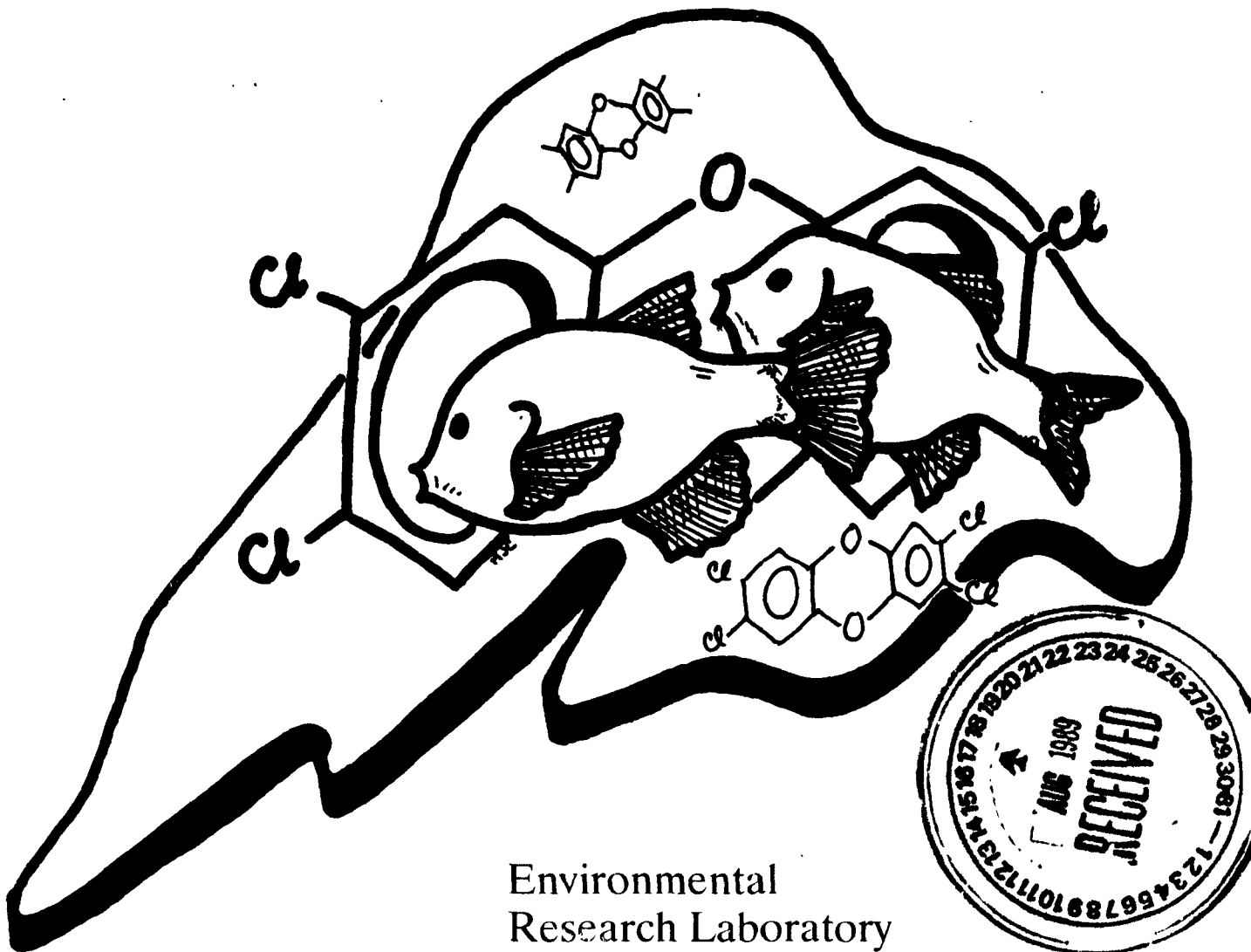




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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL RESEARCH LABORATORY - DULUTH
6201 CONGDON BOULEVARD
DULUTH, MINNESOTA 55804

August 15, 1989

MEMORANDUM

SUBJECT: Third Quarter FY89 Progress Report on Projects of the
Environmental Research Laboratory-Duluth (ERL-D)

FROM: Nelson A. Thomas, Chair *Nelson A. Thomas*
Strategic Communications Council, ERL-Duluth

TO: Addressees

Attached is a copy of the ERL-Duluth progress report on research projects for the third quarter. The following are highlights from various projects/activities:

- ▶ ACQUIRE data base further expanded and updated in user friendly formats (Project 03, page 15)
- ▶ Lab results concur with field observations in that low pH and inorganic monomeric Al drastically reduce fish survival during winter conditions (Project 43, page 21)
- ▶ Initial models, computer programs and historical bases developed for Green Bay/Fox River (Project 33, page 26)
- ▶ Major strides made in implementing the Great Lakes Geographic Information System (Project 34, page 27)
- ▶ Preliminary expert system models developed as an aid to predict the metabolites of toxicants (Project 46, page 43)

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3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 51
TITLE: Ecological Effects of Global Climate Change
PROJECT OFFICER: John G. Eaton
PHONE: 780-5557

PROJECT DESCRIPTION:

GOAL: Explore means of using an existing data base on temperature requirements for freshwater fish, in conjunction with available data on surface water temperatures and fish distributions, to forecast the impact of global warming on the distribution of fisheries resources of the U.S.

RATIONALE: No information is available on the probable impact of global warming on economically important fishery resources of the U.S.

APPROACH: Complete analysis of the temperature requirements of freshwater fish from a lab and field data base developed at ERL-D. Verify the ability to predict fishery resources on the basis of water temperature using ERL-D STORET and perhaps U.S. FWS surface water temperature and fish survey data. Estimate the current range of cold-, cool- and warmwater fishes by mapping the distribution of the required surface water temperatures. Based on regional weather change scenarios predicted from GCM models, estimate changes in surface water characteristics of the U.S. Project changes in fish distribution (thermal guilds) corresponding to the changed surface water conditions. Subsequent work will involve a more comprehensive estimation of impacts, considering effects on other aquatic organisms, trophic relationships, bioenergetics, functional attributes, water quality conditions, etc.

STATUS AND ACCOMPLISHMENTS TO DATE:

A workplan which summarizes our plans to measure the effects of global climate change on fisheries resources of the United States has been developed and is in inhouse review. A manuscript has been prepared for the American Fisheries Society editorial staff entitled "Temperatures supporting stream fish populations in field and laboratory: Implications for regulatory criteria and climate change." The ASOI Corporation staff is responsible for data management and has been editing and resurrecting a 15-year-old fisheries temperature database in support of this activity; they have also begun a literature search on lethal temperature data for freshwater fishes to use in global climate change assessments. A cooperative agreement proposal to model changes in surface water temperature has been submitted to Headquarters and is now receiving external reviews. Long-term planning activities continue toward site selection for the cooperative agreement and securing databases for the corresponding fisheries assessment.

Hydrological data sources relevant to the distribution of aquatic organisms are being identified and a work plan is being written. FY90 funding levels are uncertain at present, limiting our ability to plan the program.

SCHEDULE OF DELIVERABLES:

| | | | |
|------|---|----------|------------|
| 7932 | DUE: 07/31/90 | REVISED: | COMPLETED: |
| | DRAFT REPORT ASSESSING THE SENSITIVITY OF FRESHWATER FISH TO CHANGES IN HABITAT DUE TO CLIMATIC CHANGE | | |

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 35
TITLE: Aquatic Life Sediment Criteria Development
PROJECT OFFICER: Anthony R. Carlson
PHONE: 780-5523

PROJECT DESCRIPTION:

GOAL: Develop sediment quality criteria protocols for use in protecting aquatic life.

RATIONALE: Generally particulate bound chemicals from anthropogenic sources remain in aquatic systems for long periods of time. Suspended particulates regulate toxic chemical dispersal, sedimentation and ecological effects. Bioaccumulation extends the exposure to such chemicals through food webs to fish, wildlife, and humans. The release of toxic chemicals from different sediment types to water or organisms varies with sediment types and physical and chemical characteristics of the overlying water. Thus, techniques are needed for use in deriving numerical sediment criteria for the protection of aquatic life that account for the effect of environmental variables on the toxicity and/or bioavailability of chemicals of interest.

APPROACH: Relationships between tissue residue and just-barely-safe toxic endpoints for sediment associated organisms chronically exposed to specific non-polar organic chemicals and metals of high environmental concern will be determined. Criteria will be based on just-barely-safe residue concentrations for sensitive organisms. Data base needs and protocols(s) to field evaluate and implement the approach will be identified and generated.

STATUS AND ACCOMPLISHMENTS TO DATE:

Data has been compiled from the literature and used to determine the relative sensitivity of benthic and non-benthic organisms to specific chemicals. Cultures of five benthic invertebrates have been established for use in long-term or chronic exposures to chemicals via sediment. The laboratory is set up and running. The test apparatus has been constructed so that multi-species testing is possible. Two diluters are up and running. One diluter is capable of quadruplicate testing in the multi-species mode. The other diluter is capable of multi-species testing with duplicates of each of 6 test concentrations. Cadmium toxicity tests were completed on 6 different species in water. The species and their respective LC50 in ug/liter for cadmium are as follows:

1. Lumbriculus (worm) = 96h=158.2 240h=134.7
2. Helisoma (snail) = 96h=163.4 240h=160.8
3. Planaria (flatworm) =96h>760.9 240h>760.9
4. Daphnia magna (waterflea) = 48h=14.7
5. Ceriodaphnia (waterflea) = 48h=17.7
6. Hyalella (amphipod) = 240h<2.80

A 10-day, 4-test series was conducted to test the hypothesis that cadmium is bound to the sediment on a mole-per-mole basis with acid-volatile sulfide (AUS) and is biologically unavailable. Three diverse, uncontaminated sediments with different AUS concentrations were chosen for testing. Each sediment was spiked with cadmium at 0.1, 0.3, 1.0, 3.0 and 10 times the AUS concentration for each sediment. Additionally a water-only test was conducted with cadmium chloride to determine the 96- and 240-hr LC50s for the two tested species, aquatic earthworm, *Lumbricus variegatus* and snail, *Helisoma* sp. Presently the fate and concentrations of cadmium chloride in the different sediment compartments, as well as body burdens in the animals, are being determined.

