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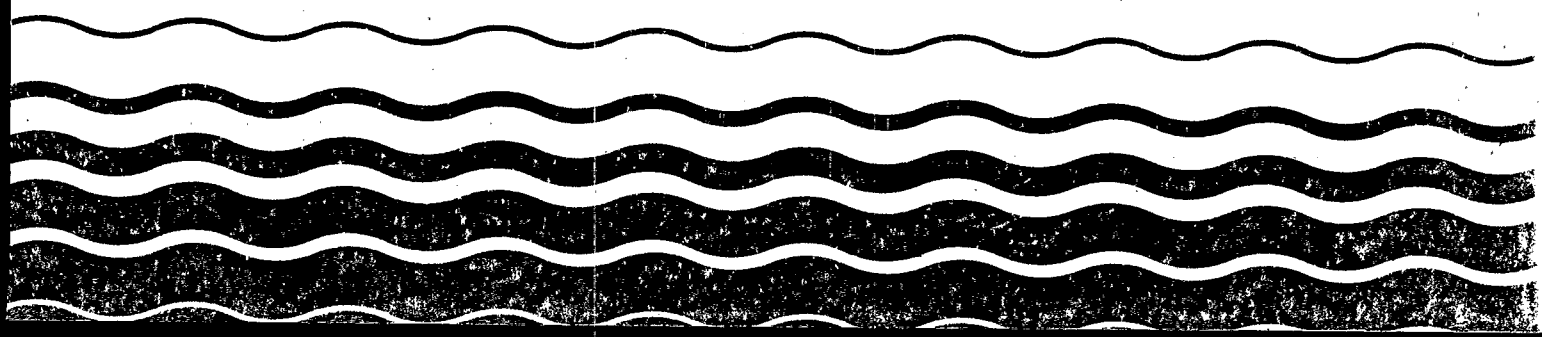
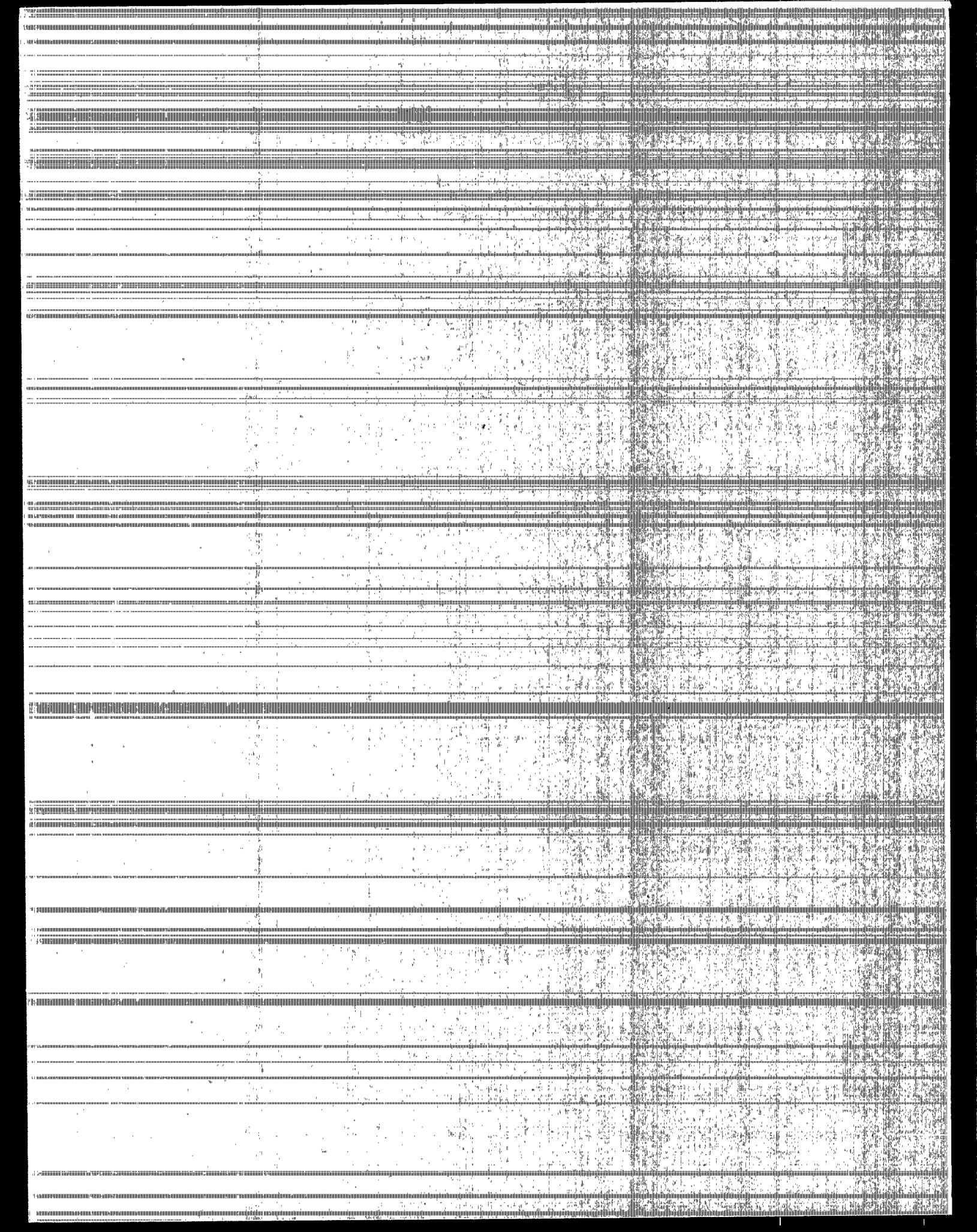
Water

EPA

Abstracts of Toxicity Reduction Evaluations





EXECUTIVE SUMMARY

The "Abstracts of Toxicity Reduction Evaluations" provides access to information contained in 23 TREs performed in 8 states. The abstracts are intended to provide investigative and remedial profiles of industrial and municipal efforts to reduce toxicity in effluents. These profiles include information on industry types, production and treatment unit processes, causes of toxicity, permit limits and discharge conditions. The TRE abstracts are intended to assist permit writers measure their expectations when evaluating TRE plans and results when similar to the abstracted case studies.

The document begins with a summary of the statutory and administrative context of whole effluent toxicity limitations in permits. Chapter 1 also summarizes EPA's initiatives in helping industries and municipalities meet these limits through TRE guidance manuals. The second chapter presents the methodology used to obtain TRE information from the Regions and States as well as charts showing TRE activity and tables comparing State TRE objectives. Chapter 3 presents the abstracts of the actual TRE cases. The document ends with a bibliography of the available TRE cases studies.

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1.1 PURPOSE

The purpose of this document is to consolidate and abstract available information on Toxicity Reduction Evaluations (TREs) that have been performed over the last 3 years. Toxicity reduction is required when municipal wastewater treatment plants and industries fail to meet whole effluent toxicity limits or biomonitoring requirements set in National Pollutant Discharge Elimination System (NPDES) permits. This document provides accounts of TREs that have resulted in a demonstrated improvement in whole effluent toxicity to protect water quality standards. The accounts present information about the actual application of TRE approaches to different industrial and municipal discharges.

1.2 BACKGROUND

One of the provisions set forth in the Clean Water (CWA) and reiterated in the 1987 Water Quality Act Amendments states that:

> The discharges of toxic chemicals in toxics amounts shall be prohibited [WQA Sec. 101(a)(3)].

The CWA provides the U.S. Environmental Protection Agency (EPA) and States with NPDES authority to regulate point source discharges of wastewater so that they are free from toxics in toxic amounts.

The EPA Office of Water's Policy for the Development of Water Quality-Based Permit limits for Toxic Pollutants [49 FR 9016] published in March 1984 states:

> Where there is a significant likelihood of toxic effects to biota in the receiving water, EPA and the States may impose permit limits on effluent toxicity and may require an NPDES permittee to conduct a toxicity reduction evaluation. Where toxic effects are present but there is a significant likelihood that compliance with technology-based requirements will sufficiently mitigate these effects, EPA and the States

may require chemical and toxicity testing after installation of treatment and may reopen the permit to incorporate additional limitations if needed to meet water quality standards.

EPA uses the NPDES permit program to control the discharge of pollutants to surface waters of the U.S. Both the Clean Water Act and the NPDES regulations provide the permit writer with sufficient legal and regulatory authority to establish whole effluent toxicity permit limits.

EPA has produced two guidance documents, the Technical Support Document for Water Quality-Based Toxics Control (EPA 440/485-032) and the Permit Writer's Guide to Water Quality-based Permitting for Toxic Pollutants (EPA 440-81-005), that can be used by the permit writer to develop permit limits for a particular point source discharger.

As more whole effluent toxicity limitations are written, there is an increasing need by industries and municipalities to reduce their whole effluent toxicity. Recognizing this need, EPA has developed the Toxicity Reduction Evaluation (TRE). To help the discharger, or the consultant for the discharger, implement the TRE, EPA has produced several additional documents.

1.3 TRE DOCUMENTS

The Permit Writer's Guide to Water Quality-based Permitting for Toxic Pollutants (EPA 440/4-87-005) addresses the entire context of whole effluent toxicity limits. The Permit Writer's Guide defines the TRE as:

> A step-wise process which combines toxicity testing and analysis of the physical and chemical characteristics of causative toxicants to zero in on the toxicants causing effluent toxicity. In most cases, the process proceeds from simple assessments that use the quickest, most inexpensive methods (e.g. pre-chlorination effluent toxicity testing and post-chlorination toxicity testing) to more complex analyses (e.g. effluent fractionation and subsequent toxicity testing/chemical identification of fractions).

This guide then provides a five-page summary of the basic elements of the TRE.

EPA has also developed two guidance documents which describe protocols for conducting TREs. The first manual, Toxicity Reduction Evaluation Protocol for Municipal Wastewater Treatment Plants (EPA 600/2-88/062), explains that the protocol is:

> Designed to provide guidance to municipalities in preparing TRE plans, evaluating the information generated during TREs, and developing the technical basis for the selection and implementation of toxicity control methods. A TRE involves an evaluation of the municipal WWTP performance; and identification of the specific toxicants causing effluent toxicity; a review of the pretreatment and local limits programs; a characterization of the nature, variability and sources of toxicity; and the evaluation, selection and implementation of the toxicity control options.

