BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	R08-9
EFFLUENT LIMITATIONS FOR THE	)	(Rulemaking – Water)
CHICAGO AREA WATERWAY SYSTEM	)	
AND LOWER DES PLAINES RIVER	)	
PROPOSED AMENDMENTS TO 35 ILL.	)	
ADM. CODE 301, 302, 303, and 304	)	

NOTICE OF FILING

TO:

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Deborah J. Williams, Assistant Counsel
Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Persons included on the attached
SERVICE LIST

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the Appearance of Jennifer A. Simon, a copy of which is herewith served upon you.

STEPAN COMPANY

Jennifer A. Simon

Date: August 4, 2008

Jennifer A. Simon
Mayer Brown LLP
71 South Wacker Drive
Chicago, Illinois 60606-4637
(312) 701-8407 (phone)
(312) 706-8117 (fax)
jsimon@mayerbrown.com

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APPEARANCE

I hereby file my appearance in this proceeding, on behalf of Stepan Company.

STEPAN COMPANY

Jennifer A. Simon

Date: August 4, 2008

Jennifer A. Simon
Mayer Brown LLP
71 South Wacker Drive
Chicago, Illinois 60606-4637
(312) 701-8407 (phone)
(312) 706-8117 (fax)
jsimon@mayerbrown.com

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this August 4, 2008, I have served electronically the attached Notice of Filing and Appearance upon the following person:

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

and by U.S. Mail, first class postage prepaid, to the following persons:

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Deborah J. Williams, Assistant Counsel
Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

The participants listed on the attached
SERVICE LIST

Jennifer A. Simon

SERVICE LIST

Frederick M. Feldman
Ronald M. Hill
Margaret T. Conway
Metropolitan Water Reclamation District
of Greater Chicago
111 East Erie Street
Chicago, IL 60611

Matthew Dunn, Chief
Environmental Bureau
Office of the Attorney General
100 West Randolph, 12th Floor
Chicago, IL 60601

Bill Richardson, Chief Legal Counsel
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Ann Alexander
Natural Resources Defense Counsel
101 N. Wacker Dr., Ste. 609
Chicago, IL 60606

Keith Harley
Elizabeth Schenkier
Chicago Legal Clinic, Inc.
205 West Monroe, 4th Floor
Chicago, IL 60606

Susan M. Franzetti
Franzetti Law Firm P.C.
10 South Lasalle St.
Suite 3600
Chicago, IL 60603

Katherine D. Hodge
Monica T. Rios
Hodge Dwyer Zeman
3150 Roland Avenue
P.O. Box 5776
Springfield, IL 62705-5776

Albert Ettinger
Jessica Dexter
Environmental Law & Policy Center
35 E. Wacker Dr., Suite 1300
Chicago, IL 60601

Dennis Duffield
Director of Public Works & Utilities
City of Joliet
921 E. Washington St
Joliet, IL 60431

Richard Kissel
Roy Harsch
DrinkerBiddle
191 N. Wacker Dr., Suite 3700
Chicago, IL 60606-1698

Claire Manning
Brown Hay & Stephens LLP
700 First Mercantile Bank Bldg
205 S. Fifth St
Springfield, IL 62705-2459

Charles Wesselhoft
James Harrington
Ross & Hardies
150 N. Michigan Ave
Chicago, IL 60601-7567

Frederick Keady
Vermillion Coal Company
1979 Jolms Drive
Glenview, IL 60025

Fred L. Hubbard
P.O. Box 12
16 West Madison
Danville, IL 61834

Georgia Vlahos
Naval Training Center
2601A Paul Jones St
Great Lakes, IL 60088-2845

W.C. Blanton
Blackwell Sanders LLP
4801 Main St, Suite 1000
Kansas City, MO 64112

Jerry Paulsen
Cindy Skukrud
McHenry County Defenders
132 Cass Street
Woodstock, IL 60098

Bernard Sawyer
Thomas Granto
Metropolitan Water Reclamation District
6001 W. Pershing Rd
Cicero, IL 60650-4112

Fredric Andes
Erika Powers
Bames & Thornburg
1 North Wacker Dr
Suite 4400
Chicago, IL 60606

Bob Carter
Bloomington Normal Water Reclamation
PO Box 3307
Bloomington, IL 61702-3307

Kenneth W. Liss
Andrews Environmental Engineering
3300 Ginger Creek Drive
Springfield, IL 62711

Albert Ettinger
Jessica Dexter
Environmental Law & Policy Center
35 E. Wacker
Suite 1300
Chicago, IL 60601

Kay Anderson
American Bottoms
One American Bottoms Road
Sauget, IL 62201

Robert VanGyseghem
City of Geneva
1800 South St
Geneva, IL 60134-2203

Lisa Frede
Chemical Industry Council of Illinois
2250 E. Devon Ave
Suite 239
Des Plaines, IL 60018-4509

Jack Darin
Sierra Club
70 E. Lake St
Suite 1500
Chicago, IL 60601-7447

Susan Hedman
Andrew Armstrong
Environmental Counsel
Suite 1800
69 West Washington Street
Chicago, IL 60602

Tom Muth
Fox Metro Water Reclamation District
682 State Route 31
Oswego, IL 60543

Vicky McKinley
Evanston Environmental Board
223 Grey Avenue
Evanston, IL 60202

Marc Miller
Jamie S. Caston
Office of Lt. Governor Pat Quinn
Room 414 State House
Springfield, IL 62706

James L. Daugherty
Thorn Creek Basin Sanitary District
700 West End Avenue
Chicago Heights, IL 60411

Tracy Elzemeyer
American Water Company
727 Craig Road
St. Louis, MO 63141

Irwin Polls
Ecological Monitoring and Assessment
3206 Maple Leaf Drive
Glenview, IL 60025

Jeffrey C. Fort
Ariel J. Tesher
Sonnenschein Nath & Rosenthal LLP
7800 Sears Tower
233 S. Wacker Drive
Chicago, IL 60606-6404

Dr. Thomas J. Murphy
2325 N. Clifton St
Chicago, IL 60614

Cathy Hudzik
City of Chicago
Mayor's Office of Intergovernmental Affairs
121 North LaSalle Street, Room 406
Chicago, IL 60602

Brent Fewell
Kristy A. N. Bulleit
HUNTON & WILLIAMS LLP
1900 K Street, N.W.
Washington, DC 20006

Sharon Neal
Commonwealth Edison
125 South Clark Street
Chicago, IL 60603

Margaret P. Howard
Hedinger Law Office
2601 South Fifth Street
Springfield, IL 62703

James Huff
Huff & Huff, Inc.
915 Harger Road, Suite 330
Oak Brook, IL 60523

Fredric P. Andes
Carolyn S. Hesse
David T. Ballard
Barnes & Thornburg LLP
1 N Wacker Dr, Suite 4400
Chicago, IL 60606

Beth Steinhorn
2021 Timberbrook
Springfield, IL 62702

Traci Barkley
Prairie Rivers Networks
1902 Fox Drive, Suite 6
Champaign, IL 61820

Stacy Meyers-Glen
Openlands
Suite 1650
25 East Washington
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Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Persons included on the attached
SERVICE LIST

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the Pre-filed Testimony of Carl Adams and Robin Garibay, a copy of which is herewith served upon you.

STEPAN COMPANY

Jennifer A. Simon

Date: August 4, 2008

Thomas V. Skinner
Thomas W. Dimond
Kevin Desharnais
Jennifer A. Simon
Mayer Brown LLP
71 South Wacker Drive
Chicago, Illinois 60606-4637
(312) 701-8407 (phone)
(312) 706-8117 (fax)
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PRE-FILED TESTIMONY OF CARL ADAMS AND ROBIN GARIBAY

Pursuant to the Hearing Officer's May 19, 2008 and July 21, 2008 Orders, Stepan Company is submitting the pre-filed testimony of Carl E. Adams, Jr., P.E., Ph.D., and Robin Garibay, REM, of ENVIRON International Corporation in the report attached as Exhibit A. The experience and qualifications of Dr. Adams and Ms. Garibay are described in the attachment.

As set forth in greater detail in the report, Dr. Adams and Ms. Garibay have analyzed the waste water treatment systems that would likely be necessary for Stepan's Millsdale plant to comply with the water quality uses and standards proposed by the Illinois Environmental Protection Agency ("IEPA") for temperature, dissolved oxygen, and disinfection, as well as the costs and cross-media environmental impacts implicated by those technologies.

The Millsdale plant is located about 2-3 miles upstream of the I-55 bridge in Elwood, Illinois. It discharges process wastewater, storm water, and sanitary discharges pursuant to a NPDES permit into the portion of the Lower Des Plaines River commonly referred to as the Upper Dresden Island Pool in this proceeding.

Specifically, Dr. Adams and Ms. Garibay have estimated that capital costs of $3,436,000 and yearly operating costs of $2,600,000 would be required to attain consistent compliance with an adequate margin of safety. Further, the technologies and equipment needed to comply with IEPA's proposal would generate significant additional electrical usage at the Millsdale plant.

They estimate Stepan's electricity demand would increase by 117.8 million kW-hr/yr. In the likely event that electricity demand is provided by coal-fired electric generating units, the IEPA proposal will generate 129,430 tons of CO_2, the primary greenhouse gas linked to climate change, 3,057 tons of SO_x, 236 tons of NO_x, and 24.2 lbs of Mercury every year. This analysis demonstrates that for a single industrial discharger (i.e. not an electrical generating station), the cross-media impacts of IEPA's proposal are significant.

While the impacts for other generators will depend upon their particular operations, a substantial overall environmental impact is likely, the extent of which the IEPA has not even begun to consider. Instead, the IEPA truncated its analysis by looking only at the water quality uses and standards without seriously considering the means and implications of compliance. As a result, the IEPA has not fully evaluated the use attainability standards as required by 40 C.F.R. § 131.11. These regulations indicate federal intent to fully consider the impact of changes to water quality designations – even impacts not directly related to water quality. Most critically, a use attainability analysis directs the Agency's attention to whether a remedy "would cause more environmental damage to correct than to leave in place" and whether "controls … would result in substantial and widespread economic and social impact." 40 C.F.R. §131.11(g)(3) and (6). Clearly, in this case the resulting economic and environmental impacts of the proposed regulation would be substantial and warrant further investigation and analysis than performed by the IEPA.

