Sub-Lethal TRE Study Plan
Outfall 003 – Central

Prepared for:

Great Lakes Chemical Company
Central Plant
2226 Haynesville Highway
El Dorado, AR 71730

Prepared by:

GBM® & Associates
219 Brown Lane
Bryant, AR 72022

May 4, 2010, Revision 2.0
1.0 INTRODUCTION

Great Lakes Chemical Company Inc., Central facility, (GLCC-Central) (Figure 1) was issued a modified National Pollutant Discharge Elimination System (NPDES) permit effective on August 1, 2008. As a condition of the permit, the facility was required to conduct chronic toxicity testing on multiple facility discharges including Outfall 003. Outfall 003 discharge is comprised predominately of storm water but also discharges other waters including; non-contact cooling water, roof drains, waters produced by freeze protection, boiler blow down, air conditioner drainage, cooling tower blow down and steam condensates. The critical dilution of the chronic WET testing is 100% effluent during the critical period (May-November) and 36% during the seasonal period (from December through April). Further, the NPDES permit required that if the 100% effluent concentration fails the lethality endpoint on a consistent basis (i.e., 100% effluent demonstrates toxicity in laboratory tests), the facility is required to conduct a Toxicity Reduction Evaluation (TRE) per Section 12.6 on Page 30 of Part III, Other Conditions.

However, the permit has no stipulation that requires additional TRE type activities to address the failure of sub-lethal endpoint as measured in the 7-day chronic WET testing (e.g. reproduction and growth). The current permit requires only that additional testing be completed should sub-lethal failures occur (Paragraph 12.5.c on page 30 of Part III).

In January 2010 (Letter dated January 12, 2010), ADEQ issued a directive to GLCC that it develop and submit a TRE plan to address sub-lethal WET test failures in Outfall 003 discharge that have been reported during the period from February 2005 through August 2009. The Sub-lethal TRE Plan (SUB-TRE) was due within 90 days of the notice and was to address the sub-lethal effects for Ceriodaphnia dubia. This document fulfills that requirement.

The discharge through Outfall 003 is discharged to an unnamed tributary of an unnamed tributary to Little Cornie Bayou, then to Little Cornie Bayou, and ultimately to the Ouachita River.
Aerial photography showing the approximate property boundary of Great Lakes Chemical Corporation Central Plant.

May 4, 2010
2.0 PURPOSE

The SUB-TRE is an evaluation intended to determine those actions necessary to correct and eliminate the sub-lethal WET test failures in effluent discharged through Outfall 003 by reducing an effluent’s effect or chemical concentration(s) to acceptable levels. A TRE is defined as a step-wise process that combines whole effluent toxicity (WET) testing and analyses of the physical and chemical characteristics of an effluent to identify the constituents causing WET test failures and/or determine the treatment methods which will eliminate the WET test failures.

The purpose of this SUB-TRE plan is to comply with the information demand letter issued by ADEQ. The SUB-TRE Plan provides an overview of the specific activities anticipated for the SUB-TRE, a general sampling plan, a quality assurance plan, project organization and a schedule for completing the SUB-TRE.

3.0 BACKGROUND

In accordance with GLCC-Central’s current NPDES permit, chronic toxicity testing is required on a quarterly basis. Previous actions related to the discharge from Outfall 003 includes; a TRE to address failures of the lethality endpoint of chronic tests. The results of this TRE were submitted to ADEQ on or about February 26, 2001 (Attachment 1). The results of the 2001 TRE implicated non-polar organics as the potential cause of the WET test failures in 100% effluent. Subsequent to the 2001 TRE, a comprehensive sampling and analyses plan was completed in an effort to identify and correct the sources of the non-polar organics and evaluate the discharge through Outfall 003 in relation to the site storm water. These investigations were submitted to ADEQ on or about July 2003 (Attachment2).

GLCC efforts to improve the discharge quality, reduce the contamination of storm water discharges, and manage site discharges resulted in the improvement of the WET tests performance as demonstrated by the history of the WET testing during the recent permit cycle where the Outfall 003 discharge PASSED the lethality endpoint of EVERY WET test during the past five (5) year period. During this permit cycle where there have been no failures of the lethality endpoint for either the fathead minnow or the water flea, and only a single sub-lethal (e.g. larval growth) test failure for the fathead minnow. Clearly, efforts to improve effluent water quality has improved WET test performance when compared to the historical WET test results reported during the 2001 TRE.
The effective NPDES permit for GLCC (AR0001171) requires the facility to conduct WET testing of Outfall 003 effluent on a quarterly basis, when discharging. The permit requires that toxicity tests be conducted using Ceriodaphnia dubia (water flea) and Pimephales promelas (fathead minnow) as test organisms. The required tests are 7-day chronic renewal and the critical effluent dilution is 100 percent (during the critical period) and 36 percent effluent (during the seasonal period). The permit requirement is a monitor and report requirement and does not constitute a WET permit limit but is a monitor and report requirement, only.

Based on a review of toxicity testing conducted since the effective date of the current NPDES permit, GLCC has demonstrated variable results depending on the test organism. As summarized in the ADEQ notification letter referenced above, the fathead minnow has passed the WET test routinely, with no lethal test failures and only a single sub-lethal test failure.

According to GLCC’s records, the fathead minnow has passed all endpoints since 2001 with the exception of the single test failure in January 2007 (passing the lethality endpoint at the appropriate critical dilution in 18 of 18 tests and 17 of 18 sub-lethal endpoints). This history indicates little potential for the discharge to demonstrate toxicity to the fathead minnow.

In contrast, the historical WET testing conducted on the water flea (Ceriodaphnia dubia) while variable, has failed the sub-lethal test endpoints. However, there have also been periods during the current permit cycle, where the water flea WET testing passed at the appropriate critical dilution, including 100% effluent. (Note: The summary of WET test results provided in the August 24, 2007 ADEQ request letter listed the 02-07 water flea test as a failure, however, this test was invalidated due to lab control failure. In addition, several of the sub-lethal test failures presented atypical dose response curves with NOECs reduced due to random variability in dilutions less than the critical dilution. These conditions often implicate that a natural pathogen/bacteria or native parasite adversely impacts the lab cultures utilized in the WET testing (See ATTACHMENT 3: Summary of historical WET tests Outfall 003). However, the detailed review of these historical results has not provided the information required to identify and correct the underlying cause of the sub-lethal test failures.

4.0 SUB-TRE APPROACH

4.1 SUB-TRE Objectives

The SUB-TRE will be completed to provide information to adequately address:

1) identification of the toxicant(s) or group of toxicants(s) that cause the failures of the sub-lethal endpoint of reproduction,
2) as possible, identify the most likely source(s) of the cause for the test failures,
3) results of treatability investigation, if required,
4) an evaluation of alternatives, either treatment or source reduction,
5) identify preferred alternatives to reduce sub-lethal test failures allowing compliance with sub-lethal WET permit requirements, and
6) a proposed schedule for compliance.

This will be accomplished by conducting a step-wise program of investigation that includes evaluation of facility practices and chemical usage, toxicity testing and analyses of physical/chemical effluent characteristics.

