuming a 30 mg/L concentration, mg/day

NH_3-N_R = NH_3-N removed through activated sludge system, mg/day

2.1.3.6 Pretreatment Requirements. The preliminary process design for the PC Tank discharge pretreatment system was developed based on batch treatability testing. Quicklime (CaO) and sulfuric acid (H_2SO_4) addition rates were based on a titration curve developed for the wastestream. Rapid mix and sedimentation times were assumed to be 3 minutes and 60 minutes, respectively. Sludge quantities were estimated based on treatability data. Filter press dewatering was selected for dewatering of the underflow due to its demonstrated performance at the BF Goodrich WWTF.

2.1.4 Biological Nitrification of Combined Wastestream

Previous work by ECKENFELDER INC. indicated that all non-PC Tank discharges will support biological nitrification at their respective peak 1996 loads. Further work indicated the PC Tank discharge would also support nitrification if pretreated by precipitation by pH 2 and limited to a 1,000 mg/L TCOD contribution (based on its unpretreated TCOD concentration) in the feed. Consequently, one alternative for effluent ammonia reduction would be pretreatment of the PC Tank discharge followed by river water addition and combined single-stage nitrification with non-PC wastestreams. The required combined wastestream flow rate would be 900 gpm based on the 1,000 mg/L contribution limit and peak PC Tank discharge of 10,800 lb/day SCOD. The required non-PC wastestream flow rate would be 750 gpm (900 gpm - 150 gpm). The available non-PC wastestream average flow rate is 453 gpm. Consequently, a river water supply system would be installed which would be capable of providing 297 gpm (750 - 453 gpm). Work completed in 1997 indicated that partial biological nitrification ($\geq$40 percent reduction in effluent NH_3-N) could be achieved in the absence of river water addition. However, river water addition was included to maximize nitrification potential.

The same calculations described in Section 2.1.3 were used to evaluate the upgrade measures required for oxygenation, biotreater tankage, and secondary clarification. Secondary clarification was also limited to the peak hydraulic loading rate sustained in 1996 (350 gpd/sq ft) due to the susceptibility of the clarifier to floc carryover. Sand filtration requirements were based on a peak solids loading rate of 1.0 lb TSS/day•sq ft and a peak secondary clarifier effluent TSS concentration of 50 mg/L. Same-sized secondary clarifier (60-ft diameter) and sand filter (9 ft x 24 ft) units were provided as needed.

2.1.5 Breakpoint Chlorination of Secondary Clarifier Effluent

A grab type sample of the Secondary Clarifier effluent was collected on April 22, 1996 and shipped via overnight delivery to ECKENFELDER INC.'s Laboratory in Nashville, Tennessee. The sample was analyzed for NH_3-N and subjected to four Batteries (I, II, III, and IV) of batch treatability tests. These tests consisted of placing 500-mL aliquots in 1,000-mL beakers. The beaker contents were rapidly mixed, spiked with a sodium hypochlorite solution (10,000 mg/L Cl_2), adjusted to the desired pH of 6.5 to 7.2 s.u. using H_2SO_4, and mixed for a given contact time. Samples were removed and analyzed for free available chlorine (FAC) and NH_3-N. The USEPA Nitrogen Control Manual suggests that the optimum pH for breakpoint chlorination is 6.5 s.u., and the BF Goodrich final effluent typically exhibits a pH of 7.2 s.u.

Battery I testing evaluated the impact of chlorine dose (0, 100, 300, and 400 mg/L FAC) on residual NH_3-N concentrations at a constant reaction pH of 6.5 s.u. and reaction time of 5 minutes. Battery I testing indicated that 400 mg/L FAC was an insufficient chlorine dose to provide significant NH_3-N reduction and that a 5-minute contact time was too brief to allow complete reaction with the FAC. Consequently, Battery II testing evaluated the impact of a much higher chlorine dose (1,000 mg/L and 2,000 mg/L FAC) and much longer contact time (60 minutes) on residual NH_3-N concentration at a constant reaction pH of 6.5 s.u. Battery II testing indicated that a 1,300 ±100 mg/L FAC dose completely oxidize all residual NH_3-N and that a shorter contact time could be provided. Battery III testing evaluated the impact of contact time on FAC residual and confirmed whether a 1,300 mg/L ±100 mg/L dose would provide complete oxidation of residual NH_3-N at a constant reaction pH of 6.5 s.u. Lastly, Battery IV testing evaluated whether there was any difference in breakpoint chlorination performance at a reaction pH of 6.5 s.u. versus the typical BF Goodrich final effluent pH of 7.2 s.u.

2.1.6 Ion Exchange Treatment of Final Effluent

ECKENFELDER INC. developed a Freundlich isotherm for ammonia removal from the final effluent using clinoptilolite, an ammonia selective ion exchange resin. This isotherm was used to estimate resin usage to achieve specified effluent NH_3-N reduction. Common design practices were used to size the ion exchange columns (i.e., 3 gpm/sq ft).

2.2 PRELIMINARY COST ESTIMATES

Preliminary cost estimates presented in this Report were developed based on vendor estimates, data from a commercial software program, and ECKENFELDER INC.'s judgment. These estimates are considered accurate to within -10 percent to +30 percent. Installed costs were based on the preliminary process design of a system required to treat the peak influent TKN load assuming complete biohydrolysis of TKN to NH_3-N through the activated sludge process. Annual operation and maintenance costs also assumed complete biohydrolysis of the influent TKN load. Present worth costs were based on a 10-year project life and an 8 percent annual interest rate.

Installed costs included construction materials and equipment plus an additional 5 percent for electrical hookup and interface instrumentation, 10 percent for interface piping and site work, 15 percent for contingency, and 30 percent for engineering, general contracting, permitting, and project administration.

Operation and maintenance costs considered only labor and chemical usage. The cost of labor was assumed as $30/hour. The cost of chemicals were as follows: $350/ton of 50 percent NaOH, $90/ton of 93 percent H_2SO_4, $750/ton of 75 percent H_3PO_4, $110/ton of Sul-PO-Mag, $200/ton of chlorine gas, $70/ton of 90 percent CaO, and $35/100 lb of sodium bisulfite. Costs for maintenance materials and electricity were not included in the estimate.

3.0 BATCH TREATABILITY TEST RESULTS

ECKENFELDER INC. conducted batch treatability tests to assess the feasibility of treatment alternatives discussed in Sections 1.0 and 2.0. Results from these tests were used to develop preliminary process designs for those treatment alternatives deemed feasible. The results are described in the following subsections.

3.1 ALKALINE AIR STRIPPING

3.1.1 pH Adjustment

The PC Tank discharge, PVC Tank discharge and secondary clarifier effluent required pH adjustment to provide alkaline air stripping for ammonia removal and subsequent discharge. The pH adjustment requirements of these three wastestreams are illustrated in Figures 3-1, 3-2 and 3-3 and are discussed below.

The quantity of 93 percent by weight (w/w) H_2SO_4 required to lower the PC Tank discharge pH (10.6 s.u.) to that required for discharge to the biotreaters (pH 9.25 ± 0.25 s.u.) is 5 lb/1,000 gallons. Consequently, the average and peak usage of 93 percent H_2SO_4 in 1996 would have been 770 lb/day and 1,080 lb/day, respectively.

The quantity of 50 percent, w/w, NaOH required to elevate the PVC Tank contents from pH 8.3 s.u. to pH 10.5 for stripping is 70 lb/1,000 gallons. At the average and peak day flow rates of 401 gpm and 499 gpm, the required daily quantities of 50 percent NaOH would have been 40,400 lb/day and 50,300 lb/day, respectively. The quantity of 93 percent H_2SO_4 required to lower the pH from 10.5 s.u. after stripping to that required for discharge to the biotreaters (pH 9.25 ± 0.25 s.u.) is 4 lb/1,000 gallons. The average and peak quantities of 93 percent H_2SO_4 required would have been 2,310 lb/day and 2,870 lb/day, respectively.

The quantity of 50 percent NaOH required to elevate the secondary clarifier effluent from pH 7.8 s.u. to pH 10.5 is 7.5 lb/1,000 gallons. At average and peak day flow rates of 560 gpm and 670 gpm, the daily quantities of 50 percent NaOH required would have been 6,050 lb/day and 7,240 lb/day, respectively. The quantity of 93 percent H_2SO_4 required to lower the pH to 8.5 s.u. to ensure effluent permit