SCHEDULE OF DELIVERABLES:

- 7896 DUE: 08/31/89 REVISED: 08/31/90 COMPLETED:
REPORT ON DEVELOPMENT OF TEST METHODS WITH BENTHIC ORGANISMS TO DEFINE THE BIOAVAILABILITY AND/OR TOXICITY OF SEDIMENT-BOUND TOXICANTS.
- 7969 DUE: 05/31/89 REVISED: COMPLETED:
Report on minimum tox. data set for Sed.Qual.Criteria based on relative sensitivity of benthic and non-benthic organisms.
- 7971 DUE: 05/31/90 REVISED: COMPLETED:
Report on Biological Assessment of Known Sediment-Activity of Metal Ions in Pore Water and Its Activity
- 8205 DUE: 09/30/92 REVISED: COMPLETED:
Guidelines for the Development of Sediment Criteria

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 45
TITLE: Aquatic Life Sediment Criteria Development
PROJECT OFFICER: Anthony R. Carlson
PHONE: 780-5523

PROJECT DESCRIPTION:

GOAL: Ecological assessment of predictive cause and effective methods for determining sediment quality criteria for the protection of aquatic life and its uses.

RATIONALE: There are currently no EPA approved protocols for determining sediment quality. Several methods have been proposed, or are in use across the U.S.A., but none have been evaluated and/or validated as a cost-effective regulatory tool. Research is needed to determine whether selected criteria approaches being pursued by the OW and ORD are protective, but not overly protective of aquatic life.

APPROACH: Specific toxic and/or bioaccumulative components of sediments from impacted ecosystems will be identified and quantified. Based on laboratory derived water and sediment quality criteria, predicted safe and unsafe conditions for aquatic life will be evaluated. Safe and unsafe conditions will be determined using ambient toxicity testing, bioaccumulation and ecological survey data.

STATUS AND ACCOMPLISHMENTS TO DATE:

Sediment samples for 13 Fox River/Green Bay systems of Lake Michigan have been collected, homogenized and stored for later analysis. Macroinvertebrate samples for analyses of chemical body burdens have been collected, sorted and frozen for later analysis. Macroinvertebrate communities at each site have been sampled, sorted and identified to subfamily and/or genus. The chironomids predominantly consist of the subfamilies Tanypodinae and Chironominae.

Third quarter objectives accomplished include the completion of a 30-day worm bioassay, completion of a fish 10-day bioassay and completion of a 10-day insect bioassay. A 30-day fish bioassay and a 10-day amphipod bioassay are underway. Preliminary Ames mutagenicity assays have been completed and data are being analyzed. Ames testing will be completed in the fourth quarter. Studies concerning the toxicity of interstitial (pore) water prepared from sediments from 13 sites in the lower Fox River/Green Bay to *Photobacterium phosphoreum* (Microtox R), *Ceriodaphnia dubia*, *Pimephales promelas* and *Selenastrum capricornutum* have been completed. Pore water from 10 of the 13 sites was acutely toxic to *C. dubia* and *P. promelas*, and all 13 sites exhibited some degree of chronic (reproductive) toxicity to *C. dubia*. Approximately one half of the sites exhibited toxicity in the 14-day *S. capricornutum* bioassay. None of the sites significantly inhibited light production in the *P. phosphoreum* bioassay.

Toxicity identification work indicated that toxicity of the pore water was reduced by lowering pH, and also could be reduced by passing the samples over a zeolite resin, indicating the presence of ammonia. Measurement of ammonia indicated sufficient concentrations to have resulted in a significant degree of the observed toxicity.

Subsequent TIE work indicated that most, if not all, of the acute toxicity of the pore water samples to fathead minnows and *C. dubia* was due to ammonia. A final report for the project has been completed and accepted for publication in a peer-reviewed journal.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 05
TITLE: Effluent Toxicity Identification
PROJECT OFFICER: Teresa Norberg-King
PHONE: 780-5529

PROJECT DESCRIPTION:

GOAL: Develop a scientific basis to identify the cause of toxicity in industrial and municipal effluents.

RATIONALE: Many NPDES permits contain toxicity limits as part of the Water Quality Based Approach (WQBA) to control toxics. The WQBA should identify the cause of toxicity and predict impact of the chemicals. Interpretation of toxic or bioaccumulative chemicals in wastewater has relied on water quality criteria standards or chemical analysis and toxicity testing of specific chemicals. These methods are limited by the need for large data bases. EPA needs to provide the states with cost effective methods to identify toxicity in discharges.

APPROACH: Before effluent toxicity can be reduced or eliminated, primary toxicants need to be identified. Techniques characterizing effluents have been developed to rely on the use of aquatic organisms to detect toxicity, and chemical fractionation to follow the changes in toxicity. Once narrowed down to probable toxicant(s), chemical analyses are used to determine the quantity of toxicant(s). Additional methods for toxicity identification evaluations are under development, and further work relies on simultaneous biological and chemical efforts to confirm the cause(s) of toxicity.

STATUS AND ACCOMPLISHMENTS TO DATE:

Emphasis is being placed on toxicity testing to aid in toxicity reduction evaluations, and ERL-D is combining toxicity testing with chemical fractionation, called toxicity identification evaluations (TIEs). This permits more positive coupling of chemical identification with toxicity. Acute toxicity tests with Ceriodaphnia, Daphnia magna, medaka and fathead minnows are used to assess toxicity of the whole effluent and concentrated fractions of the effluent. Three documents describing the TIE process are now complete; Phase I, Phase II and Phase III and all have been distributed to each region.

A total of 64 sites have been evaluated at least once for a TIE, with 31 industrial discharges, 27 municipal discharges and 6 from other sources (such as ambient waters, elutriates or hazardous wastes). Of the 64 sites, only 6 lacked enough acute toxicity to proceed. In some instances, only Phase I (chemical/physical characterization) was done to identify the characteristic toxicant(s); and for 39 of the 40 Phase I's the chemical/physical characteristics were identified. Questions such as "Is the toxicity due to ammonia or total dissolved solids?" were posed for some of the samples that did not require toxicant identification. In those cases, Phase I was successful in all 18 requests. The results of Phase I tests have shown toxicity to be pH dependent (n=3), due to inorganics (n=15), due to oxidants (n=9), due to

non-polar organics (n=25), and due to volatiles (n=1). Where further toxicity identification was needed (Phase II and/or III), 16 out of 18 times they were successful. In the instances where they were not completely identified, it was because only one sample was evaluated. With the industrial effluents, several compounds have been identified: zinc and non-polar organics, salinity (TDS), ammonia and nickel. Compounds identified for the municipal effluents were zinc and non-polar organics; ammonia, diazinon and malathion; nickel; diazinon and chlorfenvinphos; diazinon and dichlorovos; ammonia and non-polar organics; diazinon and non-polar organics; and diazinon. In the other samples, additional toxicants such as carbofuran and methyl parathion and diazinon have been identified, as well as ammonia.

A TIE workshop was held in Region III and there currently are two more planned for this fiscal year. These workshops are given to permit writers, contractors and dischargers.

Results of the diazinon survey have been summarized and indicate that the presence of diazinon occurs more frequently in the southern United States. This report is in the draft stage and will be available by early summer. Additional method development for TIEs on chronically toxic effluents are being initiated. Further techniques for acute TIEs and chemical separations are also being initiated.

SCHEDULE OF DELIVERABLES:

- | | | | |
|------|--|----------|------------|
| 7823 | DUE: 09/30/89 | REVISED: | COMPLETED: |
| | Protocol for an Abbreviated NPDES Permit Toxicity Testing Methods | | |
| 7824 | DUE: 09/30/89 | REVISED: | COMPLETED: |
| | REPORT ON THE COMPARATIVE SENSITIVITY OF A FOUR-DAY TO SEVEN DAY CERIODAPHNIA DUBIA TEST TO SINGLE TOXICANTS | | |
| 8206 | DUE: 09/30/91 | REVISED: | COMPLETED: |
| | Protocol for the Use of Toxicity Testing in the Water Quality Based Approach for the Control of Toxics | | |

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 44
TITLE: Whole Effluent Toxicity Methods
PROJECT OFFICER: Teresa Norberg-King
PHONE: 780-5529

PROJECT DESCRIPTION:

GOAL: Develop toxicity test methods to incorporate effluent toxicity limits in the next round of NPDES permits.

RATIONALE: Discharge of toxics in effluents must be controlled whether or not specific single chemical criteria are available and/or the specific toxicant(s) is known. Toxicity test methods for effluents that reflect effects on the aquatic system are needed.

APPROACH: Short-term chronic toxicity tests have been, and continue to be developed to test municipal and industrial wastewaters and receiving waters. A series of field studies has been used to positively evaluate their ability to predict ecosystem impact. As validation is established, issues relating to persistence, bioaccumulation, additivity of multiple discharges under an integrated approach will be the focus of research. A battery of toxicity tests is required to assess a broad range of species sensitivity. A protocol to assess bioaccumulation is being developed and will be field tested.

STATUS AND ACCOMPLISHMENTS TO DATE:

Evaluations and site reports are complete on the 7-day chronic Ceriodaphnia and fathead minnow toxicity tests to predict instream impact at nine sites. An update of a new method to analyze the combined effects of mortality and production of young-per-female for the Ceriodaphnia and weight for the fathead minnows was sent to biologists in all ten regions. A report addressing the persistence of toxicity was completed and is available. Feeding and water type generation studies are being summarized into manuscripts. The duckweed method was sent to a journal. A paper on comparative sensitivity of Ceriodaphnia, Daphnia magna and fathead minnows was presented at the April ASTM symposium. Technical assistance on methods continues; Ceriodaphnia cultures are being sent to state, EPA regions, contract laboratories, universities and industry. Cooperative agreements continue to develop and evaluate 4-d vs. 7-d Ceriodaphnia tests, and to develop techniques to generate ephippial egg production and hatching.

A chemical analysis procedure is being developed and tested to identify bioconcentratable materials in effluents. A contract to collect effluents and place clams in streams to evaluate the bioaccumulation potential of an effluent is complete, and samples have been extracted and analyzed. A draft guideline on this approach is available, and will be sent to all regions for comment next quarter.

The emphasis of CETIS has shifted from data entry and checking to programming to insure that others can enter new data. A PC version and user's manual has been developed. The new system has built-in QA to enhance error checking. Work is proceeding on file transfer protocols to transmit data to the National Computing Center (NCC). Uploads of Region V files to NCC were completed.