4.2 Approach

The basic approach to achieve the SUB-TRE objectives is outlined in the following sections. Sound scientific judgment will be employed at each step of the process. Given the historical WET testing results where the water flea has sporadically failed the WET testing sub-lethal endpoint of reproduction and the fathead minnow has demonstrated little potential for sub-lethal test failures, the focus of the sub-lethal TRE/TIE investigations will be the water flea.

Also, given the historical data, each specific activity may not be conducted in the order presented in this plan, nor will each activity necessarily be conducted if determined to be unnecessary to reach the TRE objectives. Furthermore, based on the facility history, it is possible that the sub-lethal WET failures exhibited historically will not be demonstrated at times during the initial identification and characterization. Should this occur, TRE activities would be suspended and the facility would return to monitoring as specified in the NPDES permit.

4.2.1 Toxicity Identification Evaluation (TIE) and Characterization

TIE manipulations associated with the identification and characterization portion of the SUB-TRE will be focused on the water flea since no toxicity to the fathead minnow (with the exception of the single test failure in January 2007) has been demonstrated in the historical WET testing of GLCC’s effluent, even at 100% effluent. As described in the Phase I TIE manual, the initial characterization will consist of multiple manipulations and will generally follow procedures described in EPA’s Phase I Characterization Procedures (EPA/600/6-91/003). Phase II and Phase III Characterization and Confirmation Procedures from EPA/600/R-92/080 and EPA/600/R-92/081 will be generally followed as warranted depending on results of the Phase I characterization step.
Examples of possible TIE manipulations include:

1) Degradation tests, designed to determine how toxicity changes (degrades) over time,
2) pH adjustment and graduated pH tests, used to determine the effect of pH adjustment on toxicity,
3) Filtration tests, to develop an association between toxicity and filterable materials,
4) Aeration/pH adjustment tests, to determine if toxicity is caused by oxidizable or volatile substances, including those that can be made to oxidize or become volatile through change in pH,
5) Solid phase extraction/pH adjustment tests, these manipulations are used to determine toxicity that can be attributed to non-polar-organic and metal chelate compounds (or those that can be made non-polar through pH changes),
6) Oxidant reduction tests, to determine if toxicity can be attributable to oxidents, and
7) EDTA chelation test, for evaluation of potential heavy metal toxicity.

4.2.2 Assembly of Pertinent Facility Information

Information associated with GLCC will be obtained and reviewed to assess the potential for facility materials or operations to cause or contribute to failures of the WET tests. As the TRE advances, the information obtained in this step will be relied on for more in-depth analyses. Informational categories include:

1) Facility configuration and process information: The general facility configuration, operational scenario’s, sources of wastewater, wastewater treatment system and general maintenance records will be obtained and reviewed to establish facility baseline and anticipated operating configuration and to assess whether operations could contribute to, or be used to mitigate effluent toxicity.

2) Facility chemical usage: MSDS sheets on chemicals used in the facility will be assembled and reviewed. Chemical use records will be examined and theoretical discharge concentrations of potentially suspect system additives will be calculated as warranted.

3) Facility sampling data: Monitoring information including NPDES outfall monitoring, facility process sampling or other data collected by the facility will be reviewed as needed to evaluate the potential to assist in the TRE process. Facility WET tests results and associated analytical data will be further reviewed.
4) Housekeeping and best management practices: Facility housekeeping and storm water pollution prevention records will be examined to evaluate their potential for effect on effluent toxicity. Similar to facility operating procedures, housekeeping and best management practices will be reviewed to evaluate opportunity for effluent toxicity mitigation.

4.2.3 Source Identification

Depending on the results of the facility data review, and in consideration of the results of the TIE and characterization process, the next step in the TRE process will likely be an evaluation of the various waste streams entering the treatment system. This step is designed to identify the specific source of toxicity to the final effluent. As warranted, this step may involve a more thorough review of the documents and information obtained as described in Section 4.2.3 or may include sampling, WET testing of internal waste streams and analyses of individual waste streams or process units. Source identification efforts can typically consist of the following steps, as described in EPA’s Generalized Industrial TRE Methods (EPA6002-88/070):

1) Setting initial source search from evaluation of previously collected data,
2) Collection of samples from influent (to treatment system) or selected storm water streams,
3) Development of chemical specific analyses for tracking sources,
4) Evaluation of treatment effects on identified toxicants,
5) Use of a bench scale model to simulate treatment plant degradation and track toxicity to source streams, and
6) Characterization of toxicity in suspect source stream.

4.2.4 Treatment Considerations and Chemical Optimization

The treatment consideration phase of the SUB-TRE will examine the operation and optimization of the wastewater treatment system. Facility operations and performance logs, design capacities and customary practices will be examined in conjunction with performance data obtained as described in Section 4.2.1 to assess the opportunity for operational adjustments to mitigate final effluent toxicity. Opportunities to correct final effluent toxicity will be carefully examined in light of the influent sources determined as described in Section 4.2.3. The information developed from evaluation of influent sources and treatment optimization is particularly useful when designing and implementing toxicity corrective actions whether the
action is source reduction or final wastewater treatment modification. Facility specific management practices, where warranted, will be written where it appears that the opportunity for operational adjustments may successfully meet TRE objectives.

An important component of the overall assessment of influent sources and treatment optimization involves a thorough understanding of the raw products and chemicals used in the plant. Additionally, chemicals exposed to storm water that reach the treatment system are of particular importance. A chemical optimization evaluation may be conducted in association with review of wastewater system.

4.2.5 Toxicity Reduction Method Evaluation

The selection process for choosing the toxicity reduction method or combination of methods that achieves the TRE project objective will consider a number of important factors including:

1) Probability of long term effluent toxicity reduction,
2) Cost,
3) Fit with long term facility goals,
4) Implementation and operational ease or complexity, and
5) Adaptability to changing regulations.

Potential solutions will be compared on a cost benefit basis considering these factors, and perhaps others as necessary. The solution that best fits the facility’s needs and will meet the SUB-TRE objectives will be selected for implementation.

4.2.6 Post Implementation Confirmation

GLCC will specify a post implementation monitoring schedule sufficient to confirm final effluent toxicity reduction as specified in the TRE Plan objective.

5.0 SAMPLING PLAN

5.1 General Statement and Methods

A sampling plan for conducting a SUB-TRE should be specific enough that there is confidence that the samples will be collected, handled, preserved and transported correctly so that
there will be a high degree of confidence on decisions made on the basis of those samples; yet the plan must be general enough to be modified as conditions warrant during the TRE.

For purposes of all routine samples, collection, preservation, containers, holding times and analyses will follow methods approved by EPA codified at 40 CFR Part 136, as amended. Toxicity testing completed for the TIE shall follow typical quality assurance guidelines as outlined in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters Using Freshwater and Marine Organisms (EPA, 1993). As warranted if metals toxicity is suspected, Clean Techniques Sampling following EPA Method 1669 will be conducted for samples subjected to metals analyses.