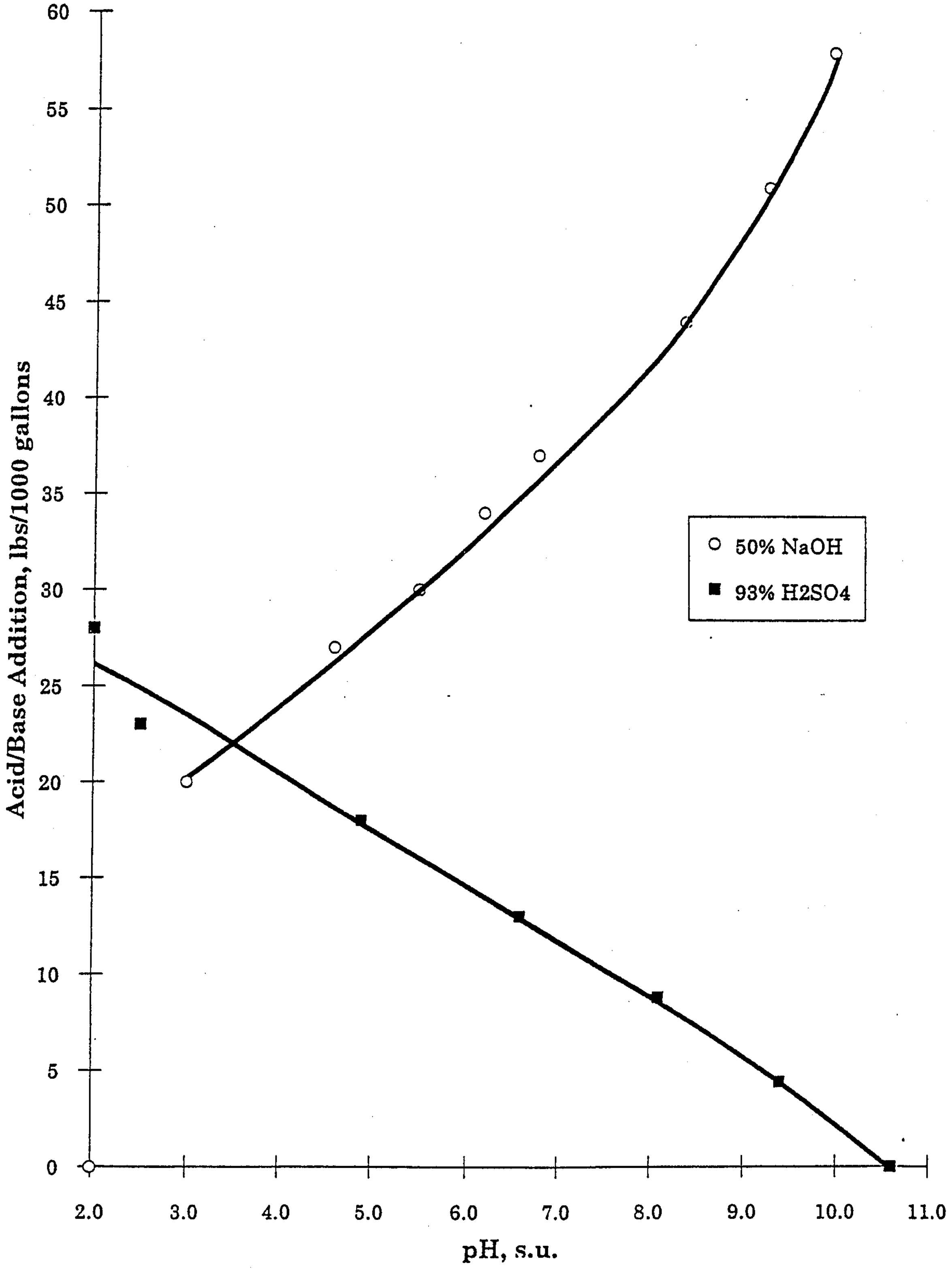

Figure 3-1 pH Adjustment of PC Tank Discharge

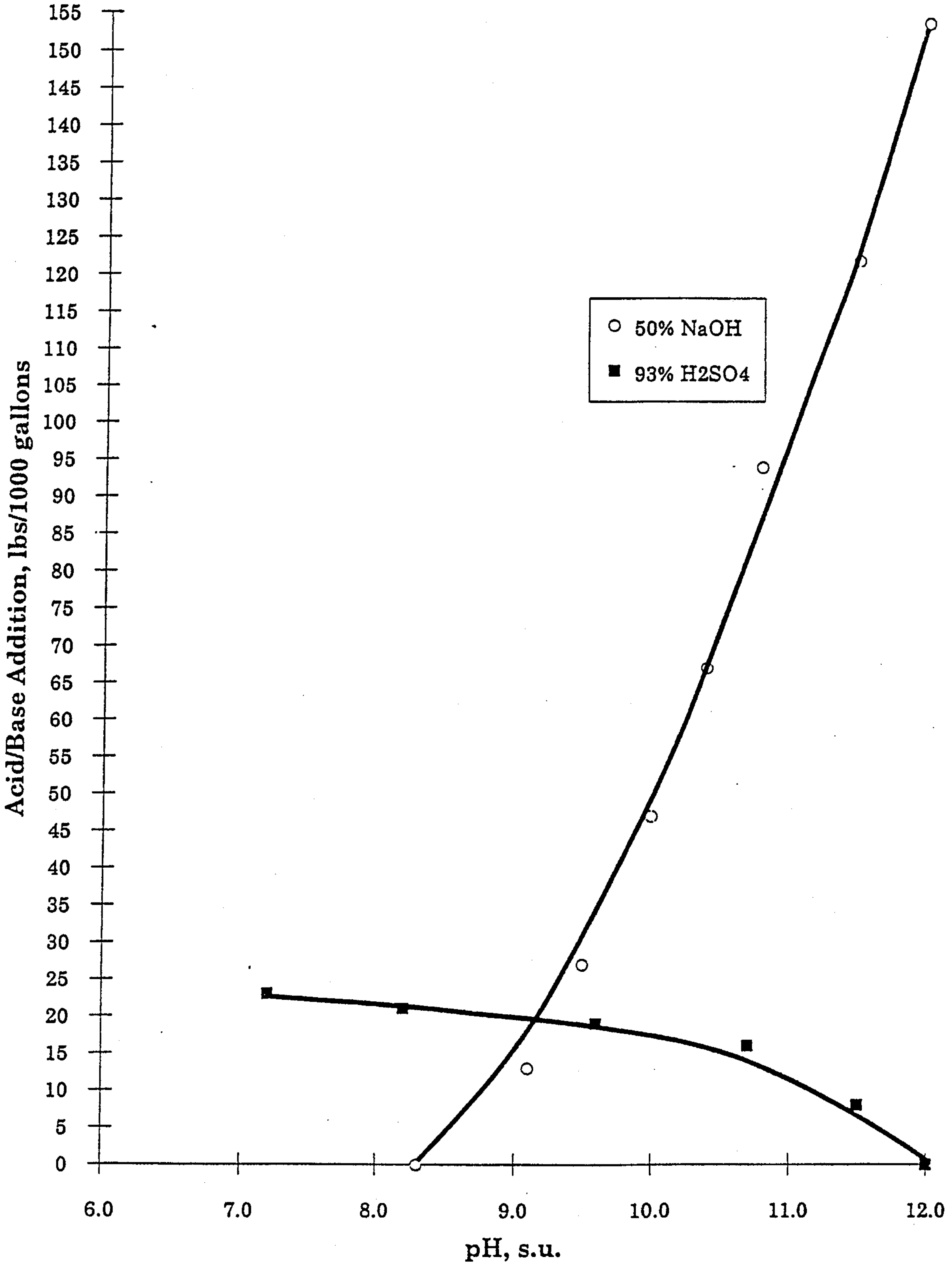

Figure 3-2 pH Adjustment of PVC Tank Discharge

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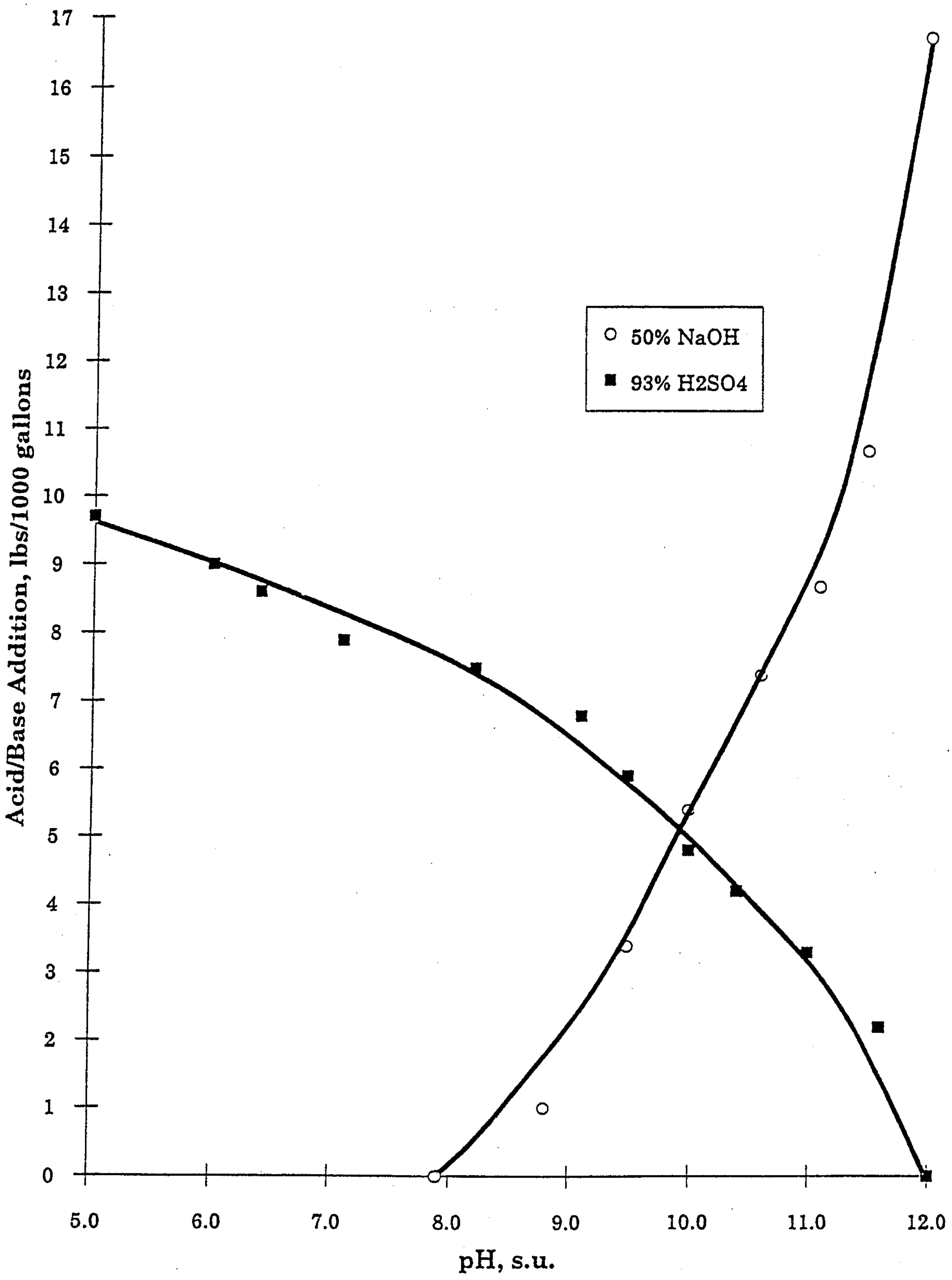

Figure 3-3 pH Adjustment of Secondary Clarifier Effluent compliance ($\leq$pH 9.0 s.u.) would have been 3.0 lb/1,000 gallons, or 2,420 lb/day average and 2,890 lb/day, peak.

3.1.2 Ammonia Removal

Batch alkaline air stripping test results for the three wastestreams are presented in Table 3-1. These results indicate that the NH_3-N present in these wastestreams can be removed through alkaline air stripping. Modeling conducted by ECKENFELDER INC. indicated that 80 percent (36 lb/day) of the 1996 average NH_3-N load discharged from the PC Tank could be removed by in situ aeration of the Tank contents at pH 10.6 and a rate of 100 cfm/1,000 cu ft. Likewise, 60 percent (129 lb/day) of the 1996 average NH_3-N load discharged from the PVC Tank could be removed by aerating the Tank contents at this same rate and at a pH of 10.5 s.u. These removal rates are $\leq$21 percent of the 1996 average final effluent NH_3-N load of 628 lb/day assuming complete biohydrolysis of the influent TKN. The low removals are due to the fact that the average influent NH_3-N load which can be removed at these two equalization tanks comprises only 34 percent of the average influent TKN load in which all TKN is assumed to be biohydrolized to NH_3-N through the activated sludge process. The 1996 average final effluent NH_3-N load could be reduced by 95 percent by alkaline air stripping of the secondary clarifier effluent. This higher rate of removal is possible since it has been assumed that all of the influent TKN load is biohydrolized by the activated sludge process and is, therefore, available for stripping from the final clarifier effluent. The secondary clarifier effluent is the most effective application point for alkaline air stripping.