SCHEDULE OF DELIVERABLES:

7163 DUE: 04/30/89 REVISED: COMPLETED: 04/30/89
REPORT ON TOXICITY IDENTIFICATION IN EFFLUENTS

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 01
TITLE: Integrated Watershed Assessment Techniques
PROJECT OFFICER: John W. Arthur
PHONE: 780-5565

PROJECT DESCRIPTION:

GOAL: Provide methods to characterize biotic resources at risk in large regional watersheds.

RATIONALE: Acceptable integrated protocols are needed to perform watershed inventories, toxicity relationships and provide tiered measures of biotic impact. The procedures will link water quality standards and designate uses into definable measures.

APPROACH: Conventional tiered procedures will be applied to furnish an integrated assessment on the status of aquatic resources within watersheds. Laboratory toxicity tests will be performed to measure ambient toxicities and relative sensitivities of test species, in situ techniques used for comparison with laboratory results and instream biological assessments of indigenous biota. The comparative data base will be gathered in two or three large watersheds impacted by common pollutant categories to evaluate the applicability of the tiered protocols. The comparative assessments will be performed over a period of two to three years and will encompass all four seasons of the year.

STATUS AND ACCOMPLISHMENTS TO DATE:

In the last quarter a manuscript was submitted to "Environmental Toxicology and Chemistry" describing results of sediment pore water toxicity tests from the lower Fox River/Green Bay, WI. This manuscript has now been accepted for publication.

An additional study was begun in the upper Illinois River basin to further describe toxicity profiles encountered with the ambient surface water samples. Last May sediments were collected in the river basin from eight waterways and pore water was prepared by centrifugation. Chronic toxicity tests were then conducted with Ceriodaphnia and Selenastrum. To achieve a "no effect" level, it was necessary to dilute the samples from the Calumet/Cal Sag Channel (at Halsted St.) to between three to six percent. It was not necessary to dilute the samples from the Fox and Kankakee Rivers. An additional evaluation is scheduled for later this summer.

SCHEDULE OF DELIVERABLES:

7830 DUE: 10/31/90 REVISED: COMPLETED:
REPORT ON APPLICABILITY OF WATER QUALITY CRITERIA AND ENVIRONMENTAL GOALS -
GREEN BAY, WISCONSIN

8207 DUE: 06/30/93 REVISED: COMPLETED:
Integrated Water Quality Approach for the Control of Toxics

8245 DUE: 03/30/89 REVISED: COMPLETED: 03/30/89
Interim Report on Ambient Toxicity in Upper Illinois River Basin

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 36
TITLE: Aquatic Resource Characterization in a BMP Demo Watershed
PROJECT OFFICER: John W. Arthur
PHONE: 780-5565

PROJECT DESCRIPTION:

GOAL: Determine meaningful relationships among Best Management Practices (BMP's), water quality designed uses and impacted biotic resources.

RATIONALE: The relationship between the effectiveness of BMP's in watersheds and the goal of meeting intended water quality standards and uses (fishable, swimmable) is unclear. Meaningful biological trend assessments are required both before and after BMP applications to demonstrate their utility.

APPROACH: This will be a long-term pilot study representative of a watershed impacted by agricultural practices. Anticipated NPS pollutants are total suspended solids, nutrients and toxics (i.e., herbicides). The comprehensive study will include defining land use and runoff measurements of instream toxicity, biotic impacts and mass balance relationships. An interagency agency will be undertaken. An appropriate state environmental agency will select and implement BMP practices in the watershed. A multidisciplinary group, USEPA and USGS, will perform the physical (hydrology, land use) chemical (contaminant mass balance) and biological assessments. The role of the USEPA will center on characterizing the aquatic resource impacts.

STATUS AND ACCOMPLISHMENTS TO DATE:

A work plan has been prepared for characterizing aquatic resource impacts in the Minnesota River. Coordination for the biology/toxics portion of this work is being done by ERL-Duluth and the Minnesota Department of Natural Resources (Ecological Services Division). Several principal investigators have been identified representing the following institutions: Minnesota Pollution Control Agency, Mankato State University and St. Olaf College. The work plan must be reviewed and approved by a steering committee spearheading the project prior to release of state funds. The study is scheduled to start in mid July, 1989.

SCHEDULE OF DELIVERABLES:

8151 DUE: 10/31/92 REVISED: COMPLETED:
Report on Indicators of Surface Water Ecological Impairment

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 02
TITLE: Ecological Research with the People's Republic of China
PROJECT OFFICER: Nelson A. Thomas
PHONE: 780-5702

PROJECT DESCRIPTION:

GOAL: To participate jointly with the People's Republic of China (PRC) in mutually beneficial studies through a cooperative research program. Scientists from both countries will participate in research and exchange scientific information on the environmental processes and effects of pollution on freshwater organisms.

RATIONALE: In support of the United States' policy to provide scientific and technological cooperation with China, the USEPA and PRC in 1980 entered into an agreement known as the US-PRC Environmental Protection Protocol. This agreement provides for establishment of a cooperative research program.

APPROACH: Participating scientists from both countries will discuss and identify the specific projects that will be conducted in the research program. Projects (subject to modification and approval) include emphasis on toxicity tests methods, effect of environmental variables on toxicity and toxicity mixtures. Scientists from PRC will study at ERL-D to develop an understanding of the testing of single chemicals and complex effluents.

STATUS AND ACCOMPLISHMENTS TO DATE:

Joint research is currently being conducted on the detection of teratogenic and carcinogenic effects of fish in areas containing contaminated sediments. Two field collections are complete on the Fox River. Black bullheads were collected for histopathological analyses. All fish have been sectioned and slides prepared. Slide analysis of the first collection indicates that none of the fish had carcinogenic livers. Examination of bullhead livers from the second sampling site in Green Bay in September 1988 is complete. There was evidence of parasitic infestation in many of the livers sampled, but no preneoplastic or neoplastic lesions were found in fish sampled from the second cruise.

After 12 months of cooperative research on the Fish Tumor Study, Zhang Fuying has returned to Wuhan. A joint study of fish tumor associated with contaminated sediments in the People's Republic of China is being planned.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 03
TITLE: Aquatic Life WQ Criteria Development Modifications
PROJECT OFFICER: Anthony R. Carlson
PHONE: 780-5523

PROJECT DESCRIPTION:

GOAL: (1) Formulate guidelines for the development of aquatic life water quality criteria and advisories. (2) Prepare criteria and advisories. (3) Evaluate criteria under site-specific conditions as to aquatic life protection afforded. (4) Assist in transferring criteria into state standards.

RATIONALE: The Office of Water, Criteria and Standards Division periodically needs updated guidelines for developing water quality criteria reflective of the state-of-the-art in ecotoxicology. Criteria must reflect (1) identifiable effects on the health and welfare of aquatic life, (2) dispersal of pollutants through biological, chemical and physical processes and (3) effects of pollutants on biological community diversity, productivity and stability.

APPROACH: Laboratory and field studies will be undertaken to evaluate and validate the guidelines and criteria. The expression of concentration, duration and frequency in the new aquatic life criteria requires the development of methodologies to classify and assess impact on ecosystem as well as to predict recovery.

STATUS AND ACCOMPLISHMENTS TO DATE:

Criteria documents for several chemicals are in various stages of development for submission to Criteria and Standards Division (CSD) of the Office of Water. Thallium, and methyl parathion have been reviewed by ERLD and ERLN and are being revised to incorporate the comments. The test for a freshwater acrolein document was completed and is being reviewed by the laboratories. Seven documents including (diazinon, phenol, 1,2,4-TCB and acenaphthene are scheduled for submission to CSD by fall of 1989. Test needs for 1990 criteria chemicals (malathion, dichlorvos, propoxur, atrazine and carbaryl) have been delineated. Work on these documents has already begun for their submission in 1990. A work plan on three projects involving low log P (<5) chemicals (whose mode of action is narcosis) has been completed for research work needed to revise current advisory guidelines. Work is expected to begin as soon as this work plan is reviewed by ERL-D.

Work to update and customize the AQUIRE data base is continuing. Work completed this quarter included several programming efforts to make AQUIRE more user friendly. Bioconcentration data was separated into its own sections for output and streamlined to improve the quality of BCF data in AQUIRE. AQUIRE files were

formatted, taped and sent to NTIS for distribution to the University of Utrecht, Netherlands. AQUIRE was demonstrated at Headquarters 6th Annual OIRM/WIC Open House. Currently AQUIRE contains 104,507 data entries for 5,238 chemicals and 2,410 species from 6,010 publications.

The database management system for the Aquatic Toxicity Test Analysis System (ATTAS) was completed. Ongoing work includes the addition of a statistical analysis section. An ATTAS user guide is scheduled for completion this fall.

A series of 30-day early life stage toxicity tests on the effect of fluctuating concentrations of copper sulfate on fathead minnows is complete. These tests strongly indicate that most of the copper effect on the test organism can be elicited using intermittent exposures with concentrations only slightly to moderately higher than steady concentrations producing the same effect and that periods of non-exposure do not result in protection proportionate to their length, relative to the exposure periods. Applying steady concentration toxicity tests to situations with fluctuating concentrations can therefore result in underprotection unless averaging periods are suitably restricted or appropriate mathematical models are used to account for fluctuations. Effects could not be modeled based on the total accumulation of copper by the fish. Ninety-six hour and 30-day tests are being initiated for selected organic chemicals. Laboratory and dosing apparatus modifications to accommodate pentachloroethane were made. Testing and analytical procedures have been developed. Initial acute and chronic exposures have been completed and additional exposures are in progress. An extensive uptake and depuration rate exposure has been conducted to support toxicokinetic calculations. Papers from the Recovery Workshop were received and revised in accord with the reviewers' comments. A revision of Appendix D (Duration and Frequency) of the Technical Support Document (TSD) for Water Quality Based Toxics Control (6964A) has been drafted and internally reviewed. It was submitted to the Water Quality Analysis Branch (OW) for incorporation into the overall revision of the TSD. A final report, "Clark Fork River Nuisance Algae Study" was reviewed for the Region 8, Montana Office.