In the Illinois Pollution Control Board's rulemaking proceeding, it must now consider what the IEPA has failed to analyze. Specifically, the Board should consider "the existing physical conditions, the character of the area, … and the technical feasibility and economic reasonableness of measuring or reducing the particular type of pollution." 415 ILCS 5/27. In doing so, the Board must weigh whether modifications to the water quality standards are worth the considerable financial and environmental sacrifices that would be required of the dischargers and of all the local residents.

STEPAN COMPANY

Jennifer A. Simon

Date: August 4, 2008

Thomas V. Skinner
Thomas W. Dimond
Kevin Desharnais
Jennifer A. Simon
Mayer Brown LLP
71 South Wacker Drive
Chicago, Illinois 60606-4637
(312) 701-8407 (phone)
(312) 706-8117 (fax)
jsimon@mayerbrown.com

CERTIFICATE OF SERVICE

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Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

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100 West Randolph Street, Suite 11-500
Chicago, IL 60601

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Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

The participants listed on the attached
SERVICE LIST

Jennifer A. Simon

SERVICE LIST

Frederick M. Feldman
Ronald M. Hill
Margaret T. Conway
Metropolitan Water Reclamation District of Greater Chicago
111 East Erie Street
Chicago, IL 60611

Matthew Dunn, Chief
Environmental Bureau
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100 West Randolph, 12th Floor
Chicago, IL 60601

Bill Richardson, Chief Legal Counsel
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Ann Alexander
Natural Resources Defense Counsel
101 N. Wacker Dr., Ste. 609
Chicago, IL 60606

Keith Harley
Elizabeth Schenkier
Chicago Legal Clinic, Inc.
205 West Monroe, 4th Floor
Chicago, IL 60606

Susan M. Franzetti
Franzetti Law Firm P.C.
10 South Lasalle St.
Suite 3600
Chicago, IL 60603

Katherine D. Hodge
Monica T. Rios
Hodge Dwyer Zeman
3150 Roland Avenue
P.O. Box 5776
Springfield, IL 62705-5776

Albert Ettinger
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Environmental Law & Policy Center
35 E. Wacker Dr., Suite 1300
Chicago, IL 60601

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Director of Public Works & Utilities
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Joliet, IL 60431

Richard Kissel
Roy Harsch
DrinkerBiddle
191 N. Wacker Dr., Suite 3700
Chicago, IL 60606-1698

Claire Manning
Brown Hay & Stephens LLP
700 First Mercantile Bank Bldg
205 S. Fifth St
Springfield, IL 62705-2459

Charles Wesselhoft
James Harrington
Ross & Hardies
150 N. Michigan Ave
Chicago, IL 60601-7567

Frederick Keady
Vermillion Coal Company
1979 Jolms Drive
Glenview, IL 60025

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16 West Madison
Danville, IL 61834

Georgia Vlahos
Naval Training Center
260lA Paul Jones St
Great Lakes, IL 60088-2845

W.C. Blanton
Blackwell Sanders LLP
4801 Main St, Suite 1000
Kansas City, MO 64112

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Bames & Thornburg
1 North Wacker Dr
Suite 4400
Chicago, IL 60606

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PO Box 3307
Bloomington, IL 61702-3307

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Andrews Environmental Engineering
3300 Ginger Creek Drive
Springfield, IL 62711

Albert Ettinger
Jessica Dexter
Environmental Law & Policy Center
35 E. Wacker
Suite 1300
Chicago, IL 60601

Kay Anderson
American Bottoms
One American Bottoms Road
Sauget, IL 62201

Robert VanGyseghem
City of Geneva
1800 South St
Geneva, IL 60134-2203

Lisa Frede
Chemical Industry Council of Illinois
2250 E. Devon Ave
Suite 239
Des Plaines, IL 60018-4509

Jack Darin
Sierra Club
70 E. Lake St
Suite 1500
Chicago, IL 60601-7447

Susan Hedman
Andrew Armstrong
Environmental Counsel
Suite 1800
69 West Washington Street
Chicago, IL 60602

Tom Muth
Fox Metro Water Reclamation District
682 State Route 31
Oswego, IL 60543

Vicky McKinley
Evanston Environmental Board
223 Grey Avenue
Evanston, IL 60202

Marc Miller
Jamie S. Caston
Office of Lt. Governor Pat Quinn
Room 414 State House
Springfield, IL 62706

James L. Daugherty
Thorn Creek Basin Sanitary District
700 West End Avenue
Chicago Heights, IL 60411

Sharon Neal
Commonwealth Edison
125 South Clark Street
Chicago, IL 60603

Tracy Elzemeyer
American Water Company
727 Craig Road
St. Louis, MO 63141

Margaret P. Howard
Hedinger Law Office
2601 South Fifth Street
Springfield, IL 62703

Irwin Polls
Ecological Monitoring and Assessment
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James Huff
Huff & Huff, Inc.
915 Harger Road, Suite 330
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Ariel J. Tesher
Sonnenschein Nath & Rosenthal LLP
7800 Sears Tower
233 S. Wacker Drive
Chicago, IL 60606-6404

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Carolyn S. Hesse
David T. Ballard
Barnes & Thornburg LLP
1 N Wacker Dr, Suite 4400
Chicago, IL 60606

Dr. Thomas J. Murphy
2325 N. Clifton St
Chicago, IL 60614

Beth Steinhorn
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121 North LaSalle Street, Room 406
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Prairie Rivers Networks
1902 Fox Drive, Suite 6
Champaign, IL 61820

Brent Fewell
Kristy A. N. Bulleit
HUNTON & WILLIAMS LLP
1900 K Street, N.W.
Washington, DC 20006

Stacy Meyers-Glen
Openlands
Suite 1650
25 East Washington
Chicago, IL 60602

Pre-filed Testimony of Carl Adams and Robin Garibay of ENVIRON International Corporation (ENVIRON)

I. Background of Experts

My name is Carl E. Adams, Jr., PE, PhD, and I have over 35 years of experience in Industrial Wastewater Treatment Management. Since May 1, 2005, I have been the Global Practice Area Leader of Integrated Industrial Wastewater Management for ENVIRON International Corporation. Prior to that, for 20 years I was President and Chief Executive Officer of The ADVENT Group, Inc., an international firm offering integrated industrial wastewater management services to industry. Before founding The ADVENT Group, I spent 16 years with Associated Water and Air Engineers, Inc. (first as Technical Director and, subsequently, as President and CEO), which I established as one of the premiere industrial wastewater management engineering organizations in the United States.

I have been a consultant to various industries and municipalities both in the United States and globally, regarding design and operational aspects of wastewater management systems. Over my career, I have consulted on over 900 wastewater management projects in 28 countries. I hold three patents on technologies related to wastewater treatment, and I have authored or coauthored three books and numerous articles and papers in industrial wastewater management. In October, 2005, I was elected a Distinguished Alumni from the College of Architecture and Environmental Engineering at The University of Texas-Austin.

In my role as Technical Director and Principal of many projects, I have had responsibility for evaluating, designing or supervising the design of various technologies for management of temperature in wastewater treatment facilities, especially in regard to increasing the efficiency of biological treatment processes. I have been registered as a Professional Engineer in as many as 17 states at one time and, as such, I had the responsibility to sign engineering documents for final review, including heat reduction and addition processes.

My name is Robin L. Garibay, REM, and I am a principal of ENVIRON International Corporation and the Manager for the Wastewater Management services of the Integrated Industrial Wastewater Management Practice Area. I have over 20 years of experience in wastewater management, including participation in the development of federal and state water quality standards, NPDES permitting and establishment of water quality-based effluent limits based on water quality criteria.

I am a Registered Environmental Manager (REM) with a B.S. in biochemistry from Rice University and graduate work in biochemistry at Texas A&M University. Prior to joining The ADVENT Group, Inc. (now ENVIRON) in 1987, I worked for the State of Kansas Board of Agriculture Laboratories focusing on pesticide characterization in products, residues, and groundwater. Since joining ADVENT, I worked on characterization studies of groundwater, stormwater, process streams, effluents, and receiving waters in support of NPDES permits. My work has been on behalf of both municipal and industrial clients. I have managed projects that have pollutant minimization and source control of constituents to wastewater, options for end-of-pipe treatment, and assessment of multi-media impact of control options.

I personally have worked on behalf of numerous industrial and municipal clients in the State of Illinois on the development of elements of the Illinois water quality standards program and on NPDES permitting issues. I have participated in the Illinois rulemaking process on adopting the federal Great Lakes Water Quality Agreement ("GLI") into the Illinois Water Quality Standards, revision to the antidegradation standard and implementation procedures, and revisions to the sulfate and TDS water quality standards.

Our resumes are included in Attachment 1.

The Illinois Environmental Protection Agency ("IEPA") has proposed to revise the water quality use designations and the water quality standards for the Chicago Area Waterway System and the Lower Des Plaines River. Our assistance was requested to assess the impact of several aspects of the IEPA proposal on the Millsdale plant of Stepan Company located in Elwood, Illinois, including the methodology and technology that the plant could adopt to meet the IEPA proposed standards for temperature, fecal bacteria, and dissolved oxygen of the final treated effluent (wastewater) prior to discharge into the Lower Des Plaines River near River Mile 280, the cross-media impacts of the methodology and technology necessary to meet those standards and the costs and technical feasibility of that methodology and technology.

As such, we have reviewed the Statement of Reasons, including the proposed revisions to the Illinois regulations, filed by IEPA on December 20, 2007, appropriate documents and data provided by Stepan Company staff or known to us based on our knowledge and experience in the wastewater field and consulted with Millsdale plant staff to develop our findings. In addition, we visited the Millsdale plant and observed the wastewater treatment system currently in place at the plant. We have supervised and requested efforts from several individuals, working directly for us in ENVIRON, to prepare supporting documentation to this testimony.

II. Company Background

Stepan Company is a global manufacturer of specialty and intermediate chemicals used in consumer products and industrial applications, primarily in the soap and detergent industry. Most of the chemicals Stepan produces are surfactants, which are the key ingredients in consumer and industrial cleaning compounds. Stepan also produces other specialty products, which are often custom-made to meet individual needs. In part, these include flavors, emulsifiers and solubilizers used in food and pharmaceutical industries. Headquartered in Northfield, Illinois, Stepan has over 1,500 employees worldwide and production facilities located in North and South America, Europe and Asia.