3.2 STRUVITE PRECIPITATION

Batch treatability tests evaluated precipitation of struvite (NH_4MgPO_4) from the combined wastestream. Results of these tests are summarized in Table 3-2. They indicate that the combined wastestream NH_3-N concentration can be reduced to approximately 25 mg/L under two operating conditions.

- A magnesium dose of 2.0 mg Mg/mg N, phosphorus dose of 3.7 mg P/mg N and an operating pH of 10.5 to 12.5 s.u.

TABLE 3-1

BATCH ALKALINE AIR STRIPPING TEST RESULTS

Wastestream	Time of Aeration at 100 cfm/1,000 cu ft (days)	Reaction pH (s.u.)	NH_3-N Residual (mg/L)	NH_3-N Removal[a] (lb/day)
PC Tank Discharge				
	0	12.5	23	0
	0.1	12.5	19	5
	1.0	12.5	4	24
	2.0	12.5	4	24
	3.0	12.5	4	24
	7.0	12.5	3	26
PVC Tank Discharge				
	0	10.0	50	0
	1.0	10.0	44	29
	2.0	10.0	25	120
	6.0	10.0	6	210
Secondary Clarifier Effluent				
	0	10.0	100	0
	1.0	10.0	70	200
	2.0	10.0	43	380
	3.0	10.0	28	480
	6.0	10.0	6	630

[a] Based on average 1996 flow rates for PC Tank discharge, PVC Tank discharge, and final effluent of 107 gpm, 401 gpm, and 560 gpm, respectively.

TABLE 3-2

PRECIPITATION OF STRUVITE FROM COMBINED WASTESTREAM

Test Battery No.[a]	Magnesium Addition			Phosphorus Addition			NaOH Addition		Reaction pH (s.u.)	Filtered NH_3-N (mg/L)	NH_3-N Removal[c] (lb/day)
	Dose[b] (%)	Dose (mg/L as Mg)	Dose[c] (lb/day)	Dose[b] (%)	Dose (mg/L as P)	Dose[c] (lb/day)	Dose (meq/L)	Dose[c] (lb/day)			
1995 Wastestream											
I	0	0	0	0	0	0	0	0	10.0	41	0
	114	80	4,860	166	150	3,730	0	0	8.0	37	27
	114	80	4,860	166	150	3,730	2.2	1,180	8.5	35	41
	114	80	4,860	166	150	3,730	5.8	3,130	9.0	35	41
	114	80	4,860	166	150	3,730	10.4	5,600	9.5	32	61
	114	80	4,860	166	150	3,730	14.6	7,860	10.0	32	61
	114	80	4,860	166	150	3,730	20	10,800	10.5	24	113
	114	80	4,860	166	150	3,730	22	11,800	11.0	29	81
	114	80	4,860	166	150	3,730	37	19,900	11.5	20	139
	114	80	4,860	166	150	3,730	43	23,200	12.0	26	104
	114	80	4,860	166	150	3,730	89	47,900	12.5	21	139
II	229	160	9,810	333	300	7,470	59	31,800	12.0	25	104
	229	160	9,810	333	300	7,470	105	56,500	12.5	20	139
III	114	80	4,860	166	150	3,730	9.4	5,060	9.5	35	41
	171	120	7,380	166	150	3,730	9.6	5,170	9.5	28	76
	229	160	9,810	166	150	3,730	9.6	5,170	9.5	25	104
Peak 1996 Wastestream											
IV	0	0	0	0	0	0	0	0	10.5	34	0
	229	160	9,810	166	150	3,730	5.0	2,690	9.5	28	41
	229	160	9,810	166	150	3,730	15	8,070	11.5	23	74

[a] Test Battery Nos. I, II, and III considered treatment of the 1995 average influent and Test Round No. IV considered treatment of the peak 1996 influent.

[b] Percent of stoichiometric dose added.

[c] Based on 560 gpm flow rate.

- A magnesium dose of 3.9 mg Mg/mg N, phosphorus dose of 4.1 mg P/mg N and an operating pH of 9.5 s.u.

The second condition is less costly. It substitutes 4,950 lb/day more Sul-PO-Mag ($270/ton) for 5,630 lb/day less 50 percent NaOH ($350/ton). It also eliminates the need for the 5 lb/1,000 gallons of 93 percent H_2SO_4 required to lower the pH from 10.5 s.u. to 9.5 s.u. prior to discharge to the biotreaters (See Figure 3-4).

This treatment process is feasible, but would have provided only a 17 percent reduction (105 lb/day) in the average final effluent NH_3-N load projected for 1996. This low removal rate is due to the fact that the average influent NH_3-N load comprises only 37 percent of the average influent TKN load and, as such, the bulk of the potential effluent nitrogen load is not yet available for removal at this point in the treatment system.

3.3 BREAKPOINT CHLORINATION OF SECONDARY CLARIFIER EFFLUENT

Batch treatability testing of breakpoint chlorination used sodium hypochlorite (NaOCl). Sulfuric addition was required to maintain the desired reaction pH of 6.5 to 7.2 s.u. during the tests. Due to the large quantity of chlorine that would be required, chlorine gas (and not NaOCl) would be used in the full-scale application. Treatability testing indicated that chlorination of the Secondary Clarifier effluent caused a net increase in alkalinity since NaOCl was used. However, a net decrease in alkalinity would be experienced in full-scale application with chlorine gas addition, and 12.0 lb NaOH per lb NH_3-N oxidized would be required to maintain a target pH of 6.9 ±0.3 s.u. At average and peak effluent ammonia loads of 628 lb/day and 1,013 lb/day, the average and peak addition rates of 50 percent NaOH would have been 15,100 lb/day and 24,300 lb/day, respectively. Excess chlorine would be quenched using 1.4 lb sodium bisulfite ($NaHSO_4$) per lb chlorine reduced. Post aeration would be provided downstream of $NaHSO_4$ addition to quench residual bisulfite.

Results of the batch treatability tests are summarized in Table 3-3. They indicated that the secondary clarifier effluent exerted a background chlorine demand of 130 mg/L and required 7.8 mg Cl_2/mg NH_3-N oxidized. This is in excellent

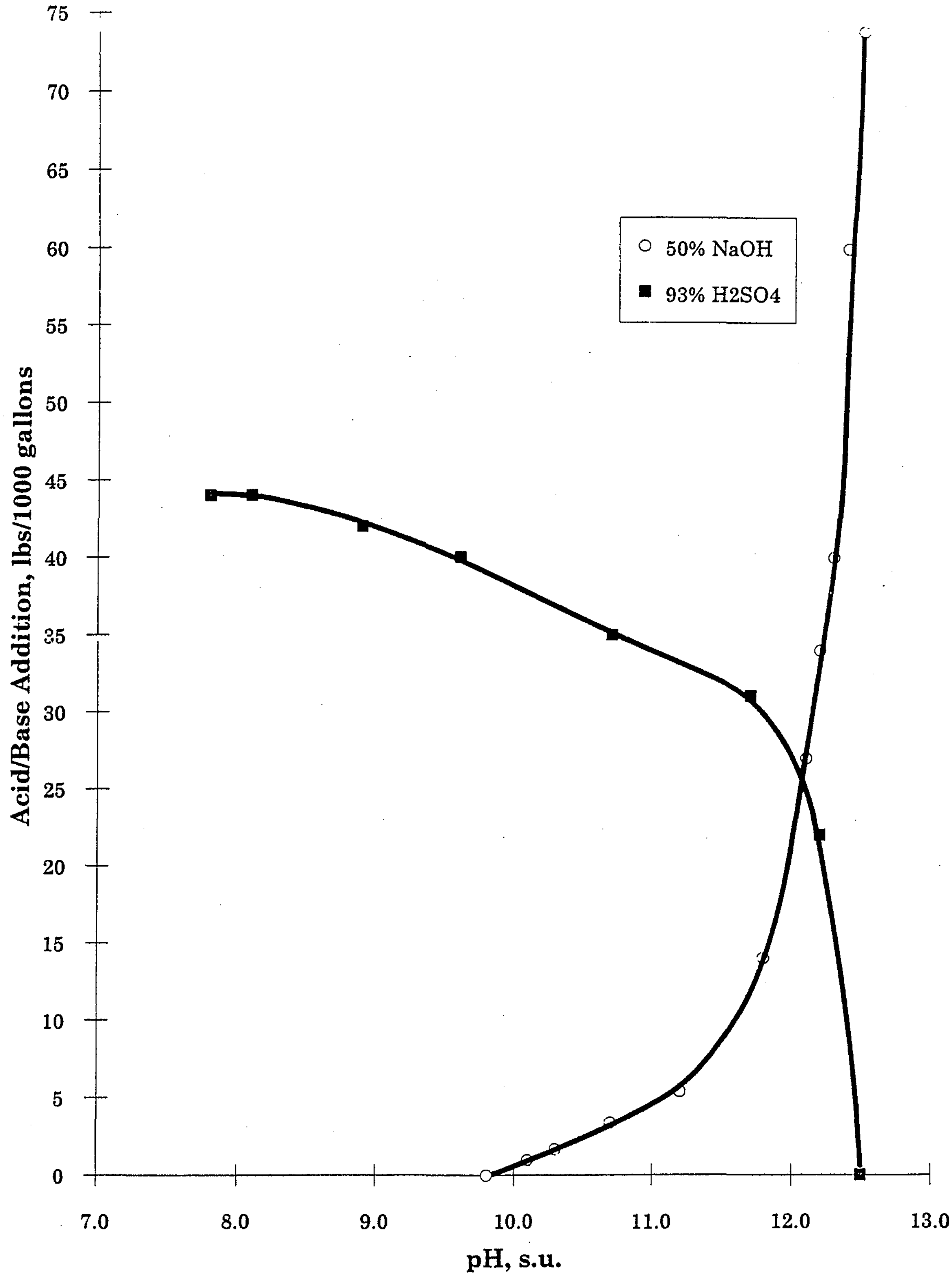

Figure 3-4 pH Adjustment of Combined Wastestream

TABLE 3-3

BREAKPOINT CHLORINATION OF SECONDARY CLARIFIER EFFLUENT

Test Battery No.	Chlorine Addition Dose (mg/L)	Chlorine Addition Dose[a] (lb/day)	Reaction Time (min)	FAC (mg/L)	Reaction pH (s.u.)	H_2SO_4 Dose (meq/L)	NH_3-N Residual (mg/L)	NH_3-N Removal[a] (lb/day)
1	0	0	0	0	7.2	0	138	0
	100	680	5	6	6.5	1.6	110	190
	300	2,020	5	17	6.5	2.2	110	190
	400	2,690	5	16	6.5	4.6	120	120
2	1,000	6,770	60	5	6.5	6.6	27	750
	2,000	13,500	60	51	6.5	17.6	1.4	920
3	1,200	8,070	15	10	6.5	4.6	NA[b]	NA
	1,200	8,070	30	8	6.5	4.6	NA	NA
	1,200	8,070	45	6	6.5	4.6	NA	NA
	1,200	8,070	60	6	6.5	4.6	1.5	920
	1,400	9,460	60	106	6.5	8.2	0.23	930
4	1,200	8,070	45	8	7.2	2.5	1.3	920

[a] Based on 560 gpm flow rate, chlorine gas addition, and 93 percent w/w H_2SO_4 addition.
[b] Not analyzed.

agreement with the stoichiometric value of 7.6 mg Cl_2/mg NH_3-N oxidized. Furthermore, the results indicated that near complete destruction of final effluent NH_3-N was achieved at an operating pH of 6.5 s.u. to 7.2 s.u. and a 60-minute contact time.