5.2 Basic Sampling Plan

Sampling shall initially be conducted for the Phase I TIE and associated permitted parameters from the final effluent only. Samples will be collected in the location used for NPDES permit requirement purposes. Samples for TIE WET testing shall be collected in the volume and containers required by the laboratory for completion of the Phase I characterization. Samples shall be collected by personnel wearing latex gloves in a manner designed to prevent sample contamination (e.g. modified clean sampling based on Method 1669). Samples shall also be collected concurrently for analysis of NPDES permit parameters. All samples collected for analyses of conventional parameters will be as allowed by the NPDES permit. Samples for metals collected using clean techniques sampling will consist of four equally spaced grab samples collected over an 8-hour period. Volumes to be collected will be calculated on a case by case basis in advance of the sampling event to ensure sufficient water is collected for all foreseeable TRE purposes. When there is question regarding sample volume, additional sample volume will be collected.

In addition to samples collected for analyses, in-situ measurements of physiochemical parameters will all be made. Multiple measurements will be obtained during the course of collection of composite samples where feasible. The parameters of dissolved oxygen, pH, conductivity, and temperature will be measured as described.

5.3 Confirmation Sampling

Should the Phase I toxicity testing identify a potential source of toxicity, the testing must be repeated using another set of effluent samples from a new sampling event. A minimum of two series of Phase I TIEs should be conducted to determine the potential source of toxicity. If the Phase I TIEs do not return similar results then additional sampling is required for completion
of additional Phase I toxicity characterization. All methods and procedures described in Section 5.2 Basic Sampling will be followed for identification confirmation sampling.

6.0 QUALITY ASSURANCE PLAN

Trained personnel will be conducting the sampling, toxicity testing and data analysis during the study. The laboratory conducting all analytical testing and toxicity testing shall be an ADEQ certified laboratory with experience in the respective areas. Records will be kept recording all samples collected, flows recorded, tests completed, and data analyzed. Field check sheets will be completed for days requiring multiple samples and multiple sampling locations to ensure that all necessary samples are collected. Notes will be made of any unusual observations occurring during each sample run such as water color changes, odors, and noticeable plant process changes. All record sheets, calibration logs, field notes, and other study documentation will be reviewed for completeness and accuracy by the Project Manager.

All samples collected will be placed in the appropriate clean containers supplied by the laboratory. Each sample container will be labeled with the sample I.D., date, time, and initials of collector(s). Samples will be placed in ice chests for delivery to the laboratory. Chain of Custody (COC) forms that include information on each sample delivered to the laboratory for analysis will be completed. Each COC form will be signed by each person handling the samples from collection in the field to receipt in the laboratory. The COC form will include all required information and will be checked for completeness prior to submission of samples to the laboratory.

Duplicate samples and field blanks for each analyte (other than toxicity testing) shall be collected at a minimum frequency of 10 percent of the samples collected for the entire study. A minimum of one duplicate sample and one field blank sample shall be collected during each sampling event.

Duplicate samples consist of a second sample taken immediately following the test sample from the same location to be used to measure variability in the test media and repeatability of the sampling techniques. Duplicate samples shall vary by no more than 20 percent relative percent difference (RPD) or the sample results will be considered suspect. In the event an RPD exceeds 20 percent, the Project Manager will investigate the incident to determine the cause of the exceedence and what action, if any, is necessary.

Field blanks will consist of a sample of ultra pure laboratory water poured into the appropriate sample container in the field to simulate all possible contaminant exposures. If a
field blank is found to be contaminated, by a chemical of concern, an analysis will be conducted to determine the potential impact of the contamination on the results of the associated batch of samples. The Project Manager will determine the appropriate course of action from the results of the analysis.

The laboratory will validate analytical data by use of blanks, laboratory controls, spikes, and spike duplicates. Laboratory blanks measure the amount of each respective analyte contributed from the analytical procedure. A laboratory blank is considered out of control for a specific analyte if the value exceeds the higher of either the minimum detection limit (MDL) or five percent of the measured concentration in the sample. A laboratory control measures the ability of the laboratory to recover an analyte from a blank matrix. The laboratory spike sample is used to evaluate the laboratory’s ability to recover an analyte in the sample matrix. The QC exceedence criteria for laboratory controls and spikes is based on upper and lower control limits derived from the laboratory’s method specialized limits. The laboratory spike duplicate is used to evaluate the laboratory’s precision (ability to attain similar analytical results from duplicate samples). A relative percent difference (RPD) is calculated for the spike and spike duplicate. The RPD is compared to method specialized limits to determine QC exceedence. Any significant excursion from one of the QC parameters will result in a repeat of the analysis in question following an investigation by the laboratory as to the cause of the QC excursion and a report of the corrective actions taken.

WET testing shall include minimum control survival of 80 percent and an acceptable level of control organism performance (sub-lethal reproduction) required by the prescribed testing for a valid WET test. It should be emphasized that toxicity tests with control survival of 70 percent to 80 percent and/or sub-par production of neonates may still contain valuable data that may be used towards characterization of effluent toxicity but must be used with caution. Additional requirements specific to TIEs (EPA, 1991) include the addition of a baseline toxicity test to ensure toxicity exists in the original sample and method controls in which laboratory dilution water is treated identical to the test treatment and run parallel to the test treatment to ensure that the test treatment itself is not causing toxicity.

7.0 PROJECT ORGANIZATION

The following personnel and roles are currently contemplated for the GLCC Sub-lethal TRE:

Project Manager: Tom Hammons (David Hill), GLCC
Responsible for overall project, planning, logistics and coordination. Also serves as the Projects facility QAQC Supervisor.

Consulting Services: GBM² & Associates
Provide technical support to Mr. Hammons/Hill including but not limited to sampling strategies, data evaluation and interpretation, wastewater engineering, specialized sampling techniques.

Routine Sample Collection: Roland McDaniel, GBMc & Associates. Responsible for collection of treated waste water samples in accordance with QA/QC provisions of the sampling protocols.

Laboratory services: Bioanalytical (routine WET testing), Great Lakes Environmental Center (GLEC) of Columbus, Ohio (specialized sub-lethal TRE/TIE manipulations) and TRE Phase II and TRE Phase III manipulations, if required.

8.0 PROJECT SCHEDULE

The effective NPDES permit for the facility specifies that a final report on toxicity reduction activities shall be submitted no later than 28 months from the date of lethality confirmation. This 28 month study goal will also be applied to the sub-lethal investigation. The date of confirmation for GLCC was established as January 12, 2010, the date of ADEQ request letter from ADEQ. The TRE plan submittal was required within 90 days of notification (on or about April 12, 2010). The TRE plan submittal is to be followed by a 30 day period for Agency review and approval, providing a start date for the SUB TRE on or about May 12, 2010.

Due to the complexity and variability demonstrated in the historical sub-lethal WET testing of Outfall 003 effluent, and the nature of the discharge (storm water dominated); the following schedule represents a best estimate of the time frame required to complete the SUB TRE requirements. The total project is expected to take 28 months to complete. This time schedule may be modified (compressed or expanded) as required by developments within the TRE process.

