

Fiscal Year 1991 Program Report



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Fiscal Year 1991 Program Report
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The U.S. Department of the Interior
Geological Survey

By

The D.C. Water Resources Research Center
University of the District of Columbia
Washington, D.C. 20008

Dr. H. M. Watt
Director

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ABSTRACT

The FY91 Institute Final Program Report describes the completed projects funded by the D.C. Water Resources Research Center (D.C. WRRC), between August 1, 1991, and July 31, 1992. All the research projects funded in this year's program dealt with the Anacostia River and with the urban land use impact on the surface water and the ground water in the District of Columbia. These projects are summarized below.

The "Urban Land Use" project examined in detail the different land use activities in D.C. Using computerized information systems the investigators provided an estimate of the vulnerability of the D.C. ground water from different land use activities. There is a lack of information on the identity and quantity of the organic and inorganic contaminants present in the District ground water. The project entitled "Development of New Techniques for Rapid Identification of Pollutants in Ground Water" attempted to resolve this problem, by assessing the level of pollutants from the surrounding jurisdictions which rely on ground water as a source for drinking water. The project entitled "Field measurement of Ground Water and River Water Levels, and Calibration and Verification of the Ground Water Numerical Model" was based on a predictive mathematical model using newly available technology to be used as a management tool for the ground water resources of the District of Columbia. This numerical model is able to predict the response of the ground water resource relative to different uses and pollution sources through appropriate calibrated and verified modeling techniques.

The lower Anacostia River basin in the District of Columbia has little benthic life. Toxicity of sediment was found at several locations. Conventional analysis of sediment priority pollutants was not able to positively identify the causes or sources of sediment toxicity. The research objective of this year of the project was to attempt to correlate variations in sediment toxicity with concentrations of ammonia in sediment, and rain events. Sediment ammonia concentrations appeared inversely related to rainfall events in July, which had two-thirds normal total rain.

During the same period the Center completed phase II of the projects entitled: "Ground Water Assessment in the District of Columbia" and "Urban Stormwater Management and Sediment Control Clearinghouse". These projects were funded by the Environmental Control Division (ECD) of the D.C. Department of Consumer and Regulatory Affairs (DCRA).

In addition to the above the Center is involved with information dissemination, public outreach and advisory services to the D.C. government. A dozen seminars, workshops, and field trips were organized. The Center also published four issues of its newsletter "The Water Highlights" and other public outreach materials. About thirteen students from different fields of academic studies participated in the Center's activities and research projects.

WATER PROBLEMS AND ISSUES IN THE DISTRICT OF COLUMBIA

For more than a decade, the DC Water Resources Research Center, in setting priorities for water research in the District of Columbia, has focused on measures to support the improvement of the Anacostia River water quality. The WRRC has approached the problem in two major directions; the Anacostia River clean-up and the overall impact of non-point source pollution on the surface and the ground water.

The water quality of the Anacostia River and its tributaries remains poor. These water bodies are frequently characterized as neighborhood nuisances. In fact, the Anacostia Watershed suffers from chronic problems of dumping, sewage leaks, combined sewer overflow, erosion, and sedimentation. The major cause of the Anacostia River pollution comes from non-point source pollutants. Non-point source pollutants are those contaminants that are carried away by heavy rain and cannot be traced to a specific source. The non-point source pollution creates significant problems to urban areas. These concerns about the Anacostia River water quality have led policy makers and citizen interest groups to coordinate their efforts toward the restoration of the Anacostia River. The District of Columbia's government, the Montgomery County and the Prince George's County have organized to restore the Anacostia River. A plan prepared by the Anacostia Restoration Team of the Metropolitan Council of Governments presents six goals. The six goals are as follows: reduce pollutant loads to tidal estuary, restore ecological integrity of streams, restore habitat for fish, restore and enhance wetlands, restore and expand forest cover, and increase public involvement.

The local agencies have performed a number of research projects in the Anacostia Watershed. The research studies have given scientific and technical information to the restoration team. Studies are directed towards the identification of critical water quality problems and trends, the assessment of pollution loading and the evaluation of the restoration projects.

The restoration research accomplishments include: the investigation of the dynamics of the bottom sediments, the automated storm monitors to estimate urban pollutant loads generated during storm events, the field assessment of the effectiveness of sediment traps, and the coordinated Anacostia monitoring plan for the long-term monitoring of the core stations.

DCRA and other agencies have conducted extensive sampling programs on the river. These programs reveal that there are high levels of contaminants in the bottom sediments. These are: PCB, DDT, DDE, Chlordane, Petroleum Hydrocarbons and trace metals. These contaminants have also been detected in fish tissues. Over the years, the Center has also contributed to the understanding of the Anacostia River processes. Close to 50% of all the projects funded have studied the Anacostia River.

The Center's research projects dealt with several aspects of the river's water quality including; non point source pollution, chemistry, biology and physical processes, sedimentation and management.

However, the problems are not limited to surface water alone. Pollutants also affect the groundwater in different ways. In urban areas, the pollutants originate from many activities including; materials spilled on parking lots and highways, chemical applications to golf courses, business and residential landscapes, and construction activities which result in soil disturbance. The toxic nature of these urban pollutants is a major concern. Two aspects of urban land use that require special consideration are the pollution potential of historic land uses and the impact of residential areas. The threat of pollution resulting from previous land uses is not readily apparent and little understood. Cemeteries, abandoned railways and inactive dumps are not obvious hazards, yet they may be a continuous source of contaminants. Identifying and quantifying the risk they pose should be the first step in addressing this problem. Additionally the impact of residential areas on ground water quality can be significant. The cumulative effect of inadequate past management practices in residential neighborhoods may be greater than that of single sources, yet there have been no studies thus far, to recognize its extent.

The Anacostia River

- One of the big problems the River recently experienced was the oil spill (January 20, 1992). Fortunately the Stuart Petroleum Company and the U.S. Coast Guard started clean up immediately so that the leaving resources wouldn't be too affected.



PROGRAM GOALS AND PRIORITIES

A. PROGRAM GOALS

The basic goal of the DC WRRC is to conduct, stimulate and support water and water related research in the District of Columbia. The DC WRRC program considers research of either basic or practical nature, or both, in relation to water resources problems. The center's broad focus includes research on water quality and quantity and institutional and management related water resources problems.

Research to support the Anacostia River restoration efforts have remained the major focus of the Center during the past year. Not only do the research projects themselves address the Anacostia River but the public outreach, information dissemination and training activities all are designed to effectively support a better understanding of the Anacostia River.

In addition to research, both formal and informal meetings with representatives of federal, local and private agencies are frequently held to review the Center's current program and to discuss potential research ideas. The Center also provides a forum for exchange of information between scientists, managers, experts and the general public on subjects pertinent to land and water resources. It engages in a broad range of activities to raise the level of awareness of the general public concerning water issues through publications, seminars, field trips and exhibits. Finally, the Center assists management agencies and other experts in keeping abreast of the latest water research developments.

B. PROGRAM PRIORITIES

The FY 1991 DC WRRC's research program priorities are described below:

- 1) - - Anacostia River Research, which includes:
 - a. Study of flow dynamics and sedimentation processes in Anacostia estuary funnel (hydrodynamics of river flow and wave/tidal energy)
 - b. Study of physical, chemical and biological sediment characteristics in estuary funnel (threat to water quality from toxic/nutrient release, shipping channel depth, etc.); also: possible impacts of dredging on toxic/nutrient release from sediments
 - c. Study of sediment distribution/siltation along Anacostia; (determine areas of high deposition/input; correlate with urban runoff dynamics; develop sediment reduction strategies under source reduction aspect)
 - d. Study of floatable debris distribution along Anacostia (determine areas of accumulation; correlate with urban runoff dynamics;

develop trash reduction strategies under source reduction aspect: ° locate target areas for public education efforts)

- e. Study of ground water/surface water interaction: establish monitoring wells to determine degree of interaction (temporal variations in ground water levels due to tidal impact, level of base flow, pollutant input from ground water in low and high flow periods (shallow water tables adjacent to Anacostia may be contaminated and releasing pollutants into river);
 - f. Study of role of "forgotten" Anacostia tributaries (partly sewerred), potential for recreational or ecological use, water quality, protection/restoration potential
 - g. Feasibility study of recreational potential along Anacostia and tributaries.
- 2) - - Investigation of mechanisms that influence non-point source pollutants, including erosion and sedimentation.
 - 3) - - Characterization, localization and accumulation of toxins and hazardous substances threatening surface water quality.
 - 4) - - Studies on undesirable effects of urbanization and land use policies on water quality from development projects.
 - 5) - - Investigation of physical, chemical and biological parameters controlling ground water quantity and quality.