Breakpoint chlorination would have provided 97 percent reduction in the 1996 average final effluent NH_3-N load. This is the best removal performance achieved by any of the treatment alternatives considered.

3.4 ION EXCHANGE TREATMENT OF FINAL EFFLUENT

Batch treatability tests evaluated treatment of the secondary clarifier effluent using clinoptilolite, an ammonia selective ion exchange resin. Results of this work are illustrated in Figure 3-5. They indicate that greater than 50 lb of clinoptilolite would be required to remove each 1 lb of NH_3-N at residual NH_3-N concentrations less than 100 mg/L. This poor removal efficiency is presumed to be due to the large concentration of competing cations in the effluent. The total dissolved solids concentration of the final effluent is typically 8,500 ±1,500 mg/L. This treatment alternative would provide near complete NH_3-N removal. However, the impracticality of adding and regenerating this quantity of clinoptilolite precluded further consideration of this alternative.

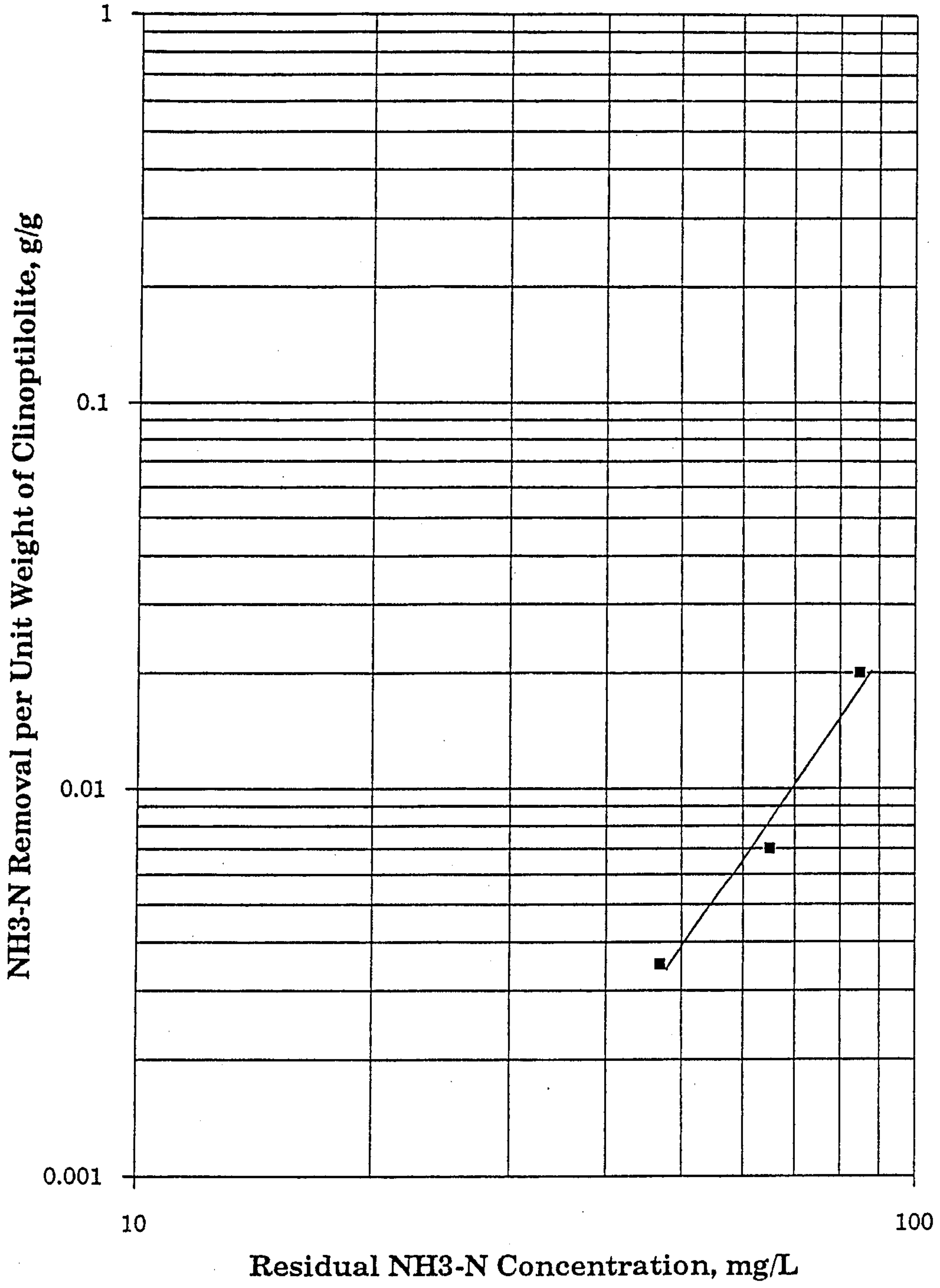

Figure 3-5 Clinoptilolite Treatment of Final Effluent for Ammonia Reduction

4.0 PRELIMINARY PROCESS DESIGN AND COST ESTIMATE FOR ALTERNATIVES

Only three alternatives were both practicable and capable of providing greater than a 25 percent reduction in the average effluent ammonia load (628 lb/day) and greater than 65 percent removal in the peak effluent ammonia load (1,013 lb/day) projected for 1996. These were, in descending order of effectiveness: Biological nitrification of the combined wastestream, alkaline air stripping of secondary clarifier effluent, and breakpoint chlorination of secondary clarifier effluent. Block flow diagrams for these Alternatives were presented in Figures 1-5, 1-2, and 1-6, respectively.

4.1 BIOLOGICAL NITRIFICATION OF COMBINED WASTESTREAM

Biological nitrification of the combined wastestream will require a pretreatment system for the PC Tank discharge, additional biotreater tankage, and additional aeration equipment. The required oxygenation capacity is 10,500 lb O_2/day to satisfy the 1996 peak TCOD and TKN loads. This treatment capacity would be satisfied by providing an additional 1.5 MG of equally oxygenated biotreater volume.

The system would likely provide a 95 percent reduction in the average effluent ammonia load. The effluent ammonia load associated with the peak day TKN load (an additional 385 lb/day) could be nitrified if the load were preceded by a gradual increase or could "pass through" if it were associated with a sudden increase. Oxygenation and alkalinity addition capacities must, therefore, be capable of supporting nitrification of the peak day TKN load.

In addition to biotreater tankage, the peak flow required to provide adequate dilution for uninhibited nitrification is 300 gpm. This additional flow will necessitate a river water supply system, additional secondary clarifier, additional sand filter, additional RAS pumping capacity, and reworking of WWTF piping. A summary of the preliminary cost estimate for these upgrades is provided in Table 4-1.

TABLE 4-1

SUMMARY OF PRELIMINARY COST ESTIMATE FOR BIOLOGICAL NITRIFICATION OF COMBINED WASTESTREAM

Description	O&M		Installed Cost	Present Worth
	($/yr)	($)[a]	($)	($)
Pretreatment System				
Sulfuric Acid Addition System				
Quicklime Addition System				
2-Stage Rapid Mix Before Sedimentation				
Flocculation				
Sedimentation				
Rapid Mix After Sedimentation				
Filter Press for Sludge Dewatering				
Sitework, Piping, Instrumentation, Electrical				
Biological Treatment				
300 gpm River Water Supply System				
Additional 1.5 MG in Biotreater Tankage				
Additional 6,200 lb O_2/day Transfer Capacity				
Additional 60 ft diameter Secondary Clarifier				
Additional 9 ft x 24 ft Sand Filter				
Additional 300 gpm RAS pumping capacity				
Additional 75 cu ft filter press				
Sitework, Piping, Instrumentation, Electrical				
	0	0	3,900,000	3,900,000
Sulfuric Acid (4,950 lb/day of 93% H_2SO_4)	81,300	546,000	0	546,000
Quicklime (4,000 lb/day of 90% CaO)	51,100	343,000	0	343,000
Labor (24 hr/day)	263,000	1,765,000	0	1,765,000
	395,400	2,654,000	3,900,000	6,554,000

[a] Costs expressed in February 1997 dollars. Assumes 10-year project life at 8 percent interest and no salvage value.

[b] Approximately $1,500,000 in capital and $2,000,000 in present worth would be saved if no river water addition were provided since the river water supply system, additional secondary clarifier, additional sand filter, and additional RAS pumping capacity would not be required.

4.2 ALKALINE AIR STRIPPING OF SECONDARY CLARIFIER EFFLUENT

Secondary clarifier effluent would discharge by gravity at a year-round temperature of ≥25°C through a pH adjustment step to raise the pH to 10.5 s.u. The pH adjusted effluent would discharge to a wet-well and be pumped to packed tower air strippers. The discharge from the air strippers would flow by gravity through pH neutralization (reduction to pH 8.5 s.u.) and then to the existing sand filters. The system would likely provide a 95 percent reduction in effluent ammonia load. A summary of the preliminary cost estimate for this system is provided in Table 4-2.

4.3 BREAKPOINT CHLORINATION OF SECONDARY CLARIFIER EFFLUENT

Secondary clarifier effluent would discharge by gravity to a completely mixed reaction tank. Chlorine gas would be sparged into the tank and caustic soda would be added to the tank contents to maintain a target pH of 6.9 ± 0.3 s.u. Effluent from the reaction tank would discharge into a second completely mixed reaction tank into which sodium bisulfite would be added to quench residual chlorine (as needed). Lastly, the effluent would discharge by gravity to a post aeration tank to quench residual bisulfite and then to the existing sand filters.

This treatment system is capable of providing the greatest effluent NH_3-N reduction of the three alternatives discussed in this Section (likely a 97 percent reduction). A summary of the preliminary cost estimate for this system is provided in Table 4-3

4.4 COMPARATIVE ANALYSIS OF TREATMENT SYSTEMS

The projected effluent quality, reliability, and costs of the three alternative treatment systems were compared. Results of this comparison are provided below.