Stepan's Millsdale plant was initially constructed in 1954 and is located in an unincorporated area at 22500 West Millsdale Road near Elwood in the southern half of Will County. The plant employs about 400 people, of which about 230 are union members. The Millsdale plant operates in many respects as a specialty chemical manufacturer, producing 1,200 to 1,500 somewhat varying products according to customer specifications. Among the chemicals produced at Millsdale are alkoxylates, alpha sulfo methyl esters, amides, amine oxides, esters, sulfonates, sulfates, soap and detergent blends, phosphate esters, quaternaries, phthalic anhydride, polyols, and urethane systems.

The Millsdale plant employs a complex wastewater treatment system, which involves over fifteen tanks and numerous processes, including decantation, equalization, two aeration stages, clarification, two aerobic digestion stages, and activated sludge with dual media filtration. The treatment system generates digested sludge that is land applied in accordance with the plant's land application permit. The effluent outflow is then discharged into a buried pipeline that discharges to the Lower Des Plaines River approximately at river mile 280, which is 2 to 3 river miles upstream of the I-55 Bridge. This discharge is in the segment of the Lower Des Plaines River denominated as the Upper Dresden Island Pool in the IEPA Statement of Reasons. Figure 1 presents a schematic of the wastewater treatment plant.

The NPDES Permit No. IL0002453 was renewed with an effective date of April 1, 2008. The renewed Permit authorizes the discharge of wastewater generated from process operations, cooling tower blowdown, sanitary waste and stormwater via Outfall 001 to the Lower Des Plaines River. As present in the Permit, plant operation results in an average discharge of 0.88 MGD of treated process wastewater, sanitary wastewater and stormwater from Outfall 001. The discharge quality is monitored and regulated through discharge limits for 68 parameters. The majority of discharge limits are based on the use of the best available treatment technology for the organic chemicals industry. Over a year, 600 results are generated to monitor the quality of the effluent discharged to the River. Historically, the compliance record for this Plant has been very good. Since permit renewal there have been no exceedences of discharge limits.

III. Temperature

IEPA has proposed a re-designation of the aquatic life use of the Lower Des Plaines River, Upper Dresden Island Pool that would result in revisions to the current temperature standards to seasonal period average and daily maximum temperature standards. Currently, Stepan's discharge is not subject to temperature limitations in its NPDES permit, and the applicable water quality standard is a maximum (93°F) not to be exceeded more than 5 percent of the time and an absolute maximum of 100°F, IEPA Statement of Reasons, pps. 11-12. The proposed standards would reduce the daily maximum temperature to 88.7°F and would establish period averages ranging from 85.1°F during most summer periods to 53.6°F during the month of February. IEPA Statement of Reasons, p. 85 Stepan's Outfall 001 would be subjected to these proposed temperature standards likely without the option of a mixing zone due to upstream sources of warm effluent and the general nature of the Lower Des Plaines River. If implemented as proposed, the IEPA water quality standards would probably be imposed as NPDES Permit discharge limits on the Millsdale plant's Outfall 001 and would necessitate radical temperature reduction/control efforts. Those efforts will be both costly to construct and operate and are subject to complications due to the varying requirements throughout the calendar year. Those efforts would also have significant cross-media impacts.

The source of heat in the wastewater is from process water, RO reject water, and cooling tower blowdown; however this heat is needed to assure a warm environment to maintain a healthy biomass (activated sludge) in the Millsdale wastewater treatment plant (WWTP) for the reduction of BOD in the effluent. Ideally, temperatures for effective biological treatment of this type of wastewater water should consistently be above 70°F. Figure 2 presents daily influent temperature (monitored at Tank 9 or the equalization tank) and daily effluent temperature (monitored at Tank 8 or the final effluent tank).

It would be contradictory to cool the influent wastewater during cool weather months when this is the most critical time period for the WWTP to maintain a warm environment for the WWTP biomass for BOD treatment efficiency. The Stepan biological wastewater treatment plant is operated to achieve discharge limits all year, operations are not adjusted or varied seasonally.

Although our opinions/conclusions do not address the impact on the river directly, it is very evident that maintaining heat within the biological treatment process and then being required to remove that heat prior to discharge of the effluent is contrary to most, if not all, laws of nature on conservation and carbon footprint. The energy that creates the heat in the WWTP effluent cannot be destroyed and can only be removed from the effluent by transferring it to some other environmental media, for example ambient air, through processes that themselves require energy resources and thus the production of more energy and heat.

In developing the options available to control temperature of the treated discharge, we have framed the following conditions:

- Due to upstream river temperatures and sources of heated discharges, it is assumed that a mixing zone will not be available for implementation of the temperature standards; i.e., the temperature standards will apply at end-of-pipe.
- Due to Stepan Company policy to always be in compliance with an adequate margin of safety and the inability to significantly vary the temperature conditions during the wastewater treatment process, engineering will be such that the daily temperature will be at the proposed ‘period average temperature standards’. Therefore, the potential Outfall 001 temperature discharge limits are equal to the proposed ‘period average temperature standards’. For engineering design, a margin-of-safety of 3°F would be applied.

From a pure technological-economical standpoint, it would be most efficient to reduce the wastewater temperature prior to biological treatment where the temperature is highest, thus, improving the economics of heat reduction. However, this heat is required for maximum biological activity particularly during cooler months of the year. Thus, all heat reduction methods must be on the treated discharge, reducing the efficiency of the heat reduction process.

Current temperature results for the effluent (treated discharge) as monitored at Tank 8 as compared to the IEPA proposed temperature discharge limits are presented in Figure 3. Based on close to daily monitoring of the treated discharge for slightly over 2 years, the compliance with the IEPA proposed temperature discharge limits would be achieved only about 22 percent of the time without further treatment. Therefore, temperature reduction would be needed and as presented in Figure 4, there are periods of time where significant removal of heat (as BTU/hr) would be required, e.g., more than 6 million BTU/hr.

The technologies/processes commonly considered for end-of-pipe temperature reduction are:

1. Cooling ponds with surface aerators/sprayers

2. Flow augmentation, using a cooler water (such as ground water) to dissipate the heat

3. Cooling towers
    1. Open direct contact
    2. Closed circuit

4. Heat exchange
    1. Plate and frame
    2. Tube and shell

5. Chillers (either directly or to supplement another option)

6. Cooling Air (from Blowers)

7. Surface Aeration in Tanks

We will touch briefly on the feasibility of the more commonly applied cooling technologies as it applies to Stepan's discharge and the cooling required (Figure 4).

1) Cooling Ponds and Larger Storage

Cooling ponds rely on the interaction of the water surface with the ambient air to promote cooling. The larger the water surface area the greater the cooling effectiveness. This could also be enhanced via the installation of aerators. For the 0.88 mgd treated effluent discharge, the minimum amount of land necessary to possibly achieve the cooling required with the use of 5 surface aerators would be about 2.5 acre of land (to site a 3 million gallon cooling pond). The area around the Stepan WWTP is severely restricted in additional area and given that this size of pond and number of aerators have no allowance for any safety factors, this option is considered to be infeasible for Stepan's discharge.

Larger storage has been used successfully at other facilities. It consists of storing the waters during periods that temperature standards would not be met, such as during the winter months, and then discharging during times when the discharge standards could be met. For Stepan, this would involve storing waters until the discharge standards would be above 75°F in the summer months. As such, Stepan could at times require up to 6 months of storage. Assuming a discharge flow of 0.88 MGD and a pond depth of 12 feet, a pond size of over 40 acres would be required. In addition to this acreage not being available for the Stepan plant, there are also times in the summer months where cooling would be required, so consistent and complete compliance cannot be achieved with this option.

2) Flow Augmentation

Flow Augmentation is the process in which the final treated effluent is mixed with cooler waters from another source. The resulting mixed temperature is thereby cooler than the original discharge. The current source of water supply for the Stepan Plant is groundwater. Based on data summaries from the USGS, the aquifer used by Stepan can range in temperature from 55°F up to as high 65°F. These temperatures alone are higher than some of the proposed temperature standards, thereby making this option technically infeasible for Stepan. Even if the cooler ranges of the groundwater temperatures consistently existed, about 3 million gallons per day would be needed to cool the treated effluent. The Will County aquifers are under scrutiny for allowing additional water withdrawals due to the concerns with managing the availability of this valuable water supply resource. Based on our recent experience in siting new manufacturing plants, we are uncertain that use of groundwater to ‘cool’ a treated effluent would be viewed favorably. We do not believe flow augmentation is a feasible technology for application to the Stepan discharge.

3) Cooling Towers

Cooling towers is the process in which water is exposed to the air to promote evaporation of the water to the atmosphere. Cooling towers can be open direct contact or closed circuit.

For open direct contact towers, evaporation is utilized for cooling of the water streams. Evaporation of water is extremely effective in cooling wastewater streams in low humidity conditions (as an example, it is similar to the cooling effects of a fan in your house on a hot day). However, like the ineffectiveness of a fan on a very humid day, cooling towers can also be very ineffective during humid days. Cooling towers can only cool down to a certain amount above the temperature in which there is 100% saturation (which is called the wet-bulb temperature). The certain amount above wet bulb temperature is called approach temperature.

Typical designs of cooling towers assume a 10 to 15°F approach to wet bulb. Therefore, cooling tower discharge temperatures can be approximated by simply adding the approach temperature to the wet bulb temperature. For a conservative evaluation of the anticipated cooling tower discharge temperatures for the Stepan Plant, a wet bulb temperature of 78°F was used (based on the a NOAA data). The corresponding anticipated cooling tower discharge temperatures (calculated by adding an approach temperature of 10 °F) would not consistently and completely achieve the potential discharge limits. Even considering seasonal wet bulb temperatures and a specialized open cooling tower design, discharge temperatures would not consistently and completely achieve the potential discharge limits; thereby this option is technically infeasible for application to the Stepan treated effluent. In addition, open cooling towers applied to treated effluent can generate particulate matter and VOM emissions that are subject to air emission regulation. Whether the additional emissions from open cooling towers could be permitted is uncertain.