RESEARCH PROJECT SYNOPSES

The fiscal year 1991 research projects described on the following pages are:

Urban Land Use Activities and the Ground Water: A Background Survey. Dr. Fred Chang, Prof. O'Connor and Ms. Schneider, The University of the District of Columbia

Development of New Techniques for Rapid Identification of Pollutants in Ground Water. Dr. Akbar Montaser, George Washington University

Field Measurements of Ground Water and River Water Levels and Calibration and Verification of the Ground Water Numerical Model. Dr. H.P. Pao, The Catholic University of America

Identifying Sediment Toxicity in the Anacostia River.
Dr. Harriette Phelps, The University of the District of Columbia

SYNOPSIS

PROJECT NUMBER:

02

START: 08/91 END: 07/92

TITLE:

Urban Land Use Activities and the Ground Water:
A Background Survey of the District of Columbia

INVESTIGATORS:

Chang, Fred M.; O'Connor, James V.; Wade, Clarence,
Watt, Hame M. and Schneider, Jutta DC Water Resources
Research Center-University of the District of Columbia

FOCUS CATEGORIES:

GW, WQL, WQN, M&P, EDU

CONGRESSIONAL DISTRICT:

District of Columbia

DESCRIPTORS:

Ground water quality, ground water movement, ground
water management, urban land use, urban water systems,
Geographic Information System, pollution control, District
of Columbia

PROBLEM AND RESEARCH OBJECTIVES:

While ground water is not used as a drinking water supply in the District, it is nevertheless necessary to understand the impacts of land use activities on the ground water and to alert citizens to the less obvious hazards associated with indiscriminate ground water pollution. Contaminated ground water seeping into basements presents a risk to private citizens. Construction workers and sump pump engineers may be subject to health hazards if construction pits or sumps fill with contaminated ground water. Discharge of contaminated ground water into surface water bodies endangers the water quality of the Potomac and Anacostia Rivers and ultimately the Chesapeake Bay. It also poses a health risk to District residents that use these waters for recreation or fish as food supply. Ground water as a potential emergency drinking water supply for the District will be lost if this valuable resource is not protected. Contamination of the interstate Potomac Group aquifer also poses a threat to the drinking water supply of neighboring counties.

Because the primary drinking water source in the District of Columbia is surface water, information regarding urban ground water quality and quantity is scarce. The need for management and protection of ground water has only recently been

recognized. Two hundred years of unchecked disposal practices are now being called to account by city agencies.

With the high possibility of contaminated ground water flowing into local streams, basements and construction pits, and the threat to the interstate aquifer, a detailed study of D.C.'s ground water and how it is affected by land usage is required.

The research focussed on available land use and ground water quality data to identify and locate the common sources of ground water contamination. The main objective was to develop pollution potential maps that will aid in preparing monitoring programs, management plans and regulations for the prevention and control of ground water contamination.

METHODOLOGY:

The multitude of data required for this project were compiled using a Geographic Information System (GIS). GIS maps were developed for hydrogeologic settings, land use categories, specific urban pollution sources, and voting wards.

To determine ground water vulnerability based on hydrogeologic setting, a modified DRASTIC approach was applied. The modifications were necessitated by the limitations of data and software availability. Factors included in the analysis were recharge, depth to water/topography, aquifer media, soil media and vadose zone media. The resulting indices were displayed as a ground water vulnerability map.

Land use data were selected according to their suitability in scale and time, because not all classification systems matched the requirements of this project. Weight and ranking factors for various land use and pollution source categories were determined by a Delphi approach. The findings were augmented by a survey of 30 environmental professionals. The final result of this analysis was a pollution potential map.

Analysis of potential ground water pollution was conducted in two ways: based on physical boundaries (hydrogeologic settings) and political boundaries (voting wards). The pollution potential map combined with the ground water vulnerability map allowed the city-wide assessment of probability of ground water contamination. A transparent map of voting wards can be overlaid and used to educate residents on environmental conditions in their neighborhood.

PRINCIPAL FINDINGS AND SIGNIFICANCE:

Contaminant migration in urban ground water flow systems is difficult to assess because subterranean effects of urban land use are superimposed on the natural flow

regime. Utility and subway lines form obstacles in the ground water flow paths shaped by natural gradients. De-watering activities affect both flow behavior and ground water quantity. During well installation for a centralized ground water monitoring program, it was found that water levels in some locations were significantly lower than expected. An assessment of both ground water depletion and current flow paths must be undertaken in order to obtain the information necessary to predict contaminant migration patterns.

The probability of ground water contamination varies greatly across the city. The area with the highest pollution potential based on general land use categories is the industrial corridor. However, its location atop an area with low ground water vulnerability makes its impact most likely negligible. Areas with high probability of ground water contamination, i. e. with high ground water vulnerability and high pollution potential, are scattered throughout the downtown area and towards the eastern part of the city. However, the District of Columbia averages five potential pollution sources per square mile. The high density illustrates the need to incorporate point sources in urban investigations, because using general land use classes alone may lead to an underestimation of the pollution potential in a specific area.

Two aspects of urban land use that require special consideration are the pollution potential of historic land uses and the impact of residential areas. The threat of pollution resulting from previous land uses is not readily apparent and little understood. Cemeteries, abandoned railways and inactive dumps are not obvious hazards, yet they may be a continuous source of contaminants. Identifying and quantifying the risk they pose should be the first step in addressing this problem. The impact of residential areas on ground water quality can no longer be ignored. The cumulative effect of bad management practices in residential neighborhoods may be greater than that of single sources, yet there are no attempts to recognize its extent. The age of a neighborhood, as a major characteristic of urbanization, could be a useful indicator in determining residential areas with higher pollution potential.

Assessing ground water conditions by physical or political boundaries, using the GIS developed in this background survey, presents a viable approach to increasing awareness of the complex urban hydrologic cycle. The GIS maps can be used by city planners to establish environmental equity, to educate citizens on the interrelationship between ground water and urban land use activities and to design and implement ground water protection strategies.

Urban Land Use Activities and the Ground Water

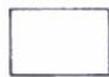
Probability of Ground Water Contamination

Explanation

Ground Water Vulnerability

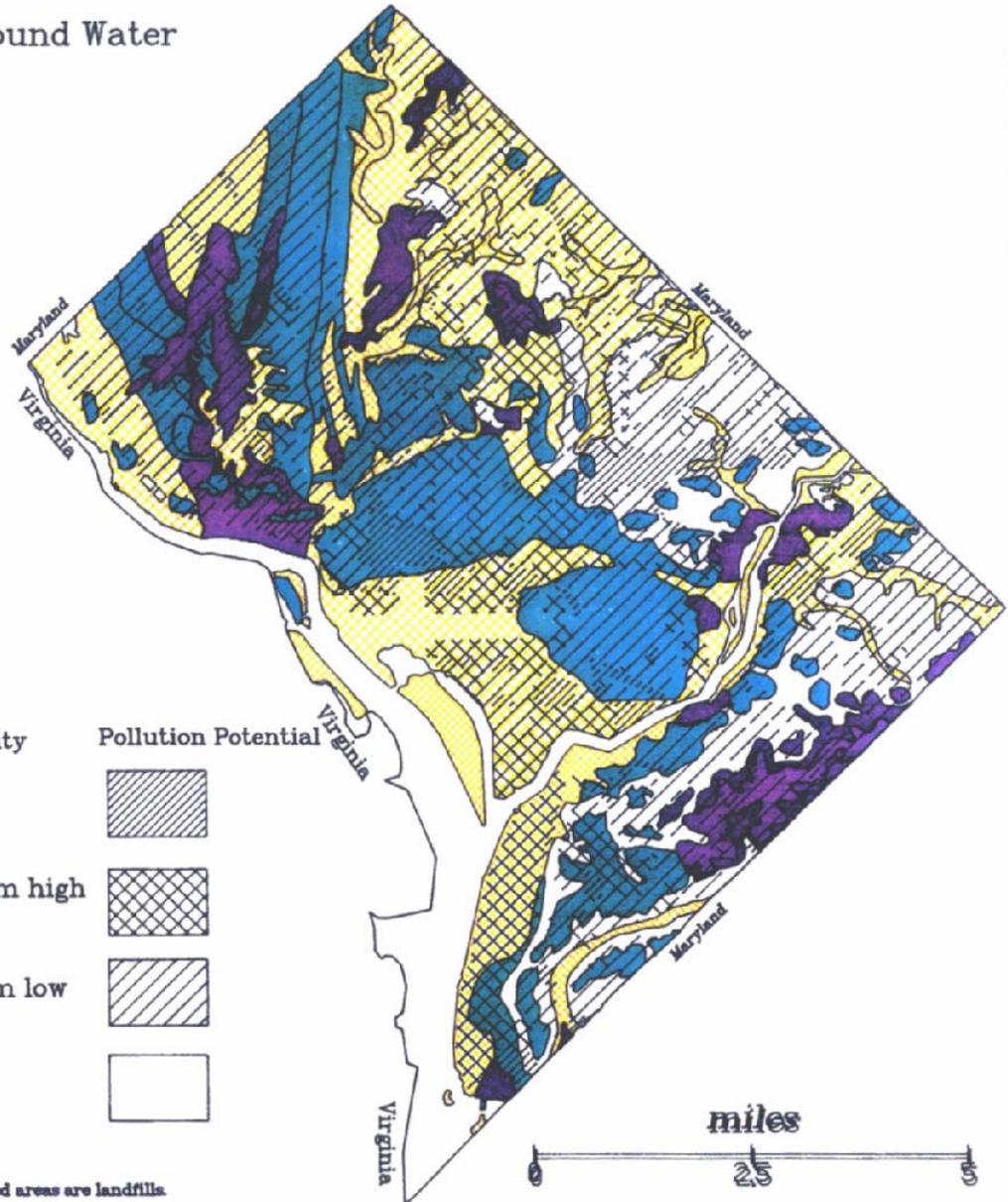
- | | |
|---|-----------------|
|  | 1 = high |
|  | 2 = medium high |
|  | 3 = medium low |
|  | 4 = low |