Therefore, the timing for the final report to ADEQ would not be later than September 2012. This becomes the date upon which the final report is to be submitted to ADEQ. During the course of the TRE, individual activities may overlap or may be completed sequentially as dictated by the initial stages of the TRE activities. The other timeframe specified in the permit is for submittal of a quarterly TRE activities report. These reports, to be submitted throughout the TRE project are to be submitted with Discharge Monitoring Reports in the months of July and October for 2010, January, April, July and October 2011 and January, April and July 2012. For this SUB TRE project the initial quarterly activities report will be submitted in July 2010. The final report will be submitted no later than
September 2012. The schedule currently contemplated for the TRE is shown as follows. GLCC may alter the schedule as warranted based on the results of the TRE activities.

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<thead>
<tr>
<th>Activity</th>
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<tr>
<td><strong>Activity</strong></td>
<td><strong>Date</strong></td>
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<tr>
<td>Submit TRE Action Plan</td>
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<td>Receive plan approval from ADEQ</td>
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<tr>
<td>Assemble facility information</td>
<td>June 2010</td>
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<tr>
<td>Baseline toxicity and analytical testing</td>
<td>June 2010</td>
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<td>Toxicity identification and characterization</td>
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<td>Confirmation TIE</td>
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<td>Source identification</td>
<td>July 2010</td>
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<td>Treatment considerations and chemical optimization</td>
<td>January 2011</td>
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<td>Evaluation of toxicity reduction methods</td>
<td>January 2011</td>
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<tr>
<td>Post implementation confirmation</td>
<td>January 2011</td>
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<tr>
<td>Submit quarterly activity reports</td>
<td>July 2010</td>
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<tr>
<td>Submit final TRE report</td>
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Attachment 1
ADEQ demand Letter Dated January 12, 2010
January 12, 2010

Tom Hammons
Great Lakes Chemical Corporation – Central Plant
P.O. Box 7020
El Dorado, AR 71731 - 7020

RE: Request to begin Toxicity Reduction Evaluation (TRE).
NPDES Permit No. AR0001171
AFIN: 70-00012
Outfall 003

Dear Mr. Hammons:

During a review of the whole effluent toxicity (WET) testing data for the past five years, it was noted that there have been numerous failures reported for *C. dubia* sub-lethality (reproduction). It is necessary at this time for GLCC Central Plant to take the appropriate actions to address *C. dubia* toxicity at outfall 003. Therefore, the Department requires that GLCC – Central plant begin a Toxicity Reduction Evaluation (TRE) for *C. dubia* sub-lethality.

Reg 2.508 states "Toxic substances shall not be present in receiving waters, after mixing, in such quantities as to be toxic to human, animal, plant or aquatic life or to interfere with the normal propagation, growth and survival of the indigenous aquatic biota."

According to Part III 12.2.a.ii. of NPDES Permit No. AR0001171, "...A TRE may be also be required due to a demonstration of persistent sub-lethal effects or intermittent lethal effects at or below the critical dilution, ...

Below is a summary of the reported WET test failures for NPDES Permit No. AR0001171

Number of tests performed during previous 5 years by species:
*Pimephales promelas* (Fathead minnow): 18
* Ceriodaphnia dubia* (water flea): 18

Failed test dates during previous 5 years by species:
*Pimephales promelas* (Fathead minnow):
  Lethal
  None
  Sub-lethal
  02-07

* Ceriodaphnia dubia* (water flea):
  Lethal
  None
  Sub-lethal
  02-05
  11-05
  02-06
Enclosed are the Department's standard requirements for permittee's conducting a TRE, including guidelines, schedules, and reporting requirements.

If you have any questions, please contact myself or Sarah Clem.

Sincerely,

Mary Barnett  
Ecologist  
501-682-0566  
barnett@adeq.state.ar.us
TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the critical dilution and include the following:

i. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) and "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA-600/6-91/005I), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081), as appropriate.

The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (800) 553-6847, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.). The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization,
identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified;

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 48 hours of test initiation, each composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual composite samples, for the chemical specific analysis;

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report, with the Discharge Monitoring Report in the months of January, April, July and October, containing information on toxicity reduction evaluation activities including:

i. any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

iii. any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution.

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

Quarterly testing during the TRE is a minimum monitoring requirement. EPA recommends that permittees required to perform a TRE not rely on quarterly testing alone to ensure success in the TRE, and that additional screening tests be performed to capture
toxic samples for identification of toxicants. Failure to identify the specific chemical compound causing toxicity test failure will normally result in a permit limit for whole effluent toxicity limits per federal regulations at 40 CFR 122.44(d)(1)(v).
Attachment 2

GLCC Outfall 003 TRE 2001
(letter, cover, and submittal receipt)
Submittal Receipt

The following signature, by a representative of the ADEQ, acknowledges the submittal of the Final TRE Report for Great Lakes Chemical Corporation due on February 25, 2001 submitted next business day February 26, 2001.

[Signature]

[Date] 2/26/01

GBM & Associates
Strategic Environmental Services
February 26, 2001

Ms. Lorraine A. Spann
Enforcement Administrator
NPDES Branch, Water Division
P.O. Box 8913
Little Rock, AR 72219-8913

Re: Great Lakes Chemical Corporation (GLCC) Final TRE Report
NPDES Permit No. AR0001171
GBM® No. 2072-00-052

Dear Ms. Spann:

As required by the above referenced NPDES Permit and in accordance with the Toxicity Reduction Evaluation (TRE) Plan for Great Lakes Chemical Corporation’s Central Facility (GLCC-Central), GBM® hereby submits the final TRE Report on behalf of GLCC-Central. This report provides a summary of activities completed in accordance with Part 3 Other Conditions, Section 5. Paragraph l ili as detailed on Page 12 of Part 3 of the above referenced Permit.

According to our existing permit, the TRE report is to address the following five items:

1. the source of the toxicity;
2. results of any treatability studies conducted;
3. discussion of alternatives to treatment or management techniques to reduce or eliminate toxicity;
4. selection of appropriate courses of action to be followed by the permittees; and
5. an implementation schedule for making any required change to reduce or eliminate toxicity.

This report provides a summary of the activities completed under each of the above items and provides the details of the analyses in the attachments hereto.

SOURCE OF THE TOXICITY

Outfall 003 is a storm water outfall. The Outfall 003 drainage basin is the largest of the GLCC-Central drainage basin areas. It includes non-process runoff from facility production areas. These areas include:

1) Bromine Tower
2) Fine Chemicals
3) Alkyl Bromides
4) BOC
5) NAHS
6) Groundwater Treatment
7) IOB
8) OCP
9) CaBrHBr
10) TCO
11) Bromine Recovery Unit
12) Process Water Area
13) Packaging and Shipping Area
14) Spray Dryer Area
Outfall 003 also receives runoff from the western portion of the railroad loading/unloading area, the maintenance building, the hazardous waste storage area, the north and south landfill, and the solid waste landfill.

A discussion of activities and storage areas within the Outfall 003 drainage basin can be found in the facility Storm Water Pollution Prevention Plan (SWPPP). The SWPPP is maintained onsite and is available for review.

Due to the storm water nature of Outfall 003, TRE activities to characterize it are limited to periods when sufficient rainfall creates a discharge event. The historical record identifies the variability of the discharge quality and the resulting degree of effluent toxicity. Attachment 1 provides a summary of the effluent toxicity test results. The details of the toxicity tests included in Table 1 that were not part of a Toxicity Identification Evaluation (TIE) effort have been submitted to the ADEQ as routine tests results. The toxicity tests completed as part of this TRE are provided in Attachment 2. As demonstrated by the summary, the toxicity of the effluent continues to demonstrate significant variability.