A closed circuit cooling tower operates by cooling a water source to the range of an open tower and then cools the wastewater stream by heat exchange over coils. They can be as efficient as open direct contact towers from the perspective of temperature reduction. However, closed circuit cooling towers tend to foul less than open towers, thereby being preferred for wastewaters that may tend to foam or exhibit high suspended solids, which has been observed with the influent to Stepan's WWTP. Since a closed cooling tower is not expected to reduce the temperature more effectively than open cooling towers, closed towers are therefore also technically infeasible for the Stepan discharge for the reduction of temperature.

4) Plate & Frame Heat Exchangers

Plate & Frame heat exchanges operate on the premise that the heat from a water source that needs to be cooled is transferred to cooler water from a different source. As discussed previously for the Flow Augmentation alternative, the other source of water for the Stepan plant is groundwater, which as discussed previously is not cool enough to meet temperature standards, thereby making this option technically infeasible without pretreatment (i.e., additional cooling) of the groundwater.

5) Chillers

This option would consist of using a water chiller to further cool waters from a cooling tower. Since the water chiller utilizes a medium other than water (i.e., propylene glycol, ammonia), cooler water temperatures can be achieved for the groundwater used for a heat exchanger or with a cooling tower alone. The water chiller would be operated integrally with a heat exchanger (e.g., plate and frame) that would remove heat from a cooling tower during those times of the year when discharge temperatures from a cooling tower alone would not be successful in meeting the proposed temperature standards. A cooling tower/chiller option should thereby be able to achieve the proposed temperature standards from a technical perspective.

6) Cooling Air (from Blowers)

This alternative would consist of utilizing air from the wastewater treatment plant blowers that supply air to Tank 9 (Equalization Tank), Tanks 15 and 16 (Aeration Tanks), and Tank 2 (Aeration Tank). Currently, the air supplied by the blowers is warm to hot, installation of devices (e.g., water sleeves around piping) to cool the air would provide some cooling of the wastewater. However, the cooling of the wastewater in the tanks would be limited to the temperatures needed to provide optimal biological performance (e.g, not less than 70°F). In addition, the estimated ability of cooling air from the blowers is (maximum) about 1.6 million BTUs/hr, far less that the required cooling of over 6 million BTUs/hr (and up to 9.68 million BTUs/hr). This option is technically infeasible.

7) Surface Aeration in Tanks

This alternative would consist of the installation of aerators within the final effluent tank (Tank 8). The aerators would increase the air-water interaction to promote cooling. The volume of this tank is only about 36,000 gallons with a resulting retention time (< 1 hour) that would require a number and size of surface aerators that cannot be accommodated in this size of tank. This option is infeasible.

As briefly mentioned in the discussion outlining potential options, the technically feasible option to achieve consistent and complete compliance with the IEPA proposed temperature discharge limits would be a cooling tower in combination with a heat exchanger/chiller combination. As discussed previously, for the Stepan discharge a closed-circuit cooling tower would be preferred given the potential for fouling of an open-circuit cooling tower and the need to consider air permitting issues for an open-circuit tower. The heat exchanger/chiller would be operated during periods in which the cooling tower alone would not be sufficient to comply with the proposed temperature standards. For this option to achieve the required cooling (Figure 4), we have evaluated their financial and environmental impact.

The details of this evaluation, which included preliminary quotes from equipment vendors, can be made available to interested parties.

Financial Impact

Capital Cost:	$1,640,000 (includes equipment, engineering, installation)
O & M Cost:	$1,300,000/yr (includes labor, electrical, chemicals, maintenance)

Environmental Impact

Effluent Quality:	Will not change chemical or biological characteristics of discharge
Land Use:	1,200 sq ft
Solid Waste:	Generation insignificant
Air Emissions:	Insignificant from closed-circuit cooling tower (intentional consideration)
Electrical Usage:	117 million kW-hr/year
Equivalent Population:	9,065 residential customers or 31,728 people[1]
CO_2 Emissions:	128,530 tons/year[2]
SO_x Emissions:	3,037 tons/year[3]
NO_x Emissions:	234 tons/year[4]
Hg Emissions:	24 lbs/year[5]

IV. Effluent Bacteria Standards

IEPA has also proposed re-designation of the use of the Lower Des Plaines River, including the Upper Dresden Island Pool, to "Incidental Contact Recreation" that would result in application of a "technology-based value designed to assure that disinfection technologies are functioning properly" during the months of March to November. The technology-based value or effluent standard for the disinfection is 400 fecal coliforms (#) per 100 mL. IEPA Statement of Reasons, p. 92.

Currently, Stepan's Outfall 001 is not subject to NPDES permit discharge limits for fecal coliforms and the current wastewater management does not include a disinfection system. Because IEPA has proposed this standard as an effluent standard rather than a water quality standard, compliance with the standard will be required at the discharge point from the WWTP. Hence, installation of a disinfection system to achieve the effluent fecal standard will be required. The source of fecal coliform in the wastewater is from the overflows from the about 15 septic systems located at distinct locations throughout the Stepan Plant. The septic systems do not use and will not be able to use leach fields.

Based on a limited amount of treated effluent monitoring data, more than a 98 percent reduction of fecal bacteria would be needed to achieve compliance with the bacteria effluent standard. The technologies commonly considered for disinfection to 'kill' bacteria include:

1) Source Treatment (chlorination) prior to septic system overflows entering process wastewater sewers.
2) End-of-pipe chlorination

[1] Equivalent population based on 1.47 kW-hr/residential customer with an average of 3.5 people per residence
[2] Based on a factor of 2.2 lbs/kW-hr based on coal-fired utility plant
[3] Based on a factor of 0.052 lbs/kW-hr based on coal-fired utility plant
[4] Based on a factor of 0.004 lbs/kW-hr based on coal-fired utility plant
[5] Based on an average value of 0.21 ppm Hg and 1.02 kW-hr/lb coal

3) Other end-of-pipe applications (e.g., UV, ozonation, or peroxide)

We will touch briefly on the feasibility of these technologies as it applies to Stepan's wastewaters and discharge.

1. Our concern with source treatment at the individual septic systems is assuring that the chlorine concentration is effective to kill bacteria, but not at such a level that the residual chlorine could chlorinate organic material present in the untreated process waters (with which the septic overflows commingle) or that the residual chlorine could inhibit activated sludge. Given that specific information and data are not available on the effectiveness and reliability of source treatment and the potential detriment to overall wastewater management, this option is not considered technically feasible.

2. The most common end-of-pipe process for disinfection of a treated effluent is chlorination. It is known to be effective and has been proven to work well on a variety of treated wastewaters. However, de-chlorination would be required to assure that the total residual chlorine (TRC) standard proposed by IEPA for the Lower Des Plaines River, which is the same as the General Use TRC standard, Statement of Reasons, p. 65, would be attained. The TRC standard, as discharge limits, in effect require complete destruction of residual chlorine. These systems (chlorination followed by dechlorination) as applied to the Stepan treated effluent are considered technically feasible.

3. Other end-of-pipe systems have been shown to be effective in destroying fecal bacteria, e.g., ultraviolet light (UV), ozonation (facilitated with UV), hydrogen peroxide (facilitated with UV). However, the effectiveness of these systems would be limited as applied to Stepan's treated effluent due to the type of TSS present, the tendency for the effluent to contain materials that 'foam', the level of BOD, and the 'color' of the treated effluent. Though these wastewater characteristics are controlled to more than acceptable levels for an organic chemical facility, they are not at the levels that these disinfection systems would have been engineered for e.g., municipal applications. For example, bio or chemical (e.g., scaling) fouling of UV lamp banks would be anticipated to occur excessively as applied to Stepan's treated effluent. Therefore, use of other end-of-pipe systems for disinfection of the treated effluent is not considered technically feasible.

We consider the technically feasible option to achieve consistent and complete compliance with the effluent bacteria standard to be chlorination followed by dechlorination to assure being in compliance with the Illinois TRC limit. For this option to achieve compliance, we have evaluated its financial and environmental impact.

The details of this evaluation, which included preliminary quotes from equipment vendors, can be made available to interested parties.

Financial Impact

Capital Cost:	$1,771,000 (includes equipment, engineering, installation)
O & M Cost:	$650,000/yr (includes labor, electrical, chemicals, maintenance)

Environmental Impact

Effluent Quality:	Chloride will, on average, increase by about 19 percent Sulfate will, on average, increase by about 31 percent Potential formation of chlorinated organics, but level of organics very low in treated effluent.
Land Use:	~5,700 sq ft
Solid Waste:	Generation significant
Air Emissions:	Insignificant from treatment systems
Electrical Usage:	0.784 million kW-hr/year
Equivalent Population:	61 residential customers or 213 people[6]
CO_2 Emissions:	900 tons/year[7]
SO_x Emissions:	20 tons/year[8]
NO_x Emissions:	2 tons/year[9]
Hg Emissions:	0.2 lbs/year[10]

V. Dissolved Oxygen

IEPA has also proposed re-designation of the use of the Lower Des Plaines River, Upper Dresden Island Pool that would result in revisions to the dissolved oxygen (DO) criteria. Though a DO criterion already does apply to these waters (4.0 mg/L, 35 IAC 302.405), IEPA has not developed the data to assess the assimilative capacity of the Upper Dresden Island Pool water for DO (e.g., DO sources, DO sinks, relationship between flow, DO, temperature, conductivity, kinetics of BOD and ammonia, etc.). Normally, the assimilative capacity of a water (or a simple DO model) is used to limit those substances that impact in-stream DO. Therefore, we are assuming that IEPA will implement the proposed more stringent DO criteria as end-of-pipe limits. This would mean that the discharge from Outfall 001 would be required to meet the DO standards proposed by IEPA for the Upper Dresden Island Pool. For March to July, the proposed standards are not less than 5.0 mg/L at any time and not less than 6.0 mg/L as a 7-day mean of daily means. For August to February, the proposed standards are not less than 3.5 mg/L at any time, not less than 4.0 mg/L as a 7-day mean of daily minima and not less than 5.5 mg/L as a 30-day mean of daily means. IEPA Statement of Reasons, 56-60. As such, the

[6] Equivalent population based on 1.47 kW-hr/residential customer with an average of 3.5 people per residence
[7] Based on a factor of 2.2 lbs/kW-hr based on coal-fired utility plant
[8] Based on a factor of 0.052 lbs/kW-hr based on coal-fired utility plant
[9] Based on a factor of 0.004 lbs/kW-hr based on coal-fired utility plant
[10] Based on an average value of 0.21 ppm Hg and 1.02 kW-hr/lb coal

temperature and conductivity of Stepan's treated effluent impacts the ability of the treated effluent to 'saturate' to a level to achieve potential DO limits. Currently, DO is not subject to NPDES Permit discharge limits at Outfall 001. To assure consistent compliance with the proposed DO criteria, the averaged daily mean (March through July or August through February) DO will be the daily potential discharge limit as applied to Outfall 001.