The second TRE guidance document, Generalized Methodology for Conducting Industrial Toxicity Reduction Evaluations (EPA 600/2-88/070) provides essentially the same systematic approach as the municipal TRE document, except that it addresses circumstances pertinent to industrial dischargers.

In addition, EPA has developed a manual that describes a three phased approach for identifying the causative agents of effluent toxicity (TIE). Methods for Toxicity Identification Evaluations-Phase I: Toxicity Characterization Procedures (EPA/600/3-88/034) describes procedures for the characterization of the physical/chemical characteristics of the toxicants in an effluent sample, as well as the variability associated with the type and concentration of compounds that cause effluent toxicity. More specifically, the manual states that the first phase is conducted to isolate and characterize the physical/chemical properties of the effluent toxicant(s) using a series of relatively simple, low cost analyses. In effect, the Phase I characterization involves systematically removing or rendering inert specific groups of toxicants sharing similar physical/chemical characteristics (e.g., metals, nonpolar organics, ammonia, chlorine) and measuring the toxicity of the treated

aliquot of effluent sample. With this mechanism, the investigator can determine the type of compounds that may be responsible for the toxicity. The Phase I studies also provides information on the variability of the effluent toxicity.

Results of the Phase I characterization are utilized in Phase II of the TIE (Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures. EPA 600/3-88/035) which provides the analytical techniques for identification of the specific compounds responsible for the effluent toxicity. Having determined in Phase I the physical/ chemical classes of compounds that are the causative agents of the effluent toxicity, Phase II involves further analyses based on these results to identify the specific chemicals causing the toxicity. Once the causative agents are identified and confirmed (Phase III TIE) the discharger can take steps to reduce the outflow of these causative compounds in the discharge.

Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures (EPA-600/3-88/036) addresses the "confirmation phase" of the TRE. This phase is conducted to assure the investigator that the toxicants identified in Phase II are consistently the cause of effluent toxicity. This step is essential to preclude any unnecessary treatment or control methods that might result from insufficient study of effluent toxicity.

The Phase I, II and III TIE manuals have been published and are currently available from EPA. The "Technical Support Document" (EPA 44--81-005) and "Permit Writer's Guide" (EPA 440/4-87-005) are also available. The two general TRE protocols are in press.

1.4 FUTURE UPDATES TO TRE ABSTRACTS

The Toxicity Reduction Evaluation (TRE) abstracts in this document were conducted prior to, or during the early stages of development of guidance on TREs. For this reason, the approaches utilized in the TREs do not necessarily follow the EPA recommended procedures described in the above TRE guidance documents. However, these TREs do represent useful case studies on reducing whole effluent toxicity.

In the future EPA intends to update this document in order to consolidate the information from additional States, as well as TREs currently being conducted. In addition, as more TREs are performed, refinements to the existing TRE guidance will emerge. These new approaches will be reflected in the new TRE abstracts.

EPA's long term objectives are to develop a TRE PC Data Base. Once there is a sufficient number and cross-section of abstracts (relative to industry type, toxicants, treatment, geographical areas, etc.), EPA intends to produce a TRE PC Data Base which will not only contain the TRE abstracts, but include the ability to retrieve and sort the TRE abstract(s) according to name or by the use of key words.

2.0 TRE ABSTRACT METHODOLOGY

Between June and September 1988, EPA surveyed all of the States and EPA Regions to determine the status of Toxicity Reduction Evaluations for both industries and municipalities. The objective was to find case examples of industries and municipalities that had successfully conducted TREs to reduce effluent toxicity.

The method of survey involved preliminary telephone contact with the State or Regional environmental regulatory personnel. State and Regional contacts were identified through use of the Office of Water's Program Survey-- Biological Toxicity Testing in the NPDES Permits Program. Each contact was asked: 1) whether they knew of any industrial or municipal dischargers that had effectively reduced whole effluent toxicity in the State, 2) if the discharger had attempted to work within the conceptual framework of the Phase I TRE Manual, and 3) if so, was the information documented and available.

In most cases, States either claimed that reductions in whole effluent toxicity had been successfully accomplished, or that implementation of the whole effluent toxicity limits in the State had not yet progressed to the point where TREs have been completed. In the former case, State files and any available documents on whole effluent toxicity were reviewed for verification in California (San Francisco Bay Region), Delaware, Maryland, New Jersey, North Carolina and Virginia.

In some cases file reviews in these States allowed EPA to determine both the specific technical elements of the TRE and the history of the State program, including any permittee/State correspondence that resulted in TRE implementation. Discussions with State personnel were often critical in understanding both the technical and the regulatory processes.

This method of survey was not the only approach used to identify toxicity reduction case studies. The EPA Environmental Research Laboratory in Duluth, Minnesota, has conducted numerous TIEs and produced reports describing several of the evaluations. These reports were used, in combination with other available material, to identify additional case histories.

Figure 1 identifies States where information was collected. This information included incorporation of TREs as part of a State's toxics control strategy, initial interactions between the State and the discharger(s) to begin initiation of TRE(s), or actual progress regarding specific TREs, both ongoing and completed. State TRE objectives are presented in Table 1.

The information collected during the survey is presented in Table 2. As a result of EPA's initial survey of the States and Regions, 23 TRE case histories were selected and abstracted. The resultant abstracts are presented in Section 3.0. Section 4.0 of this document presents a reference bibliography.

States With TRE Programs

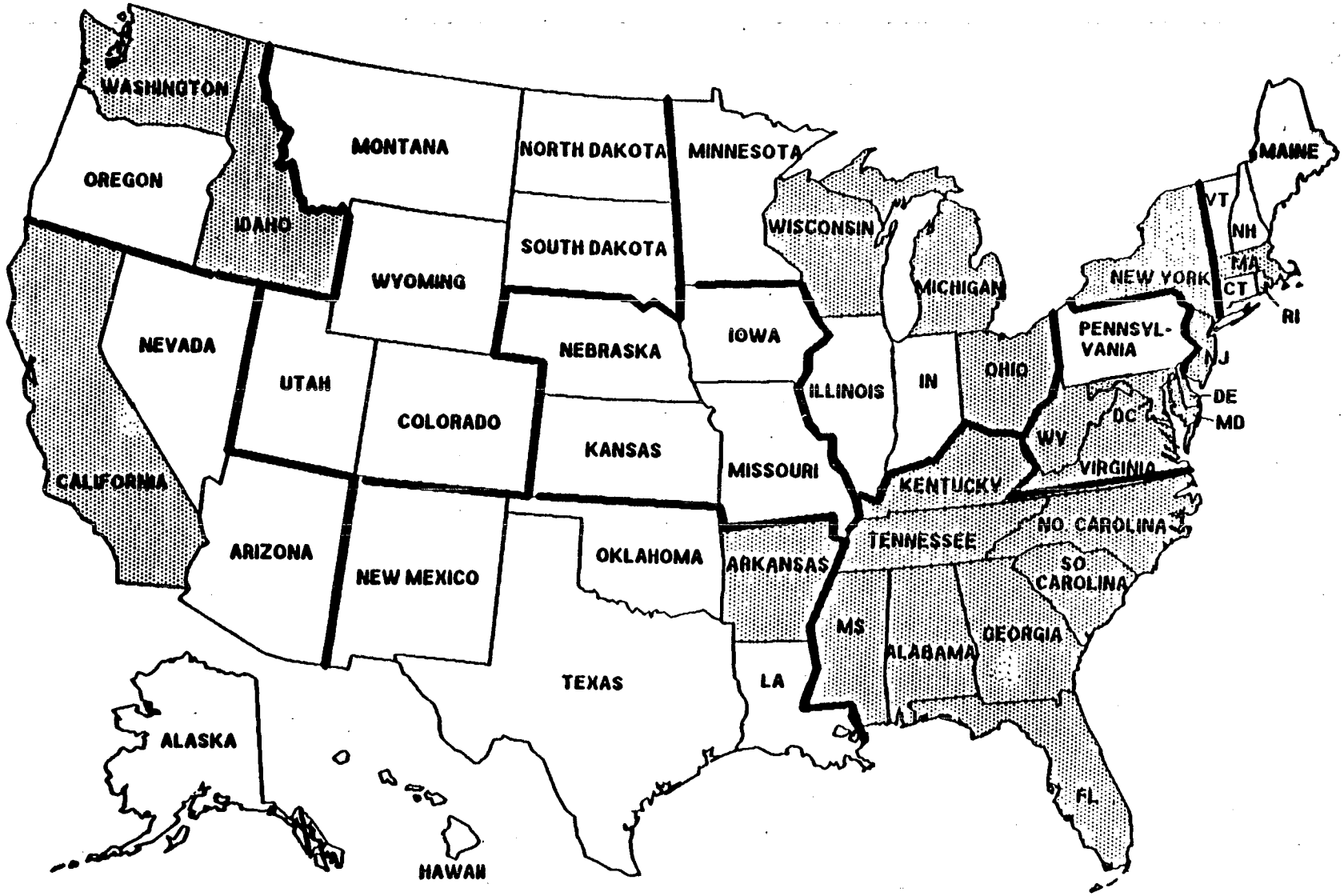

Figure 1.