Throughout the TRE, storm events resulting in measurable runoff were infrequent and therefore limited the activities completed during the TRE. There were long periods when the receiving stream was dry and therefore the uses, for which the NPDES permits are designed to protect, were non-existent during extended periods of time.

RESULTS OF TREATABILITY STUDIES

Since the discharge from Outfall 003 is storm water, classical treatability studies to evaluate the effect of treatment alternatives are of limited value due to the:

- volume of water which can be produced depending on the magnitude of an individual storm event; and
- variability of discharge as demonstrated by the results of the 48-hour toxicity tests.

Although a TIE is not a classical treatability study, the manipulations completed to identify potential toxicants also indicate treatments that may reduce or eliminate toxicity. The results of the TIEs completed on effluent from Outfall 003 indicated several activities that could reduce toxicity. The primary manipulation that eliminated toxicity was pH adjustment plus Polymer sorption (C-18). Other manipulations that reduced toxicity included aeration and filtration. The details of these TIE manipulations are provided in Attachment 2.

In addition to the TIE manipulations, Microtox and analytical chemistry were utilized to identify potential toxicants in effluent from Outfall 003. These efforts are summarized in the following sections and the details are provided in Attachment 3 and Attachment 4, respectively.

TIE Findings

The following characteristics of the Outfall 003 effluent are based on the results of the TIE efforts.

1) The results of toxicity tests vary significantly on effluent from Outfall 003, as does the physiochemical complex of the discharge.

2) Non-polar organics appear to be contributing to the demonstrated response in the toxicity tests.
3) Vertebrae (fathead minnows) are consistently more sensitive to the Outfall 003 effluent than are the invertebrates (water flea).
4) The toxicity of the storm water samples collected in January 2001, after initial BMP efforts had been completed, indicate significant reduction in effluent toxicity. The reductions in the toxicity measured in January effluent have not yet been verified by additional toxicity tests.

The results of the TIEs are discussed in greater detail in the following paragraphs.

The first set of TIE manipulations was accomplished on effluent collected on June 22, 1999. The discharge was created as a result of a 0.85-inch storm event. The results of this baseline toxicity test indicated that fathead minnows were more sensitive to the discharge than the water flea, therefore the TIE manipulations were completed on the fathead minnow only. The results of the TIE manipulations indicated that non-polar organics were responsible for the majority of the lethality demonstrated. In addition, metals were indicated as contributing to the toxicity. The toxicity of any metal(s) was/were magnified due to the low hardness of the effluent during this discharge event. Typically, the hardness of the Outfall 003 effluent is two to three times that measured during this discharge event. The variability in effluent hardness may account, at least in part, for the variability demonstrated by the toxicity tests. The TIE report is provided in Attachment 2.

The second set of TIE manipulations was completed on effluent collected on July 7, 1999. The discharge was created as a result of a 0.25-inch storm event. The initial 48-hour toxicity tests again indicated the fathead minnow was more sensitive to the Outfall 003 effluent than the water flea. In fact, the water flea passed the initial toxicity test demonstrating 97.5% survival in 100% effluent. This compares to only 30% survival in the initial test of the first TIE. The reduced response to the second TIE effluent sample was also demonstrated by the fathead minnow. The NOECs were less than 32% effluent and 42% in the first and second samples, respectively. The TIE report is provided in Attachment 2.

Despite the reduced toxicity in the second storm event sampled, the TIE manipulations were completed. The controls in baseline toxicity test and several of the blanks associated with individual manipulations of the second TIE indicated mortality sufficient to invalidate the baseline toxicity tests and several of the individual manipulation toxicity tests. Despite the control and blank mortality, the results of the second set of TIE manipulations indicated that non-polar organics might be responsible for the results demonstrated.

The second TIE did not implicate metals as potential toxicants. However, increased blank mortality and increased effluent hardness may have reduced and/or eliminated the contribution of metals to effluent toxicity.

A third TIE effort was completed in September 1999. This effort was to verify the previous results and consisted of limited TIE manipulations. The results supported previous findings indicating a non-polar organic as a likely toxicant group and again indicating little or no metal toxicity. The TIE report is provided in Attachment 2.

A fourth series of TIE manipulations was completed on effluent collected in January 2001. This sample was collected after the initial efforts to improve BMPs were completed. The results of this TIE effort demonstrated significant improvement in the reduction of toxicity. In fact the initial tests and the baseline tests indicated that the toxicity was not persistent. This lack of persistence was observed in previous TIE efforts but not to the degree demonstrated with the effluent collected in January 2001. Also the toxicity measured during the initial and baseline tests were reduced significantly when...
compared to the tests completed during the previous TIE efforts (see Table 1). The details of the fourth TIE are provided in Attachment 2.

**Microtox**

In addition to the TIE efforts, duplicate samples were analyzed using the Microtox test to evaluate the storm water toxicity. The Microtox was used in an effort to develop a tracking tool to use as a surrogate to the 48-hour toxicity tests. Several tests were completed on both the effluent and internal waste streams. These results indicated that the variability demonstrated with the standard acute tests was also demonstrated in the Microtox analyses. Due to the variability and the lack of support by the regulatory agency, additional efforts to develop the Microtox test as an alternative monitoring tool were limited. The results of the Microtox analyses are provided in Attachment 3.

**Ancillary Analytical Chemistry**

Analytical chemistry completed in conjunction with the TIEs failed to indicate a specific toxicant(s) that would have caused the results demonstrated by the fathead minnow. Although some metals were identified with the TIE, the associated hardness values and TSS of the storm water would have resulted in little dissolved metals.

**ALTERNATIVES TO TREATMENT OR MANAGEMENT TECHNIQUES**

Despite the success of the TIE manipulations to reduce toxicity, the application of these treatments on a scale sufficient to treat storm events that can generate in excess of 6.4 mgd of discharge is not considered feasible. The application of these treatment alternatives can create additional waste disposal issues that often have greater environmental consequence than the condition to which they are applied. Also, the variability demonstrated by the historical toxicity record demonstrates that the toxicity of the storm water is not consistent over an extended period of time and at times is non-existent.

Despite the limits imposed by the frequency of storm events, and as presented in Item 2, several TIE efforts were completed during the course of the TRE. The general conclusion supported by all the TIE efforts indicates that non-polar organic(s) is (are) likely the primary toxicant(s). Non-polar organic chemicals generally fall into the group of chemicals utilized as cleaners, non-polar solvents, and water treatment additives. Based on these results, it was determined that the approach most likely to result in long term control of storm water toxicity would be to improve the quality of the storm water runoff through limiting exposure potential. This would be achieved through the process to review and revise the facility's storm water pollution prevention plan (SWPPP). This effort would include:

1. the correction of any deficiencies identified during a facility SWPPP audit;
2. the implementation of Best Management Practices (BMP);
3. the implementation of a SWPPP training program; and
4. a revision of the policies utilized in the operation of the west side sump (WSS).