The 'source' of DO (or DO sink) for the treated effluent is the aeration of the effluent to promote activated sludge to biologically degrade organics. Aeration tanks are specifically operated at DO levels between 2 and 4 mg/L to assure reliable yet cost-effective performance in attaining BOD discharge limits. It would be detrimental to operations and to biological treatment to operate the aeration tanks at higher levels of DO. Therefore, the treatment options to achieve the potential DO limits will be at 'end-of-pipe' – after Tank 8.

Current DO results for the effluent (treated discharge) as monitored at Tank 8 as compared to the IEPA proposed DO discharge limits are presented in Figure 5. Based on the close to daily monitoring of the treated discharge for slightly over 2 years, the compliance with the IEPA proposed DO discharge limits would be achieved only about 10 percent of the time without further treatment. Therefore, treatment to add DO to the treated effluent would be needed with as much as 5.2 mg/L DO needed to be added at some times and on average 2.2 mg/L additional DO needed.

The technologies commonly considered for adding DO or supplemental aeration of a treated effluent includes:

1) Pressurized Air Diffusers
2) Stair-step aeration
3) Surface aerators
4) Direct injection of oxygen
5) Hydrogen peroxide

We will touch briefly on the feasibility of these technologies as it applies to Stepan's wastewaters and discharge.

1) The use of air diffuser systems is generally a good solution to adding DO to wastewater but for this wastewater there is a concern about causing foaming. Also, the small size of the Tank 8 would not accommodate a diffuser system (sized for the amount of DO addition needed). This option is not considered technically feasible for application to the Stepan treated effluent.

2) A step aeration system would be difficult as it is normally incorporated into a natural feature. The routing of the treated effluent from Tank 8 to the River is via underground pipe. It would be possible to construct a large stand alone unit if the land was available; however not enough land is available. This system would also be very vulnerable to foaming over as the water cascades down the steps, which would require the use of chemicals to control, and use of defoaming chemicals at this point could be problematic. This option is not considered

technically feasible for application to Stepan treated effluent and the in-place wastewater conveyance system.

3) Surface aerators are also a physical system commonly used to add more oxygen in waters, however, similar to application to step aeration systems, there is a concern with foam creation with the treated effluent. Another limitation of this technology to the Stepan Plant is that the number of surface aerators needed to add DO cannot be placed in Tank 8. This option is infeasible as applied to the treated effluent.

4) Direct injection of oxygen to saturate the treated effluent requires very specific and detailed safety measures as oxygen is a fire accelerant. These systems are known to be extremely energy intensive and the injection of oxygen would have potential to cause foaming issues. This option is not technically feasible for the Stepan Plant.

5) We consider the technically feasible option to achieve consistent and complete compliance with the potential DO limits to be hydrogen peroxide addition. For this option to achieve compliance, we have evaluated its financial and environmental impact.

The details of this evaluation, which included preliminary quotes from equipment vendors or historical costs, can be made available to interested parties.

Financial Impact

Capital Cost:	$25,000 (includes chemical injection quill, piping, in-pipe static mixer, engineering, installation)
O & M Cost:	$650,000/yr (includes labor, electrical, chemicals, maintenance)

Environmental Impact

Effluent Quality:	Could change chemical composition by oxidizing certain chemicals; will add oxygen (as measured by DO as mg/L) to treated effluent
Land Use:	100 sq ft
Solid Waste:	Generation insignificant
Air Emissions:	Insignificant from treatment system
Electrical Usage:	~500 kW-hr/year (insignificant impact on emissions)
Equivalent Population:	9,065 residential customers or 31,728 people
Solid Waste:	
Air Emissions:	
Electrical Usage:	

VI. Findings

The proposed re-designation of use of the Lower Des Plaines River which in turn affects the numeric standards and criteria for temperature, fecal bacteria, and dissolved oxygen will result in significant financial and cross-media environmental impacts. Those impacts cannot be understood at a theoretical level without considering the actual engineering steps that Stepan and other dischargers will have to take to comply with the proposed standards. In managing the wastewater to achieve consistent and complete compliance with the IEPA proposed discharge limits Outfall 001, Stepan will have to install and operate technologies that are well beyond the treatment considered "best" for organic chemical manufacturing plants and to achieve an effluent quality that now is considered excellent based on the Millsdale plant's NPDES Permit compliance history. Control options deemed technically feasible to treat the effluent, beyond the existing secondary treatment (biological) and tertiary treatment (filtration) as presented in Figure 1, are presented in Figure 6.
Based on our knowledge and experience, no chemical manufacturing facility in the USA has installed all of these end-of-pipe control systems.

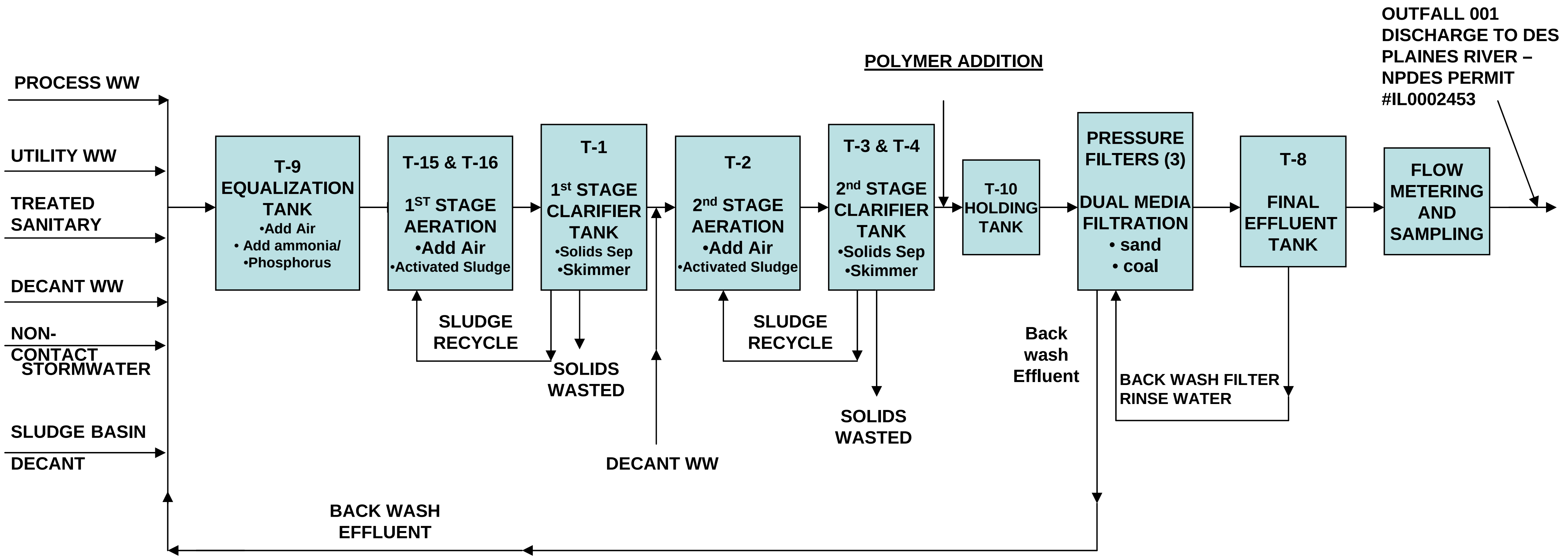
We offer the following summary of the impacts of all three additional control systems:

Financial Impact	
Capital Cost:	$3,436,000 (+/- 50% includes equipment, engineering, installation)
O & M Cost:	$2,600,000/yr (includes labor, electrical, chemicals, maintenance)
Environmental Impact	
Effluent Quality:	Will be an increase in chloride and sulfate (and salt overall). It is not known if the overall increase in salt would cause issues with complying with acute or chronic whole effluent toxicity. There is also a small possibility that chlorinated organics, not currently present in the discharge, could form during the chlorination process necessary to meet IEPA's proposed effluent disinfection requirement.
Land Use:	~7,000 sq ft (~0.2 acres)
Solid Waste:	Generation insignificant
Air Emissions:	Insignificant from treatment systems
Electrical Usage:	117.8 million kW-hr/year
Equivalent Population:	9,126 residential customers or 31,941 people
CO_2 Emissions:	129,430 tons/year
SO_x Emissions:	3,057 tons/year
NO_x Emissions:	236 tons/year
Hg Emissions:	24.2 lbs/year

In conclusion, Stepan's ability to reliably comply with the temperature limits, effluent bacteria standard, and DO limits proposed by IEPA would result in significant costs and significant cross-media environmental impacts. Because the Millsdale plant does not have its own power plant, the electrical usage needed to operate the treatment systems that would be necessitated by IEPA's proposed rules would have to be purchased from the electricity grid. Thus, electrical demand is likely to be met primarily by coal-fired electrical generating plants, which are themselves significant sources of thermal discharges and decreased DO.

We assume that time would be granted to design and construct controls to meet the proposed discharge limits and effluent bacteria standard, but time will not reduce economic and environmental impacts of the control systems. We understand that the IEPA believes that technologies required for compliance with temperature, bacteria and DO are technically feasible. However, that belief was apparently based on virtually no engineering analysis and did not analyze the real economic and cross-media environmental impacts that would occur. In addition, the impacts on the Millsdale plant, as analyzed in our report, will certainly be replicated in varying degrees at other industrial dischargers. While we have not analyzed how other industrial dischargers might comply with the proposed IEPA standards, they are also likely to require treatment technologies requiring significant energy usage with substantial costs and cross-media environmental impacts. The simple scientific truth is that the energy present in wastewater that creates higher temperature discharges cannot be destroyed. It can only be transferred to some other environmental media via the use of energy-intensive processes. In our opinion, the IEPA proposal has failed to consider these environmental and economic impacts and whether those impacts outweigh any projected benefits to water quality from the proposal. In our experience, the economic reasonableness to "smaller dischargers" and the overall significant multi-media impacts of technically feasible controls ought to be thoroughly considered in any proposal to modify water quality uses or water quality standards.