Pollution Potential

- | |
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|  |
|  |
|  |

WRR 1992

Note: Darkened areas are landfills.



SYNOPSIS

PROJECT NUMBER: 03

START: 08/91

END: 07/92

TITLE: Development of New Techniques for Rapid Identification of Pollutants in Ground Water

INVESTIGATORS: Montaser, Schmidt, Perros, and Caress, George
Washington University

FOCUS CATEGORIES: GW

CONGRESSIONAL DISTRICT: District of Columbia

DESCRIPTORS: Plasma source mass spectrometry; trace elements; water analysis; groundwater

PROBLEM AND RESEARCH OBJECTIVES:

The overall objective of this research program is to identify and quantify contaminants present in the ground water of the District of Columbia (DC). A comprehensive data base on the quality of DC ground water is needed to: 1) explore the prospects of extensive use of the DC resources for emergency and nonemergency situations, and 2) assess the level of pollutants that might affect aquifers of the surrounding counties relying on ground water as a drinking water source. To conduct these studies efficiently, new techniques are developed for identification and quantification of the pollutants. These techniques allow us and others to improve sensitivity, reliability, ease of operation, and reduce the cost of analytical determinations. These studies also contribute to the preparation of suitably trained scientists to strengthen the research programs in ground water analysis.

METHODOLOGY:

This project constitutes the second phase of an earlier project initiated on August 1, 1990. In general, argon and helium inductively coupled plasmas (Ar ICP, He ICP) were coupled either to a quadrupole-based mass spectrometer (MS) or an atomic emission spectrometer (AES) for the measurements of inorganic contaminants.

Most of the studies conducted in the second year were focused on He ICP-MS as a new tool for the sensitive detection of nonmetals. The instrumental arrangement used in these studies included a quadrupole mass spectrometer coupled to a solid-state, crystal-controlled 40.68-MHz ICP system. Atomic emission studies were conducted with an Ar ICP fed by sample aerosol produced by ultrasonic nebulizers (USN). For these studies, the applicability of a low-cost, humidifier USN (HB-USN) for foods and ground water analysis we explored. In addition, particle-size distribution produced by an HB-USN, a thermospray nebulizer-membrane separator (TNMS), and a pneumatic nebulizer (PN) were measured by using differential mobility particle sizer.

PRINCIPAL FINDINGS AND SIGNIFICANCE:

A number of interrelated investigations were conducted on He ICP-MS for the injection of aqueous aerosol. Because our previous studies had indicated the presence of an intense secondary discharge between the plasma and the mass spectrometer, various approaches were used to reduce the intensity of the interfering discharge. The most effective approach was the use of a non-conductive sampler. Sub parts-perbillion detection limits were measured for difficult-to-ionize elements such as As, Se, and I. A low cost HB-USN was successfully used for the multi-element detection of pollutants in ground water using an Ar ICP-AES system. In a related study, the differential electromobility technique was applied to the measurement of droplet- and particle size distributions in the 0.01 to 0.8- μm range for this and other nebulizers used in ICP spectrometry. Among the nebulization systems investigated, thermospray nebulization produced the largest volume of submicron particles. The pneumatic nebulizers and the frit-type nebulizer produced aerosols that exhibited smallest geometric volume mean diameter.

SYNOPSIS

PROJECT NUMBER: 04

Start: 08/91

End: 10/92

TITLE: Field Measurements of Groundwater and River Water Levels and Calibration and Verification of the Groundwater Numerical Model.

INVESTIGATORS: Pao, Hsien P. and Ling, S.C., The Catholic University of America, Washington, DC

FOCUS CATEGORIES: GW, SW

CONGRESSIONAL DISTRICT: District of Columbia

DESCRIPTORS: Groundwater assessment, surface water levels, measurement, instrumentation.

METHODOLOGY:

The primary objective of this project is to use the newly available technology to carry out field measurements of groundwater and river water elevations accurately, reliably, automatically, and at an affordable cost. These baseline information will be used as inputs to the groundwater numerical model for calibration and verification. In addition, the data of the surface elevation of the Anacostia River will be useful for the study of the water quality and related problems of erosion and sedimentation along the River.

a) Summary of previous results.

1) Automated bubbler gauge. A bubbler tide gauge had been selected as the gauge for the measurement of both groundwater and river water levels for this project. The pneumatic bubbler gauges are widely used for water level measurements by the National Ocean Service (NOS) in coastal waters, and by U.S. Geological Survey (USGS) in the inland waters and estuaries.

2) Low-pass traveling-wave filter for noise attenuation. The key innovation here is the development of an effective low-pass traveling-wave filter for the pressure waves along the transmission line. With proper design, the filter damps out the noise above a selected cut-off frequency. The results of mathematical model simulation led to the development of an effective low-pass filter, which is analogous to the traveling wave filter in modern radio and television sets. In the gauge hardware this was implemented by a coil of micro-bore plastic tubing.

3) Design and fabrication of the new automated bubbler tide gauge. Based on the results of theoretical and experimental investigations, a completely new bubbler gauge had been designed and fabricated for this project. The new gauge is equipped with a high precision pressure transducer, a properly designed filter coil, a leakage-proof tubing system, and an automated data acquisition and control unit. Thus the gauge is completely automated and compatible with many standard digital data-acquisition systems. The recorded digital data can easily be transferred to any PC computer for further processing and analysis.

4) Laboratory testing. Laboratory tests of the new prototype water level gauge had been carefully carried out, using our unique tide simulator. The tide simulator can give a water level fluctuation with a period of 12 hours.

b) Continuation of laboratory testing of the gauge.

The tide gauge has been checked with respect to accuracy, stability, and reliability. The gauge was finally tested before the field installation. The high-precision Paroscientific Digiquartz pressure transducer with temperature correction is highly accurate which provides a water level resolution better than 1 mm.

c) Laboratory demonstration of the new advanced automated bubbler tide gauge.

A laboratory demonstration of the new gauge was taken place in our laboratory at The Catholic University of America on November 20, 1991. Over twenty engineers and scientists in the neighboring institutions, such as U.S. Geological Survey, D.C. Water Resource Research Center, Water Resources Management Division of D.C. Government, Corps of Engineers of U.S. Army.

d) Site selection for field installation of the gauge.

Considerable amount of effort was made to select a suitable site for the location of the new gauge, with input from various organizations. Several considerations and requirements for a proper site are: (1) The location must be a secure place so that the gauge will not be stolen or damaged; (2) Along the river bank, there should be a pier, pile or vertical wall, so that the gauge outlet tubing can be securely fixed; (3) It should be in a straight portion of the River; and (4) The gauge is operated on a small battery, thus no A.C. power source is needed. However, for future data transmission through a modem, an A.C. power supply and a telephone line nearby would be desirable. The final site selection was chosen which was located inside PEPCO Benning Generating Station on Anacostia River within District of Columbia.

e) Field installation of gas outlet orifice.