In addition to the revision and implementation of BMPs through the SWPPP, the GLCC-Central facility intends to evaluate the potential for the collection and use of site storm water. This potential reuse is being considered as part of the effort to reduce the need for ground water withdrawal. Although this alternative is not currently available or feasible, future restrictions on the use of ground water may warrant this activity.

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APPROPRIATE COURSES OF ACTION

Based on the variability and the storm water nature of the discharge, GLCC-Central has elected to continue the development of the SWPPP and activities associated with preventing the contamination of the storm water. This involves the development and implementation of best management practices (BMPs) identified in the updated and revised SWPPP.

The revised SWPPP is currently in under final editing and will be finalized by the end of February. Once completed, recommended actions will be implemented to prevent and/or limit contamination of storm water. Included in the draft SWPPP are alternatives to limit exposure as well as methods to ensure that existing west side sump is operated to capture first flush storm flows which are routed to central waste treatment.

The current NPDES permit requires that the SWPPP address specific baseline measures and controls, also referred to as BMPs, that are or are planned to be implemented at the facility. The required baseline BMPs are:

1) Good Housekeeping,
2) Preventive Maintenance,
3) Facility Transfer Operations,
4) Spill Prevention and Response Procedures,
5) Inspections,
6) Employee Training,
7) Record keeping and Internal Reporting Procedures,
8) Sedimentation and Erosion Control, and
9) Management of Runoff.

The details of these BMPs are provided in the facility SWPPP. Many of the baseline BMPs, have been already been implemented. The results of which are indicated by the improved results of the toxicity tests completed in January 2001.

In addition to the baseline BMPs, GLCC-Central is evaluating the implementation of site specific BMPs that are unique to the facility. The primary site specific BMP in place at GLCC-Central is the capture and return of water from incidental leaks and spills from the manufacturing areas that drain to the west side sump. The majority of the manufacturing areas at GLCC-Central are within the drainage basin for the sump, where automatic level controls activate pumps which return the water to the Process Water treatment system for treatment and disposal along with the facility's process wastes. The controls are set to return all water entering the sump up to the point that inflow exceeds the pump rate and the sump begins to overflow as a result of storm water contributions. Conductivity and pH of the sump water is monitored in the Process Water control room to detect any malfunction of the system.

In addition to the west side sump BMP, GLCC-Central is evaluating additional site specific BMPs in the following areas:

1. Bromine Area,
2. BOC Area,
3. IOB Area,
4. CCP Area,
February 26, 2001
Page 6

5. CaBr/HBr Area, and

As required by the existing permit, acute toxicity tests will continue at the frequency of once per quarter during the permit cycle.

IMPLEMENTATION SCHEDULE

The following schedule is provided as required. This proposed schedule is dependent on numerous factors outside the control of GLCC-Central. As such this implementation schedule is subject to modification.

Table 2. Proposed implementation schedule of activities to reduce effluent toxicity. GLCC-Central

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Task Description</th>
<th>Proposed Date Initiated</th>
<th>Proposed Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Baseline BMP</td>
<td>October 2000</td>
<td>December 2001</td>
</tr>
<tr>
<td>Task 2</td>
<td>Complete SWPPP</td>
<td>March 30, 2001</td>
<td>March 30, 2001</td>
</tr>
<tr>
<td>Task 3</td>
<td>SWPPP Training</td>
<td>April 15, 2001</td>
<td>May 15, 2001</td>
</tr>
<tr>
<td>Task 4</td>
<td>Site Specific BMP's</td>
<td>June 1, 2001</td>
<td>June 1, 2002</td>
</tr>
<tr>
<td>Task 5</td>
<td>Quarterly Toxicity Testing</td>
<td>April 2001</td>
<td>April 2004</td>
</tr>
<tr>
<td>Task 6</td>
<td>Additional TIE (if required)</td>
<td>August 2001</td>
<td>October 2001</td>
</tr>
<tr>
<td>Task 7</td>
<td>Permit Compliance</td>
<td>November 2001</td>
<td>November 2004</td>
</tr>
</tbody>
</table>

The implementation of the baseline BMPs recommended in the SWPPP have been initiated and will be completed during the 4th quarter 2001. Subsequent discharges from Outfall 003 will be evaluated to determine the benefit of the BMP activities and to determine the potential source of any toxicity indicated. As data allows, and if acute toxicity is demonstrated, TIE manipulations may be completed on future storm water effluent samples. The TIE methodology will become a tool implemented by GLCC-Central whenever the discharge from Outfall 003 consistently demonstrates acute toxicity.

As discussed under Item 1, the discharge from Outfall 003 is into an unnamed tributary that is dry prior to the specific storm event. Under the Arkansas Water Quality Standards (WQS), the size of the watershed (less than 1 mi²) limits the designated aquatic life use to that of a seasonal Gulf Coastal Fishery. In addition, although other uses are designated in the WQS, the watershed size precludes the attainment of those uses. Future permit conditions should reflect the protection required for the attainable uses.
February 26, 2001
Page 7

Please do not hesitate to call me at (870) 862-5141 or Mr. Roland McDaniel at (501) 847-7077 should you have any questions regarding the information provided above or if you need additional information.

Respectfully submitted,
GBM® and ASSOCIATES

[Signature]

Roland McDaniel
Principal/Project Scientist

Attachments

cc: J.R. "Pete" Howard w/o attachments
## ATTACHMENT 1

### Table 1
Table 1. Summary of toxicity test results of 100% effluent from Great Lakes Chemical Outfall 003.

<table>
<thead>
<tr>
<th>Months</th>
<th>Daphnia pulex</th>
<th>Pinophales promelas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Survival</td>
<td>LC50 (%)</td>
</tr>
<tr>
<td>February 1994</td>
<td>90</td>
<td>&gt;100</td>
</tr>
<tr>
<td>October 1994</td>
<td>85</td>
<td>&gt;100</td>
</tr>
<tr>
<td>May 1995</td>
<td>100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>December 1995</td>
<td>75</td>
<td>&gt;100</td>
</tr>
<tr>
<td>April 1996</td>
<td>80</td>
<td>&gt;100</td>
</tr>
<tr>
<td>July 1996</td>
<td>90</td>
<td>&gt;100</td>
</tr>
<tr>
<td>April 1997</td>
<td>40</td>
<td>89.6</td>
</tr>
<tr>
<td>September 1997</td>
<td>0</td>
<td>14.7</td>
</tr>
<tr>
<td>June 1998</td>
<td>100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>July 1998</td>
<td>65</td>
<td>&gt;100</td>
</tr>
<tr>
<td>July 1998</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>August 1998</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>October 1998</td>
<td>na</td>
<td>95</td>
</tr>
<tr>
<td>November 1998</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>December 1998</td>
<td>na</td>
<td>95</td>
</tr>
<tr>
<td>January 22, 1999</td>
<td>62.5</td>
<td>&gt;100</td>
</tr>
<tr>
<td>January 29, 1999</td>
<td>65</td>
<td>&gt;100</td>
</tr>
<tr>
<td>February 7, 1999</td>
<td>64</td>
<td>&gt;100</td>
</tr>
<tr>
<td>March 9, 1999</td>
<td>66</td>
<td>&gt;100</td>
</tr>
<tr>
<td>April 15, 1999</td>
<td>85</td>
<td>&gt;100</td>
</tr>
<tr>
<td>May 19, 1999</td>
<td>55</td>
<td>30</td>
</tr>
<tr>
<td>June 25, 1999</td>
<td>97.5</td>
<td>&gt;100</td>
</tr>
<tr>
<td>June 28, 1999 (TIE)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>June 30, 1999 (TIE)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>July 10, 1999</td>
<td>97.5</td>
<td>&gt;100</td>
</tr>
<tr>
<td>August 3, 1999 (TIE)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>August 5, 1999 (TIE)</td>
<td>97.5</td>
<td>&gt;100</td>
</tr>
<tr>
<td>August 8, 1999 (TIE)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>September 2, 1999 (TIE)</td>
<td>97.5</td>
<td>&gt;100</td>
</tr>
<tr>
<td>September 4, 1999 (TIE)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>February 26, 2000</td>
<td>95</td>
<td>&gt;100</td>
</tr>
<tr>
<td>May 20, 2000</td>
<td>40</td>
<td>46</td>
</tr>
<tr>
<td>July 30, 2000</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>January 14, 2001 (TIE)</td>
<td>90</td>
<td>&gt;100</td>
</tr>
<tr>
<td>January 15, 2001 (TIE)</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