TABLE 2. OUTLINE FOR TOXICITY REDUCTION EVALUATION REPORTS DATA COLLECTION

I. General Information

- o name
- o location (if possible lat./long.)
- o NPDES permit #
- o flow
- o SIC #(s)
- o industrial category(s)
- o pollutants controlled in NPDES permit and by effluent limitations guidelines
- o whole effluent toxicity limits
- o types of processes and any additional significant pollutants not listed in NPDES permit
- o types of controls/treatment
- o name of receiving water(s) and reach # (if available)
- o 7Q10 (or low flow of receiving stream required by state)
- o instream waste concentration
- o conditions indicating need for TRE (biomonitoring or screening test used)
- o biomonitoring tests (species, frequency, type of test)
- o TRE timetable/compliance schedule
- o date of TRE abstract
- o costs (where information is available and verifiable)

II. Causes of Final Effluent Toxicity

- o characterization results (e.g., volatility, solubility, filterability, etc.)
- o type of chemical analyses and summary of results

III. Sources of Toxicity

- o summary of source investigation (IU, commercial)
- o processes/treatments showing toxic waste streams

IV. Control of Toxic Pollutants

- o description of control options
- o toxicity reduction required to meet TRE objectives.
- o summary of follow-up monitoring and compliance

V. Sources of Information for Abstract and Contact

TABLE 1

STATE TRE OBJECTIVES

STATE	REFERENCE TOXICITY TESTS	TOXICITY REDUCTION OBJECTIVES
California (San Fransisco Bay Region)	96-hr flow through effluent test using three-spine stickleback and either rainbow trout or fathead minnows for dischargers with flows > 1 MGD.	LC 50 must be passed 9 out of 10 times for 90% effluent.
Delaware	96-hr definitive test with Daphnia magna.	LC 50 > 50%
Maryland	96-hr static renewal w/fathead min.; 48-hr static renewal w/D. magna.	LC 50 > 100% or LC 50 > $\frac{IWC}{0.3}$
North Carolina	48-hr w/D. magna.	no significant acute mortality in 90% effluent. No observable inhibition of reproduction.
New Jersey	96-hr Mysid shrimp test.	LC 50 must be passed 9 out of 10 times for 90% effluent.
Virginia	96-hr static or static renewal w/Daphnia and fathead minnows.	LC 50 > IWC

3.0 TRE ABSTRACTS

9/7/88

Chevron, USA, Incorporated, Richmond Refinery; Chevron Chemical Corporation, Richmond Plant; and General Chemical Corporation (formerly Allied Chemical), Richmond Works

NPDES # CA0005134: Chevron USA operates a petroleum refinery that manufactures fuels, lubricants, asphalt, and petrochemicals. Classified as an integrated refinery (SIC code: 2911), Chevron USA has a crude-run throughput of 256,000 barrels per day. The plant, located in Richmond, Contra Costa County, California, discharges into Castro Creek 500 yards from its confluence with Castro Cove, an embayment of San Pablo Bay.

Wastestream 001, which averages 13.8 mgd, consists mainly of refinery process wastewater that has been treated in aerated lagoons and oxidation ponds. This wastestream also includes 0.072 mgd of wastes from General Chemical Corporation, which consists of cooling tower blowdown, boiler blowdown, steam condensate, plant washings, and storm water. General Chemical Corporation manufactures sulfuric acid and oleum, using alkylation acid and spent sulfuric acid from the Chevron USA refinery as raw material.

Chevron Chemical Company, Ortho Division, Richmond Plant, manufactures fertilizers, pesticides, fungicides, herbicides, and fuel additives. Exhaust gas scrubber blowdown from an incinerator is also discharged (average flow 0.18 mgd) through the Chevron USA wastewater system, combining with wastewater 001 to form wastewater 004.

The treated wastes are discharged through a diffuser into San Pablo Bay about 2,000 feet offshore at a depth of about 10 feet. The date of issuance of the latest permit was March 15, 1985.

In 1986, the California Regional Water Quality Control Board, San Francisco Bay Region, issued the Water Quality Control Plan Amendments for the San Francisco Bay Plan. This Plan, designed to protect human health and aquatic life from toxic pollutants, included an Effluent Toxicity Control Program that specifically stated:

> All dischargers (except cooling water dischargers) shall determine compliance with the toxicity requirements using flow-through effluent bioassays and the species identified above (the three-spine stickleback and either the rainbow trout or the fathead minnow) except for those that discharge intermittently and discharge less than 1.0 mgd.

The Basin Plan also identified an implementation schedule for industries to meet the whole effluent discharge limits. Consistent with the Basin Plan, the
permit calls for 50-percent survival of test fish in standard 96-hour bioassays for dischargers with deepwater outfalls with 10:1 diffusers. The permit also requires that more than 50 percent of the test fish must survive in nine out of every ten tests to be in compliance. The permit has effluent limitations for BOD, TSS, TOC, oil and grease, phenolic compounds, ammonia, sulfide, chromium (total and hexavalent), and settleable solids. In addition, the oil refinery had chemical-specific limitations for arsenic, cadmium, copper, cyanide, lead, mercury, nickel, selenium, silver, zinc, phenols, and PAHs.

In April 1987, bioassay results of the effluent indicated high fish mortality. Samples were extracted with freon and were analyzed with an infrared spectrometer (IR) and a gas chromatograph (GC) equipped with a flame ionization detector (FID) and an electron capture detector (ECD). The GC-ECD selectively detects oxygenated carbonyl compounds, carbonyl, acids, and phthalates. The effluent was found to have some of these dissolved organic compounds. Chevron concluded that the dissolved organics seemed to play a major role in effluent toxicity.

The Toxicity Reduction Evaluation conducted by the Chevron USA Richmond Refinery was completed in March of 1988. The TRE was triggered on July 1, 1987 when Chevron USA found that the effluent could not meet the new effluent limitation for juvenile rainbow trout of an LC_{50} of 100-percent effluent. The deadline for compliance with the rainbow trout flow-through toxicity test was October 1, 1987.

Chevron USA took the following immediate actions to reduce the final whole effluent toxicity:

- Established an Environmental Operating Department
- Instituted an Operator Training Program
- Revised and updated Operating Standards

- Constructed a new bioassay facility consisting of six holding and 24 test tanks to perform weekly flow-through toxicity tests

- Installed 30 process water sample stations

- Instituted enhanced management and holding tanks for better control of intermittent sources of pollutants.

The next step involved identification of major sources of pollutants. To identify substances that might contribute to aquatic toxicity, Chevron inventoried all pollutants used at the refinery and compared them with Cal OSHA's Hazard Communication program (HAZCOM). Furthermore, a standard procedure was developed for review of any new chemicals brought to the refinery. Given the industry's knowledge of the refinery processes, a likely list of pollutant sources was developed. Then, given water flow determinations and pollutant concentration measurements, loadings of each pollutant from these sources were determined. If the sum of the known loadings doesn't agree with the separator effluent measurement, Chevron would attempt to identify the missing sources.

Chevron identified surfactants to be a major potential source of toxicity and immediately initiated an inventory program for all chemical products at the refinery that used surfactants. Products that contained surfactants thought to be toxic, such as branched alkyl phenol ethoxylates (APES), which are highly toxic to fish and degrade slowly, were banned from use or replaced by other, much more rapidly biodegrading substances, such as Neodol, a primary alcohol ethoxylate. Chevron also installed caustic recovery facilities so that all of the caustic could be reused. Chevron did not find metal levels to be linked to effluent toxicity.

To reduce toxicity still further, Chevron instituted several additional source control methods, including segregation of major pollutant sources, control of discharge rates to the effluent system, pretreatment of some of the wastestreams, and institution of an extensive monitoring operation of principal pollutant sources, separators, bioreactors, and final effluent. Since the primary sources of the dissolved organic materials believed to be toxic were the "California crudes," and they have a high solubility in water, the refinery built a full-scale pilot unit to remove dissolved organics (Desalter Effluent Source Control Unit). The unit acidifies the desalter water, causing dissolved organics to precipitate out of solution as oil droplets. The oil is separated out and recycled back to the crude feed unit.

Ammonia is also very highly controlled at the major plant sources. Salinity is minimized by backing out salt water from the effluent system and recycling streams with high conductivities.

Since Chevron implemented the actions discussed above, including startup of the Desalter Effluent Source Control Unit, the refinery has passed all of the flow-through juvenile rainbow trout bioassays, averaging 94-percent survival between October 1, 1987 and the time of its TRE report of March 3, 1988.

Sources:

1. "Toxicity Reduction Evaluation/Environmental Hazard Assessment on Chevron USA, Richmond Refinery Effluent". March 1988.

2. Environmental Impact Report of Chevron USA Richmond Refinery Deep Water Outfall Project. 1987.

3. Series of letters, memoranda, and reports in files of San Francisco Bay Water Quality Board. Regional Contact: Dr. Tom Mumley (415) 464-0579.

6/13/88
Tosco Corporation Avon Oil Refinery

NPDES # CA0004961: Tosco Corporation Avon Oil Refinery, located in Martinez, California, refines crude oil to gasoline and diesel fuel (SIC Code: 2911). The principal process units are distillation, "cracking," reforming, and alkylation. The plant produces 3.1 mgd of process wastes, cooling tower blowdown, sanitary wastes, storm water runoff, and wastes from a sulfuric acid plant. Process waste treatment includes an API Separator/-Dissolved Air Flotation (DAF) Unit, aerated lagoons, and a rotating biological contractor system (Powered Activated Carbon fed system. This system is fed by four major process streams: ammonia recovery unit effluent, foul water stripper bottoms, dissolved air flotation effluent, and acid plant effluent. The final effluent, after filtering and passing through a diffuser, discharges into Suisun Bay. The toxicity limit in the NPDES permit requires 96-hour flow-through bioassays using 3-spine sticklebacks with a minimal survival of 50 percent in undiluted effluent (i.e., 96-hour LC_{50} > 100%).

After establishing Microtox as an appropriate surrogate for the 96-hour flow-through bioassay using 3-spine sticklebacks, series of samples were characterized for the magnitude and variability of the final effluent toxicity. The effluent was then fractionated into organic (acidic, basic, and neutral) and inorganic (cationic and anionic) fractions. Toxicity was found to be associated with the organic fraction (primarily neutral but some acidic organics). However, GC/MS analysis failed to identify compounds in toxic concentrations. It was concluded that the toxicity is caused by a synergistic combination of compounds.

Bench-top models were used to determine the level of toxics degradation resulting from the various treatment steps. It was found that the inorganic class of toxic constituents was reduced by the treatment steps (total influent toxicity reduction was 85 percent), but that the neutral and acidic organic compounds were resistant to degradation. The sources of these neutral and acidic organic compounds were likely to be wastewaters produced by the foul water strippers and the ammonia recovery unit.

Favored treatment options considered by Tosco included the use of activated carbon and increased residence time in surface impoundments. Further work is needed to determine the best treatment option.

Source:

1. "Toxicity Reduction Evaluation at the TOSCO Corporation Avon Refinery, Martinez, California". EA Engineering, Science, and Technology, Inc. Sparks, MD. July 1987.

9/7/88
Union Oil Company of California

NPDES # CA0005053: Union Oil Company of California, located in Rodeo, Contra Costa County, operates a petroleum refinery that manufactures fuels and lubricants. Classified as a lube refinery (SIC code: 2911), Union Oil Company of California has a crude-run throughput of 58,800 barrels per day. The plant is located in Rodeo, Contra Costa County, California and discharges into San Pablo Bay. Outfall 002, which averages 2.4 mgd, consists of process wastes, sanitary wastes, boiler blowdown, cooling water blowdown, ballast water, and storm water runoff. The treated wastes are discharged through a diffuser into San Pablo Bay about 1,400 feet offshore.