A copper cup which is used as a gas outlet orifice has been designed and

fabricated. It was so designed that the positive pressure error contributed by the frictional effect is essentially- cancelled by the negative pressure error due to the tube breathing effect. The gauge and the gas outlet orifice were installed on August 13, 1992 at PEPCO Benning Generating Station, together with a nitrogen gas cylinder for filling the nitrogen in the pressure transmission line. The elevation of the bottom of the copper cup is 8 ft - 11 3/4 in below the top of PVC pipe. The nitrogen gas was turned on August 21, 1992 and the electronic data logger was activated for automatic data recording at a rate of 6-minute interval.

f) Data transfer and analysis.

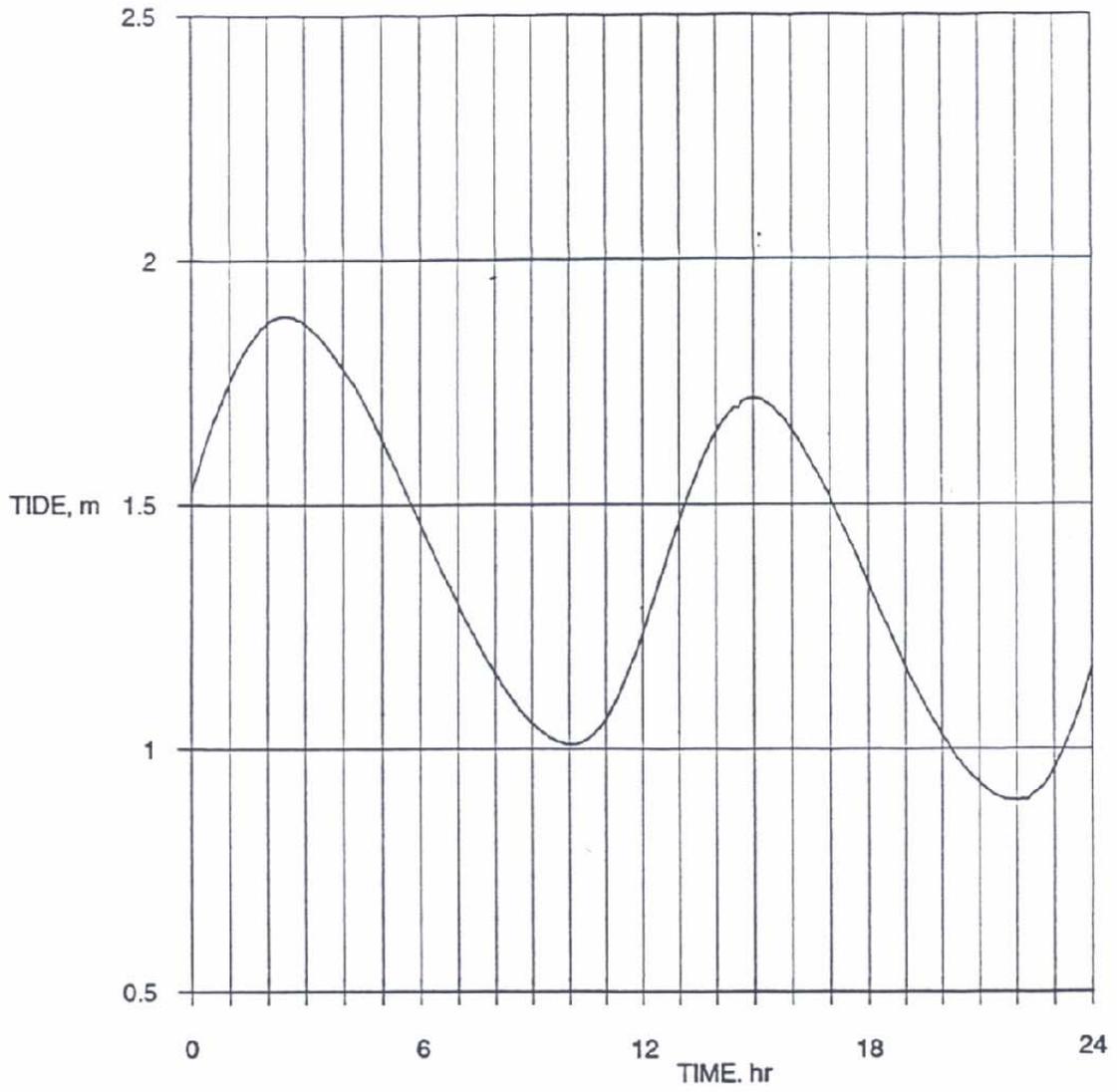
Data is to be transferred once a month. The first data transfer took place on September 24, 1992. The data has been converted from pressure readings to water levels. A daily water level profile was plotted. The quality of the data appears to be excellent. In order to relate the local water levels to the standard bench mark elevation provided at the PEPCO station by the U.S. Geodetic Survey, a surveying was performed using a leveling instrument for that purpose. Unfortunately, the surveying result was not accurate enough so that another leveling survey must be performed later. Nevertheless, the gauge and recording device have been working flawlessly for almost two months. It is planned that the data will be transferred once a month for a continuous operation of 12 months.

PRINCIPAL FINDINGS AND SIGNIFICANCE:

Present tide monitoring systems of both NOAA and U.S. Geological Survey are not sufficiently accurate for the measurement of sea slope and long term variation of mean sea-level. It is very difficult to evaluate the trend of yearly change in the mean sea-level based on existing gauges having basic precision of typically ± 0.001 meter under worst environmental conditions. The present automated bubbler tide gauge, however, meets the above requirements. The gauge is equipped with an acoustic traveling-wave filter that can cutoff wind-generated wave and swell signals and pass all low-frequency storm-surge and tide signals. By preconditioning the tide signal, one can avoid the error due to a stilling well and large data sampling under high sea-states.

Stilling well or protective well may be subject to the following errors: (1) Nonlinear waves, (2) Breaking waves, (3) Solitary waves, and (4) Currents. All of them are related to nonlinear effects. Moreover, the present gauge does not require a stilling or protective well. Therefore, the errors associated with the above nonlinear effects are eliminated.

BENNING RD POWER STATION 08/22/92



Bubbler Tide Gauge System - The Catholic University of America

1. Tide Gauge Box:

Dimension: 31 cm x 41 cm x 17 cm
Weight: 30 lbs
Major components: Digital data recorder, use a 9-V battery no external power source Digiquartz pressure transducer Low-pass travelling-wave filter (coil) Valves and copper tubings.

Wall mounted; the box is water tight.

2. Nitrogen (compressed) Cylinder:

Dimension: 3-feet length, 20-inch diameter
Weight: 80 lbs
Maximum pressure: 2000 psi

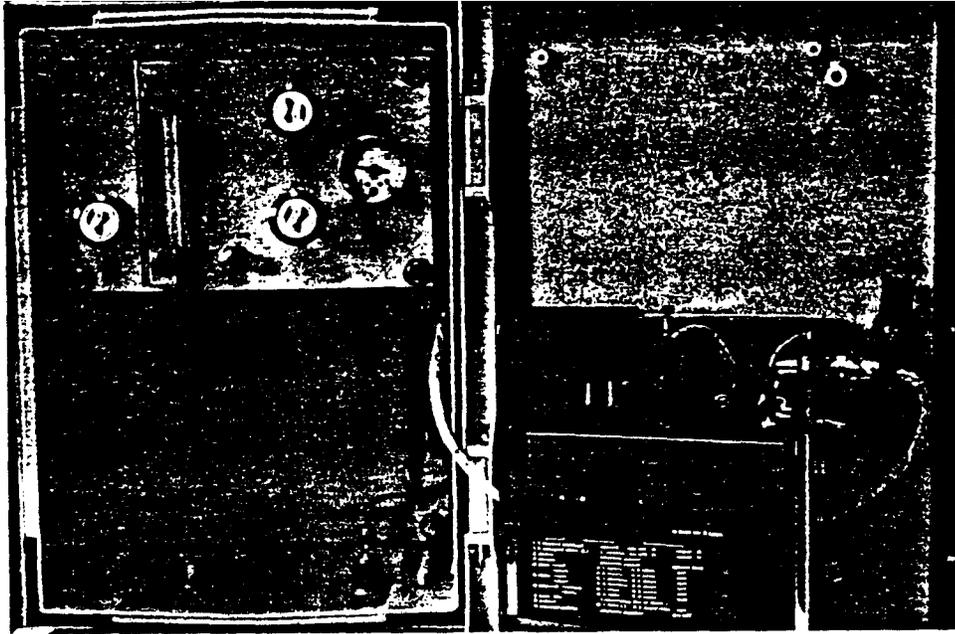
Attached to wall

3. Gas Transmission Tubing and Outlet Orifice

3/8-in O.D. plastic tubing, about 40 ft long
1-1/2 in PVC protective tube, 8 ft long
3-in diameter copper outlet cup.