All three treatment alternatives are capable of providing at least a 95 percent reduction in the average effluent NH_3-N load. Breakpoint chlorination will provide the lowest achievable effluent ammonia concentration of the three treatment alternatives. However, effluent alkaline air stripping and breakpoint chlorination could increase effluent aquatic toxicity due to alteration of effluent constituents and/or an increase in effluent TDS (≥1,300 mg/L).

TABLE 4-2

SUMMARY OF PRELIMINARY COST ESTIMATE FOR ALKALINE AIR STRIPPING OF SECONDARY CLARIFIER EFFLUENT

Description	O&M ($/yr)	O&M ($)[a]	Installed Cost ($)	Present Worth ($)
Sodium Hydroxide Addition System Sulfuric Acid Addition System 2-Stage Rapid Mix before Wet Well Wet Well and Pumping Station Packed Tower Air Strippers 2-Stage Rapid Mix after Strippers Piping, Instrumentation, Electrical				
	0	0	2,100,000	2,100,000
Sulfuric Acid (2,420 lb/day of 93% H_2SO_4)	39,800	267,000	0	267,000
Sodium Hydroxide (6,050 lb/day of 50% NaOH)	386,000	2,590,000	0	2,590,000
Labor (8 hr/day)	88,000	590,000	0	590,000
	513,800	3,447,000	2,100,000	5,547,000

[a] Costs expressed in February 1997 dollars. Assumes 10-year project life at 8 percent interest and no salvage value.

TABLE 4-3

SUMMARY OF PRELIMINARY COST ESTIMATE FOR BREAKPOINT CHLORINATION OF SECONDARY CLARIFIER EFFLUENT

	O&M		Installed Cost	Present Worth
Description	($/yr)	($)[a]	($)	($)
Sodium Hydroxide Addition System				
9,000 lb/day Chlorinator				
2-Stage Reaction Tank (60 min HRT)				
Sodium Metabisulfite Addition System				
Reaction Tank (15 min HRT)				
Post Aeration Tank (15 min HRT)				
Aeration System				
Piping, Instrumentation, Electrical				
	0	0	1,700,000	1,700,000
Chlorine Gas (5,770 lb/day)	210,600	1,413,000	0	1,413,000
Sodium Hydroxide (15,100 lb/day of 50% NaOH)	964,500	6,472,000	0	6,472,000
Sodium Bisulfite (30 lb/day of $NaHSO_3$)	3,800	25,000	0	25,000
Labor (8 hr/day)	88,000	590,000	0	590,000
	1,266,900	8,500,000	1,700,000	10,200,000

[a] Costs expressed in February 1997 dollars. Assumes 10-year project life at 8 percent interest and no salvage value.

Biological nitrification is the least reliable of the three treatment processes since it is most susceptible to process upsets and requires the longest process recovery. These upsets may be caused by improper pH and DO maintenance, slug loading and/or bioinhibitory compounds present in the wastewater. Alkaline air stripping has the next lowest reliability since its performance is affected by ambient air temperatures, scaling of the media, and fouling of the media related to elevated levels of effluent TSS. Breakpoint chlorination is the most reliable of the three treatment alternatives. Its effectiveness is a function of chlorine dose and operating pH, both of which are controllable.

The three alternatives have present worth costs that vary from $4,554,000 for biological nitrification of combined wastestream without river water addition to $10,200,000 for breakpoint chlorination (see Table 4-4). The treatment alternative with the next lowest present worth cost was alkaline air stripping ($5,547,000). In addition, alkaline air stripping has the lowest NH_3-N removal cost ($2.55/lb NH_3-N removed).

TABLE 4-4

EFFECTIVENESS OF ALTERNATIVE TREATMENT PROCESSES ON FINAL EFFLUENT AMMONIA LOAD REDUCTION

Treatment Process	Present Worth Cost ($1,000)	Average NH_3-N Removal[a] (lb/day)	NH_3-N Removal Cost[b] ($/lb)
Combined Wastestream Nitrification			
With River Water Addition	6,554	595	3.02
Without River Water Addition	4,554	~420	2.97
Alkaline Air Stripping of Secondary Clarifier Effluent	5,547	595	2.55
Breakpoint Chlorination of Secondary Clarifier Effluent	10,200	610	4.58

[a] Assumes complete biohydrolysis of influent TKN load to NH_3-N through the activated sludge process.

[b] Based on removal during 10-year period of present worth analysis.

7

BROWN AND
CALDWELL

MEMORANDUM

TO: Mark Latham, Esq. **JOB NO:** 27-21522.001

FROM: T. Houston Flippin, P.E., DEE

DATE: May 17, 2002

SUBJECT: Ammonia-Nitrogen Treatment Alternatives Support Exhibit

Brown and Caldwell is providing below a summary of information intended to support the discussion of ammonia-nitrogen (NH_3-N) treatment alternatives described in the Petition For Adjusted Standard. This information is the product of treatability testing, full-scale plant testing, and data provided by the Noveon-Henry Plant staff.

In order to develop treatment alternatives, a "design influent and effluent wasteload" was required. This wasteloads were developed based on individual wastestream data gathered in 1995 and effluent data gathered in 1999 through 2000 and are summarized below in Tables 1 and 2. A flow schematic is provided in Attachment A of the wastewater treatment facility (WWTF) provided at the Henry Plant.

Table 1. Influent Wasteload Used In Developing Treatment Alternatives

Parameter	PVC Tank	PC Tank	C-18 Tank	Holding Pond/ Well No. 3 Waters	Total
Flowrate, gpm					
Average	401	107	6	46	560
Peak	499	150	15	105	769
SCOD, lbs/day					
Average	2,650	8,280	1,320	50	12,300
Peak	4,330	10,840	2,940	50	18,160
Estimated BOD, lbs/day					
Average	795	2,485	395	15	3,690
Peak	1,300	3,250	880	15	5,445
TKN, lbs/day					
Average	459	494	82	3	1038
Peak	640	693	198	7	1537
NH_3-N, lbs/day					
Average	295	62	27	1	385
Peak	411	87	66	3	571

A summary of conceptual level operations and maintenance costs for each of these alternatives are summarized in Table 4. The total costs presented in this table are considered accurate to within ± 30 percent.

Table 4. Annual Operating and Maintenance Cost Estimates For Treatment Alternatives

	Annual O/M Costs in $ Thousands for Treatment Alternative Number									
Cost Components	1	2	3	4	5	6	7	8	9	10
Labor ($40/hour)	32	32	60	8	60	60	60	60	30	60
Electrical ($0.06/kwh)	64	29	214	0	4	10	98	10	1,363	88
Natural Gas ($0.06/therm)	18	0	0	0	0	0	0	0	0	0
Chemicals (Plant Costs)	0	1,794	575	642	1,028	218	788	147	226	459
Resin Replace. ($35/cu ft)	0	0	0	0	0	0	0	242	0	0
Off-site Disposal[a]	0	0	0	0	0	0	0	51	0	0
Maintenance Materials[b]	17	2	105	1	19	11	45	14	115	22
Sub-total	130	1,858	954	652	1,111	299	990	524	1,735	629
Contingency (10 %)	13	186	95	65	111	30	99	52	173	63
Total Annual	143	2,044	1,049	717	1,222	329	1,089	576	1,908	692

[a] Cost of disposing of spent regenerant containing 29.7 percent by weight NH_4Cl (8 percent N) assumed to be $0.10/gallon.

[b] Based on 5 percent of equipment costs.

A comparison of alternatives regarding present worth costs and ammonia removal is provided in Table 5.

Table 5. Comparison of Present Worth Costs and Ammonia Removal for Treatment Alternatives

	Treatment Alternative Number									
Components	1	2	3	4	5	6	7	8	9	10
NH_3-N Removal, lbs/day	247	147	864	217	891	423	891	891	891	891
NH3-N Removal, %	27	16	95	24	98	47	98	98	98	98
Present Worth Costs										
• Capital	1.35	0.34	6.98	0.25	1.53	2.68	4.40	1.20	7.52	6.76
• O/M[a]	0.96	13.71	7.04	4.81	8.20	2.20	7.31	3.87	12.80	4.64
• Total	2.31	14.06	14.02	5.06	9.73	4.88	11.71	5.07	20.32	11.41

[a] Based on 10 year period, 8 percent annual interest, and no salvage value.