In 1986, the California Regional Water Quality Control Board, San Francisco Bay Region, issued the Water Quality Control Plan Amendments for the San Francisco Bay Plan. This plan, designed to protect human health and aquatic life from toxic pollutants, included an Effluent Toxicity Control Program that specified the following:

> All dischargers (except cooling water dischargers) shall determine compliance with the toxicity requirements using flow-through effluent bioassays and the species identified above (the three-spine stickleback and either the rainbow trout or the fathead minnow) except for those that discharge intermittently and discharge less than 1.0 mgd.

The Basin Plan also identified an implementation schedule for industries to meet the whole effluent discharge limits. Consistent with the Basin Plan, the permit calls for 50-percent survival of test fish in standard 96-hour bioassays for dischargers with deepwater outfalls with 10:1 diffusers. The permit also requires that more than 50 percent of the test fish must survive in nine out of every ten tests to be in compliance.

The Basin Plan stipulated that, unless the process wastewater was diluted by a factor of 10 with dilution water, a concentration of 50-percent effluent can not result in test organism mortality of 50 percent or more in more than one out of ten effluent samples. The Water Quality Board stated that, while the process effluent was diluted by noncontact cooling water on average by tenfold, the process effluent was not always diluted by this factor. Therefore, Union was asked to install a deepwater diffuser.

In May 1986, Union submitted a list of alternative modifications to its wastewater treatment system. By April 1987, Union reported that the consultants Brown and Caldwell were contracted to study wastewater treatability and that two pilot plant units were constructed and operated to compare treatability. Of the two treatments, extended aeration and powdered activated carbon enhanced activated sludge (PACT), the latter treatment was found to provide a better reduction of effluent toxicity. PACT treatment expansion involves careful dosing of the wastewater with a dose of powdered activated carbon of approximately 100 mg/liter. Both treatment expansion and increased wastewater storage capacity for containment of 10-year high flow storm water were installed. In June 1987, Union reported that there were still problems with meeting the toxicity limit, even with the installation of the PACT system. As organic analysis did not indicate that organic compounds were responsible for the impact, Union suspects H_2S might be the cause of the remaining toxicity problem.

Source:

1. Series of letters, memoranda, and reports in files of San Francisco Bay Water Quality Board. Regional Contact: Dr. Tom Mumley (415) 464-0579.

6/21/88
NVF Company

NPDES # DE0000451: NVF Company owns Yorklyn and Marshall Brothers Paper Mills, which both discharged into Red Clay Creek through a common outfall. The mills manufacture vulcanized fibers.

The effective date of the most recent permit was March 8, 1984. Permit conditions (mg/l) were: BOD_5, 73; TSS, 73; zinc, 0.25; and surfactants, 0.5. pH was allowed to vary between 6 and 9 pH units. Surfactants and BOD_5 have repeatedly exceeded effluent limits, and the zinc limit has occasionally been exceeded. Groups of three 24-hour Daphnia magna acute toxicity screening tests were to be conducted, each separated by a 24-hour down time. If average survival of the three tests did not exceed 80 percent, and control survival exceeded 80 percent, a 96-hour "definitive" test was to be conducted. If an LC_{50} could be generated in less than 50-percent effluent, a plan was to be submitted within 30 days to reduce effluent toxicity.

In June 1984, EPA conducted three screening tests according to permit conditions. Survivability was 52 percent. The definitive test, conducted in August 1984, exhibited an LC_{50} of 1 percent.

The NVF Company and the Delaware Department of Natural Resources and Environmental Control (DNREC) studied the feasibility of eliminating the discharge to Red Clay Creek by diverting the effluent to the New Castle County Sewer System. By October 1985, it was determined that, to divert the effluent, the NVF sewer discharge limit would have to be increased from 0.525 to 1.0 mgd. The county indicated that it would charge a one-time amortization fee of $687,500. NVF reported to DNREC that diversion was not possible because of the charge.

However since that time modifications of the plant have occurred and negotiations between NVF and the New Castle County Sewer System have resulted in the elimination of all process waste treatment discharges to Red Clay Creek.

Source:

1. Series of letters, memos, and reports in NVF permit file of Delaware Department of Natural Resources and Environmental Conservation, Dover Office. State Contact: Richard Green: (302) 736-5732.

6/21/88
Hollywood POTW

NPDES # FL0026255: A Toxicity Identification Evaluation was conducted on the Hollywood POTW (SIC Code: 4952) in Hollywood, Florida, by Don Mount and his research team at EPA's Environmental Research Laboratory in Duluth, Minnesota. The average discharge flow of the POTW was 18.3 mgd to the Atlantic Ocean. Permit conditions, pre-TRE history, and plant characteristics information were not available for incorporation into the abstract.

The toxicity of the initial sample, collected in August 1986, was characterized rapidly, since the solid phase extraction column removed effluent toxicity. This suggested that the toxic fraction was at least, in part, one or more nonpolar organic toxicants. There was a check for chlorine and EDTA chelatable metal toxicity, and no toxicity was found. This finding provided further evidence that the nonpolar organic fraction may have been substantially responsible for the toxicity. Samples collected on March 3, 1987, and January 5, 1988, were also characterized and results were similar to the August 1986 results.

GC-MS analyses of the SPEC fractions 80-percent and 85-percent methanol from the SPEC revealed that diazinon was largely responsible for the observed toxicity. Effluent toxicity was then compared with diazinon concentrations to determine the extent to which diazinon was responsible for effluent toxicity. A log-log plot of diazinon concentration, measured by GC, and whole effluent LC_{50} was graphed and linear regression analysis was conducted. Analysis indicated that diazinon was primarily responsible for effluent toxicity. When all "toxic" fractions were combined (70-percent to 85-percent methanol), additional toxicity was reported, though this toxicity was not quite as much as actual whole effluent toxicity. This indicated some toxic contribution by both the "toxic" and "nontoxic" fractions of the effluent. Chlorfenvinphos would be especially likely to occur in the 70-percent fraction. The added toxicity of the nontoxic fractions may have resulted from methanol toxicity (elutant). However, fathead minnows exposed to whole effluent exhibited some mortality when exposed to some whole effluent samples. Since fathead minnows are much more resistant to diazinon toxicity, it is likely that other toxic compounds are also present in the effluent.

Source:

1. Mount, D.I. "Report on Hollywood POTW". Memorandum. EPA. 2-25-88.

6/20/88
Chemetals, Incorporated

NPDES # MD000175: Chemetals, Incorporated, located in Baltimore, Maryland, manufactures manganese sulfate, manganese dioxide, and manganese chloride. The single outfall at this facility discharges both noncontact cooling water and process wastewater. The process wastewater is treated, then placed in settling ponds before being discharged into Arundel Cove a tributary of Curtis Creek, which is classified for water contact recreation for fish, other aquatic life, and wildlife. The current NPDES permit limits manganese, TSS, pH, chlorine, and the discharge of floating solids or persistent foam from the outfall.

Biological testing by the Maryland State Biomonitoring Laboratory indicated effluent toxicity. In March 1988, E.A. Engineering, Science and Technology, Incorporated performed Phase 1 testing using Daphnia magna and Menidia (Atlantic silverside). The addition of a chelating agent, EDTA, greatly reduced the toxicity of the effluent, indicating that the metal content in the wastewater is responsible for the toxicity. A filtration test showed that the insoluble fraction contributes significantly to the toxicity of the effluent.

Chemetals plans to conduct testing to determine the most effective way to upgrade its treatment system. Testing will include aerating a sample of the effluent, and adding a flocculating agent to enhance precipitation. The concentration of manganese, the most abundant metal in the effluent, will be tested to determine the effectiveness of treatment. If, after installation of a modified treatment system, toxicity is not reduced to acceptable levels, Chemetals will develop a system for chelating the effluent.

Sources:

1. NPDES Permit. September 1985.

2. "Toxicity Reduction Evaluation of Chemetals, Inc. Effluent Waste Stream". March 1988. Prepared by E.A. Engineering, Science and Technology, Inc., Sparks, Maryland.

3. Letter from James Underwood, Chemetals on the results of Chemetals TRE and its proposed Toxicity Treatment Plant. May 10, 1988.

6/20/88
W.D. Byron & Sons, Incorporated

NPDES # MD0053431: W.D. Byron & Sons, Incorporated, located in Williamsport, Maryland, operates a cattle hide chrome tanning and finishing facility (SIC Code: 3111). Salt-packed hides are washed and hair is removed chemically with lime and sulfide. This wastewater is pretreated by chemical oxidation (manganese sulfate and aeration), neutralization (carbon dioxide from flue gas), and settling prior to lagoon aeration. Hides are split and delimed with ammonium sulfate, and enzymes are added to remove protein degradation products and peptized fibers and to reduce swelling. This bate process is followed by a pickle process, which exposes the hide to sulfuric acid and salt. Trivalent chromium is added to the pickle solution for tanning. These wastewaters are treated by a lime and anionic polymer precipitation process and lagoon aeration. Finally, retanning adds many chemicals in low concentrations, and fatliquor processes add oil. This wastewater is treated by primary clarification and lagoon aeration.

The treatment systems discharge 0.5 mgd to the Conocochaeque River (7Q10:33 mgd) above the confluence to the Potomac River. The permit's effluent guideline requirements included BOD, COD, TOC, TSS, NH_3, chlorine, color, total chromium, surfactants, magnesium, and pH.

In January 1987, Byron submitted an application for permit renewal. The Maryland Department of Environment tested this effluent and found that it was acutely toxic to Daphnia magna and Pimephales promelas. A TRE was required in the Special Conditions section of the permit. Phase I of the TRE is complete. This investigation found that the toxicity is associated with ammonia and moderately acid organic compounds believed to be anionic or nonionic surfactants. Chemical analyses of the effluent showed elevated levels of BOD (170 mg/l), ammonia nitrogen (170 mg/l), and total suspended solids (290 mg/l). Methylene Blue Active Substances, which indicate the presence of anionic surfactants, were found in the effluent.

Source:

1. "W.D. Byron & Sons Toxicity Reduction Evaluation Report". Prepared by Fishbeck, Thompson, Carr, and Huber. ADA, Michigan. June 1988.