We also understand that IEPA is not aware of any water quality standards, except DO, temperature, and disinfection, that would require specific technology upgrades to achieve compliance. Stepan is in the process of evaluating whether additional controls will be necessary to assure compliance with certain metals and salt criteria that are being revised or added in support of the proposed re-designation of use. As IEPA is aware, a biological treatment system, even one with tertiary treatment like Stepan, is not designed to remove metals or salts. As Stepan's source of salts would be from process area cooling tower blowdowns, process area reverse osmosis system reject water, seasonal use of salt for de-icing for safety, and additional of acids or bases at the wastewater treatment plant to maintain pH and alkalinity that is needed for optimal biological treatment, source controls are not an option. Similarly, there are no specific sources of metals at this chemical manufacturing plant. Therefore, any treatment would be at end-of-pipe and would likely have significant economic and environmental impacts.



Notes: WW = Wastewater

T = Tank

ENVIRON

Figure 1. Stepan Wastewater Treatment Flow Diagram

20-22102A

04-Aug-08

Figure 2. Daily Effluent Temperature (Tank 8) & Daily Influent Temperature (Tank 9)

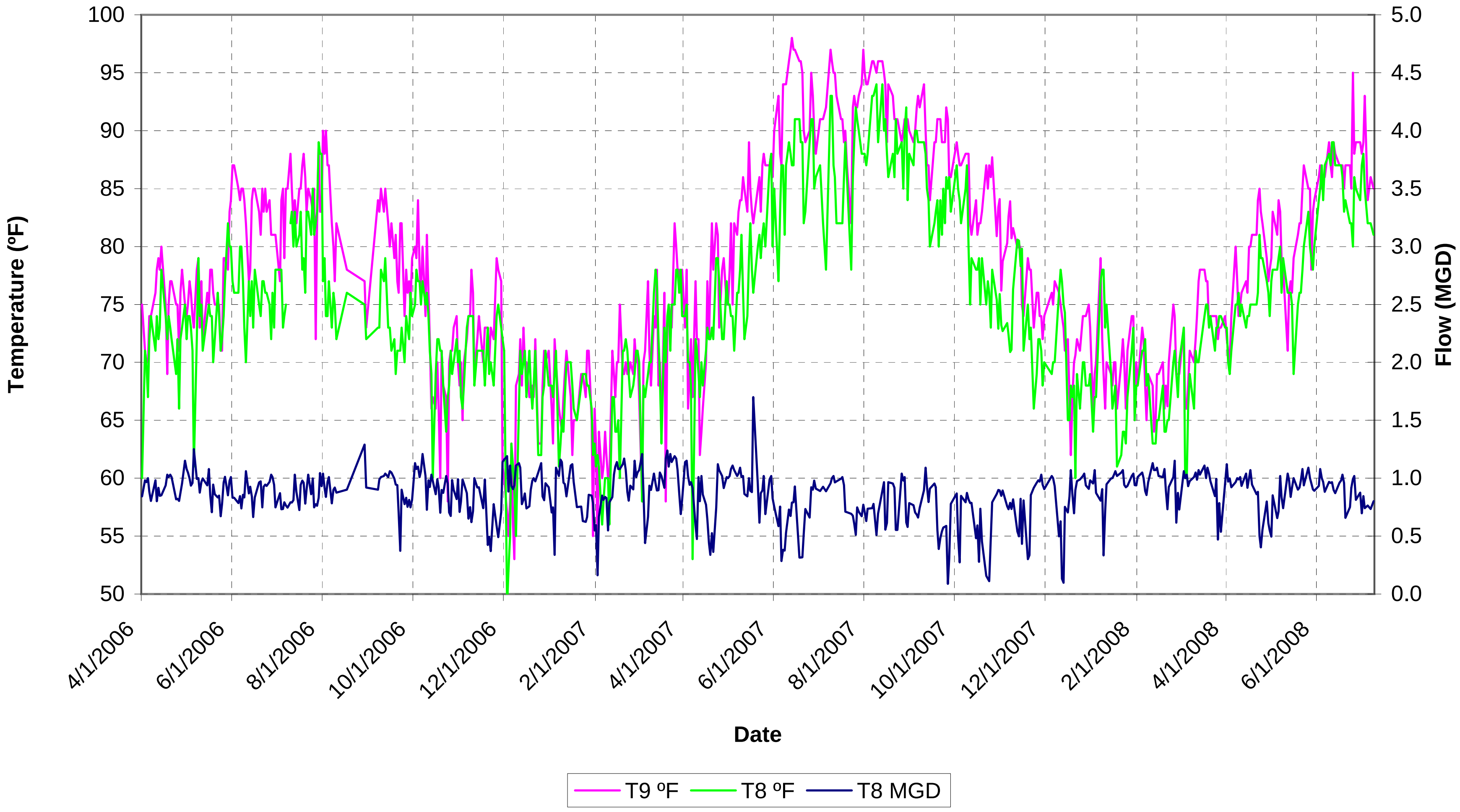


Figure 3. Comparison of Tank 8 Effluent Period Temperature Averages with IEPA Proposed Temperature Averages