The gauge box and nitrogen cylinder will be installed inside the building with a gas-transmission tubing extending 6 feet below the water surface. Digital tide data are recorded automatically every six minutes and transferred to a PC computer once a month. The 9V battery will be replaced every other month. The nitrogen gas in the cylinder will last about six months. The gas outlet copper cup placed in the water should be inspected and cleaned at least once a year for marine growth. Clean more often, if marine activities are high at the site.

(a)



(b)

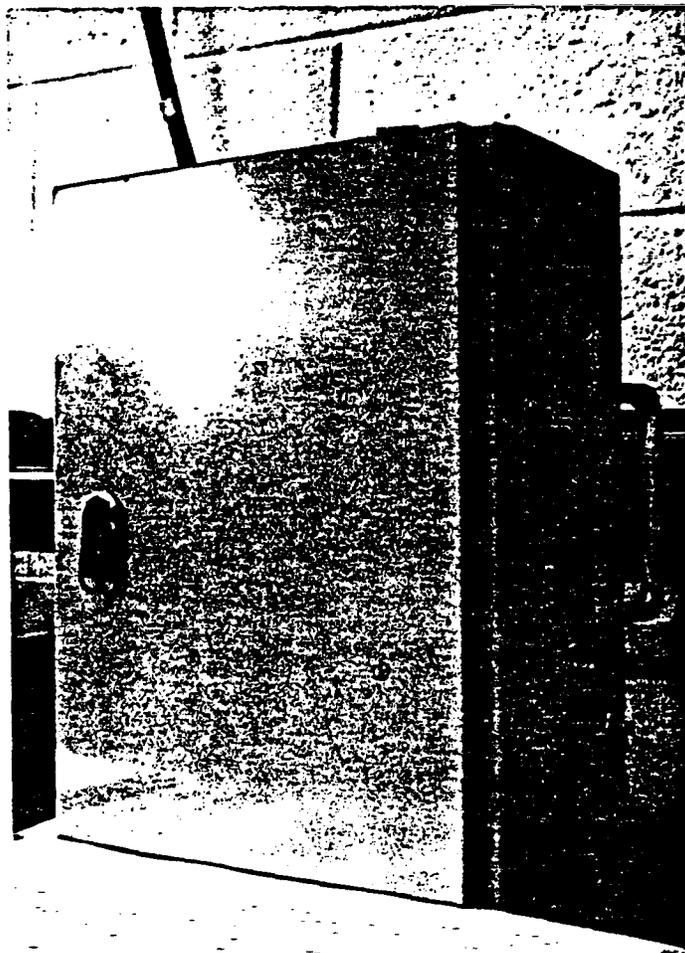


Figure 8. A picture of the prototype of the new automated tide gauge.
(a) Open position; (b) Closed position.

SYNOPSIS

Project Number: Start: 10/91
End: 10/92 (expected)

Title: Identifying Sediment Toxicity in the Anacostia River

Investigator: Dr. Harriette L. Phelps, University of the District of Columbia,
Washington, DC

Focus Categories: NPP; SED

Congressional District: District of Columbia

Descriptors: Benthos, biomonitoring, estuaries, shellfish, toxic substances

Problem and Research Objectives:

The lower Anacostia River basin in the District of Columbia has little benthic life. Toxicity of sediment was found at several locations but was absent at some times. Conventional analysis of sediment EPA priority pollutants was not able to positively identify the causes or sources of sediment toxicity. The first year of this project found ammonia in sediment was related to bivalve larvae mortality by using a Corbicula larva bioassay. Ammonia builds up in sediment over time due to organic decomposition. The residence time of water in the Anacostia basin is from several days to weeks. The research objective of this year of the project was to attempt to correlate variations in sediment toxicity with concentrations of ammonia in sediment, and rain events.

Methodology: Numerous samples of sediment were taken from an easily accessed site known to have variably toxic sediment, the Washington Navy Yard pier. Sediment samples were taken near the end of Pier #2 with a six-inch Ekman dredge, along with Secchi disc depth readings. Control sediment was taken from the mid-Potomac River at Rosier Bluff. Sediments were extracted with water (1:25) and elutriates analyzed for ammonia concentration using Dry-Tab (Aquarium Pharmaceuticals Inc., Chalfont, PA).

The sediment samples were to be bioassayed using orbic I clam larva. Larvae would be obtained from adult Corbicula gathered from the nearby Potomac River during the July spawning season. They would be placed in tissue culture wells with filtered (75P) sediment for 96 hours, removed by filtration, and numbers of surviving clam larvae counted. A second sediment bioassay was performed with adult Corbicula using burrowing speed inhibition as endpoint. Ten adult Corbicula were placed on 500 gm sediment and the number burrowed noted at intervals up to two hours. Logit analysis was used to calculate ET50 (Effective Time for 50% burrowing) for this bioassay.

Principal findings and significance:

Sediment ammonia-concentrations appeared inversely related to rainfall events in July, which had two-thirds normal total rain (Figure 1).

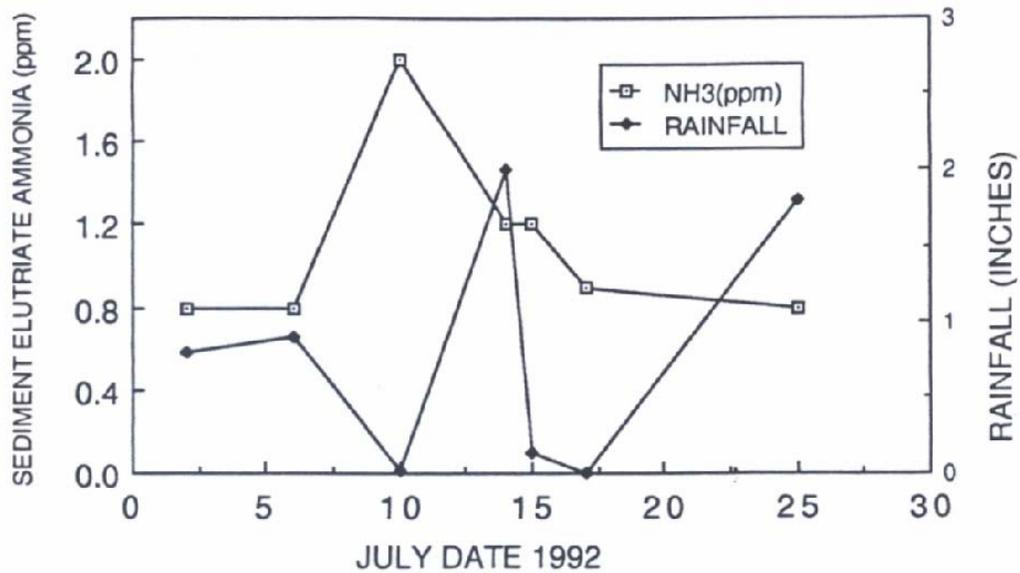


Figure 1. July rainfall and sediment elutriate ammonia concentrations.

Secchi disc depth was also inversely related to rainfall but there was no significant correlation with sediment elutriate ammonia concentrations (Figure 2). Secchi disc depth could not be used to predict sediment ammonia concentrations.