6/21/88
Las Vegas POTW

NPDES # NV0020133: A Toxicity Identification Evaluation (TIE) was conducted on the Las Vegas POTW (SIC Code: 4952) in Las Vegas, Nevada, by Don Mount and his research team at EPA's Environmental Research Laboratory in Duluth, Minnesota. The average flow of the POTW was 25.9 mgd to the Las Vegas Wash, with a 7Q10 of 0.12 mgd. Permit conditions, pre-TRE history, and plant characteristics information were not available for incorporation into the abstract.

The whole effluent toxicities of the samples collected between September 1986 and June 1987 indicated that acute toxicity to Ceriodaphnia (48-hour LC_{50}) and fathead minnows (96-hour LC_{50}) varied from greater than 100 percent LC_{50} to less than 10 percent. When effluent toxicity was characterized, using solid phase extraction column (SPEC), toxicity occurred consistently in the 80-percent and 85-percent methanol fractions and, sporadically, in the 75-percent fraction. Therefore, the toxic fractions were at least, in part, nonpolar organic toxicants. GC-MS analyses of the SPEC fractions revealed that diazinon and dichlorvos were largely responsible for the observed toxicity in these fractions. Dichlorvos concentrations varied most between samples and were thought to be primarily responsible for variable effluent toxicity.

Whole effluent toxicity was compared to diazinon concentrations to determine the extent to which diazinon was responsible for effluent toxicity. A log-log plot of diazinon concentration, measured by GC, and whole effluent LC_{50} was graphed and linear regression analysis was conducted. Analysis indicated that diazinon was primarily responsible for effluent toxicity. When all "toxic" fractions were combined, additional toxicity was reported, though this toxicity was not quite as much as actual whole effluent toxicity. This indicated some toxic contribution by both the "toxic" and "nontoxic" fractions of the effluent.

Fathead minnows exhibited some mortality when exposed to some samples of whole effluent. Since they are much more resistant to diazinon and dichlorvos toxicity than Ceriodaphnia, this indicates that other toxic compounds were also likely to be present in the effluent. Propoxur and simazine, other pesticides, were consistently present, but not at acutely toxic concentrations. Both compounds were, however, near chronically toxic concentrations and of concern.

Source:

1. Mount, D.I. "Las Vegas TIE". Memorandum. EPA. 3-24-87.

CIBA-GEIGY Corporation

NPDES # NJ0004120: CIBA-GEIGY Corporation operates an organic chemical facility that manufactures synthetic organic pigments, organic dyestuffs and intermediates, and epoxy resins (SIC Codes: 2865 and 2815). The plant is located in Toms River, New Jersey, and discharges into the Atlantic Ocean. The outfall, which averages 4 to 5 mgd, consists of process wastes from dye and epoxy resin production, miscellaneous end use products, sanitary, and storm sewers. The wastewater treatment plant included equalization basins, a neutralization tank, and primary and secondary clarifiers with an intermediate aeration basin phase for oxygenation and bacterial action.

In May 1985, the New Jersey Department of Environmental Protection (NJDEP) issued a permit to CIBA-GEIGY that set whole effluent toxicity limits for its 10-mile long underground pipeline extending approximately two-thirds of a mile into the ocean at a depth of 45 feet below the ocean surface. The effluent is discharged through 50 discharge ports spaced over the last 1,000 feet of pipe. The permit established an interim whole effluent toxicity limit for the outfall of less than 50-percent mortality of mysid shrimp exposed to 5-percent effluent for 96 hours and a final toxicity limit for the outfall of 50-percent effluent. By July 1, 1986, the permit required CIBA-GEIGY to conduct a toxicity reduction study and to submit a plan for how the plant would met the interim and final whole effluent limitations.

By the effective date of the permit, CIBA-GEIGY had conducted preliminary screening tests, prioritized and reduced identified in-plant wastewater sources of contaminants, and conducted bench scale end-of-pipe treatability tests. Since a wide variety of potential contaminants enter the treatment plant, the key issue was to determine the type of treatment that would work best under many conditions and to reduce the likelihood that biological treatment would be adversely affected by large doses of toxicity.

Bench scale end-of-pipe treatment options included powdered activated carbon in activated sludge (PACT), grandular activated carbon (GAC) adsorption, ozonation in pretreatment, interstage treatment, and post-treatment configurations, and anaerobic pretreatment. PACT was determined to be the most technically feasible alternative to meet both the interim and final toxicity limitations in the 1985 permit.

Existing equalization tanks were replaced with larger, covered tanks to equalize the concentrations of the contaminants before they enter the biological treatment system. Aeration basin biological action was also improved by addition of PACT, as

indicated by the batch studies. Furthermore, in-plant management practices that reduced the loss of toxic compounds to the wastewater treatment plant were implemented.

CIBA-GEIGY currently meets interim toxicity limits and is expected to meet final toxicity limits.

Sources:

1. Huff, G., and S. Schexnailder. 1988. "Toxicity Reduction at Toms River". Poll. Eng. 20:98-100.

2. Quarterly Reports of CIBA-GEIGY Corporation of the Effluent Toxicity Reduction Program. Inception through June 1986.

3. Series of letters, memoranda, and reports in files of New Jersey

7/26/88
American Tobacco Company

NPDES # NC0003328: American Tobacco Company is a tobacco stemming and redrying plant (SIC Code: 2141) located in Reidsville, North Carolina. Discharge includes any combination of boiler blowdown, once-through cooling water, cooling tower bleed-off, air washers water, softener backwash water, and soot spray water. There is no treatment of the plant wastewater. The outfall flows into the unnamed tributary to Wolf Island Creek, with a 7Q10 (low flow) = 0.00 cfs. The permitted flow of the outfall is 0.065 mgd, and the resultant calculated instream waste concentration (IWC) = 100.00 percent. The date of issuance of the latest permit was December 1, 1985. Chemical-specific effluent monitoring requirements in the permit were in place for chromium and zinc, and limitations existed for conventionals.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at the instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of American Tobacco, the instream waste concentration was determined to be 100.00 percent. Since the effluent exhibited acute toxicity, toxicity reduction was necessary. The toxicity problem was identified prior to April 1987. A biocide used in the cooling towers was suspected of contributing to the toxicity of the cooling water bleed-off.

In September 1987, American Tobacco Company submitted a plan of action, prepared with the aid of the consulting firm Russell and Axon, to the Department of Natural Resources and Community Development (DNRCD). To determine the cause of the cooling water toxicity, American Tobacco would conduct a series of static toxicity tests while controlling for chlorine sources on different "make-up" cooling water samples, and TTO scans would be conducted on all of the samples. The toxicant could then be identified. Russell and Axon also found and have repaired a potable water line leak which was causing high chlorine residuals.

American Tobacco proposed in early April, 1988 to change the cooling water biocide to Chemtreat CL-1461 (trichloro-s-triazine

trione, a slow release chlorine doner) which the Company considers as a nonbiocide additive. In subsequent effluent toxicity tests conducted in April and May, no acute mortality was observed in 90-percent effluent. American Tobacco has also passed its chronic limits through September, 1988.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Athol Manufacturing Company

NPDES # NC0036846: Athol Manufacturing, located in Butner, North Carolina, produces various plastics products, particularly coated fabrics that are not rubberized (SIC Code: 2295). Outfall #004 discharges the wastewater from the building floor drainage to an unnamed tributary to Picture Creek in the Neuse River Basin, which has a 7Q10 (low flow) = 0.00 cfs. The calculated instream waste concentration (IWC) for outfall #004 = 100.00 percent. The facility does not treat its wastewaters.

The date of issuance of the latest permit was December 1, 1985. Permit effluent monitoring requirements were set for chlorine and zinc. The permit was issued with requirements for chronic toxicity testing annually on outfall #004. The permit chronic limit is set at 99-percent effluent.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of Athol Manufacturing (004), the instream waste concentration was determined to be 100.00 percent. Since the effluent failed the pass/fail test, toxicity reduction was necessary to bring the effluent into compliance with the permit conditions. The incoming city water also failed the chronic test, probably because of the high chlorine levels.

To overcome the toxicity problem, Athol Manufacturing proposed in January 1988 to close off outfall #004 and tie it into the closed loop cooling system that already serves the rest of the factory. While this approach does not strictly identify the toxic components of the effluent, it does achieve effluent toxicity reduction.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Town of Columbus WWTP

NPDES # NC0021369: Wastewater treatment for Columbus WWTP (SIC Code: 4952), located in Polk County, North Carolina, includes an aeration lagoon, secondary clarifier, and effluent chlorination facilities. The outfall flows into an unnamed tributary to White Oak Creek in the Broad River Basin, which has a 7Q10 (low flow = 2.1 cfs). The permitted flow of the outfall is 0.8 mgd, and the resultant calculated instream waste concentration (IWC) = 37.08 percent. The latest permit was issued on August 13, 1987. Monthly monitoring requirements and effluent limits were set for residual chlorine, phosphorus, and conventional pollutants.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the pass/fail chronic test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

Toxicity tests conducted in July, 1987 exhibited LC_{50}s of 74-percent effluent and 8-percent effluent for fathead minnows and Daphnia pulex, respectively, and an NOEC of 2-percent effluent for Ceriodaphnia dubia. Therefore, toxicity reduction was necessary. North Carolina DNRCD established both a chronic and an acute toxicity limit for the Columbus WWTP. It was suspected that the extreme acute toxicity of the undiluted effluent could present a risk to aquatic life even if effluent diluted to the IWC did not pose a chronic risk. Therefore, an acute limit of 90-percent effluent was recommended (2/1/86).

Milliken and Company's Hatch Mills Plant wastewater represented 90 percent of the influent to the Columbus WWTP. The influent acute toxicity to Daphnia magna was found to be less than 1 percent and was suspected to be responsible for treatment plant whole effluent toxicity.

In May 1987, Burlington Research, Incorporated (BRI) presented a proposal to identify the toxic component of the Hatch Mills Plant wastewater. To determine the toxic component of an effluent, BRI removed different fractions of the whole effluent and tested the

toxicity of the remaining fractions. When the whole effluent toxicity is significantly reduced, the removed fraction is the primary suspected cause of the toxicity.

Solid phase extraction, which removes nonpolar organics such as industrial solvents, significantly improved the toxicity characteristics of the effluent. This suggested that the toxic fraction consisted primarily of nonpolar organic chemicals.