ATTACHMENT A

ILLUSTRATION OF AMMONIA-NITROGEN TREATMENT ALTERNATIVES

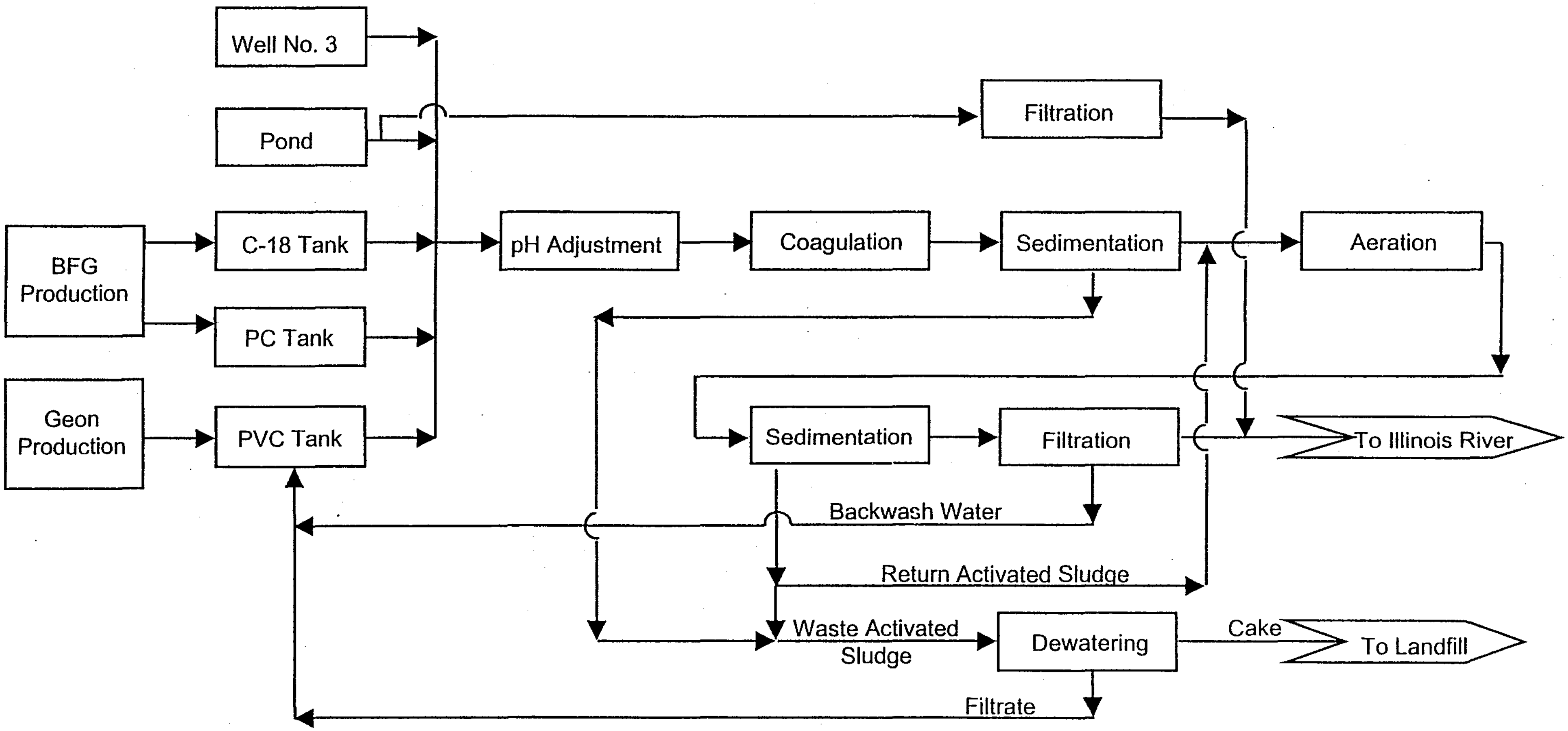

FIGURE 1

BLOCK FLOW DIAGRAM OF WASTESTREAM SOURCES AND WWTF

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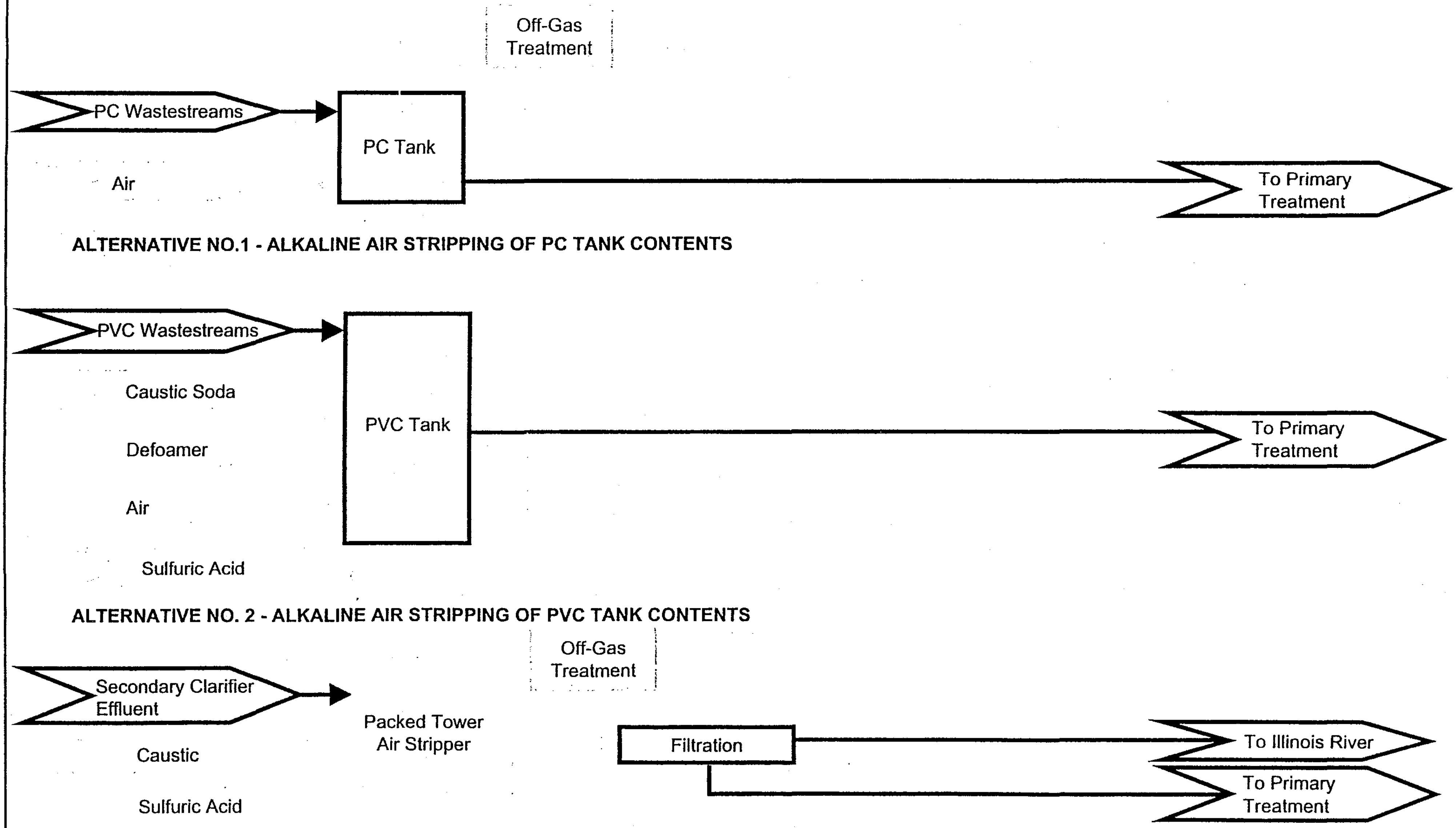

ALTERNATIVE NO.1 - ALKALINE AIR STRIPPING OF PC TANK CONTENTS

ALTERNATIVE NO. 2 - ALKALINE AIR STRIPPING OF PVC TANK CONTENTS

ALTERNATIVE NO. 3 - ALKALINE AIR STRIPPING OF SECONDARY CLARIFIER EFFLUENT

▭ **Existing Equipment**

New Equipment

P:/PROJ/21522/Fig 2

FIGURE 2

BLOCK FLOW DIAGRAM OF ALKALINE AIR STRIPPING TREATMENT ALTERNATIVES (Nos. 1, 2, and 3)

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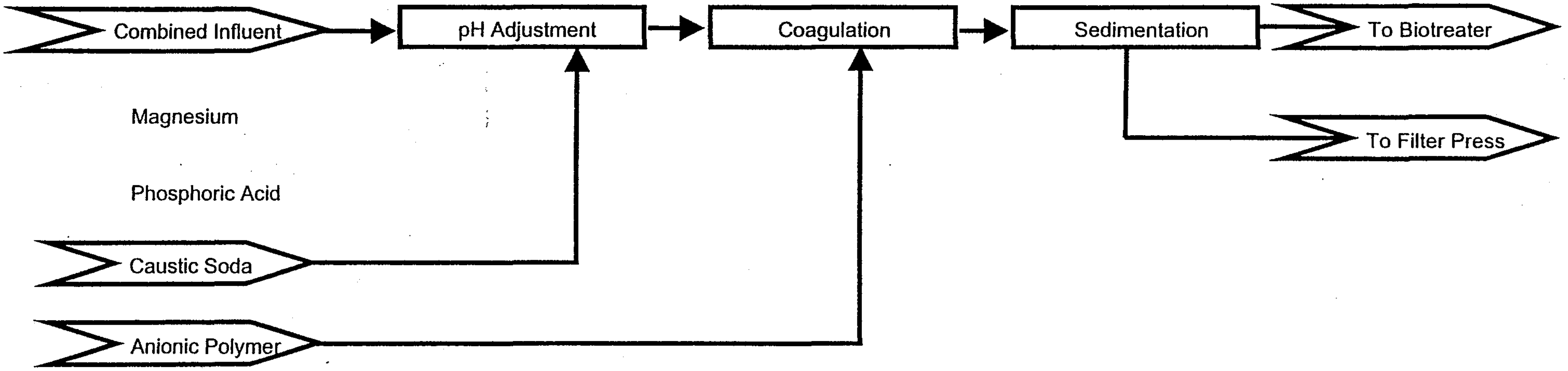
Nashville, Tennessee



NOTE: Existing $FeCl_3$ Addition would be discontinued

▭ Existing Equipment

New Equipment

FIGURE 3

BLOCK FLOW DIAGRAM OF STRUVITE PRECIPITATION TREATMENT ALTERNATIVE (No. 4)

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Nashville, Tennessee

P:/PROJ/21522/Fig 3

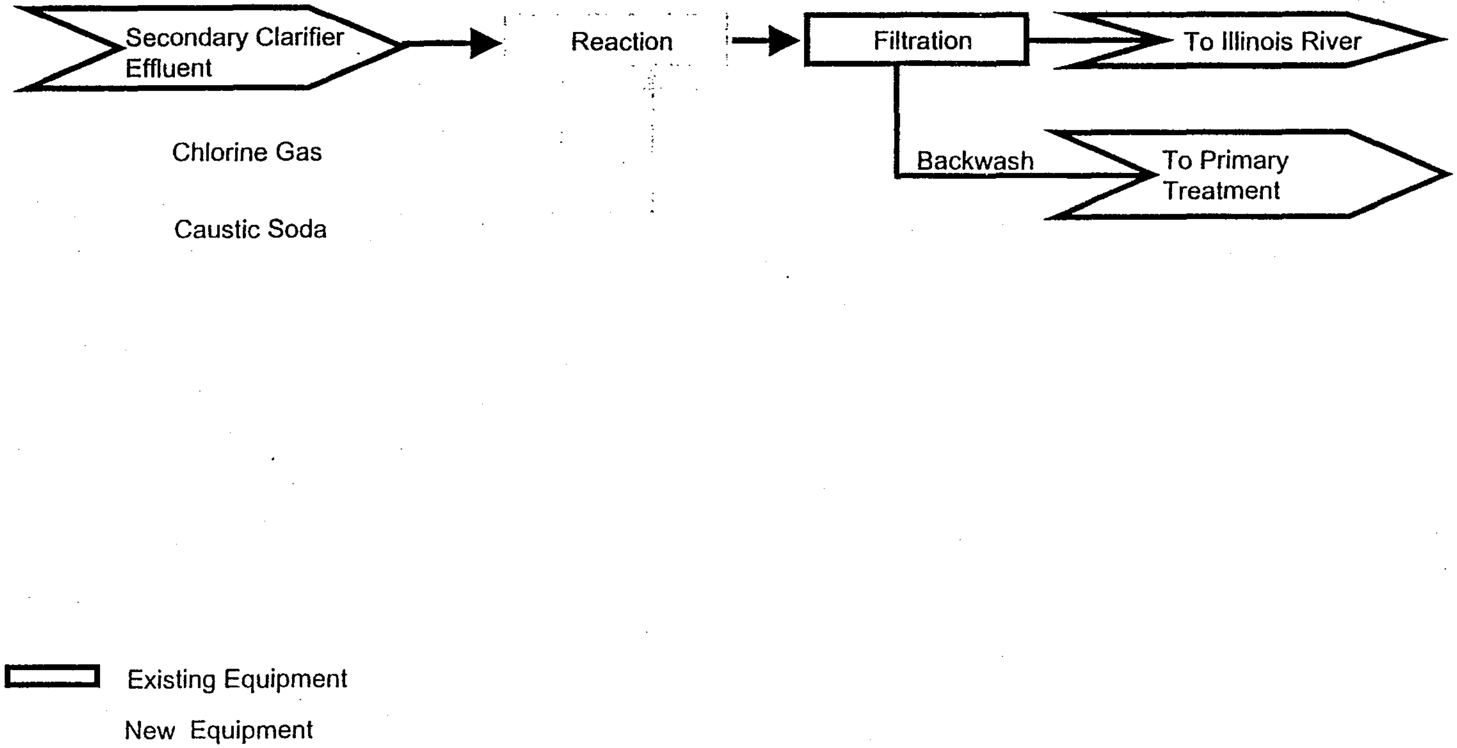

FIGURE 4

BLOCK FLOW DIAGRAM OF BREAKPOINT CHLORINATION ALTERNATIVE
(No. 5)