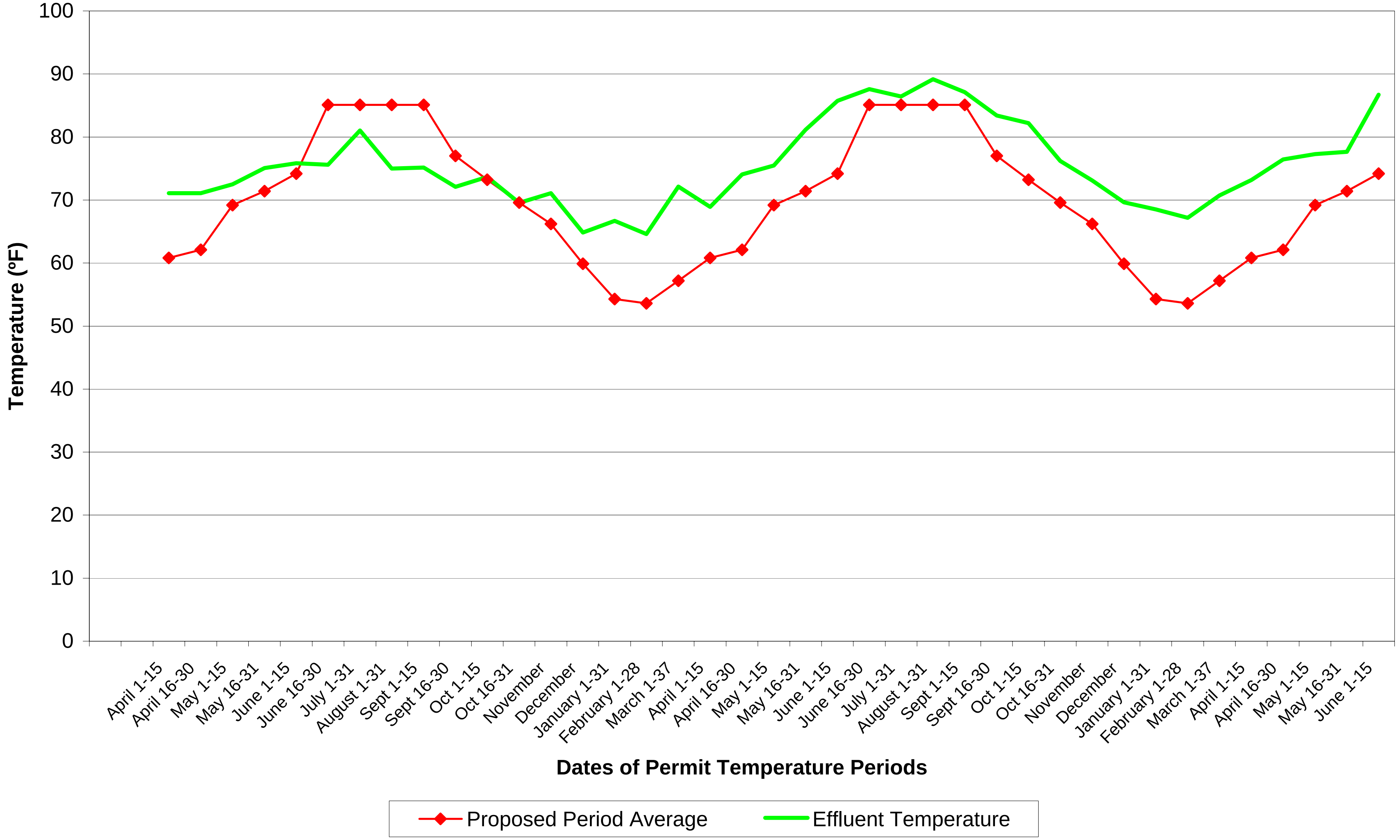


Figure 4. Cooling Required To Attain Discharge Limits

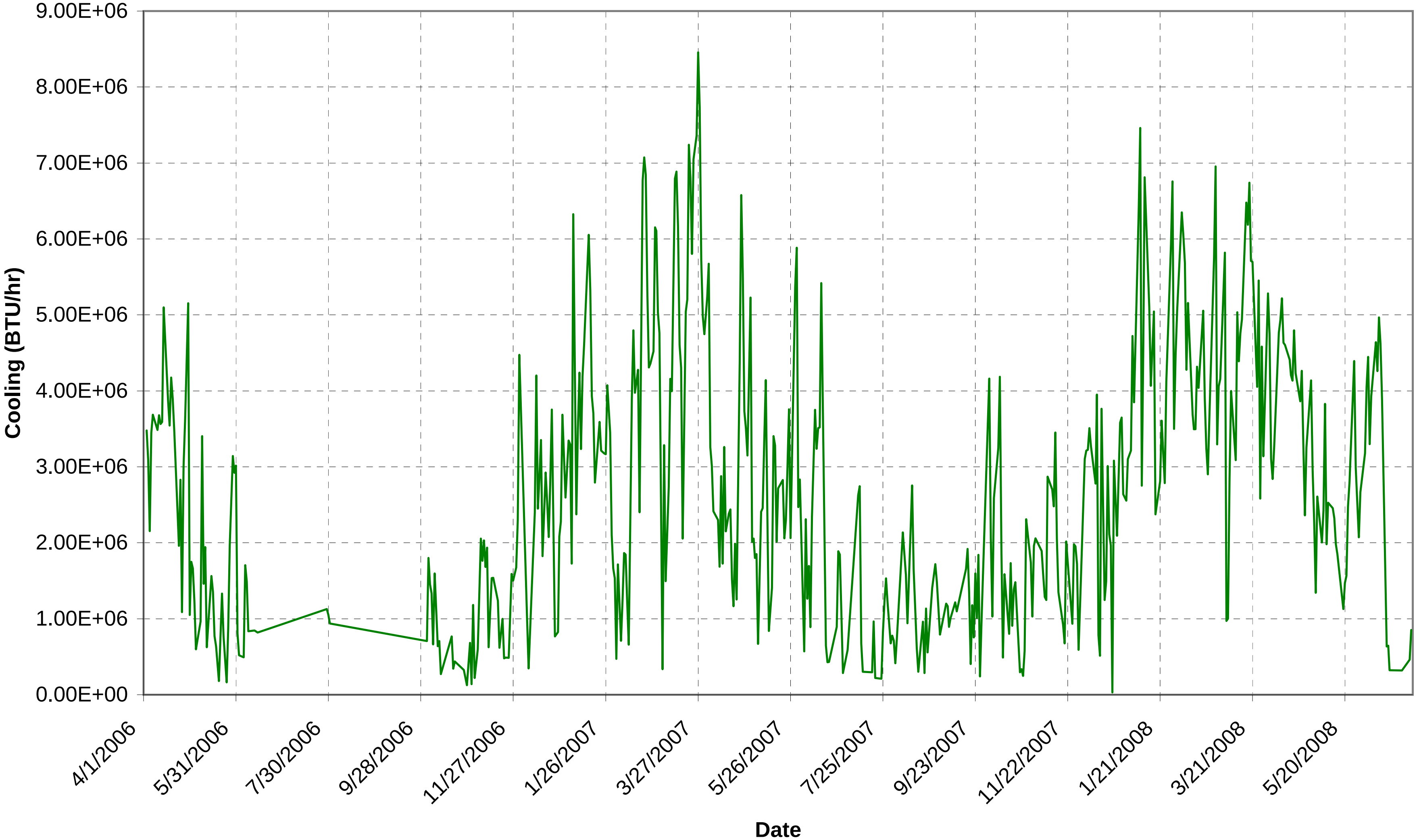


Figure 5. Tank 8 (Final Effluent) Characteristics: Flow, DO, Temperature

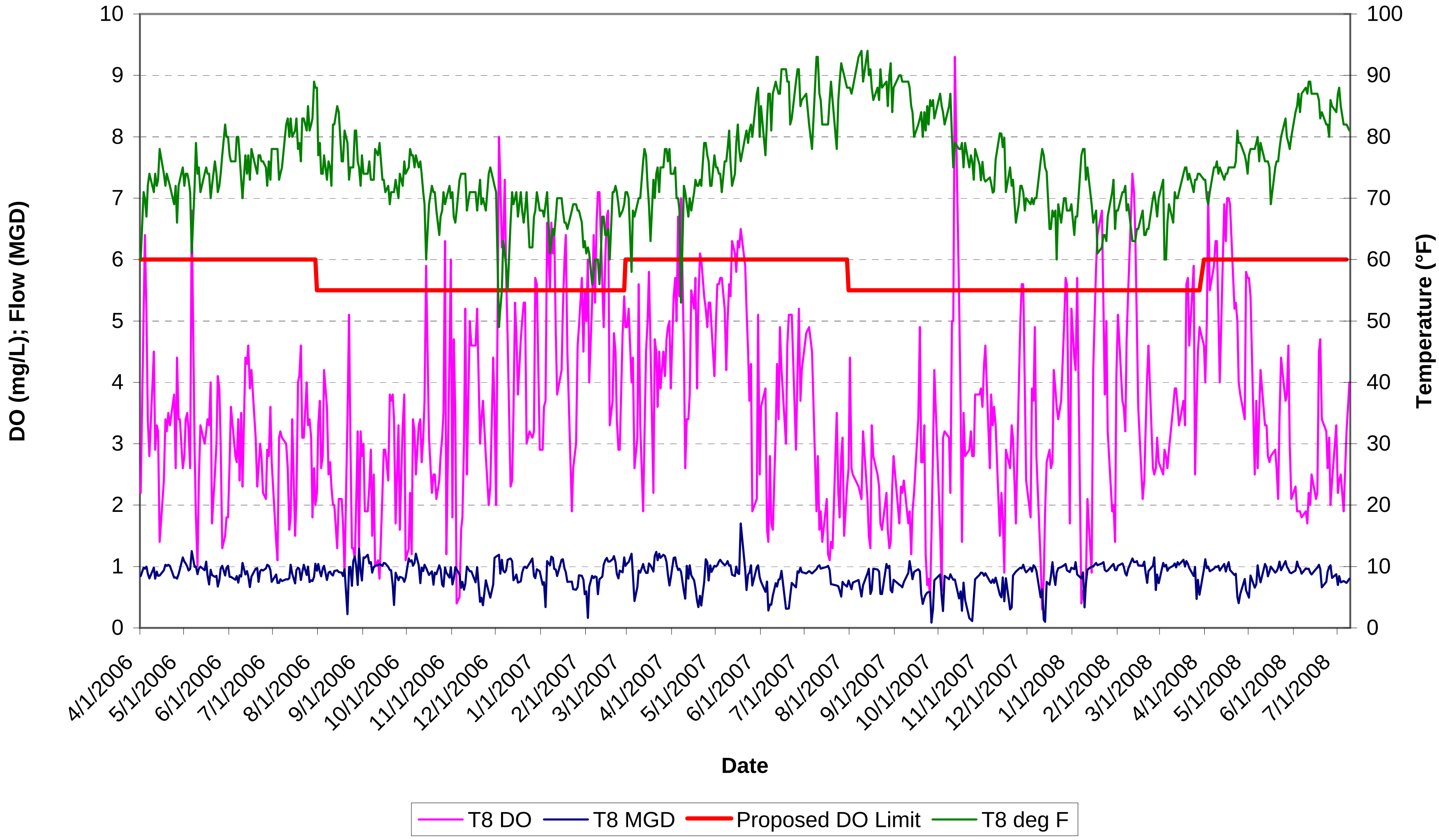
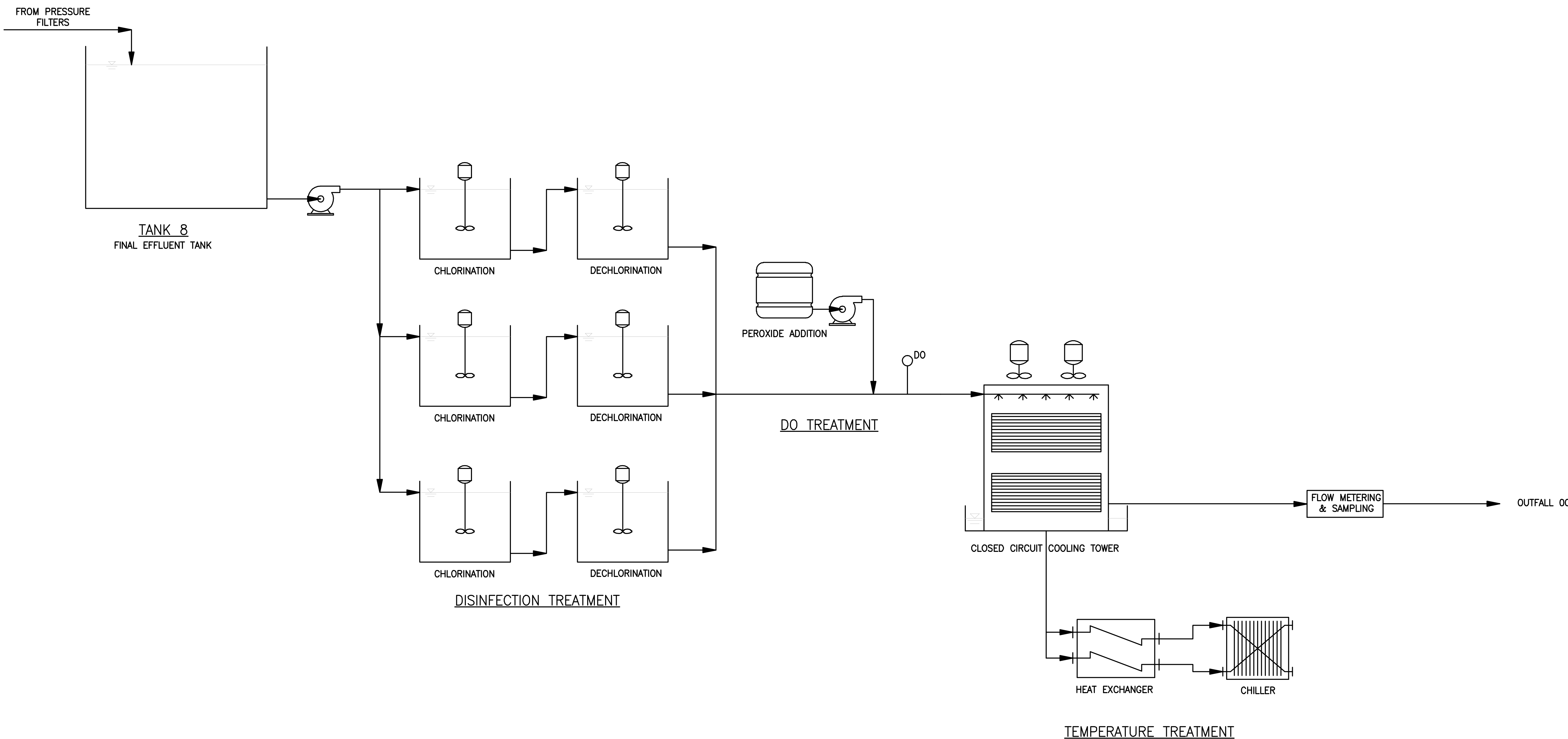


FIGURE 6. CONCEPTUAL DESIGN OF FEASIBLE TECHNOLOGIES TO MEET PROPOSED STANDARDS FOR BACTERIA, DO AND TEMPERATURE



Prepared For:	Prepared By:	
STEPAN ELWOOD, IL	ENVIRON INTERNATIONAL CORPORATION NASHVILLE, TN	FIGURE 6 BACTERIA, DO AND TEMPERATURE TREATMENT

SCALE:	NTS	DRAWN BY:	MDB	APPR. BY:		DATE	04JUL08
CONTRACT NO.	20-21102A	SKETCH NO.	FIGURE 6	REV.	1		

Attachment 1

Resumes of ENVIRON Personnel

Carl E. Adams, Jr., PE, PhD

EDUCATION

1969	PhD, Environmental Health Engineering, The University of Texas, Austin, Texas
1966	MS, Sanitary and Water Resources Engineering, Vanderbilt University, Nashville, Tennessee
1965	BS, Civil Engineering

REGISTRATIONS & CERTIFICATIONS

Professional Engineer: Alabama, Florida, Indiana, Kentucky, Louisiana, Mississippi, Ohio, Tennessee, Virginia and Texas.