The next step was to screen the process chemicals used by the Hatch Plant to identify those less biodegradable compounds that might be responsible for pass-through toxicity. The two groups of identified compounds were (1) alkyl phenyl ethoxylates (APEs) (48-hour LC_{50} Daphnia pulex; 12.5 mg/l) which have potentially toxic metabolites as well, and (2) benzyl trimethly ammonium chloride (BTMAC) (48-hour LC_{50} Daphnia pulex; 11.9 mg/l). BRI conducted an FTIR scan on the non-ionic surfactant extract (CTAS), which indicated high levels of APEs in the Hatch Mills wastewater.

A stepwise linear regression analysis indicated a significant correlations between whole effluent toxicity and both BTMAC and Hatch Mills Plant flow for all but two of the nine months of the study. While the results further indicated that the Hatch Mills Plant nonpolar organic chemicals may have been responsible for the whole effluent toxicity, the two months when correlations were not apparent indicated that the effluent toxicity could also be affected by other components of the wastewater. Highly toxic BTMAC metabolites or unidentified influent streams and/or chemicals were suspect. Furthermore, given the highly cationic nature of the BTMAC component of the Hatch Mill wastewater, increased use of cationic polymer by WWTP personnel during those months may have resulted in discharge.

While these chemicals are suspected, further work needs to be conducted to remove toxicity.

Sources:

1. "Town of Columbus WWTP TRE Phase I Report". 1987. Burlington Research, Inc.

2. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Croft Metals, Incorporated

NPDES # NC0035530: Croft Metals, located in Lumber Bridge, Robeson County, North Carolina, produces nonferrous aluminum extrusion ingot, vinyl plastics, injection nylon molded parts, and aluminum building products (Secondary smelting, refining nonferrous, SIC Code: 3341). Outfall #001 has a physical-chemical wastewater treatment system consisting of a collection sump, two batch treatment tanks, a sludge holding tank, and a plate and frame filter for the sludge. Outfall #002 is an extended aeration package type plant consisting of aeration tanks, a settling tank, a sludge holding tank, a chlorine contact chamber, and a post-aeration chamber. An industrial wastewater treatment plant is being constructed for outfall #003.

The outfall flows into Big Marsh Swamp after mixing with the Design Technologies outfall. Big Marsh Swamp has a 7Q10 (low flow) of 0.20 cfs and the resultant calculated instream waste concentration (IWC) = 42.00 percent. The latest permit, issued on January 7, 1988, set chemical-specific limits for cadmium, chromium, copper, lead, nickel, zinc, silver, cyanide, and conventional pollutants, and established monitoring requirements for aluminum.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

After identifying a whole effluent toxicity problem, it was determined by Department of Natural Resources and Community Development (DNRCD) that the Croft permit should be modified to include chronic Pass/Fail toxicity testing. October 1987 test results on the effluents from both Croft and DTI, an adjacent facility discharging into the Croft wastewater treatment plant, and on the combined effluent indicated failure in all cases. Consequently, by December 1987, a closed loop system was proposed by DTI for reusing a large percentage of DTI wastewater. Croft

reported, in early January, that the closed loop system for DTI was 98 percent complete. Furthermore, DTI ordered different chemicals for use in the wastewater treatment system. Toxicity data for 1988 have not yet been reported to the DNRCD.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
City of Fayetteville Cross Creek WWTP

NPDES # NC0023957: Fayetteville Cross Creek WWTP (SIC Code: 4952) is located in Cumberland County, North Carolina. Wastewater treatment consists of spiral effluent screw pumps, grit chambers, pure oxygen activated sludge process, clarifiers, tertiary sand filters, and post-chlorination. The outfall flows into the Cape Fear River, which has a 7Q10 (low flow) of 657.0 cfs. The permitted flow of the outfall is 22.00 mgd, and the resultant calculated instream waste concentration (IWC) = 4.93 percent. The date of issuance of the latest permit was May 5, 1988. Chemical-specific monitoring requirements were set for the priority pollutants and additional monitoring for cadmium, chromium, nickel, lead, zinc, and cyanide.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of Fayetteville Cross Creek WWTP, the instream waste concentration was determined to be 4.93 percent. The permit chronic limit was initially set for 4.9 percent, which the effluent passed in July and September 1987. However, in December 1987, the chronic limit was lowered to 3.6-percent effluent, per pending Judicial Order of Consent. In January 1988, Cross Creek WWTP failed the chronic test at 4.0-percent dilution. Test failure was attributed to continuous dosing of cationic polymers to secondary clarifiers to control effluent suspended solids. Addition of polymers to clarifiers were stopped in February. The quarterly chronic pass/fail tests conducted through January, 1988 were passed at 3.6-percent effluent.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Halstead Industries, Incorporated

NPDES # NC0035173: A facility of Halstead Industries, Incorporated, Halstead Metal Products is located in Pine Hall, Stokes County, North Carolina. The company rolls, draws, and extrudes copper (SIC Code: 3351). Wastewater treatment consists of a bar screen, aeration basin, dual clarifier, dual return sludge, disinfection unit, and a reaeration chamber. The outfall flows into an unnamed tributary to the Dan River, which has a 7Q10 (low flow) = 0.075 cfs. The permitted flow of the outfall is 0.025 mgd, and the resultant calculated instream waste concentration (IWC) = 34.05 percent. The date of issuance of the latest permit was June 1, 1987.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of Halstead Metal Products, the instream waste concentration was determined to be 34.05 percent. Since the effluent failed the chronic pass/ fail test of the latest permit at 34 percent, toxicity reduction was necessary. The effluent in June, July, and August of 1987 was acutely toxic to Ceriodaphnia dubia at concentrations of 6.48, 10.9, and 15.99 percent, respectively.

Halstead Metals contracted Burlington Research, Incorporated (BRI) to determine the cause of the toxicity problem. BRI conducted a tour of the plant. The wastewater treatment plant operator informed BRI that there was an accumulation of granules, some of which were copper, at the influent and treatment basins and that it had been 7 years since the last cleanup of these granules. BRI also noticed an oil and grease surface film in the separator and the high use of hand cleaner by the employees.

Copper was suspected immediately. Over 12 months of data indicated that copper concentrations in the effluent consistently averaged above .5 mg/l, with a low of .436 mg/l and a high of 1.931 mg/l. This high level is in marked contrast with EPA criteria document copper concentrations, which have an impact on aquatic life and can be as low as .007 mg/l.

BRI conducted metals analysis on a weekly basis on well water, water taps, influent, and effluent. It found that influent concentrations exceeded effluent concentrations by 1.4 to 1.9 fold and that effluent concentrations of copper exceeded LC_{50} concentrations for Ceriodaphnia dubia and Daphnia magna. Zinc concentrations in the effluent were below but close to LC_{50} values for these two species.

In addition, the effluent was determined to have high oil and grease levels. While oil and grease degradation products may cause a toxicity problem, high levels were not suspected to cause the high degree of acute toxicity of the Halstead Metals effluent.

By June 1987, BRI reported on its progress in reducing and/or removing copper. Tests indicated that the best copper reduction was achieved on effluent aliquots adjusted to high pH (9 to 12). Copper was reduced by 92.2 percent, and the LC_{50}s of the pH adjusted effluent increased to greater than 90 percent. However, BRI also indicated that the .015 mg/l action level of North Carolina still would not be achieved under 7Q10 conditions, using this treatment technology.

BRI then applied lime to the aeration basin and to the clarifier and had solids pumped from the aeration basin. LC_{50} values were subsequently greater than 90 percent. BRI conducted EPA toxicity characterization bioassays that confirmed the contribution of metals and an oxidant to effluent toxicity. Minimal chemical usage at Halstead Metals indicates that chlorine, found in concentrations exceeding 32 mg/l, was the responsible oxidant. BRI concluded that copper and, to a lesser extent, zinc and chlorine were the primary contributors to effluent toxicity and that minor engineering modifications were necessary to reduce the levels of these compounds still further.

In March 1988, Halstead Metals provided the Department of Natural Resources and Community Development with a proposal by the consultant Applied Water Technology to evaluate the wastewater treatment technology at the Halstead Plant and to identify and evaluate alternative treatment technologies to reduce the identified toxic components in the effluent.

Sources:

1. "Halstead Metal Products TRE Phase III Report". 1987. Burlington Research, Incorporated.

2. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
City of High Point Eastside WWTP

NPDES # NC0024210: High Point Eastside WWTP (SIC Code: 4952) is located in Guilford County, North Carolina. Wastewater treatment consists of mechanical screening, grit removal, primary sedimentation using clarifiers, trickling filters, activated sludge, secondary sedimentation, sand filters, and flow measurement and recording. The outfall flows into Richland Creek, which has a 7Q10 (low flow): 1.00 cfs. The permitted flow of the outfall is 16.00 mgd, and the resultant calculated instream waste concentration (IWC) = 96.11 percent. The latest permit, issued on September 1, 1987, set chemical-specific limitations for total chromium, cadmium, lead, and nickel. It also established monitoring requirements for copper, zinc, and priority pollutants, and additional monitoring for copper and zinc.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of High Point Eastside WWTP, the instream waste concentration was determined to be 96.11 percent. Therefore, the chronic limit adopted into the permit of September 1, 1987, was 96 percent. As the WWTP effluent was consistently acutely toxic to Daphnia pulex from 1985 to 1987 and failed the chronic toxicity pass/fail test, whole effluent toxicity reduction was necessary.

Using the EPA Toxicity Characterization Bioassay Procedure, Burlington Research, Incorporated (BRI), attempted to determine the chemical component responsible for the effluent toxicity. Unfortunately, the baseline effluent sample (untreated, 100-percent effluent) was not toxic relative to control water. However, it appeared that the "toxic" fraction might have been degradable or volatile (and, therefore, most likely organic), because the test organisms exhibited a greater reproduction rate in the degraded effluent samples than in the baseline samples. This difference was not statistically significant.

In February 1988, the class of non-ionic surfactants identified by BRI as a major contributor of toxicity was reportedly eliminated. The facility was considered in noncompliance until the effluent toxicity test was passed.

By mid-March 1988, High Point had banned industrial user discharge of chlorinated hydrocarbons, alkyy phenols, and phthalate esters. The city received no objection to banning of chlorinated hydrocarbons or alkyl phenols, but received objections about banning phthalate esters. The Department of Natural Resources and Community Development would not object to removal of the city's ban on phthalate esters.