SCHEDULE OF DELIVERABLES:

- | | | | |
|------|--|----------|------------|
| 6964 | DUE: 11/30/89 | REVISED: | COMPLETED: |
| | REPORT ON ANALYSIS OF FREQUENCY OF CRITERIA EXCEEDANCES AS RELATED TO AQUATIC COMMUNITY IMPACT | | |
| 7170 | DUE: 09/30/89 | REVISED: | COMPLETED: |
| | REPT. ON THE FEAS. OF PRED. THE EFFECTS AND INCORP. FLUTUATING EXP. IN THE APPLICATION OF WQC AND EFFLUENT TOXICS TESTS. | | |
| 7171 | DUE: 12/31/90 | REVISED: | COMPLETED: |
| | Report on Field Validation of Methods for Predicting and Assessing Fluctuating Exposure Effects | | |

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 41
TITLE: Criteria Document Testing and Test Endpoint Evaluation
PROJECT OFFICER: Robert L. Spehar
PHONE: 780-5564

PROJECT DESCRIPTION:

GOAL: To provide the Office of Water with aquatic toxicity test data for deriving water quality criteria documents and to define new toxicity test endpoints to more accurately predict environmental hazards.

RATIONALE: Aquatic toxicity tests are conducted to fulfill data requirements for deriving water quality criteria and advisory documents for chemicals of priority to the Office of Water. At the same time, current EPA test procedures may underestimate the toxicity of specific classes of toxic pollutants in the environment. Research is needed to develop new cost effective methods to obtain chronic test endpoints to more accurately predict long-term adverse effects of toxics in aquatic systems.

APPROACH: Acute and chronic toxicity tests with several species of aquatic organisms and chemicals from a variety of classes will be conducted. Concurrently, new toxicity test end points will be studied to predict adverse chemical effects on long-term biological processes. The data obtained from this research will be used to develop a chemical toxicity profile which can be used by several program offices and will be aligned with current research to validate predictive extrapolation models.

STATUS AND ACCOMPLISHMENTS TO DATE:

A 90-day early life stage test and a 96-hr flow-through acute test with rainbow trout and phenol were completed to fill data gaps needed for deriving a phenol criteria document for the Office of Water. Results indicated that the chronic value and 96 LC50 values were 157 and 6,082 ug/l respectively. These data provided definitive endpoints for the development of the phenol criteria and will be used to lower the previous phenol criteria to specifically protect this important species.

Research to validate the medaka assay is continuing. Exploratory tests with cyclophosphamide (a human carcinogen) and 2-imidazolidinethione were completed. Both biological range finding tests and extensive chemistry analysis techniques for measuring these chemicals in water were needed in this exercise. Results from these studies will be used to conduct 28-day exposures as part of the validation and screening process for the medaka assay. Culture work has continued to provide test organisms for various laboratory projects. The fathead culture unit has supplied 6 lots of embryos, 50 lots of larvae and 24 lots of juveniles for testing at ERL-D, and has provided outside

groups with organisms for culture 24 times. The medaka culture unit has supplied 1 lot of embryos, 11 lots of larvae and 10 lots of adults for tests with single chemicals, sediments, liver enzyme work and for the medaka assay development program. A protocol for culture of the Japanese medaka is scheduled to be completed this fall. In addition, several other species are now being considered for inhouse projects as a needed response to the program offices.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 42
TITLE: Water Quality Criteria Evaluation in Controlled Ecosystems
PROJECT OFFICER: Steven F. Hedtke
PHONE: 777-2491

PROJECT DESCRIPTION:

GOAL: To evaluate the level of protection provided by water quality criteria to aquatic life, wildlife and wetlands. To investigate the relationship between water quality criteria and sediment contamination.

RATIONALE: Water quality criteria are derived primarily from laboratory toxicity data. We need to know the degree of protection criteria provide to aquatic ecosystems under field conditions for regulatory activities. Criteria are needed for the protection of wildlife and wetlands. The ability to adapt current criteria to wildlife and wetlands would be both cost- and time-effective.

APPROACH: Data on toxicological effects can be developed in the laboratory, the degree of protection provided by criteria can only be determined in the field. The experimental ecosystems at the Monticello Ecological Research Station can simultaneously test criteria for aquatic life, wildlife and wetlands. Controlled inputs of chemicals into the streams and the subsequent effects on stream and wetland structure and function will be evaluated. The relationship between water concentrations and sediment concentrations can be evaluated under stream and wetland conditions.

STATUS AND ACCOMPLISHMENTS TO DATE:

Previous research results in the Monticello outdoor experimental streams show that exposure to 30 ug/l selenium (IV) caused complete mortality to adult bluegills over a 356-day period. In addition, exposure to 10 ug/l resulted in bluegill larvae which were unable to survive past 5-7 days. These impacts were not predicted by standard laboratory tests. This difference between lab and field data was due to selenium having accumulated in fish food organisms and served as a major route of exposure to fish that was unaccounted for in lab tests.

To further test the application of the current water quality criterion for selenium (5 ug/l), exposure of two streams was initiated at 2.5 ug/l in October 1988. The two stream studies in which bluegill are exposed to 10 ug/l selenium are being continued to verify the effects observed at this concentration. In addition, the 30 ug/l dose studies were terminated. These streams are being studied to determine whether selenium persists in the ecosystem and therefore influences recovery rates.

As of June 1989, the sediments in the recovery streams show selenium concentrations similar to levels that existed during dosing. Because sediments may be a source of selenium for fish food organisms, the potential for effects on fish still exists. No effects on adult survival or growth have been detected in these streams or in those being dosed at 2.5 and 10 ug/l. However, due to the low concentrations of selenium, any effects are expected to involve larval survival. Bluegills in all streams are just beginning to enter the spawning period. Therefore, any effects will not be detectable until later in the summer.

SCHEDULE OF DELIVERABLES:

7827 DUE: 04/30/90 REVISED: COMPLETED:
Report on Validation of Water Quality Criteria for Selenium

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 43
TITLE: Studies on Physical and Chemical Factors Affecting Toxicity
PROJECT OFFICER: John G. Eaton
PHONE: 780-5557

PROJECT DESCRIPTION:

GOAL: To determine the toxicity of low pH and aluminum in very soft, (low Ca) water for several species of North American warmwater fishes. To relate the toxicity of combinations of these laboratory variables to responses of fish populations exposed to them in a whole lake acid manipulation experiment.

RATIONALE: Adverse effects of Al on aquatic ecosystems are often a consequence of acidification of surface waters, which sometimes produces inorganic monomeric Al concentrations which are toxic. The low Ca concentrations usually found in poorly buffered surface waters exacerbate pH and Al toxicity. Little information is available for warmwater fish and invertebrates. Previous work at this laboratory has demonstrated that early life stages are the most sensitive to direct effects.

APPROACH: Conduct laboratory bioassays to determine the toxicity of combinations of low pH and Ca and elevated Al which could occur under adverse field circumstances. Concentrate on tests with early life stages of sensitive species and fish occurring in experimentally acidified Little Rock Lake (IRL). Conduct in situ exposures of species tested in the lab and that occur in IRL in order to more precisely relate lab and field conditions.

STATUS AND ACCOMPLISHMENTS TO DATE:

A journal article on the life-cycle chronic toxicity of fathead minnows exposed to H⁺ ions, low Ca and elevated Al has been accepted for publication. Laboratory exposures of embryos and larvae of yellow perch, largemouth bass and rock bass have been completed and are described in a submitted journal article. Additional lab tests and in-situ field exposures of rock bass, yellow perch, largemouth bass and black crappies have been completed and are being summarized prior to manuscript preparation. Observations from the Little Rock Lake field project indicate that the added stresses of low pH and elevated aluminum might reduce over-winter survival of young-of-the-year (YOY) largemouth bass. To test this hypothesis, YOY bass have been exposed to a series of aluminum concentrations and low pHs at winter temperatures by the Duluth Environmental Research Laboratory. Results concur with field observations that low pH and 25 ug/l inorganic monomeric Al drastically reduces survival during winter conditions. Data reduction and analysis are underway.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 39
TITLE: Wetlands Research on Mitigation & Cumulative Effects of Loss
PROJECT OFFICER: William D. Sarville
PHONE: 780-5723

PROJECT DESCRIPTION:

GOAL: Develop procedures which enable Regional Wetland Coordinators to forecast wetland water quality enhancement and life support functional losses following wetland hydrological, physical or biological modifications.

RATIONALE: Important wetland functions include water quality enhancement and life support. We need to understand these functions quantitatively to predict the effect on them of wetland alterations. The effect of the alteration must be understood from the single, isolated wetland to the landscape perspective encompassing the entire aquatic resource. In addition, it is necessary to develop criteria to establish maximum tolerable wetland loading rates for a variety of substances. Lacking these, the wetland functional values will be altered and their importance to ecosystem integrity will be lost.

APPROACH: A literature survey, water quality workshop and meetings with regional EPA wetland staff will be the basis for the development of a five-year work plan. General program structure will include the following: 1) general models of water quality functions and their quantification, 2) how changes in number or extent of wetlands affects higher level landscape processes and 3) criteria for establishing permissible wetland loading rates.

STATUS AND ACCOMPLISHMENTS TO DATE:

The RFP entitled "Experimental Determination of Factors Affecting Assimilative Capacity of Freshwater Wetlands" was advertised in the Commerce Business Daily as scheduled. We received 21 preproposals in response and these were distributed to 12 reviewers. The 21 will be ranked and 4 institutions will be requested to submit expanded proposals. We have requested that we receive final proposals by mid-July to enable us to fund the project in this fiscal year. Richard Horner, University of Washington, will serve as the reviewer for the WET 2.0 (Wetland Evaluation Technique) authored by Paul Adamus and now being evaluated for the Corp of Army Engineers and EPA's Office of Wetlands Protection. NRRI Cooperative Agreement status: The project is continuing on schedule. The early spring water quality sample collection (including routine, snow melt and event-based samples) was successfully completed. Sediment cores to be used for calibrating the Pb dating technique were obtained from two wetlands for which previous loading data were available. These are currently being analyzed. Late spring sampling and water quality analyses are now underway. GIS mapping of site watersheds continues. The early summer sampling period will begin on July 15 and continue until mid-August.

SCHEDULE OF DELIVERABLES:

- 8154 DUE: 08/31/90 REVISED: COMPLETED:
Report on water quality functions of wetlands
- 8234 DUE: 10/31/89 REVISED: 01/31/90 COMPLETED:
Report on the Applicability of Current Aquatic Life Water Quality to
Wetlands

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 29
TITLE: Assessment & Remedial Strategies for Contaminated Sediment
PROJECT OFFICER: Russell G. Kreis
PHONE: 313/675-7706

PROJECT DESCRIPTION:

GOAL: Develop methods to measure and predict effects of inplace pollutants, identify/prioritize sites for remedial action, determine the optimal combination of mitigative strategies, and simulate the results/consequences of actions.