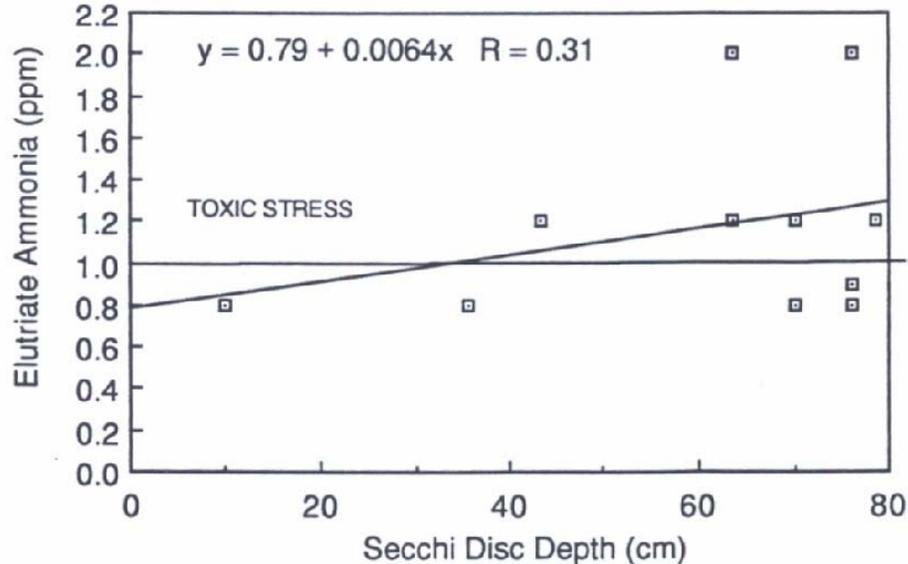


Figure 2. Secchi disc depth and sediment ammonia levels at Washington Navy Yard.

Ammonia concentrations in Navy Yard sediment elutriates ranged from 0.8 to 2.0 ppm NH_3 from late June to mid August (Fig. 3). Fish mortality can occur above 1 ppm NH_3 . However, sediment elutriates were extracted at 1:25 (sediment:water) and actual levels of ammonia in sediment may have been much higher. The sediments may have been toxic to infaunal benthic organisms at all the measured elutriate concentrations.

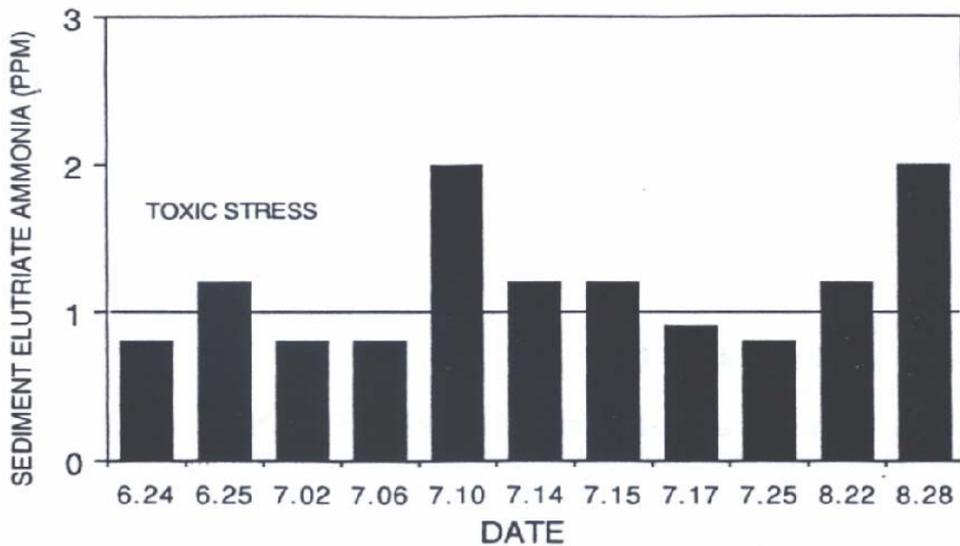


Figure 3. Ammonia concentrations in Washington Navy Yard sediment elutriates June-August 1992.

There were problems with the Corbicula larva bioassay. This summer there was very low reproduction and not enough viable larvae to conduct bioassays. This condition may be related to a fall 1991 reproduction failure in Corbicula. This was suggested by a July Potomac population survey which found only one population peak rather than the two normally present from biannual spawning.

The one burrowing bioassay conducted with adult Corbicula found no significant difference in burrowing speed between control sediment and Navy Yard sediment with 1.2 ppm elutriate ammonia. Apparently, burrowing behavior is not sensitive to sediment conditions that may be toxic to larvae, probably because these adult clams are filter feeders and have limited exposure to sediment interstitial water.

INFORMATION TRANSFER ACTIVITIES

A. Principal Activities

Information and technology transfer activities conducted and /or sponsored by the WRRC during FY 1991 continued many of the refinements and enhancements to programs begun the previous year. In addition, a number of new programs and initiatives were begun in response to both local government and regional area requirements such as the Chesapeake Bay Program and the Interstate Commission for the Potomac River Basin. The Center was also recognized by its peers through election of Dr. Watt, WRRC Director, to chairmanship of the Mid Atlantic Region and member of the Executive Board of the National Institutes of Water Resources.

Center sponsored research and related information dissemination for the scientific community was expanded considerably during FY 1991 through continuing WRRC leadership responsibility over a consortium of local universities undertaking a three year Ground Water Assessment/Study of the District of Columbia funded by the D.C. government for the USEPA. The first phase of the study was completed last year. The second phase including drilling of wells for monitoring is well underway and will be completed this year.

The Center also continued to take the initiative in forging coalitions with local, state, federal government agencies, educational institutions, and regional agencies and advisory bodies to solve water resources management problems and to promote improved public understanding of water related environmental issues.

These included: Strengthened collaboration with the D.C. Department of Consumer and Regulatory Affairs through conducting a D.C. Ground Water Study, undertaking management of a new D.C. Storm Water Clearing House project, and cone initiation of a feasibility study for the establishment of a joint D.C. government/WRRC corn Environmental Laboratory; provision of assistance to the D.C. Public Works plan Department in assessing research plans and regulatory requirements for air and water publ at the Blue Plains Sewage Treatment Facility; assistance to the Interstate Commission for the Potomac River Basin in devising an assessment of Anacostia River research B. needs, proposals to institute minority business enterprise policies and programs and the establishment of graduate and undergraduate student internship programs; sponsorship of scientific critiques of current water management issues for the benefit UDC of local and state government officials and members of the Congress; playing a key and pivotal role in assisting the Chesapeake Bay Program management in designing and executing policies and programs to correct problems associated with serious Racn under representation of ethnic and racial groups in Bay program participation; assisting Marl the Maryland Water Research Center in evaluating its project proposals and close Dep, support to other Institutes and Centers in the Mid Atlantic region in joint program planning; collaboration with EPA, Howard University, the US Small Business

Administration in producing a joint exhibit and consultation at an Annual Environmental Career Conference and Job Fair; and the continued sponsorship of public tutorials and tours of local rivers and streams in collaboration with local community action groups.

The Center continued for the Sixth year to sponsor Special Awards for Water Research which are presented to student finalists in the annual D.C. Science Fair. Additionally, student winners were offered opportunities to work directly with professional mentors to refine their projects for future regional and national science fair competition.

The Center worked closely with the Chesapeake Bay Scientific and Technical Advisory Committee (STAC) through chairmanship of a special Work Group on Human Resources charged to study and report on the issue of under representation of ethnic and racial minorities and women within state and federal government agencies affiliated with the Bay program. Continuing efforts by the Center through presence on the key executing group in the Bay program serves to expedite the implementation of policy initiatives and the Action Plan to extend participation in the Chesapeake Bay Restoration Program to all previously underrepresented groups including the urban and rural poor.

The Center continued to assist the Alliance for Space, Science and Technology and an affiliated network of local and regional groups whose goal is to bring about a dramatic increase in African-American participation in the science and engineering professions.

Center accomplishments also included the publication and distribution of scientific reports, proceedings, newsletters and brochures and the planning and convening of symposia, seminars, field trips, exhibits, and demonstrations. The Center plans to make use of the newly established university cable station to augment its public environmental program range and impact.

B. Presentations and Meetings

November 1991. DC WRRC sponsored a Seminar by Dr. Clarence Wade of the UDC Chemistry Department entitled, "A DC Stormwater Screening Survey".