While High Point WWTP effluent failed the chronic pass/fail toxicity tests from September 1986 to December 1987, it has passed the toxicity tests in both March and May of 1988.

Sources:

1. "City of High Point Eastside WWTP TRE Phase I Report". 1988. Burlington Research, Incorporated.

2. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Town of Jefferson WWTP

NPDES # NC0021709: Jefferson WWTP (SIC Code: 4952) is located in Ashe County, North Carolina, which receives and treats both domestic wastewater and process effluents from three industries. The outfall flows into Naked Creek, which has a 7Q10 (low flow): 2.8 cfs. The permitted flow of the outfall is 0.15 mgd, and the resultant calculated instream waste concentration (IWC) = 7.65 percent. The latest permit was issued on July 1, 1987.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In the case of Jefferson WWTP, the instream waste concentration was determined to be 7.65 percent. Since the effluent failed the 8.0-percent dilution pass/fail test written into the permit, toxicity reduction was necessary.

Burlington Research, Incorporated (BRI) conducted a toxicity reduction evaluation between December 1986 and January 1987. Because the chemical composition of the WWTP effluent exhibited wide variations in acute toxicity, BRI did not attempt to identify the toxic components of the effluent. Instead, the primary goal was to determine the best treatment for reducing the overall toxicity of the WWTP effluent.

Chemical analysis of a composite sample of the effluent revealed several compounds in either or both of the samples that were at levels high enough to account for the acute toxicity. These compounds included anionic surfactants (MBAS), nonionic surfactants (CTAS), zinc, copper, lead, and ammonia nitrogen. Several other compounds detected at concentrations below toxic concentrations may have been contributors to overall whole effluent toxicity. These compounds included arsenic, cadmium, mercury, chloroform, methylene chloride, and 1,1,2,2-tetrachloroethane.

Laboratory effluent toxicity reduction experiments were then conducted to find an effective treatment for reduction of effluent toxicity to a level that would meet the interim goal established by the Department of Natural Resources and Community Development (DNRCD) for the plant of 50-percent mortality or less of

Daphnia magna exposed to 90-percent effluent. Extended bio-treatment of both 13 and 25 hours effectively reduced effluent toxicity to meet the interim goal. In a subsequent study, BRI found that 13 hours of extended biological treatment also rendered the effluent nonchronically toxic to test organisms at effluent concentrations even considerably greater than the permit limitation.

BRI speculates that alkyl phenols, and not metals (at least, as individual compounds), were responsible for effluent toxicity. Volatile organic com pounds are suspected, given the extreme variation in acute static LC_{50}s during warm and cold periods of the year.

BRI recommended, among other items, reduction of alkyl phenol ethoxylate use, equalization of wastewater influents, and nutrient enhancement for aeration basin sludge. Any additional effluent toxicity reduction studies were recommended to be conducted after a new WWTP was on-line.

Sources:

1. "Town of Jefferson WWTP Two-phase TRE". 1987. Burlington Research, Incorporated.

2. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

6/13/88
Mt. Airy Wastewater Treatment Plant

NPDES # NC0021121: Mt. Airy wastewater treatment plant, in Mt. Airy, North Carolina, has a permitted flow of 4 mgd and serves a population of 7,500. The plant also serves 14 textile plants, which comprise 80 percent of the plant's total flow. The Ararat River (30Q10 = 64 cfs; 7Q10 = 16 cfs) receives the Mt. Airy discharge. As a result of an instream waste concentration (IWC) greater then one percent (IWC = 32 percent) and acute toxicity found in the effluent (48-hour static acute toxicity tests using Daphnia pulex - LC_{50} = 46 percent), Mt. Airy was required by Administrative Order (March 1986) to perform a Toxicity Reduction Evaluation.

Subsequent upstream and downstream benthic studies showed Mt. Airy to be the only source of toxicity in that part of the Ararat river. Extensive chemical analysis provided a list of suspect chemicals. Fractionation and mock effluent studies (48-hour static acute toxicity test using Daphnia pulex) showed the toxicity to be caused by surfactants, alkyl phenols, free oils and greases, copper, zinc, chloroform, dimethyl phthalate, and bis-2-ethylhexyl phthalate.

To abate effluent toxicity, Mt. Airy imposed a ban on the following substances: Chlorinated Hydrocarbons - Trichlorobenzene, Ortho, Meta, and Perchlorotoluene, Chloriform, 1,1,1-Trichloroethane, Dichlorobenzene, Perchloroethylene, and any chlorinated aromatic or aliphatic molecules; Phthalate Compounds - Dimethyle Phthalate, Bis-2-ethylhexyl Phthalate, and any other Phthalic Ester Compounds, aromatic or aliphatic; and Alkyl Phenol Compounds - Alkyl Phenol, Ethylene oxide sufactants, Styrene, Phenol Ethoxylates, and Nikyl Phenols when R=1-18 carbon atoms. In addition to the ban, Mt. Airy has adopted local limits on both copper and zinc for nondomestic users.

Subsequent permit limits (permit reissuance April 1987) require Mt. Airy to meet a chronic No Observed Effect Level (NOEL) of 32 percent or greater. DMRs show toxicity to have been reduced but not eliminated.

Source:

1. "Toxicity Reduction Evaluation at the Mt. Airy Wastewater Treatment Plant". Science Applications International Corporation, McLean, VA. August 1987.

7/26/88
New Minnette Textile Company

NPDES # NC0004235: New Minnette Textile Company in Grover, North Carolina, is a textile dyeing and finishing plant (SIC Codes: 2211, 2221, 2261, and 2262). Wastewater treatment consists of extended aeration and sludge drying beds. The outfall flows into Lick Branch, which has a 7Q10 (low flow) of 0.2 cfs. The permitted flow of the outfall is 0.625 mgd, and the resultant calculated instream waste concentration (IWC) = 78 percent. The wastewater is 5-percent domestic and 95-percent industrial. Industrial wastewater was used in the dyeing operation.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration.

The North Carolina Department of Natural Resources and Community Development (DNRCD) submitted a toxicity study report during October 1986 indicating that the effluent was chronically toxic at concentrations as low as 3.16 percent, though the low flow IWC dilution for the effluent is 78 percent. Toxicity reduction was necessary. Copper, zinc, chlorine, formaldehyde, aluminum, mercury, lead, and phenol levels were high.

In October 1986, Burlington Research, Incorporated (BRI), also submitted a report indicating that the influent sludge of metal contaminated solid waste was suspected of contributing to the effluent toxicity. BRI recommended that a floating weir be installed to improve treatment plant operation.

In April 1987, BRI submitted a report including characterizations of the Minnette Mills effluent and Grover Industries influent (an adjacent yarn and dye manufacturer). The effluent was found to contain anionic and nonionic surfactants, zinc, copper, cadmium, lead, and ammonia nitrogen in concentrations toxic to aquatic organisms.

BRI recommended that (1) exact measurements of chemicals should be used for all applied chemicals at the plants to minimize overusage without adversely affecting production, (2) surfactants used should be biodegradable, not branched alkyl phenol ethoxylates, and (3) chemical suppliers of biocides used in cooling systems should be contacted to determine toxicity of available coolants, and bioassay analysis, using Ceriodaphnia (acute tests), should be conducted on fractionated effluents.

By April 1988, Minette Mills reported that salt usage had been reduced by 25 percent, that an effluent flow suppressant had been installed to assure continuous effluent flow out of the aeration lagoon, that the contact chamber was being cleaned on a regular basis to prevent sludge accumulation, that sludge drying beds had been installed, and that a plant chemist was investigating alternative dye chemicals not containing problem metals.

The reported results from toxicity tests do not yet show improvement since the changes at the treatment plant occurred only recently.

Sources:

1. "Minnette Mills TRE Phase II Report". 1987. Burlington Research, Incorporated.

2. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
Lithium Corporation of America

NPDES # NC0005177: Lithium Corporation, located in Bessemer City, North Carolina, is a chemical manufacturing plant specializing in lithium carbonate production. The company has two domestic water treatment facilities, one of which consists of influent screening, aeration basin, clarifier, and an aeration sludge digester. The other facility comprises an aeration basin, a clarifier, and a chlorine disinfection system. The discharge from both domestic facilities flows along with process wastewater to a polishing lagoon and is discharged through one outfall. The outfall flows into an unnamed tributary to Abernathy Creek, which has a 7Q10 (low flow) of 0.20 cfs. The permitted flow of the outfall is 0.615 mgd, and the resultant calculated instream waste concentration (IWC) = 82.65 percent. The most recent permit modifications, of June 2, 1988, set monitoring requirements for copper and for conventional pollutants, and it established permit limitations for selenium.

When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

Preliminary onsite toxicity test results reported in September 1987 indicated that 21 percent of the effluent was acutely toxic (48 hour LC_{50}) to Ceriodaphnia and that the No Observed Effect Level (NOEL) was 1.0 percent effluent. The effluent was predicted to be acutely toxic instream, under average flow conditions, to organisms with similar sensitivity to Ceriodaphnia dubia. As the IWC at the 7Q10 is 82.7 percent, toxicity reduction was necessary. The effluent had high chlorine levels (.05 to .09 mg/l).

In February 1988, Lithium submitted a report. Toxicity tests were performed on 17 in-plant samples found three wastestreams more toxic than the pond effluent. The three wastestreams were from hypochlorite scrubber, Lithium chloride condensate, and metal washout. Chemical analyses of these wastestreams indicated high levels of chloride, sulfate, lithium, sodium, and available chlorine. The report stated that chlorine was not suspected as a

significant contributor to the effluent toxicity. Lithium is suspected as being a major cause of toxicity, but toxicity data on lithium toxicity are scarce.

Lithium is in the process of reducing the levels of lithium, chloride, and residual chlorine. Lithium salts are being reduced fro the discharge wash water from the metal curcuit. Chlorine and other solids are being reduced by a process modification to the hypochlorite curcuit which will recycle solids that would otherwise be dischargd to the polishing pond.