EXPERIENCE

Dr. Carl E. Adams, Jr., is considered one of the leading international experts on Industrial Wastewater Management. In September 1969, Dr. Adams established Associated Water & Air Resources Engineers, Inc. (The AWARE Corporation), which developed over 15 years into the largest industrial wastewater management engineering organization in the United States with over 250 employees in three countries (US, Venezuela and Italy).

In January 1985, Dr. Adams and a small group of experts from AWARE founded The ADVENT Group, Inc. of Brentwood, Tennessee, an innovative high tech firm offering integrated wastewater management services to industry. During ADVENT's tenure, Dr. Adams developed and is the inventor and holder of three patents involving advanced industrial wastewater treatment technology. These patents are installed in over 44 applications in 13 countries. The ADVENT Group, Inc. had four offices in the US and four international locations (Sao Paulo, Brazil; Brussels, Belgium; Beersheva, Israel; and Ahmedabad, India).

In May, 2005, Dr. Adams merged The ADVENT Group, Inc. with ENVIRON, a global environmental consultancy. He became Global Practice Leader of Integrated Industrial Wastewater Management.

Dr. Adams has been a consultant/director to more than 1,000 US and foreign industrial wastewater management projects; author of over 100 technical publications and presentations; co-author and editor of four books and several engineering manuals regarding industrial wastewater treatment design and management. Professional activities include over 100 technical seminars and courses in the United States, Eastern and Western Europe (including Russia), South America, Asia (including China), the Middle East and Australia. He also has served as a Visiting Adjunct Professor at Vanderbilt University for Application of Advanced Wastewater Technology.

His special areas of technical expertise include: aerobic and anaerobic treatment of high strength and high salt industrial wastewaters, nitrification-denitrification, membrane technology, chemical oxidation, source control and water recycle and reuse.

In October 2005, he was inducted into the Academy of Distinguished Alumni in the Department of Civil and Architectural Engineering at The University of Texas in Austin.

His major US and international clients have included: GE Plastics, ExxonMobil, MarathonAshland, Olin, Monsanto, Solutia, DuPont, Huntsman Chemicals, Nova Chemicals, Formosa Chemicals and 3M.

Carl E. Adams, Jr., PE, PhD

EMPLOYMENT HISTORY

2005 – Present	ENVIRON, Princeton, New Jersey Global Practice Area Leader, Integrated Industrial Wastewater Management
1985 – Present	The ADVENT Group, Inc., Brentwood, Tennessee Principal, Chief Executive Officer, Board Chairman
1969 – 1985	The AWARE Corporation, Nashville, Tennessee Dr. Adams founded and held technical and management positions, including President & Chief Executive Officer, Vice Chairman of the Board
1977	UNOP/W Project Environmental Pollution Abatement Center, Katowice, Poland (Three-week assignment: Recycle of Industrial Wastewaters) - Special Consultant
1974	UNOP/W Project Environmental Pollution Abatement Center, Krakow, Poland (Two-week assignment: Nitrification/Denitrification of Toxic Industrial Wastewaters) - Special Consultant
1968 – 1969	Engineering Science of Texas, Austin, Texas - Project Manager
1967-1968	University of Texas, Austin, Texas - Research Associate
1966	US Corps of Engineers, Nashville, Tennessee - Project Engineer

PATENTS

Wastewater Treatment System with Enhanced Directional Flow, United States Patent 6,224,773, Awarded May 1, 2001.

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The ADVENT Integral Clarifier in conjunction with Baker Process, IFAT Conference. Munich, Germany, May 1999.

The ADVENT Integral System: Innovative Technology for Industrial Wastewater, presented to various Indian industries, Mumbai, India, March 1999.

The ADVENT Integral System: Innovative Technology for Industrial Wastewater, presented to various European Industries, Milan, Italy, December 1998.

Innovative Technology for Pulp and Paper Wastewater Treatment: The Integral Activated Sludge System, São Paulo, Brazil, October 1996.

Biological Methodology and Option Evaluations: Integral Activated Sludge System, Ahmedabad University, Ahmedabad, India, October 1996.

Source Control and Wastewater Treatment, Envirotech 1996, Ahmedabad, India, October 1996.

State-of-the-Art Wastewater Technologies as Applied to India, Ahmedabad University, Ahmedabad, India, September 1995.

Design for the Eighties, Seminar sponsored by The AWARE Corporation, Milan, Italy, May 1981.

Operation Control and Management of Activated Sludge Plants, Seminar sponsored by Vanderbilt University, San Juan, Puerto Rico, March 1980.

Performance Monitoring, Nitrification and Denitrification, Biological Sludge Handling, Operation, Control, and Management of Activated Sludge Plants Treating Industrial Wastewaters. Seminar sponsored by Vanderbilt University, School of Engineering Continuing Education, Environmental and Water Resources and Engineering Program, Toronto, Canada, September 1979.

Pulp and Paper Mill Wastewater Treatment Seminar, with W.W. Eckenfelder, Jr. and Y. Argaman. Seminar sponsored by AWARE, Inc., Milan, Italy, May 1979.

Physical-Chemical Treatment of Industrial Wastewater, with W.W. Eckenfelder, Jr. and Y. Argaman. Seminar sponsored by Aware, Inc., Milan, Italy, June 1979.

Principles and Practice of Biological Wastewater Treatment, with W.W. Eckenfelder, Jr. Seminar sponsored by AWARE, Inc., Milan, Italy, January 1978.

Physical-Chemical Treatment of Industrial Wastewater, with W.W. Eckenfelder, Jr. and Y. Argaman. Seminar sponsored by Aware, Inc., Milan, Italy, January 1978.

Dissolved Air Flotation, Breakpoint Chlorination, Ion Exchange for Nitrogen Removal, IRCHA, Paris, France, May 1977.

Aerobic Biological Treatment, Physical-Chemical Treatment: Present Trends, Physical-Chemical Treatment: Aerated Lagoons: Nitrification-Denitrification-Nitrogen Removal, Design of Wastewater Treatment Plants: Economy and Reuse in Biological and Physio-Chemical Treatment Processes. International Course in France for Engineers, sponsored by IRCHA, Paris, France, November-December 1976.

Process Design for Industrial Waste Treatment, with W.W. Eckenfelder, Jr. and Y. Argaman. Seminar sponsored by AWARE, Inc., Tehran, Iran, October 1976.

Pretreatment Considerations: Sedimentation, Coagulation, Flotation, IAWPR Continuing Education Courses, Melbourne, Australia, October 1976.

Theory and Practice of Biological Wastewater Treatment, with W.W. Eckenfelder, Jr., Advanced Study Institute, Bogazici University, Istanbul, Turkey, July 1976.

Theory and Practice of Biological Wastewater Treatment, with W.W. Eckenfelder, Jr., NATO Advanced Study Institute, Milan, Italy, June 1976.

Industrial Waste Treatment, Process Design, with W.W. Eckenfelder, Jr., and Y. Argaman. Short course presented to Italconsult, Rome, Italy, February 1976.

Robin L. Garibay, REM

EDUCATION

1980 B.A., Biochemistry, Rice University

1983 Graduate Studies, Plant Physiology, Texas A & M University

REGISTRATIONS AND CERTIFICATIONS

Registered Environmental Manager No. 7599

EXPERIENCE

A Principal in ADVENT-ENVIRON's (ENVIRON's Integrated Industrial Wastewater Management Practice Area) Herndon, Virginia, location, Ms. Garibay has over 25 years of experience in wastewater and water quality management issues, particularly activities in support strategic planning for facility changes and permitting, compliance planning for discharges, and providing technical advocacy in wastewater and water quality rulemaking.

Ms. Garibay's specific expertise includes source surveys, toxicity reduction evaluations, fate and effects studies, bioavailability assessments, water quality criteria development, variance requests, removal credit applications, antidegradation demonstrations, generating assessments of multi-media impacts, costs, and benefits of wastewater control options, and regulatory agency negotiations.

Her project experience includes the following:

- Reviews implementation of regulations by participating in work groups, and commenting on guidance documents and methods, policy directives, compliance costs, and technical databases.
- Participated in stakeholder work groups in Illinois, Indiana, West Virginia, and Wisconsin on various regulatory issues including adoption of GLI rules, establishment of anti-degradation rules and procedures, development of TMDLs, creation of statewide mercury variance rules, and derivation of state-specific water quality criteria.
- Directed sampling and analytical tasks for the chemical identification, mixing zone delineation studies, assimilative capacity studies, reviews of toxicology and fate information to determine environmental risks, preparation of sampling and analysis plans for CWA and RCRA activities.
- Preparation of 404 Applications, 401 Certifications, CZM Applications, NPDES Permit Applications, IU Permit Applications, Land Application Permit Applications, and Plans in support of BMP, SWP3, SPCC and/or FRP.
- Directing and conducting in-plant sewer source surveys and development of water and mass balances.
- Assistance in wastewater management audits and wastewater management training.

Significant experience consulting with iron and steel mills, primary metals manufacturing, petroleum refineries, organic chemical manufacturers, power generation stations, food manufacturing, and industrial trade associations.

Robin L. Garibay, REM

- Previous experience includes the analysis of formulations and ground-water samples for pesticide identity.
- Served on an agricultural chemicals and ground-water task force for the development of a ground-water protection act and chemigation rule.