The shaded test results indicate passed tests that were not significantly different from control.

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Strategic Environmental Services
ATTACHMENT 2
TIE Reports
Corrective Action Plan
CAO LIS02-081
Outfall 003-GLCC-Central
NPDES Permit AR0001171

February 27, 2004
1.0 OVERVIEW

GLCC (Great Lakes Chemical Corporation) Central facility entered into a CAO (Consent Administrative Order) with the ADEQ (Arkansas Department of Environmental Quality) in 2002 to address permit excursions of TOC and pH in its Outfall 003 discharge. As part of that CAO, a CAP (Corrective Action Plan) was developed to identify the potential sources and implement corrective actions to eliminate the TOC and pH permit excursions. The CAP is provided as Attachment A. The CAP outlined a process to evaluate the potential sources of TOC and pH. In addition, the CAP was to identify an approach to ensure compliance of future discharges with the TOC and pH permit requirements.

A stipulated activity of the CAO was to develop a report of the CAP monitoring and submit the findings to ADEQ. This report fulfills that stipulated CAO requirement. The following sections provide:

- the background,
- significant findings,
- CAP monitoring results,
- control actions implemented,
- permit compliance,
- conclusions,
- recommendations, and
- a schedule of future actions to facilitate compliance with the TOC and pH limitations in future discharges.

2.0 BACKGROUND

The significant findings, conclusions and recommendations expressed within this report are based on the information collected during the routine monitoring as required by the Outfall 003 CAP and prior to the CAO as listed below.

- a pre-CAO period from Jan-May 2002 (117 days - January 24-May 5, 2002),
- 4th quarter 2002 (63 days - October 21-December 31, 2002),
- 1st quarter 2003 (87 days - January 6-March 26, 2003), and
- 2nd quarter 2003 (68 days March 27-June 13).

Prior to the CAP monitoring period, GLCC initiated a program of monitoring 17 internal locations for the principal parameters of concern (TOC & pH). The locations chosen for the pre-CAO monitoring are depicted in Figure 1.
Figure 1. Pre-CAO Baseline monitoring locations. GLCC- Central POR 01/24/02-May 2002.
This monitoring was initiated on January 24, 2002 and continued to May 2002. The purpose of the initial monitoring period was to establish baseline concentrations that would be used to evaluate control activities implemented as part of the CAP.

During the period from October 21, 2002-June 12, 2003, samples were collected on a weekly basis and at every storm event as specified by the CAP. During the CAP monitoring four samples were collected per day when flow was present at the eight internal monitoring locations (Figure 2).

3.0 SIGNIFICANT FINDINGS

The significant findings expressed below were based on the information collected during the routine monitoring as required by the CAP and during the pre-CAO monitoring. The CAP monitoring was completed on eight (8) internal sampling points on a weekly basis and at every storm event. The CAP internal locations are a subset of the sites monitored during the pre-CAO monitoring completed at 17 locations prior to the CAO implementation.

1) The incidence of permit excursions has been reduced as a result of the actions implemented during the CAP. There was only one TOC and one pH excursion during 2003. This is a significant reduction from previous years. (Section 6).

2) Typically, the internal TOC and pH values that exceeded the final permit limits occurred during non-storm monitoring periods and indicate these flows were generated by intermittent non-process flows.

3) During the CAP monitoring, control actions were implemented as they were identified. These controls took the form of both physical controls and procedural/policy modifications directed at reducing TOC and pH fluctuations at the source. A summary of completed controls is provided in Section 5. Additional controls being considered are also provided in Section 9.

4) As controls were implemented during the CAP, the incidence of pH values outside the 6-9 su range were generally reduced when compared to the previous monitoring periods.
Figure 2. CAP internal monitoring locations. GLCC-Central. POR October 12, 2002-June 12, 2003.
4.0 CAP MONITORING RESULTS

The TOC and pH monitoring was implemented according to the CAP developed and submitted in accordance with the CAO. The objective of the CAP was to identify the source of the TOC and pH which resulted in the historical non-compliance and develop either physical controls and/or operational policy modifications to reduce or, to the extent possible, eliminate permit excursions.

The CAP monitoring included tracking of both routine flows and storm flows as described in the CAP. Table 1 provides a summary of data generated during the CAP monitoring.

Table 1. Summary of Routine CAO water sampling data at internal monitoring locations. CAP POR 10/21/02 through 06/12/03.*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GLC-2</td>
</tr>
<tr>
<td>Days with Flow</td>
<td>62</td>
</tr>
<tr>
<td>No. Times Flow Recorded</td>
<td>192</td>
</tr>
<tr>
<td>No. Samples Collected</td>
<td>192</td>
</tr>
<tr>
<td>TOC (&gt;35 mg/L)</td>
<td>64</td>
</tr>
<tr>
<td>pH (&lt;6 or &gt;9)</td>
<td>17</td>
</tr>
</tbody>
</table>

*Data generated from samples collected at internal locations as identified in the CAP. These results do not represent flows discharged through Outfall 003.

Outfall 003 has historically been a storm water outfall; therefore, storm event monitoring was also part of the CAP. During the pre-CAP monitoring from January–May 2002, a total of 23 storm events were recorded. During the CAP monitoring period (October 24, 2002 – June 12, 2003) 27 storm events were recorded. The magnitude and duration of the storm events during the CAP monitoring are summarized in Table 2.
Table 2. Summary of storm event characteristics as sampled during CAP. GLCC Central Facility. Period of Record October 21, 2002 through June 12, 2003.