Lithium Corp. will be required to perform monthly monitoring of its discharge and will have until March 1991 to meet a chronic pass/fail test for 83% effluent.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

7/26/88
West Point Pepperell-Lumberton

NPDES # NC0004618: West Point Pepperell-Lumberton in Robeson County, North Carolina, is a textile operation specializing in knit fabric finishing (SIC Code: 2259). Wastewater treatment for plant process wastewater (Outfall #001) consists of an extended aeration process with a bar screen, an aeration basin, dual clarifiers operated in parallel, two 5-acre polishing ponds in series, and a wire belt filter press sludge dewatering unit. This facility also has influent and effluent pumps and flow measurement, nutrient addition (ammonia), and hydrogen peroxide addition. The outfall flows into the Lumber River, which has a 7Q10 (low flow) of 128.0 cfs. The permitted flow of the outfall is 2.50 mgd, and the resultant calculated instream waste concentration (IWC) = 2.9 percent. The date of issuance of the latest permit was July 1, 1988. Effluent limitations exist for chromium, sulfide, and conventionals, and monitoring requirements are set for copper, zinc, nitrogen, phosphorus, and priority pollutants.

North Carolina has whole effluent toxicity limits specific to the effluent flow: dilution flow relationships for each discharge. When the effluent is not substantially diluted by the receiving stream low flow (7Q10), chronic limits are instituted. If the instream waste concentration, which is the effluent flow divided by the receiving water flow (expressed as a percentage), exceeds 1 percent, or a dilution of 1:100, the Ceriodaphnia Pass/Fail test must be passed. This test is conducted at one dilution of effluent: the IWC. Passing the test means that there is no observable inhibition of reproduction or significant mortality at that instream waste concentration. Typically, the effluent must pass the chronic test quarterly on specified months.

In view of a pending visit by North Carolina's mobile laboratory, West Point Pepperell-Lumberton provided toxicity test results in February 1986. They indicated that the effluent was acutely toxic to fathead minnows (48-hour LC_{50}) between 86- and 100-percent effluent and acutely toxic to daphnia magna at 73.5-percent effluent. Toxicity reduction was necessary, given that the interim target level was LC_{50} responses at or above 90-percent effluent.

West Point Pepperell-Lumberton's comparisons of influent to effluent toxicity revealed that wastewater treatment was not removing toxicity. Benthic macroinvertebrate community analysis indicated that the effluent had significant impacts downstream.

It was not known whether those impacts were the result of long-term chronic impacts or short-term slugs of acutely toxic effluent. The Division of Environmental Management confirmed the findings of West Point Pepperell-Lumberton.

In August 1987, West Point Pepperell-Lumberton summarized its toxicity reduction efforts. Extraction results led the company to suspect that zinc, a constituent of many of the chemicals used at the plant, was a primary cause of effluent toxicity. The facility planned to substitute zinc-based products with others.

Since August 1987, West Point Pepperell-Lumberton has reported success in meeting the interim acute toxicity target of LC_{50} > 90-percent effluent. It appears that the company also meets the chronic limit.

Source:

1. Series of letters, memoranda, and reports in files of North Carolina Department of Natural Resources and Community Development. State Contact: Lee Gable (919) 733-5083.

6/13/88
Avtex Fibers, Incorporated

NPDES # VA0002208: Avetex Fibers, Incorporated, located in Front Royal, Virginia, produces rayon, using the viscose process, and polypropylene fibers (SIC Codes: 2823 and 2819). The manufacture of polypropylene fibers produces no wastewater. The manufacture of rayon involves the use of caustic soda, carbon disulfide, sulfuric acid, and zinc sulfate. Process waste treatment includes neutralization, clarification, polishing basins, and secondary biological treatment. The treatment system discharges 11 mgd of effluent into the South Fork of the Shenandoah River (7Q10 = 156.4 mgd; IWC = 8.8 percent). Additional waste streams discharged from this facility include 1.7 mgd from fly ash retention basins and 2.4 mgd of storm water/cooling water. Effluent guidelines limitations for the Organic Chemicals, Plastics and Synthetic Fibers industry provide Best Practical Technology (BPT) limitations for pH, BOD_5 and TSS. The guidelines also provide Best Available Technology (BAT) limitations for a list of 63 toxic pollutants common to this industrial group. The current NPDES permit limits pH, temp, TSS, BOD, Pb, and Zn for the outfalls showing toxicity.

Biological toxicity testing by the Virginia State Water Control Board indicated toxicity. Fractionation studies (Phase I), performed by the EPA Environmental Research Laboratory in Duluth (ERL-D) in January 1986 showed toxicity to be non-organic and water soluble. A chelating agent (EDTA) added to 100-percent effluent indicated the toxicant to be metal(s). Metals analysis revealed concentrations of zinc over 1000 ug/l; all other metals were less than detection limits.

Phase II confirmed zinc by showing a correlation between observed toxicity and concentrations of Zn from the outfall samples. A second toxicity test, using Ceriodaphnia and fathead minnows, showed a higher LC_{50} in the more Zn-resistant fathead minnow. Additional confirmation was achieved by spiking a set of samples to equivalent concentrations of Zn and then testing the samples on the more Zn-resistant fat minnow. The tests showed similar results from all of the samples.

A definitive phase III was recommended but not performed by EPA ERL-D.

Additional effluent bioassays conducted by the Virginia State Water Control Board, Virginia Polytechnic Institute and State University, and EMPE, Incorporated, have produced results inconsistent with EPA ERL-D. The Virginia State Water Control Board has, therefore, required Avtex Fibers, Incorporated, to

perform a more definitive Toxicity Identification Evaluation/Toxicity Reduction Evaluation. The current schedule calls for this work to be completed by the Spring of 1990.

Sources:

1. Letter from Don Mount, Senior Research Scientist, EPA ERL-D, on the test results of Avtex Fibers, Incorporated, effluents. March 5, 1986.

2. "Wastewater Toxicity Reduction Evaluation Plan for Avtex Fibers, Inc., Front Royal, Virginia". April 1987. Prepared by EMPE, Incorporated, Consulting Engineers, Nashville, TN.

3. NPDES Permit Fact Sheet. April 1988.

6/21/88
Virginia Chemical Company

NPDES # VA0003387: Virginia Chemicals, Incorporated of Portsmouth, Virginia, discharges into the Elizabeth River. Virginia Chemicals produces alkyl amines by amination of alcohols and alkylchlorides. Sodium bisulfite and sodium sulfite are also produced by reacting sulfur dioxide and water with sodium carbonate and sodium hydroxide. Other operations include formulation of sodium hydrosulfite with sodium hydroxide and sodium bisulfite, and the packaging of the insecticide, Vapona and pyrethrins, into aerosol containers. Virginia Chemicals has two SIC Codes 2869 for industrial organic chemicals and 2819 for industrial bulk inorganic chemicals.

Virginia Chemicals discharges an average flow of .7 mgd and includes most, if not all, of the contact wastewater discharge. Waste treatment facilities include extended aeration for two amines equipment wastewaters, steam stripping for one of the amines equipment wastewaters, and chemical addition, aeration, and settling for all plant wastewaters.

One year prior to the permit expiration date of September 19, 1985, the Virginia State Water Control Board, issued an NPDES permit special condition to Virginia Chemicals. Among the conditions, the 48-hour Mysid and the 96-hour Sheepshead minnow acute toxicity tests were to be conducted on the effluent every 2 months. Static Daphnia magna acute toxicity tests conducted in both January and May 1985 and fathead minnow results indicated acute toxicity. The Toxicity Reduction Evaluation (TRE) was initiated on April 8, 1985. In August 1985, toxicity tests on the fractions were conducted.

Using the 48-hour Daphnia magna acute toxicity test, the acid and base neutral organic subfractions were found to have the greatest toxicity, resulting in LC50 responses at concentrations as low as 2.56 percent and .53 percent, respectively.

While the fractions responsible for the toxicity were identified, the sources of the toxic organic material also needed to be determined. The two influent streams, tested individually, exhibited toxicity substantially lower than final effluent toxicity. Furthermore, when they were combined at a ratio representative of the final effluent, the "reconstituted" final effluent was also less toxic than the actual effluent. These results indicated the possibility of other sources of toxicity in

the holding pond, which might include the chemical interactions among the constituents, entering of contaminated ground or surface water, or leaching of holding pond sediments of contaminants from previous discharges.

The next step in the TRE phase I investigation was to identify the specific chemical components of the toxic fractions of the effluent. Gas Chromatography (GC)-Mass Spectrometry (MS) identified insignificant amounts of EPA priority pollutants in the organic fraction, but many non-priority pollutants in the effluent. Aniline and N-nitroso-dibutylamine were found in the organic fraction at concentrations of 7 and 4 ug/l, respectively. It was concluded that the toxicity of these two compounds needed to be evaluated. Within the acid fraction, butoxy butanoic and dichlorobenzoic acid were identified and thought to be potentially toxic. In the base/neutral fraction, two amines saturated the detector system: N-cyclohexanamine and alkyldiamine MW 172. Dichlorvos, a pesticide packaged at the plant, and tris [2-butoxy-ethyl] phosphate were also identified. In total, 29 organic chemicals were identified: 23 base/neutrals and 6 acids.

Toxicity data for only two chemicals, 2-methyl-N-(2-methy-propyl-)-1-propanamine and dichlorvos, could be located. Dichlorvos toxicity test results were available for nine species; six of which exhibited LC_{50}s at or below .5 ug/l. August 1985 effluent concentrations of dichlorvos were estimated at 60 ug/l. This finding was fortunate. If dichlorvos were not found in toxic concentrations in the effluent, toxicity tests might have been conducted on each of the 29 organic chemicals identified in the effluent to determine the toxic components.

On December 1, 1985, both the Pesticide Formulating and Packaging Plant and the #1 Amines Plant were shut down. While these actions do not appear directly related to the TRE, the result was a marked decrease in the only identified toxic component of the effluent, dichlorvos.

In late February 1986, toxicity tests were again conducted, using Daphnia magna, on the final effluent. The samples exhibited low dissolved oxygen. Both aerated and unaerated effluent samples were toxic with an approximate twofold increase in toxicity occurring after aeration. However, the organic fraction was not toxic, indicating that the major cause of toxicity in the previous effluent samples, perhaps dichlorvos, was eliminated.

The toxic fraction was, in this instance, inorganic. Recent toxicity test results indicate that, with the exception of a period in early 1988 when low temperatures killed the microbes in the biological treatment system, the effluent has not been acutely-toxic to Mysid shrimp and sheepshead minnows.

Sources:

1. Series of letters, memoranda, and reports in Virginia Chemical Company TRE file of State Control Board, Commonwealth of Virginia, Richmond Office. State Contact: Richard Ayers: (804) 367-0384.

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