RATIONALE: Contaminated sediment impacts both freshwater and marine ecosystems; inplace pollutants is a priority research topic in the Great Lakes. The problem is long-term even if zero discharge is assumed. Regulatory offices require guidance to establish a cost-effective mitigation policy.

APPROACH: An interdisciplinary approach will be used to develop and verify methods to measure and predict the effects of inplace pollutants and identify and prioritize remedial strategies. Research consists of: 1) field collection 2) field and laboratory experimentation, 3) data base development, 4) model development and 5) remedial action guidance. The test sites include impacted "Areas of Concern": Detroit River (1985-1988), lower Fox River - inner Green Bay complex (1987-1992), and Lake Ontario (1990-1995). Methods and strategies developed can be used in any "Area of Concern" or other national waterways and may relate to sediment criteria development, implementation of the Clean Water Act, and the US/Canada agreements. Methods will be applied to other areas as resources allow.

STATUS AND ACCOMPLISHMENTS TO DATE:

Sediment studies are continuing in the Detroit River, lower Fox River, Lake Ontario and for the Clean Water Act demonstration sites (ARCS) program. The In-Place Pollutants Project (IPP), conducted in the the Detroit River, has produced two Agency deliverables, ("Integrated study of exposure and biological effects of inplace sediment pollutants in the Detroit River, Michigan: An upper Great Lakes connecting channel" and "Development, verification and application of interconnecting channel models"), five reports to the Upper Great Lakes Connecting Channels Study, ten journal publications and numerous task reports and oral presentations. Results from the Detroit River indicate that sediments were contaminated, toxic, mutagenic and resuspendable. In addition, the water column was temporarily toxic and point sources contribute large fluxes of contaminants to the water column. These factors suggest that continued regulation and control of point and non-point sources are required prior to sediment remediation. Other aspects concerning vertical toxicity and contamination of Detroit River sediments, cause-effect relationships, and application of a numerical ranking system for contaminated sediments will be

examined during FY90, along with formulating new initiatives with the Michigan Department of Natural Resources. The primary emphasis of Project 29 during FY89 has been the lower Fox River study. The lower Fox River study is composed of numerous tasks and has been coordinated to meet the needs of three sediment initiatives: (1) Assessment and Remediation of Contaminated Sediments, (2) Sediment Quality Criteria and (3) the Green Bay/Fox River Mass Balance Study. Intensive field studies were conducted in FY88 and limited follow-up studies are underway in FY89. Numerous contaminant analyses and bioassays are complete and indicate that sediments are toxic and ammonia toxicity is a major component in these sediments; a manuscript has been submitted for journal publication regarding this topic. Fish tumor surveillance in the lower Fox River indicated that there was no evidence of neoplasia in livers from bottom-dwelling bullheads. A Fox River coordination meeting is planned for early FY90 to discuss the data and to compile the data for synthesis reports. Reports on dioxins and furans in Lake Ontario sediments are nearing completion. The ARCS Program for the Clean Water Act is in the planning stage and ERL-D personnel are represented on all ARCS work groups. Numerous meetings have been held and work plans have been prepared and reviewed for management committee approval. Six proposals have been prepared for ERL-D concerning sediment sampling, sediment characterization, toxicity identification evaluation, hazardous sediment ranking, database management and GIS graphical data management. Meetings will continue and field work may commence in Indiana Harbor early in the next quarter.

SCHEDULE OF DELIVERABLES:

- 7204 DUE: 12/31/88 REVISED: COMPLETED: 12/31/88
Models for Predicting the Probability of Exposure to Toxic Substances from Contaminated Sediments in Great Lakes Areas of Concern
- 7205 DUE: 12/31/88 REVISED: COMPLETED: 12/31/88
Report on Methods for Predicting Biological Impacts of In-place Pollutants in the Upper G.L. Connecting Channels.
- 7877 DUE: 06/30/91 REVISED: COMPLETED:
Report on Numerical Ranking of Hazardous Sediment in the Lower Fox River

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 33
TITLE: Mass Balance Models for Toxics in Freshwater Systems
PROJECT OFFICER: William Richardson
PHONE: 313/675-7704

PROJECT DESCRIPTION:

GOAL: Conduct mass balance research to link identified ecosystem effects with their causes, ensuring that results are related to possible remedial actions.

RATIONALE: Over 800 chemical compounds have been identified in Great Lakes ecosystems and biological effects continue to be documented. Fish contamination in many areas has resulted in health advisories and shutdown of commercial fishing. Site specific mass balance research is required to quantitate the processes and flux of contaminants to predict consequences of remedial actions.

APPROACH: Mathematical models for toxic substances based on mass balances, including transport, fate and bioaccumulation processes will be developed, calibrated and verified for important freshwater systems. The research includes: 1) development and application of sampling and analytical chemistry methods appropriate for low level contaminants, 2) development and maintenance of data bases, 3) development and application of mathematical models and other computational techniques. Application will be made in important areas of the Great Lakes. Models will be used in other freshwater systems as requested and as resources allow.

STATUS AND ACCOMPLISHMENTS TO DATE:

The primary accomplishment during the third quarter of FY89 has been the development of the initial Green Bay/Fox River models and associated computer programs and historical bases. Simplified transport and toxics (WASP4) models have been implemented. Hydrodynamic models have been initiated and initial computations completed for the Fox River and Green Bay with partial success in comparing model results to historical data. Food chain and ecosystem models are under development and the initial model framework completed. A number of the Green Bay principal investigators presented papers at the International Association for Great Lakes Research Conference in Madison, WI. In addition to the modeling activities, the first two Green Bay cruises have been completed by GLNPO and samples have been returned to LLRS for analysis.

SCHEDULE OF DELIVERABLES:

7876 DUE: 12/31/90 REVISED: 11/30/91 COMPLETED:
Feasibility of Using Mass Balance and Food Chain Models for the Management of Toxic Substances in Green Bay

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 34
TITLE: Technology Transfer to GLNPO, OW, IJC, Regions, State & local
PROJECT OFFICER: William Richardson
PHONE: 313/675-7704

PROJECT DESCRIPTION:

GOAL: To assure that Great Lakes research is applied to the regulatory process and to the needs of the Great Lakes Water Quality Agreement.

RATIONALE: EPA has a primary role in fulfilling the requirements of the 1978 and 1987 Water Quality Agreements with Canada. The ORD Great Lakes Program at the Large Lakes Research Station is the primary focus for EPA's response. ORD/LLRS staff and on-site contractors have the experience and knowledge to efficiently fulfill technical assistance requests from GLNPO, IJC, Regions, Office of Water, and State and local agencies.

APPROACH: Technical transfer will be accomplished through interaction with EPA Program Offices, IJC, Regions, States, and local governments. Specific areas of support will include: 1) maintenance, documentation, application and training for mathematical models, 2) computer service support for water quality and point source data bases, 3) participation on IJC committees and boards, state and local government committees, and 4) technology transfer to the regulatory community including consultants working for government agencies.

STATUS AND ACCOMPLISHMENTS TO DATE:

During the third quarter of FY89, major strides were made to implement the Great Lakes Geographical Information System (GIS) at LLRS. A GIS framework and work plan has been completed in cooperation with the Great Lakes National Program Office. Work has begun to access various databases, particularly those from the Michigan Department of Natural Resources' GIS and their files for the Detroit River basin. Organizing an October, 1989 Great Lakes GIS conference was completed. Work continued on organizing and managing the Great Lakes point source file database in cooperation with the GLNPO and the IJC.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 48
TITLE: Great Lakes Confined Disposal Facilities: Effects/Mitigation
PROJECT OFFICER: Russell G. Kreis
PHONE: 313/675-7706

PROJECT DESCRIPTION:

GOAL: Develop and field-test methods and strategies to evaluate confined disposal facility (CDF) performance. Determine if biota receive significant contaminant exposure through dike walls of disposal facilities. Develop a CDF biomonitoring protocol to address contaminant transport through dike walls. Results could impact future regulatory policy concerning CDF construction and use practices.

RATIONALE: The Great Lakes have 40 CDFs to dispose of dredged materials from navigation channel maintenance. Contaminants in CDFs have been associated with high body burden concentrations and reproductive disorders in resident biota. The primary concern is CDF performance and whether biota in the surrounding environment are impacted by contaminant transport through dike walls.

APPROACH: A combined biomonitoring and congener-specific PCB approach will be used to assess CDF performance. Each aspect will be individually evaluated for effectiveness. Caged and resident biota will be used for biomonitoring at several sites. Congener-specific PCB analyses will be conducted on all biota to determine whether congeneric patterns discriminate between contaminant sources. The sample design developed is amenable to nonparametric and parametric statistical techniques.

STATUS AND ACCOMPLISHMENTS TO DATE:

Results of the 1987 pilot CDF biomonitoring study indicated that PCB transport through Saginaw CDF dike walls was not demonstrated using a biomonitoring approach. Modeling simulations indicated that very low concentrations of PCBs would be expected to be transported through dike walls and was consistent with the biomonitoring study results. Upon completion of an "A" deliverable, "Pilot confined disposal facility biomonitoring study: Channel/Shelter Island diked facility, Saginaw Bay, Bay City, Michigan, 1987" and several other reports for studies conducted during 1987, primary effort for Project 48 is being devoted to the 1988 Biomonitoring Study, a more intensive field study than that conducted in 1987. Field work is complete and samples are being analyzed. Water sample analyses for PCB concentrations (particulate and dissolved) are complete; total suspended solids samples have been completed. A review of sample priorities was provided by the ERL-D Research Council and a response will be provided in the next quarter. The primary suggestion was that fish tissue, rather than clam tissue, be analyzed as well as a greater number of statistical methods inspected. Because of the limited number of fish available

per sample, due to the difficulty in field recovery, clam tissue must remain the primary biological tissue used in the study. Clam tissue has been prepared, extracted and is currently being analyzed. Limited samples of fish tissue will also be analyzed in the future. Sample analyses of biological specimen will continue through the next several quarters. A Wide array of parametric and non-parametric statistical analyses are planned when sample analysis is complete. Three presentations concerning the 1987 CDF studies were given at the Great Lakes Conference, May 1989, Madison, WI. One is scheduled for the SETAC meeting (October, 1989, Toronto, Ontario, Canada).