March 1992. DC WRRC sponsored a Seminar entitled, "Designing Ethnic and Racial Diversity - the Chesapeake Bay Program: A Case Study". Panelists included; Mark M. Bundy, Maryland Department of Natural Resources, Lucenia Dunn of the DC Department of Consumer & Regulatory Affairs and James H. Hannaham from WRRC

April 1992. DC WRRC sponsored a Symposium entitled, "Water Research at the University of the District of Columbia". The following papers were presented:

"Ground Water Assessment of the District of Columbia" by Dr.H. M.Watt

"Drilling Into the District of Columbia Water World" by Professor James V. O'Connor & Mr. Norris Etienne

"The Anacostia River" by Dr. Victoria Guerrero

"Litter Layer Productivity and Decomposition" by Mr. Winston Corona & Ms. Isidoro Carranza

"An Environmental Study of Melvin Hazen Park" by Ms. Kathleen Robinson

"A Survey of Street Drainage Inlets in the District of Columbia" by Dr. Fred M. Chang & Mr. Julius Elui

"A Preliminary Study for the Identification of Sediment Toxics in the Anacostia River" by Dr. Harriette L. Phelps

"A Stormwater Screening Survey of the District of Columbia" by Dr. Clarence Wade

"Effect of Lime and Sludge on Metal Content of Vegetables" by Dr. James R. Preer

"Citizens Attitudinal Survey on the District of Columbia Water Resources" by Dr. Y.Choi & Dr. H. Azani

"Pesticide Applications and Effects on Water Quality and Urban Reforestation in the Anacostia River Watershed" by Dr. Maurice Dorsey

"Urban Land Use Activities and the Ground Water" by Ms. Jutta Schneider, Dr. Fred Chang, Dr. Clarence Wade and Professor James V. O'Connor

"Storm Water Clearing House Project" by Dr. Hamd M. Watt

"The Forgotten Tributaries of the Anacostia River in the District of Columbia" by Professor James V. O'Connor & Mr. Norris Atienne

"Local and Regional Perspectives on Water Resources Technology Transfer" by Mr. James H. Hannaham - A proceedings of the Symposium is in preparation.

During FY 1991, the Center began the video recording of its sponsored seminars,

symposia and workshops for future telecasting on the university's newly established cable television station. In addition, the Center began a regular submission of planned meetings and conferences scheduled in the Washington, D.C. to the university cable station for telecasting on its Bulletin Board.

- 1) Staff members of the Center have participated and /or attended a number of conferences, meetings and seminars including those sponsored by the following:
 - o Interstate Commission on the Potomac River Basin (ICPRB);
 - o The Washington Metropolitan Council of Governments (COG);
 - o The Chesapeake Bay Restoration Program Scientific and Technical Advisory Committee (STAC) and the Multicultural Work Group of the Communications Subcommittee
 - o The National Association for Equal Opportunity in Higher Education (NAFEO);
 - o D.C. Soil and Water Conservation District Commission;
 - o The Congressional Black Caucus Symposium on Science and Technology;
 - o National and regional meetings of the National Water Resources Institutes Directors;
 - o U.S. Soil Conservation Service, Department of Agriculture;
 - o American Water Resources Association (AWRA)
 - o National Science Foundation (NSF);
 - o American Society for Public Administration (ASPA);
 - o National Black Public Administrators Foundation;
- 2) The Center has arranged meetings and /or had consultations with a number of agencies on matters of mutual interest pertaining to D.C. water problems and issues including:
 - o D.C. Department of Consumer and Regulatory Affairs regarding environmental management/water research priority issues and the work of the Center's Research Advisory Council;

- o D.C. Department of Public Works regarding requirements for environmental research and planning support for the Blue Plains Treatment facility;
- o The science and engineering faculty of several local universities who are coalition partners in the conduct of an ongoing three year assessment of groundwater in the District of Columbia;
- o Office of Technology Assessment (OTA) and the National Science Foundation regarding education and scientific manpower issues impacting the minority community;
- o Department of Health and Human Services (HHS) regarding urban environmental impacts;
- o U.S. Department of Labor, Bureau of Labor Statistics and the US Census Bureau regarding implications of demographic trends on environmental manpower training and education;
- o American Association for the Advancement of Science regarding future trends in environmental manpower training and education and their impact on underrepresentation of minorities and women in the workforce;
- o The Interstate Commission for the Potomac River Basin and the Soil Conservation Service regarding establishment of internships for undergraduate science and engineering majors;
- o Ohio Central State University regarding cooperative projects underway with the International Water Resources Institute;
- o At the University of the District of Columbia to strengthen and expand on cooperative research and education projects with the Agricultural Experiment Station and the Cooperative Extension Service.
- o With the USAID regarding arranging of special itineraries of foreign government water management officials visiting counterpart institutions and facilities throughout the U.S. and exploration of prospects for the Center to provide technical assistance to prime USAID contractors in the areas of training and project development overseas.

- o Collaboration and cooperation with the D.C. Public Schools Environmental Education Administration regarding promotion of pre college and teacher training institutes in environmental science education;
 - o The National Wildlife Federation in developing and expanding in areas of cooperation to promote public awareness and understanding of natural environmental problems and issues;
- 3) The Center has also visited other institutions and agencies to improve information exchange and to strengthen its overall program. These have included:
- o Water Institute in West Virginia
 - o Environmental Protection Agency (EPA)
 - o Maryland Department of Natural Resources
 - o Science and Engineering departments of all local universities
 - o National Institutes of Water Resources national and regional conferences and meetings
- 4) The Center has also reviewed a number of federal reports for local government agencies and local universities and has contributed to the Interstate Commission for the Potomac River Basin (ICPRB) and the Scientific and Technical Advisory Committee (STAC) and its various working groups and subcommittees and other advisory groups such as the Local Government Advisory Committee and the Alliance for the Chesapeake Bay.

Newsletters:

During FY 1991, the Center published regular newsletters containing timely information on District government, regional and federal water resources agencies, professional organizations, water policy issues, science programs for students and other related activities in the Washington metropolitan area.

The newsletters also reported on completed and ongoing water research projects sponsored by the Center, highlighted seminar programs, briefed on District and local government and regional water agency missions and functions, announced special water events, meetings and conferences, and listed vacancy announcements and publications received.

COOPERATIVE ARRANGEMENTS

The Center continued during FY 1991 to emphasize activities relating to development of joint cooperative efforts with D.C. government and other local agencies.

These activities were in part inspired by revised bilateral and multilateral river (Anacostia) and related Chesapeake Bay restoration policies and related planning and implementing actions which provided vehicles for accelerated interaction between WRRC and a multitude of participating agencies and organizations.

Noteworthy among these efforts was:

- o Joint planning with the DCRA for a cooperative project proposal to establish a Water Quality Laboratory.
- o Numerous meetings and consultations with the Interstate Commission on the Potomac River Basin (ICPRB) and staff regarding joint projects.
- o Agreement with the D.C. Department of Consumer and Regulatory Affairs to establish and direct a clearing house for storm water management data and information for the District.
- o Greatly increased participation of staff and interaction with the Chesapeake Bay Restoration Program's Scientific and Technical Advisory Committee, other affiliates and consultations relating to a new initiative to broaden participation in the Bay program.
- o Continued execution of a grant funded study and assessment of ground water in the District of Columbia involving a consortium of four universities (Howard, George Washington, Catholic and University of the District of Columbia).
- o Provision of advice and assistance to local citizens and environmental groups seeking to expand their knowledge of water and other environmental issues and problems in the District.

The Center continues to officially represent the government of the District of Columbia on the following major regional bodies:

- The Interstate Commission on the Potomac River Basin (ICPRB).
- The Chesapeake Bay Consortium.
- The-Chesapeake Bay Restoration Program's Scientific and Technical Advisory Committee and newly established mechanisms to implement region wide initiatives to broaden participation in the Bay program.
- The D.C. Soil and Water Conservation District Commission.
- The Center has cooperative agreements for research with the following:
 - The Department of Civil Engineering of the University of the District of Columbia for a research project entitled "Urban Land Use Activities and the Ground Water: A Background Survey".
 - The Department of Chemistry of the George Washington University for a research project entitled "Development of New Techniques for Rapid Identification of Pollutants in Ground Water ".
 - The Department of Civil Engineering of the Catholic University of America for a research project entitled "Field Measurements of Ground Water and River Water Levels and Calibration and Verification of the Ground Water Numerical Model".
 - The Department of Chemistry of the American University for a research project entitled "Isolation and Fraction of Humic Substances from Environmental Matrices by Supercritical Fluid Extraction".
 - The Department of Chemistry of the American University for a research project entitled "Bryozoans as Indicators of Water Quality in the Washington Area".

A current list of members of the D.C. Water Resources Research Center Research Advisory Council and the Technical Evaluation Committee is provided below:

Research Advisory Council

Ms. Ferial S. Bishop
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D.C. 20020

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Mr. Robert Stanton
Regional Director
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Washington, D.C. 20042

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Mrs. Dorothy Barton
Division of Curriculum & Educational Technology
Langdon Elementary School
20th & Franklin Streets, N.W.
Washington, D.C. 20018

Technical Evaluation Committee

Dr. Edward H. Bryan
Program Director, National Science Foundation
Washington, D.C.