<table>
<thead>
<tr>
<th>Date</th>
<th>Storm Start Time</th>
<th>Storm End Time</th>
<th>Duration (hrs.)</th>
<th>Magnitude (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/25/02</td>
<td>5:00</td>
<td>11:30</td>
<td>6.5</td>
<td>1.85</td>
</tr>
<tr>
<td>10/28/02</td>
<td>--</td>
<td>--</td>
<td>Continuous</td>
<td>0.3</td>
</tr>
<tr>
<td>11/3/02</td>
<td>4:00</td>
<td>13:30</td>
<td>9.5</td>
<td>0.65</td>
</tr>
<tr>
<td>11/4/02</td>
<td>--</td>
<td>--</td>
<td>Continuous</td>
<td>0.75</td>
</tr>
<tr>
<td>11/10/02</td>
<td>15:30</td>
<td>16:30</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>11/25/02</td>
<td>13:50</td>
<td>14:50</td>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td>12/3/02</td>
<td>14:00</td>
<td>--</td>
<td>Continuous</td>
<td>1.75</td>
</tr>
<tr>
<td>12/12/02</td>
<td>16:00</td>
<td>--</td>
<td>Continuous</td>
<td>1.1</td>
</tr>
<tr>
<td>12/18/02</td>
<td>14:30</td>
<td>--</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>12/23/02</td>
<td>11:30</td>
<td>--</td>
<td>Steady</td>
<td>2</td>
</tr>
<tr>
<td>12/30/02</td>
<td>21:45</td>
<td>--</td>
<td>Steady</td>
<td>1.35</td>
</tr>
<tr>
<td>1/29/03</td>
<td>5:00</td>
<td>15:00</td>
<td>10</td>
<td>0.15</td>
</tr>
<tr>
<td>2/5/03</td>
<td>17:30</td>
<td>--</td>
<td>Steady, light to moderate</td>
<td>0.9</td>
</tr>
<tr>
<td>2/13/03</td>
<td>4:00</td>
<td>--</td>
<td>Light drizzle</td>
<td>0.25</td>
</tr>
<tr>
<td>3/5/03</td>
<td>14:00</td>
<td>23:00</td>
<td>11</td>
<td>0.35</td>
</tr>
<tr>
<td>3/13/03</td>
<td>6:00</td>
<td>7:00</td>
<td>1</td>
<td>0.2</td>
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<tr>
<td>3/18/03</td>
<td>15:20</td>
<td>21:00</td>
<td>5.8</td>
<td>1.45</td>
</tr>
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5.0 CONTROL ACTIVITIES.

During the CAP monitoring, control activities were implemented to limit and/or eliminate TOC and/or pH as they were identified. These included:

1) Developed and implemented new storm water procedures;
2) Repaired dock 9 sump to prevent overflow to storm water ditch;
3) Repaired OCP process containment to prevent migration of contact storm water;
4) Repaired fine chemicals process containment to prevent migration of contact storm water;
5) Repaired Steam condensate line adjacent to BOC process;
6) Repaired Steam condensate line between TCO and OCP; and
7) Implemented 5S System to improve housekeeping over entire site.

6.0 PERMIT COMPLIANCE

During the period in which internal monitoring has been completed, inclusive of pre-CAO period, the TOC and pH compliance history has improved. Table 3 presents a summary of the compliance history since January 2002.

Table 3. Summary of GLCC-Central Outfall 003 compliance history, POR Jan 02-Dec 03.

<table>
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<tr>
<th>Month/Year</th>
<th>Date of Excursion</th>
<th>Parameter</th>
<th>Source</th>
<th>Antecedent conditions</th>
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* Monitoring was not in effect at date of recorded excursion.
** This reported data does not appear on CAP internal data record but reported on DMR for the period.

As demonstrated by the recent compliance history, the incidence of TOC and pH permit excursions has been reduced when compared to the historical record. The TOC and pH permit limit was exceeded on only once per parameter during 2003.
7.0 CONCLUSIONS

Based on the monitoring data developed during the CAP, it appears that the major contributors to elevated TOC levels were intermittent internal flows from three primary locations. The highest TOC values were consistently recorded in the intermittent flows from these internal monitoring locations. Based on the 2003 compliance history it appears that the control actions implemented during the CAP have reduced the incidence of TOC permit excursions.

As a result of the control activities implemented during the CAP, pH values above the final permit limits have been reduced at most internal locations but are periodically recorded at GLC-14, GLC-16, and GLC-13. Flows from GLC-13 also demonstrate pH less than the final permit limit on occasion. However, unlike the TOC, flows with the pH outside the current final permit limits are not typically measured at GLC-2 or downstream at Outfall 003.

8.0 PLANNED FUTURE ACTIONS

GLCC is currently evaluating the development of additional internal physical containment for any future sources of TOC and pH waters. A detailed plant-wide containment survey will be implemented to insure proper containment is available to prevent migration of contact storm water.

Where the need is identified, additional containment areas will limit the potential for direct access to central waste treatment so that contamination with non-exposed storm water will be minimized.

Also in response to modification in the NPDES permit, which became effective January 2004, additional modifications to Outfall 003 have been developed. There are procedures being developed to facilitate routine non-process water flows through the collection system.

Also being considered as a future resolution, is the combination of all non-process flows from all discharges into a single discharge to be transported off-site to a location allowing additional flow combinations.

The following schedule provides a timeline for the implementation of ongoing and future potential activities to address the TOC and pH issues in the discharge through Outfall 003.
Table 4. Summary of future proposed activities to eliminate TOC & pH permit excursions in Outfall 003 discharge.

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<th>Action</th>
<th>Desired Result</th>
<th>Proposed Schedule</th>
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<tr>
<td>Continue source ID</td>
<td>Continue to develop individual control(s)</td>
<td>Current -March 2006</td>
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<tr>
<td>Removal/upgrade of BRU sump</td>
<td>Provide additional containment &amp; eliminate storm water infiltration</td>
<td>October 2004</td>
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<tr>
<td>Detailed, facility wide containment survey</td>
<td>Prevent migration of contact storm water.</td>
<td>June 2004 – June 2005</td>
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<tr>
<td>Implement additional Source Controls</td>
<td>Limit contamination of storm waters</td>
<td>Current -March 2006</td>
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<td>Implement WSS Modifications</td>
<td>Allow continuous discharge of non-process waters</td>
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<tr>
<td>Consolidation of Discharges</td>
<td>Eliminate Outfall 003 discharge</td>
<td>December 2008</td>
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9.0 RECOMMENDATIONS

In order to control future internal TOC and pH discharges and thereby maintain permit compliance in the future, the following additional recommendations are provided:

1) Based on the identification of source contributors, implement the action plan developed as part of the facility wide containment analyses to eliminate the routine and/or intermittent flows through water reuse and/or conservation measures;
2) Identify specific source of pH through the implementation of a spill reporting/response program in the operational units; and
3) Complete the evaluation of the discharge consolidation potential.
Attachment 4
Outfall 003 Chronic WET Test Summary Table and Figures
## GLCC Central Outfall 003 Toxicity Summary (7-day chronic toxicity test) POR Feb 04 to Jan 2010.

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<th>Repro. CNTL</th>
<th>Repro. NOEL</th>
<th>Survival CNTL</th>
<th>Survival NOEL</th>
<th>Repro. CNTL</th>
<th>Repro. NOEL</th>
<th>Growth NOEL</th>
<th>Growth NOEL</th>
<th>TRC</th>
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**Note worthy data**