SCHEDULE OF DELIVERABLES:

8085 DUE: 12/31/88 REVISED: COMPLETED: 12/31/88
PILOT CONFINED DISPOSAL FACILITY BIOMONITORING FIELD AND DATA REPORT

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 37
TITLE: Leachage Toxicity Profiles for Hazardous Waste Characterization
PROJECT OFFICER: Douglas W. Kuehl
PHONE: 780-5511

PROJECT DESCRIPTION:

GOAL: To develop test protocols to assess the hazard of leachates to aquatic lifeforms and the effects of transport on hazard.

RATIONALE: Current methods allow the measurement of hazardous waste leachate toxicity to a variety of aquatic life. There is no acceptable protocol to apply such data to assess aquatic impacts or to adjust for modification of toxicity during environmental transport. This project will define a test "profile" for leachates which will characterize their hazard to aquatic life and the effect of fate processes on toxicity.

APPROACH: A cost-effective profile of leachate toxicity tests will be developed that includes enough diversity of organisms and toxic responses so that an assessment of aquatic life impact can be made. This profile will include evaluation of the distribution of toxicity among chemical fractions of the leachate. These fractions will be related to properties affecting fate, e.g., retardation or susceptibility to hydrolysis reactions, so that the leachate profile can be linked with OSW assessment methodologies in order to predict toxicity modifications/attenuation factors during transport.

STATUS AND ACCOMPLISHMENTS TO DATE:

Methods for the characterization of the physical chemical nature of components in aqueous samples have been developed and published (EPA/600/3-88-034, September 1988). The methodology involves manipulation of the sample and comparison of the toxicity of the altered sample to the initial sample using aquatic species. Using this methodology, toxicity characteristics of synthetic leachates of creosote and latex paint will be determined. Initial studies will focus on creosote.

Synthetic creosote aqueous leachates were found to be acutely toxic to *C. dubia* at 48 hours (LC50=2.21%) Adjustment of pH and filtration partially removed toxicity suggesting that some precipitation of toxic components may have occurred. C18 solid phase extraction removed all the toxicity. Subsequent HPLC fractionation of the extracts indicated that multiple toxicants were present. Work continues to further isolate toxicants and identify them.

SCHEDULE OF DELIVERABLES:

8092 DUE: 04/30/89 REVISED: 11/30/89 COMPLETED:
REPORT ON USE OF TOXICITY PROFILES FOR AQUATIC IMPACTS AS WASTE LEACHATE
CHARACTERISTICS

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 38
TITLE: Predicting Aquatic Toxicity of HW Constituents and Exposures
PROJECT OFFICER: Russell J. Erickson
PHONE: 780-5534

PROJECT DESCRIPTION:

GOAL: To develop toxic effects models, suitable for assessing aquatic impact of hazardous waste constituents under diverse conditions.

RATIONALE: Standard aquatic toxicology data relate toxicity to a steady water exposure for a fixed duration. Risk assessments are uncertain due to inadequate ability to extrapolate such information to different organisms, chemicals, routes of exposure, durations and environmental conditions. By developing toxic effects models which include accumulation kinetics, link response to accumulation, and adjust for organism, chemical and environmental properties, such extrapolations will be improved.

APPROACH: The relationship of toxic response to accumulation of toxicant and to chemical and organism properties will be evaluated. Kinetic models will be developed which will account for different routes of uptake and elimination, metabolic transformations and internal distribution. The role of accumulation kinetics in governing response to fluctuating concentrations will be tested. Generalized computer-based models will be developed for assessing toxicity of hazardous waste mixtures under diverse conditions.

STATUS AND ACCOMPLISHMENTS TO DATE:

A physiologically based gill model has been refined to accommodate exchange of organic electrolytes and has been tested with some success against additional data sets. Experimental protocols have been developed and tested to allow more complete evaluation of relationships among cardiac output, gill ventilation, oxygen consumption and chemical exchange. Experiments are underway to establish rates of elimination of a set of chlorinated alkanes via various routes in rainbow trout and to support development of better toxicokinetic models. The relationship of chemical accumulation to effects is being reviewed and studies on the utility of kinetic-based effects models for predicting effects of fluctuating concentrations are in progress in cooperation with other projects.

SCHEDULE OF DELIVERABLES:

8091 DUE: 08/31/89 REVISED: COMPLETED:
REPORT ON AQUATIC EFFECTS MODEL FOR FLUCTUATING TRANSIENT EXPOSURES

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 19
TITLE: Field Validation for Hazard Assessment Techniques
PROJECT OFFICER: Richard E. Siefert
PHONE: 780-5552

PROJECT DESCRIPTION:

GOAL: Design approaches to validate current methodologies to measure pesticide impact on non-target organisms in natural aquatic systems. Data generated will be used to design more appropriate tests for hazard assessments.

RATIONALE: Accurate hazard assessments are needed to effectively regulate pesticides. This field research will be used to validate existing freshwater test methods as well as to develop improved field protocols.

APPROACH: Conduct natural pond and lake studies using littoral enclosures to determine the ecological effects of pesticides on the aquatic system. Primary and secondary (ecological) effects will be studied on microbes, algae, microinvertebrates, macroinvertebrates and fish. Environmental chemistry studies will include both water and sediment. Biota recovery studies will be conducted after pesticide application. Results will be combined with information obtained from the literature to improve the accuracy and predictability of pesticide effects by freshwater laboratory methodology, and will provide field testing protocols for use in the pesticide registration process.

STATUS AND ACCOMPLISHMENTS TO DATE:

The first two seasons of field work to develop a field testing protocol using enclosures built in a natural pond were successfully completed. A testing protocol entitled "A Research Design for Littoral Enclosure Studies" has been completed and peer reviewed, and has been accepted by OPP for use as a guidance document for field testing of pesticides. The final report "Field Validation Enclosure Studies on Effects of Pesticides in A Natural Pond" has been completed and sent to OEPER and the Office of Pesticide Programs. Field work and analysis of chemical and biological samples for the littoral enclosure study with the synthetic pyrethroid pesticide, fenvalerate, has been completed and the write-up of the final report is underway. The additional six-enclosure study on the reproductive success of bluegills was successful.

A quantitative ranking scheme has been developed to determine the potential for ecological concern of inert chemicals to freshwater aquatic organisms. The inert chemicals are ranked based on a summation of scores assigned to each of five categories of effect data. Scoring is based upon data in the literature using computer data bases such as the Aquatic Information Retrieval Data Base (AQUIRE). If no literature data are available, values are predicted using

quantitative structure activity relationships (QSARS). The five categories of effect data are: (1) acute toxicity, (2) chronic toxicity, (3) bioaccumulation/bioconcentration, (4) environmental persistence and (5) environmental partitioning. An inhouse work plan has been completed for this project. A computer program is being written to facilitate the retrieval of toxicity data from the AQUIRE data base. SMILES notations (Simplified Molecular Identification and Line Entry System) are being written for the inert chemicals to allow storage, retrieval and modeling of their chemical structures and chemical information in QSAR.

SCHEDULE OF DELIVERABLES:

- 7592 DUE: 06/30/89 REVISED: 09/30/89 COMPLETED:
REPORT ON FIELD VALIDATION OF ENCLOSURE PROTOCOLS FOR EVALUATING
PESTICIDES IN NATURAL WATERS. (N)
- 8122 DUE: 02/25/90 REVISED: 09/30/90 COMPLETED:
Fish Reproductive Success Studies for Littoral Enclosures

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 06
TITLE: Develop Guideline Protocols and Test for BCA Effects
PROJECT OFFICER: Richard L. Anderson
PHONE: 780-5565

PROJECT DESCRIPTION:

GOAL: Develop or improve methods that determine the relationships of biological control agents (BCA) to the health of freshwater ecosystems.

RATIONALE: Ecological risk assessment for a BCA requires information on host range, environmental survival and distribution of the agent, and an estimate of kinds and functions of the populations that may be exposed. This information can be supplied by laboratory, microcosm and field testing. However, well-studied test guidelines and protocols are not available to the people who must produce the data.

APPROACH: BCA are registered through a tiered system of increasing test complexity. Test protocols are needed in all tiers. Our goal is to develop acute and chronic laboratory tests for target and non-target invertebrates and fish and to establish a laboratory microcosm test system that will accurately portray events in outdoor, natural systems. The microcosm data is audited with data from outdoor exposures with the same or surrogate microbes. The acute and chronic test systems extend beyond simple laboratory tests and lethal endpoints and will include techniques necessary to assure that sublethal expressions of BCA and host interactions are measured.

STATUS AND ACCOMPLISHMENTS TO DATE:

Our immediate goal is to develop acute and chronic laboratory tests that expose target and non-target invertebrates and fish to microbes and to establish a microcosm test system that will accurately portray microbe activities in outdoor, natural systems. Our extended goal is to evaluate the predictive capacity of laboratory data in situations where microorganisms are applied.

During the last quarter, activities included research and administration. The administrative activities included completion of the processing of a microcosm cooperative agreement with the University of Minnesota. Hiring and data generation has begun. Research activities included completion of a report for a microbial methods manual that describes the use of the mixed flask culture microcosm in evaluating effects, distribution and survival of biological control agents and several laboratory experiments.

Experiments aimed toward developing testing guidelines for acute and chronic testing of fungi have shown that measuring the "exposure concentration" for non-target animals is complex. Our research is using the entomopathogenic

fungus, *Lagenidium*. The infective stage is an actively swimming zoospore whose life-span can be affected by many physical and biological factors. Understanding the factors that influence the life-span of the zoospore is important because infection is time- and concentration-dependent. Developing a maximum challenge procedure for non-target animals requires an understanding of the time/survival relationships of the infecting organism. We have continued our research to describe how animals affect the survival and distribution of microorganisms added to water. We have recently shown that *Daphnia* rapidly accumulate bacterial spores from water and when placed in spore-free water they will lose the accumulated load. We are determining whether the formulation of the spore affects uptake. We are also evaluating a published report which states that acetate will inhibit the growth of *Bacillus thuringiensis* but not other spores. The report centered on soil bacillus and we are examining its use in water and sediments.