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Nashville, Tennessee

P:/PROJ/21522/Fig 4

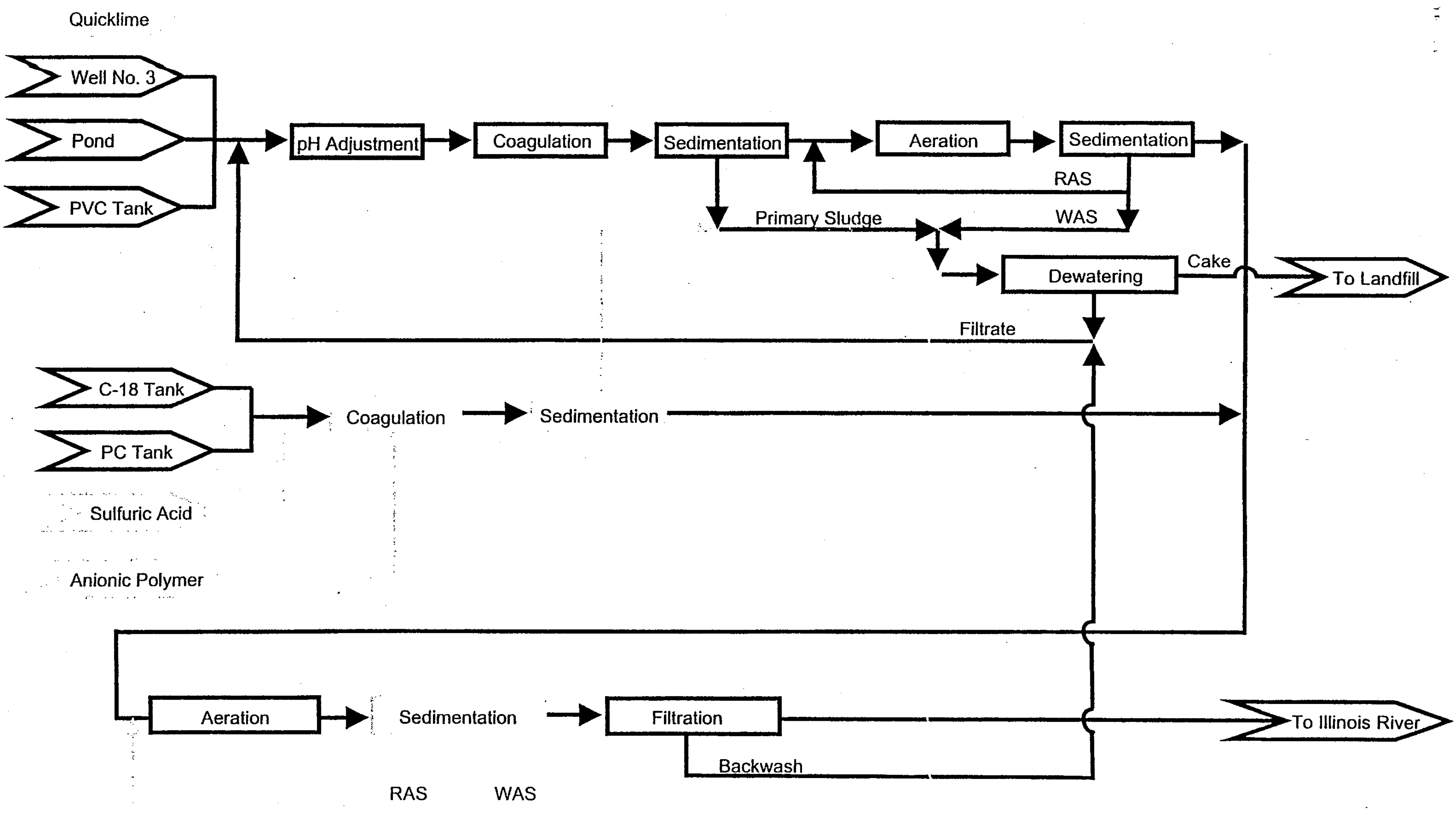

FIGURE 5

BLOCK FLOW DIAGRAM OF NON-PC WASTESTREAM NITRIFICATION TREATMENT ALTERNATIVE (No. 6)

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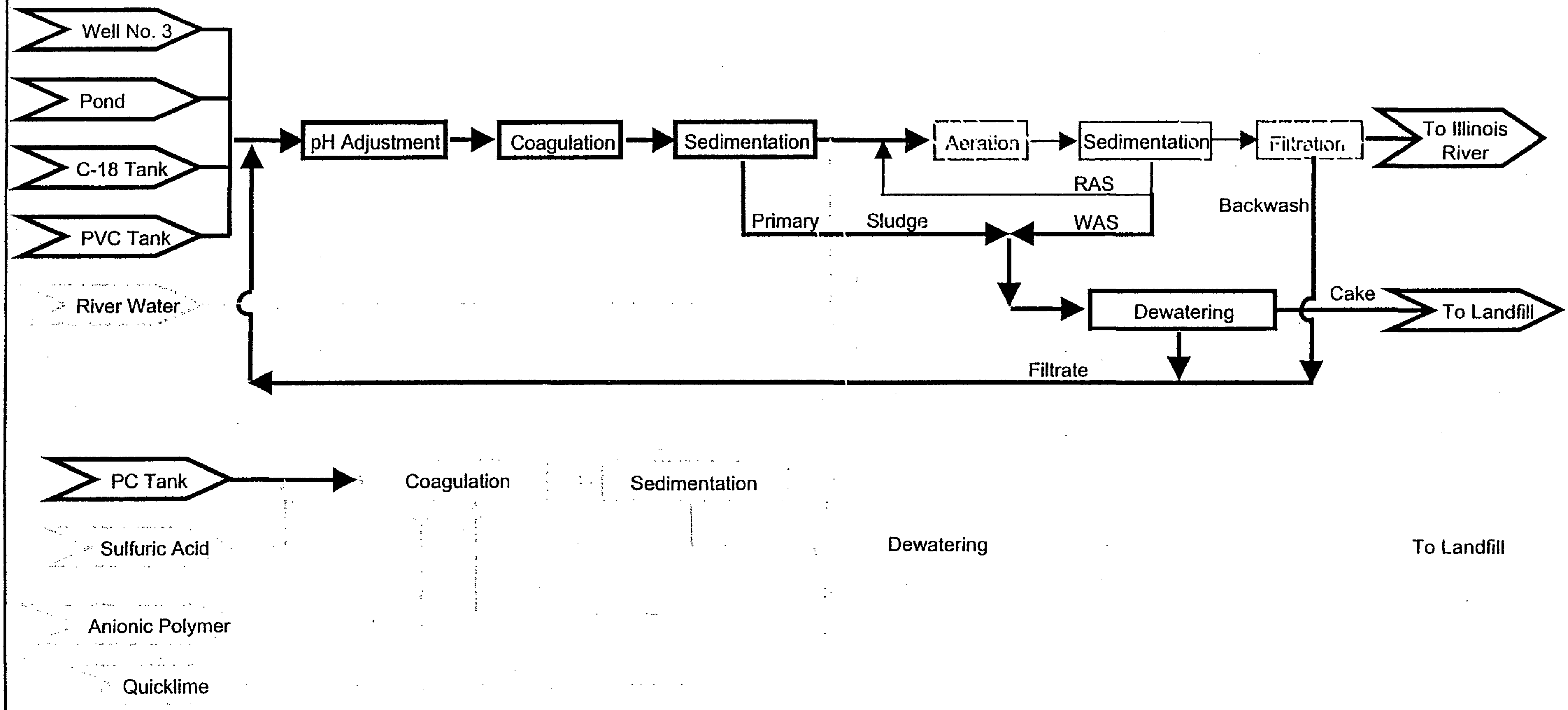
Nashville, Tennessee

P:/PROJ/21522/Fig 5



▭ Existing Equipment

⬚ New Equipment

▭ Upgraded Equipment

FIGURE 6

BLOCK FLOW DIAGRAM OF COMBINED WASTESTREAM NITRIFICATION TREATMENT ALTERNATIVE (No. 7)