SCHEDULE OF DELIVERABLES:

- 7675 DUE: 10/30/88 REVISED: COMPLETED: 10/30/88
REPORT ON THE DEVELOPMENT AND VALIDATION OF SINGLE SPECIES TEST PROTOCOLS FOR PESTICIDAL AND NON-PESTICIDAL MICROBES. (N)
- 7894 DUE: 10/31/88 REVISED: COMPLETED: 10/31/88
REPORT ON ACUTE AND CHRONIC TEST PROTOCOLS FOR EXPOSING FRESHWATER FISH TO BCA'S.
- 7895 DUE: 11/30/89 REVISED: COMPLETED:
RPT. ON THE EFFECT OF TARGET & NON-TARGET INVERTEBRATES ON THE DISTRIBUTION, PERSISTENCE & VIRULENCE OF BCA IN FRESHWATER MICROCOSMS & NATURAL SYSTEMS.
- 8126 DUE: 08/25/90 REVISED: COMPLETED:
Report: Protocols for exposing freshwater fish and invertebrates to a fungal pest control agent.
- 8236 DUE: 12/31/89 REVISED: COMPLETED:
Laboratory methods for appraising the safety of a microbial pest control agent in freshwater systems

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 32
TITLE: Testing Predictive Models in Laboratory Techniques
PROJECT OFFICER: Frank S. Stay
PHONE: 780-5542

PROJECT DESCRIPTION:

GOAL: Develop protocols to define the uncertainty in ecological risk prediction by testing ecosystem effects models and predictive laboratory techniques, and provide information to improve their efficacy.

RATIONALE: Risk assessment models and laboratory tests are the basis for registration of pesticides and for predicting effects of toxic substances in natural ecosystems. Testing these models with data from field studies will improve their predictive efficacy and reduce uncertainty associated with their use. ERL-D is currently studying effects of pesticides and toxic substances in lakes, ponds, streams, and littoral enclosures. Data from these field studies, which measure the parameters most likely to show effects, can be used to test predictive models and laboratory methods.

APPROACH: Evaluate data from littoral enclosure and ORNL pond studies for testing CASM, other effects models, and predictive laboratory methods (microcosms). Then select data from these and other field studies to test effects Models. These findings will be used to modify data requirements of the models and to improve assessment quality of field studies. The database developed for these tests will be used to evaluate other effects models when they are developed.

STATUS AND ACCOMPLISHMENTS TO DATE:

Manuscripts presented at the Lotic Ecosystem Recovery Workshop have all been reviewed by the editors (Drs. Yount and Niemi). All manuscripts have been revised and are now being prepared for submission to Environmental Management for peer review and publication. Samples from the ORNL pond experiments continue to be processed and entered into the pond database. Patterns of effects on trophic interactions are emerging from the data analysis. The ORNL model programs are now ready for use and modeling efforts will increase as the ORNL database nears completion. The principal investigator, Dr. Bartell, continued to provide technical assistance to the UWS and ERL-D staff on preparations for testing of the CASM model and the littoral enclosure model (CASM with input data specific to the littoral enclosures) with the chlorpyrifos database. Initial runs of the CASM model were conducted to insure that the model is functioning properly. Environmental characteristics of the littoral enclosure and a 96-hr. average ASANA exposure period were used as inputs to the standard model. These runs suggest that the initial biomass values in the model may be too high for northern dimictic lakes with nutrient

regimens similar to littoral enclosures. A third microcosm experiment was started to test the effects of ASANA. Although the zooplankton structure in the first two experiments were different, the results suggest that the LOEL and sensitive community components were similar for both experiments.

SCHEDULE OF DELIVERABLES:

- 7781 DUE: 04/30/90 REVISED: COMPLETED:
Final Report on Resistance and Resilience of Pond Ecosystems to Toxicant Stress
- 8128 DUE: 07/31/90 REVISED: COMPLETED:
Report: The relationship between microcosm and field studies.
- 8214 DUE: 07/31/92 REVISED: COMPLETED:
Report on the relationship between microcosm and field studies

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 40
TITLE: Small Fish to Assess Toxicological Properties of Chemicals
PROJECT OFFICER: Rodney D. Johnson
PHONE: 780-5731

PROJECT DESCRIPTION:

GOAL: To develop and validate methods for using small aquarium fish to assess the toxicological properties of chemicals.

RATIONALE: Validated assays developed on sound toxicological principles which simultaneously provide data on several different endpoints are needed for cost-effective chemical hazard evaluations.

APPROACH: Many in vivo assays used to ascertain the carcinogenic, teratogenic, and reproductive toxicology of synthetic chemicals are very costly. Relatively less expensive assays using small fish have shown promise for establishing carcinogenic endpoints as well as other endpoints associated with reproductive toxicity and teratogenicity. Appropriate exposure techniques and endpoint analysis designed on sound toxicokinetic and toxicodynamic principles will provide useful data about several endpoints. These data can be extrapolated to predict endpoints in other species as well as provide a data base for SAR predictions.

STATUS AND ACCOMPLISHMENTS TO DATE:

Medaka exposures are continuing and our progress to date includes 24 exposures. Of those 24, 4 are in final pathology analysis, 14 are in histological processing, 4 are in the growout unit and 2 are currently in exposure. Preparation of exposed fish for pathology analysis is also proceeding on schedule. Microscopic slides from fish from several assays are currently being studied. Assay responses will be reported as they are completed.

Research to quantify the peroxisome proliferation response in medaka due to DEHP exposure is on track. Fish have been sacrificed for the histochemical procedure. Computer methods for analyzing the slides are also progressing in a timely fashion.

Deliverable #8094A entitled "The medaka carcinogenesis model: February 1989 progress report" has been submitted.

SCHEDULE OF DELIVERABLES:

8094 DUE: 03/31/89 REVISED: COMPLETED: 03/31/89
REPORT ON PRELIMINARY ASSESSMENT OF USING MEDAKA FOR PREDICTING THE
CARCINOGENIC POTENTIAL OF CHEMICALS

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 47
TITLE: Dose Determination in Small Fish for use in Risk Assessment
PROJECT OFFICER: Steven P. Bradbury
PHONE: 780-5527

PROJECT DESCRIPTION:

GOAL: To provide a reliable approach to determine an organism-based dose for small aquarium fish used in bioassays to assess toxicological properties of chemicals.

RATIONALE: The use of small aquarium fish in low-cost bioassays is being developed and validated to provide data regarding a number of endpoints. To provide a toxicologically-sound basis from which to extrapolate results to other species and to perform meaningful environmental and health assessments, the ability to accurately determine an organism dose and to quantify bioactivation capabilities must be developed.

APPROACH: Current bioassays provide little information to permit an evaluation of the dose absorbed by a fish, nor the degree of metabolic activation achieved. Quantification of these factors is crucial to assess responses in carcinogenicity, reproductive and teratogenicity assays. Empirical information will be collected to provide a systematic database of organism dose and metabolic capabilities that directly support bioassay results. These data will be used to validate and perfect predictive toxicokinetic and metabolism models that will provide the required data faster and more cost-effectively.

STATUS AND ACCOMPLISHMENTS TO DATE:

Initially, aromatic amine and nitro compounds were selected as compounds for testing because those materials are being screened for carcinogenic activity in medaka and because of their interest to OTS. Preliminary method development has been initiated with aniline and 4-chloroaniline to assess uptake and elimination constants. Results from these studies are being compared to physiologically based gill uptake models. Preliminary results indicate that the model predictions are in reasonable agreement with independently determined empirical values. In vitro methodology for studying the metabolic activation of primary aromatic amines has also been initiated. Methods have been developed for analyzing the N-hydroxylamine products directly by HPLC and LSC, which provides a means for accurate quantification of this metabolic activation step. Basic methods development for performing microsomal metabolism experiments in medaka and trout is progressing. Optimal conditions (e.g., time, substrate concentration, pH) for studying the N-oxidation of these substrates in both trout and medaka are nearing completion. Additional efforts have also been initiated to study the activation of acetylenic alcohols to better explain and predict their acute toxicity in fish.

SCHEDULE OF DELIVERABLES:

8134 DUE: 09/30/90 REVISED: COMPLETED:
Progress report on determining dose for small aquarium fish used in chronic bioassays.

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 13
TITLE: Structure-Activity Relationships and Estimation Techniques
PROJECT OFFICER: Steven J. Broderius
PHONE: 780-5574

PROJECT DESCRIPTION:

GOAL: To develop comprehensive SAR models for the aquatic toxicology of acute and chronic effects of industrial chemicals. The SAR models address specific and non-specific toxicity mechanisms for new and existing chemicals.

RATIONALE: Less than one percent of the TSCA inventory chemicals are tested and for many of the PMN chemicals no test data exist. To screen for potential effects rapidly, structure-activity methods have been the only technically sound approach. The TSCA inventory is generically categorized and systematic test sets are generated for each important endpoint such as LC50 and growth inhibition. Molecular descriptors are generated for each chemical and mechanism specific structure-activity relationships are derived. The relationships are validated by independent testing and provided to OTS with full documentation.

APPROACH: A systematic reference database for acute and chronic effects of chemicals is being developed for industrial chemicals. This data set is used to develop mechanism-specific SAR models. Representative chemicals for each mechanism are being selected to develop a high quality acute and chronic effects data base which will validate SAR models for survival, growth and reproduction effects in aquatic organisms. QSAR models will be used to help assess the hazard of SARA Title III Section 313 chemicals to aquatic organisms.

STATUS AND ACCOMPLISHMENTS TO DATE:

The theoretical research on predictive toxicology has been delayed while the critical short-term objectives are being addressed. Different computerized modules to be used in the QSAR hazard evaluation of chemicals have been developed and delivered to OTS. The fathead minnow 96-hr acute and 32-day sublethal toxicity data bases currently contain test results on approximately 700 and 100 individual industrial chemicals, respectively. Our in-house research to develop QSAR methods for acute and chronic toxicity of chemicals with specific modes of action is progressing on schedule. The toxic action of chemicals is being defined from physiological type response fish acute toxicity syndromes (FATS), joint toxic action experiments and general toxic symptomatic signs and endpoints. It is assumed that chemicals acting by a common primary mode of action are concentration additive in their joint toxicity. To date we have identified seven different mode-of-action groups. Results from a knowledge acquisition exercise held during a workshop jointly sponsored by OTS/HERD and ERL-D are also being analyzed. We hope to formalize rules for assigning toxic mechanisms to chemical structures and develop a predictive computer-based system to interface with the existing QSAR system to improve estimates for toxic endpoints.

To aid in the analysis of our systematic toxicity test data and in model development, we have built a database containing physical/chemical, lipophilic, electronic, polar, steric, and reactivity properties for approximately 700 chemicals. Regression analysis techniques will be applied to the data to develop structure-activity relationships for toxicants acting by different mechanisms.