BROWN AND CALDWELL

Nashville, Tennessee

P:/PROJ/21522/Fig 6

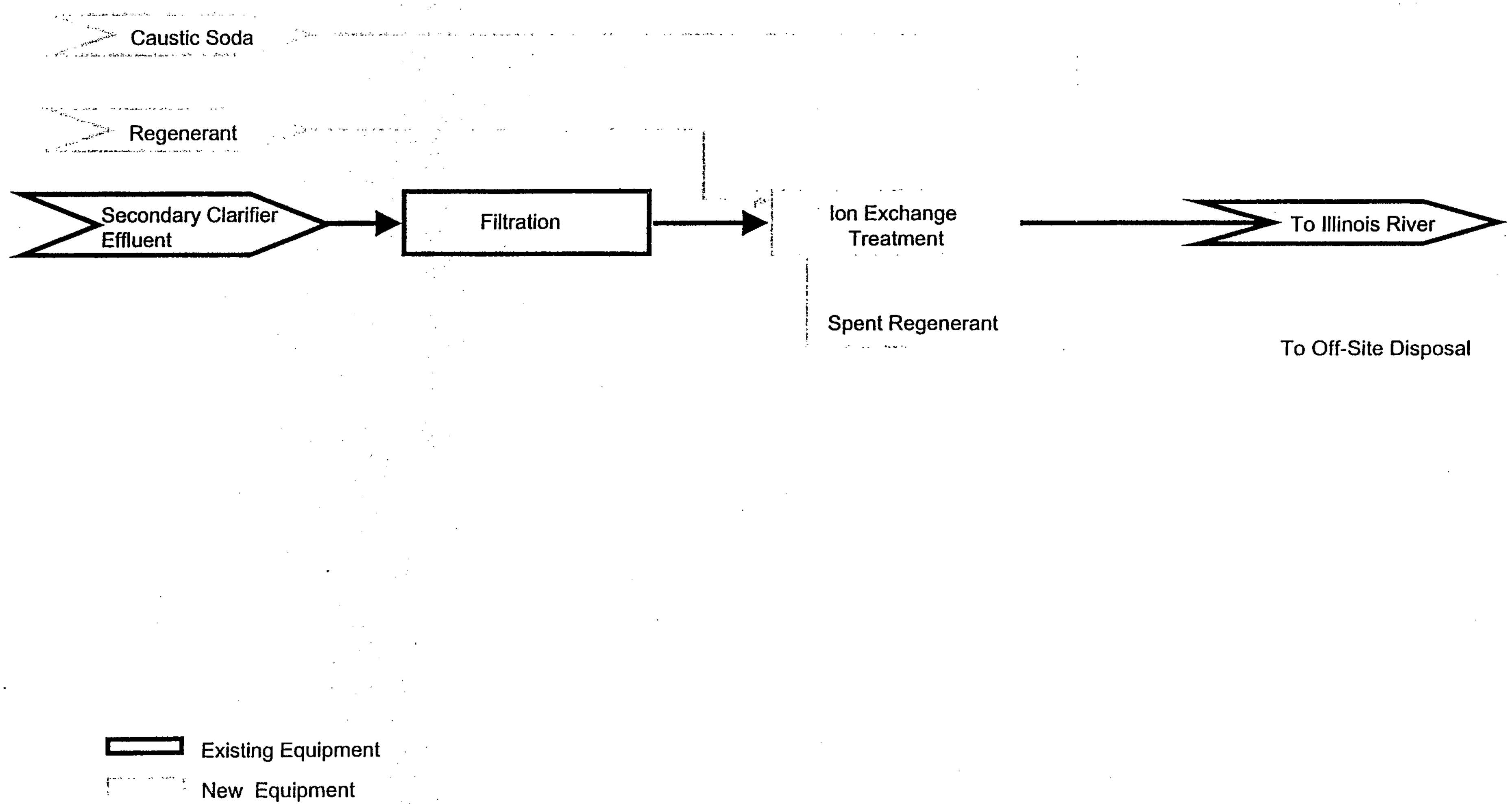


FIGURE 7

BLOCK FLOW DIAGRAM OF ION EXCHANGE TREATMENT ALTERNATIVE
(No. 8)

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Nashville, Tennessee

P:/PROJ/21522/Fig 7

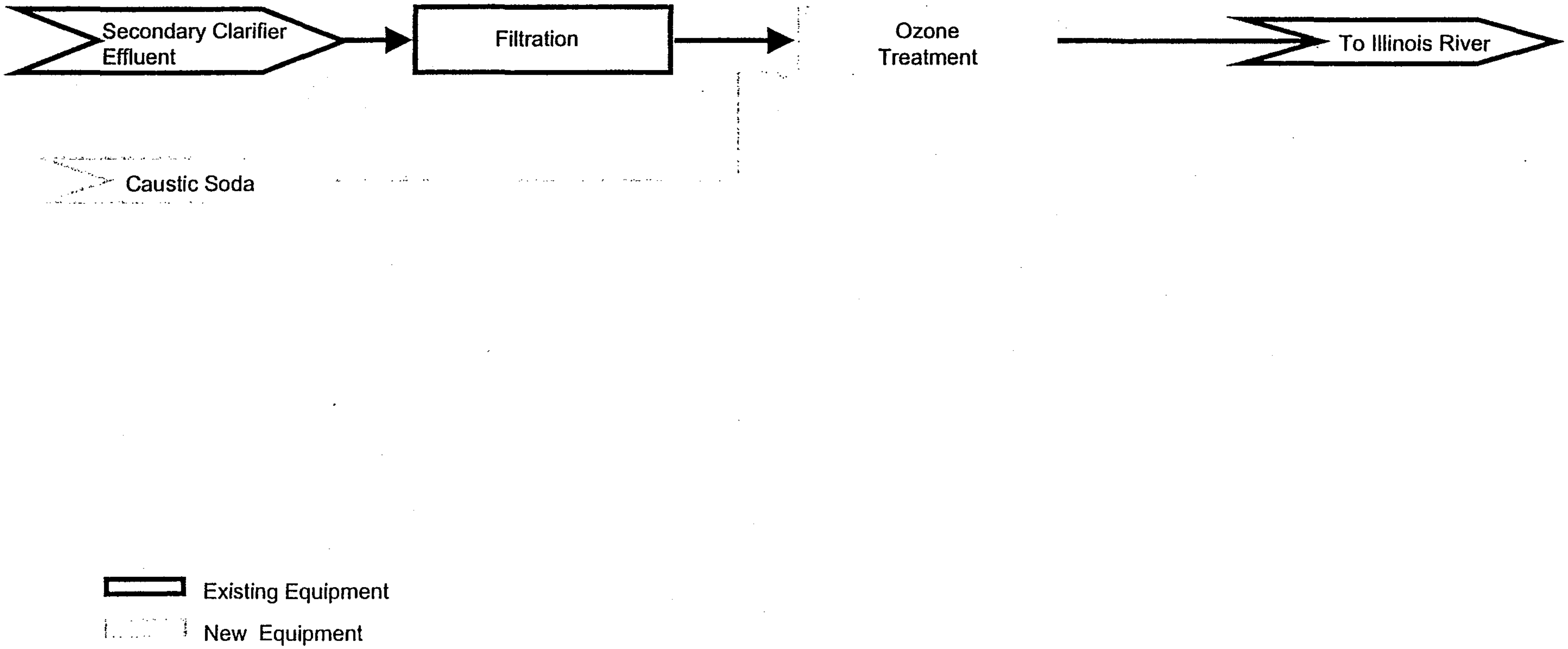

FIGURE 8

BLOCK FLOW DIAGRAM OF OZONE TREATMENT ALTERNATIVE (No. 9)

BROWN AND CALDWELL

Nashville, Tennessee

P:/PROJ/21522/Fig 8

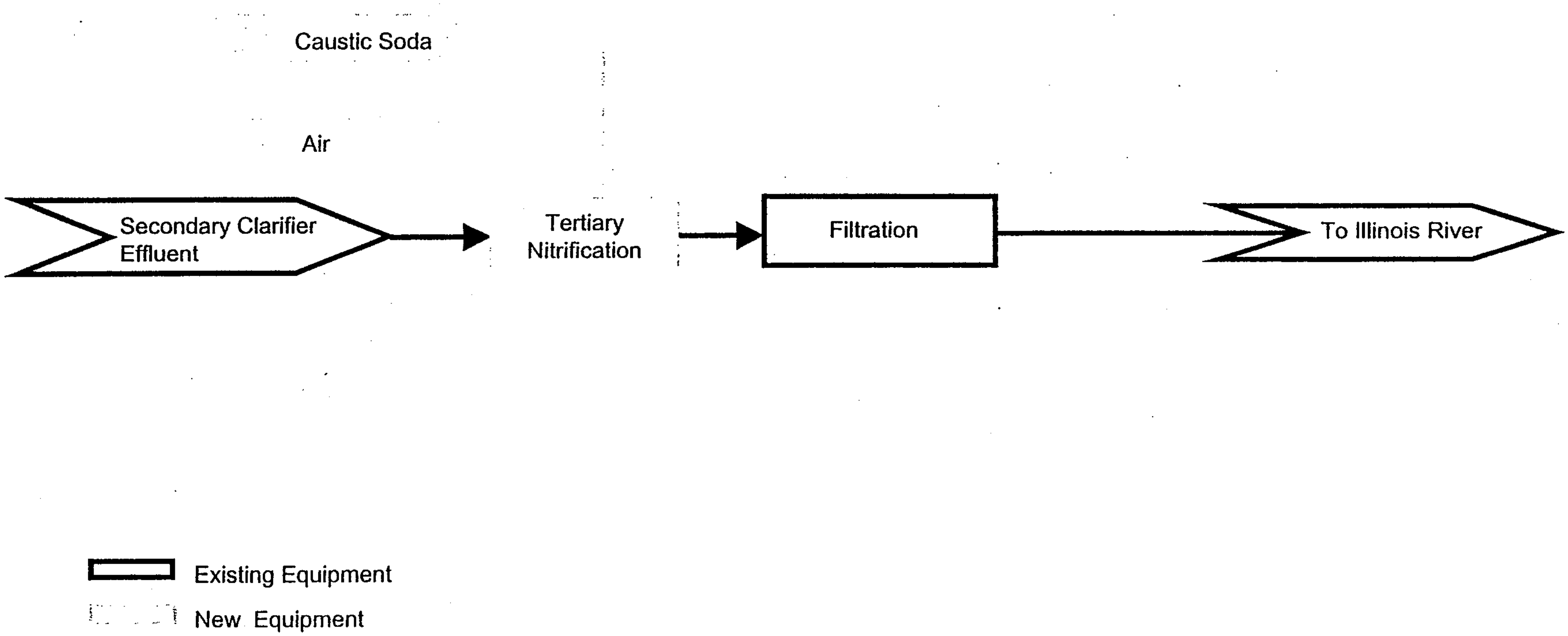

FIGURE 9

BLOCK FLOW DIAGRAM OF TERTIARY NITRIFICATION TREATMENT ALTERNATIVE (No. 10)

BROWN AND CALDWELL

Nashville, Tennessee

P:/PROJ/21522/Fig 9

8

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS

IN THE MATTER OF:	)	
	)	
Petition of Noveon, Inc.	)	
	)	**AS 02-_____**
	)	**(Adjusted Standard)**
for an Adjusted Standard from	)	
35 Ill. Adm. Code 304.122	)	

AFFIDAVIT OF DAVID E. GIFFIN

I, David E. Giffin, being duly sworn and upon oath, state as follows:

1. I am the Health, Safety and Environmental Manager at the Noveon Henry Plant.

2. In that position, I have personal knowledge of the facts set forth in the attached Petition for Adjusted Standard.

3. Having read the facts presented therein, I hereby state that to the best of my knowledge and belief the material facts set forth therein are true and accurate.

FURTHER AFFIANT SAYETH NOT

David E. Giffin
DAVID E. GIFFIN
NOVEON, INC.

LESLIE A HOFER

Leslie A. Hofer
Notary Public