A computer program has been developed that allows us to interface the QSAR system with the AQUIRE database. By using this system we are able to develop ecotox profiles for organic chemicals from their CAS number or SMILES notation.

SCHEDULE OF DELIVERABLES:

- 8142 DUE: 05/31/89 REVISED: COMPLETED:
Report: Mechanism-specific QSAR Models for Fathead Minnow acute and chronic toxicity.
- 8143 DUE: 04/29/89 REVISED: 11/30/89 COMPLETED:
Progress Report - Methods to predict toxic mechanisms from chemical structure.

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 46
TITLE: Expert System to Predict the Metabolism of Toxicants
PROJECT OFFICER: Steven P. Bradbury
PHONE: 780-5527

PROJECT DESCRIPTION:

GOAL: To develop an expert system that quantitatively predicts species-specific metabolism of xenobiotics for use in the assessment of environmental and health hazards.

RATIONALE: Predictive systems are currently available that have the capacity to quantify the adverse impact of chemicals. Many times these models grossly underestimate the toxic effects of specific classes of compounds because they fail to recognize that adverse responses may be elicited by activated metabolites. Failure to properly evaluate the metabolism of chemicals of regulatory concern leads to uncertainties in risk assessment that are unacceptably large. This project provides OPP/OTS with an expert system, compatible with current computer-based models, for the consistent, accurate, and rapid prediction of species-specific metabolites for use in subsequent hazard assessment.

APPROACH: An automated program for predicting metabolism will be founded on a knowledge base derived from the literature and experts in the field. Using the database, algorithms will be established to assess the "correctness" of predictions. Development of the model will be a micro-computer environment to enhance the adaptability and accessibility of the system for regulatory use.

STATUS AND ACCOMPLISHMENTS TO DATE:

The current system, developed in a micro-computer environment, contains a database of approximately 190 substructures, with supporting documentation, that incorporates the metabolism of about 30 common functional groups. Results of the model; i.e., predicted metabolites, can be linked to other QSAR models currently in use at OTS/HERD. A preliminary model was delivered to OTS/HERD in May, 1989 for evaluation and expansion of the knowledge base. This activity will permit the model's knowledge base to be expanded and verified faster because of its day-to-day use by program office staff.

SCHEDULE OF DELIVERABLES:

NO DELIVERABLES AVAILABLE

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 49
TITLE: QSAR Models for Chemical Reactivity
PROJECT OFFICER: Gilman D. Veith
PHONE: 780-5550

PROJECT DESCRIPTION:

GOAL: To develop methods to predict the reactivity of toxic industrial chemicals to proteins and DNA.

RATIONALE: Structure-toxicity models adequately predict the toxicity of non-reactive chemicals and those which are not metabolically activated to reactive chemicals. Current techniques are inadequate because models to quantify reactivity are lacking. This project will provide kinetic-based molecular descriptors for chemical reactivity.

APPROACH: Both classical quantum chemistry and new chemometric techniques will be evaluated for their ability to accurately identify reactive centers in toxic chemicals. Rate constants for electrophilic/nucleophilic reactions will be used to select the appropriate parameters. Ultimately toxicity databases will be used to evaluate the predictive power of this approach.

STATUS AND ACCOMPLISHMENTS TO DATE:

The program, CONCORD, has gone through three modifications, each broadening the capabilities to handle difficult structures. This program is the technology breakthrough EPA needed to study chemical reactivity. It has been released to industry under University of Texas-Austin copywrite. Extensive evaluations showed that the software computes accurate 3-dimensional structures in comparison to x-ray data. Moreover, the computation of charge density on all atoms in the structure can be done in seconds rather than hours. These advances open new possibilities for modeling hydrogen bonding which controls the toxicity of more than 20 percent of the industrial chemicals.

This project has developed a multi-wavelength, high pressure liquid chromatographic technique to identify the electrophile/nucleophile reaction products. This technique has proven extremely powerful in discriminating among the reactivity mechanisms which result in increased toxicity of electrophiles and pro-electrophiles. Moreover, ample evidence now exists to demonstrate that conventional wisdom for modeling electrophiles is incorrect, particularly with respect to building empirical reference sets for reactivity parameters. This project has initiated work on a new approach which models reactivity as concurrent, competing reaction rates with model nucleophiles.

SCHEDULE OF DELIVERABLES:

7915 DUE: 10/31/89 REVISED: COMPLETED:
REPORT ON METHODS TO COMPUTE REACTIVITY PARAMETERS FOR ELECTROPHILES

8243 DUE: 07/31/89 REVISED: COMPLETED:
Unified QSAR Strategy for Predictive Ecotoxicology and Initial Environmental
Risk Assessments

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 31
TITLE: Methods to Predict Susceptible Populations and Communities
PROJECT OFFICER: Steven J. Broderius
PHONE: 780-5574

PROJECT DESCRIPTION:

GOAL: Use information from laboratory studies to develop methods to predict susceptible aquatic populations, use microcosm and natural systems to test predictions, integrate these models into existing ecosystem effects models, and test these effects models using a database of field studies.

RATIONALE: Ecorisk assess. models require effect inputs that are generally not available at the present time. In addition, uncertainties associated w/risk assessment approaches have not been estimated. Predictive models that specify susceptible populations must be developed to provide the initial effect inputs. Population susceptibility models, & risk assess. approaches in general, must be validated against empirical field data to quantify uncertainty.

APPROACH: Initial efforts will include reviews of lab methods and data to predict susceptible populations & available field studies to test models. Methods for studying comparative bioenergetics (to predict toxicant uptake), xenobiotic metabolism, & toxic mechanisms are being developed to fill data gaps. These data will be used to evaluate methods to cluster susceptibility parameters & to computerize a species & community toxicant-specific ranking system for risk assessment. A field study database will be established to test model predictions.

STATUS AND ACCOMPLISHMENTS TO DATE:

Computerized databases have been developed for organism parameters related to toxicological response, including respiration, cardiovascular function and metabolism. Application and analyses of these databases to predict susceptibility and identification of additional parameters useful for predicting susceptibility are in progress.

Laboratory-based methods are being applied to empirically develop a toxic mode of action database. Using joint toxicity theory for chemical mixtures and an assessment of fish acute toxicity syndromes, chemicals that are associated with nonpolar narcosis, polar narcosis, oxidative phosphorylation uncoupling, respiratory membrane irritation (reactive-toxicity) and acetylcholinesterase inhibition are being defined. Efforts are continuing to differentiate additional modes of action with insecticides and industrial chemicals.

SCHEDULE OF DELIVERABLES:

7470 DUE: 07/31/89 REVISED: COMPLETED:
Report on Biological Data Base for Risk Assessment

- 8145 DUE: 01/31/89 REVISED: COMPLETED: 01/31/89
Report: Comparison of laboratory microcosms and natural pond responses to Dursban.
- 8215 DUE: 07/31/91 REVISED: COMPLETED:
Report on the biological data base for supporting freshwater risk assessment models

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 25
TITLE: Watershed Manipulation Project
PROJECT OFFICER: John G. Eaton
PHONE: 780-5557

PROJECT DESCRIPTION:

GOAL: Determine the early indicator, as well as later, more dramatic chemical and biological responses of a warmwater bass lake to acid additions causing 0.5 pH unit reductions (from 6.0 to 4.5) every other year; evaluate the current state of the art of predicting acid effects; use results to substantiate assessments of impacts inferred from lab or survey data; obtain mechanistic data needed for acid effects modeling; evaluate the use of lab data for predicting acid effects on fish populations in the field.

RATIONALE: Experimental studies on whole ecosystems are a powerful technique for determining acid effects; very few such studies have been conducted; chemical and biological results will be relatable to conditions in lakes elsewhere in the U.S. and Canada; mechanistic data result in stronger models than correlative data; no lab data validation studies have been conducted for low pH.

APPROACH: Acidify one-half of a clear, warmwater, low alkalinity lake in northern Wisconsin after dividing it with a removable plastic barrier; reduce the pH over 6 years after a 2-year baseline study; compare extensive preacidification effect predictions with observed results; conduct lab bioassays to help elucidate organism- and population-level acid effects, and to explore organism-level sublethal response indicators.

STATUS AND ACCOMPLISHMENTS TO DATE:

The first summer of acidification to pH 4.5, the lowest pH planned during the project, began with H₂SO₄ addition to the treatment basin immediately after ice-out. The intensity and breadth of effects on all trophic levels seen at pH 5.1 over the previous two years is expected to increase. Functional or process level effects, which have been minimal so far, are expected to become more evident. Reports of biological and chemical changes at pH 5.1 were submitted as scheduled in fulfillment of milestone 8225A, "Report on two years of Little Rock Lake acidification at pH 5.1." Presentation and publication of findings continues; these data will be used in the 1990 assessment.

SCHEDULE OF DELIVERABLES:

8225 DUE: 04/30/89 REVISED: COMPLETED: 04/30/89
Report on two years of Little Rock Lake acidification at pH 5.1

8226 DUE: 05/31/91 REVISED: COMPLETED:
Little Rock Lake Acidification Project Final Report

3RD QUARTER STATUS REPORT
ERL-DULUTH

PROJECT SYNOPSIS

NUMBER: 50
TITLE: Great Lakes Support for Superfund
PROJECT OFFICER: William Richardson
PHONE: 313/675-7704

PROJECT DESCRIPTION:

GOAL: Develop methods to predict the impact of hazardous waste sites on the water quality and ecosystem of the Great Lakes. Determine allowable discharges from sites based on acceptable risk.

RATIONALE: Hazardous waste disposal sites within the Great Lakes Basin are suspected of contributing significant mass loadings of toxics to the Lakes. Because of long detention times and bioaccumulation, impacts on the ecosystem are greater than might be expected in other systems. Superfund programs require guidance to establish acceptable discharge levels for specific sites.

APPROACH: An interdisciplinary approach will be used to develop, apply, and verify models to simulate and predict the longevity and biological impact of toxic substances leaking from waste sites.

STATUS AND ACCOMPLISHMENTS TO DATE:

The final report was submitted to OEPR and to Region II in May. Presentation of the project was made at the 1989 International Association for Great Lakes Research Conference in Madison, WI on May 31, 1989.

SCHEDULE OF DELIVERABLES:

8246 DUE: 06/30/89 REVISED: COMPLETED:
Report on Model of TCDD for Lake Ontario

U.S. Environmental Protection Agency
Great Lakes National Program Office
GLNPO Library