Mr. Mark Bundy
Resources Economist, Maryland Department of Natural Resources
Annapolis, MD

Dr. Frederick Carson
Associate Professor, The American University
Washington, D.C.

Dr. Benedict T. DeCicco
Professor, The Catholic University of America
Washington, D.C.

Dr. F. Chang
Chairman, Department of Engineering and Computer Science University of the
District of Columbia - Washington, D.C.

Mr. Robert Ford
Environmental Resources Management, US National Park Service
Washington, D.C.

Dr. J. Jones
Professor, Environmental Science
University of the District of Columbia - Washington, D.C.

Dr. J. Girard
Professor, The American University - Washington, D.C.

Mr. Timothy Karikari
Engineer, Soil Resources Branch, DC Depart. Cons. Regul. Affairs
Washington, D.C.

Dr. Kenneth Mountford
Chesapeake Bay Program, US Environmental Protection Agency
Annapolis, MD

PUBLICATIONS AND PRESENTATIONS

- 1) Presentation at the UDC Symposium on Water Resources Research, 28 April 1992. Urban Land Use Activities and the Ground Water: A Background Survey. Washington, D.C.
- 2) Presentation to be given at the GSA Annual Meeting , Urban Land Use Activities and the Ground Water: A Background Survey. Cincinnati, Ohio 26 - 29 October 1992.
- 3) Final Report to be submitted to the DC Water Resources Research Center, University of the District of Columbia. Urban Land Use Activities and the Ground Water: A Background Survey. Washington, DC, 1992
- 4) Montaser, H. Tan, I. Ishii, S. Nam, and S. Cai, "Argon Inductively Coupled Plasma Source Mass Spectrometry with Thermospray, Ultrasonic, and Pneumatic Nebulization"
- 5) R.H. Clifford, H. Tan, H. Liu, A. Montaser, "Submicron Particle-Size Measurements with Electromobility Techniques; Comparison of Aerosol from Thermospray, Ultrasonic, Pneumatic and Frit-Type Nebulizers"; Submitted to Spectrochim Acta.
- 6) S. Nam, W. Masamba, and A. Montaser, "Helium Inductively Coupled Plasma-Mass Spectrometry for Analysis of Aqueous Samples"; in preparation for publication in Analytical Chemistry.
- 7) S. Nam, W. Masamba, H. Zhang, and C. Hsieh, "Recent Studies on Helium Coupled Plasma Mass Spectrometry"; presented at the FACSS Meeting, Philadelphia, September 1992.
- 8) H. Liu and A. Montaser, "Food Analysis by inductively Coupled Plasma-Atomic Emission Spectrometry with a Low-Cost Ultrasonic Nebulizer; presented at the FACSS Meeting, Philadelphia, September 1992.
- 9) Watt, H.M., J. Hannaham. Special Water Resources Outreach Programs. DC WRRC No.108. Paper presented at the International Symposium on Hydrology and Water Resources and Training: The Challenges to Meet at the Turn of the XXI Century. Chihuahua, Chih., Mexico. April 15-19, 1991.
- 10) The D.C. Water Resources Research Center, December 1991. Directory Of Organizations. DC WRRC Report No.109. D.C. Water Resources Research Center, Washington, D.C.
- 11) The D.C. Water Resources Research Center, 1990-1991. FY 90 Annual Report. DC-WRRC Report No. 110(MFD). D.C. Water Resources Research Center, Washington, D.C.

- 12) The D.C. Water Resources Research Center, January 1992. DC WRRC Capabilities Statement. DC WRRC Report No. 111. D.C. Water Resources Research Center, Washington, D.C.
- 13) The D.C. Water Resources Research Center, January 1992. DC WRRC Publications List. DC WRRC Report No. 112. D.C. Water Resources Research Center, Washington, D.C.
- 14) The D.C. Water Resources Research Center, January 1992. DC WRRC Training Accomplishments DC WRRC Report No. 113. D.C. Water Resource Research Center, Washington, D.C.
- 15) The D.C. Water Resources Research Center, January 1992. List of Seminars/Conferences. DC WRRC Report No. 114. D.C. Water Resources Research Center, Washington, D.C.
- 16) Kargbo, Dave, December 1991. Proceedings on "An Agenda for Black Universities and Colleges in the XXI Century". DC WRRC Report No. 115. D.C. Water Resources Research Center, Washington, D.C.
- 17) The D.C. Water Resources Research Center, January 1992. Glossary of . Water Terms. DC WRRC Report No. 116. D.C. Water Resources Research Center, Washington, D.C.
- 18) The D.C. Water Resources Research Center, September 1991. DC WRRC 1991-92 Program. DC WRRC Report No. 118. D.C. Water Resources Research Center, Washington, D.C.
- 19) The D.C. Water Resources Research Center, January 1992. Anacostia Fisheries. DC WRRC Report No. 119. D.C. Water Resources Research Center Washington, D.C. (In Preparation)
- 20) The D.C. Water Resources Research Center, January 1992. Background Lead in Drinking Water in Washington, D.C. DC WRRC Report No. 120. D Water Resources Research Center, Washington, D.C.
- 21) The D.C. Water Resources Research Center, February 1992. Dry Weather Field Screening of Stormwater Outfalls in the District of Columbia. DC WRRC Report No.121. D.C. Water Resources Research Center, Washington
- 22) The D.C. Water Resources Research Center, March 1992. FY 92 Water Research Institute Program. DC WRRC Report No.122. D.C. Water Resources Research Center, Washington, D.C.
- 23) The D.C. Water Resources Research Center, January 1992. Project Plan Assessment of The Impact of Non-Point Source Pollution on The Ground Water in The District of Columbia (Group B Wells). DC WRRC Report No. 123. D.C. Water Resources Research Center, Washington, D.C.

- 24) The D.C. Water Resources Research Center, January 1992. Project Plan-Assessment of The Impact of Non-Point Source Pollution on The Ground Water in The District of Columbia (Group A Wells). DC WRRC Report No.124. D.C. Water Resources Research Center, Washington, D.C.
- 25) The D.C. Water Resources Research Center, August 1992. Urban Land Use Activities and the Ground Water. DC WRRC Report No .125. D.C. Water Resources Research Center, Washington, D.C.
- 26) The D.C. Water Resources Research Center, August 1992. Ground Water Monitoring. DC WRRC Report No.126. D.C. Water Resources Research Center, Washington, D.C. (In Preparation)
- 27) The D.C. Water Resources Research Center, August 1992. Ground Water Drilling Field Operations. DC WRRC Report No. 127. D.C. Water Resources Research Center, Washington, D.C. (In Preparation).
- 28) The D.C. Water Resources Research Center, August 1992. Urban Stormwater Clearinghouse. DC WRRC Report No. 128. D.C. Water Resources Research Center, Washington, D.C.
- 29) The D.C. Water Resources Research Center, October 1992. Combined Work/Quality Assurance Project Plan for the Ground Water Assessment Study in Washington, D.C. Phase III. DC WRRC Report No. 129. D.C. Water Resources Research Center, Washington, D.C.
- 30) The D.C. Water Resources Research Center. D.C. WRRC FY 1991 Program Report. DC WRRC Report No. 130. D.C. Water Resources Research Center, Washington, D.C.
- 31) The D.C. Water Resources Research Center. Urban Land Use and Ground Water Vulnerability; An approach to Environmental Equity. DC WRRC Report No. 131. D.C. Water Resources Research Center, Washington, D.C.

SPECIAL RECOGNITION AWARDS/ NOTABLE ACHIEVEMENTS

Leadership Washington's April Program on "The Environment"

The D.C. WRRC Director, H.M. Watt was among panelists at a special program organized by "Leadership Washington" and held on April 14, 1992, at Blue Plains Waste Water Treatment Facility, 5000 Overlook Ave., S.W. Washington, D.C. The "Leadership Washington" is a non-profit, education organization founded to develop a diverse network of leaders throughout greater Washington with a broad understanding of the community's needs. The organization brings together, often for the first time, selected individuals who are proven leaders in their communities or in the region. Dr. Watt addressed the Non-Point Sources of Pollution issues in the District.

The DC WRRC takes Fankof Institute High School students to the Tributaries of the Anacostia

The DC WRRC staff and Ms. Ama Alford, teacher at the Fankof Institute took about 0180 a dozen students to the Tributaries of the Anacostia River. There the students enjoyed the sites and collected samples of water, which they analyzed later on at the lab facilities of the College of Life Sciences, UDC. The Center as well as the Fankof Institute were very pleased with the students' reaction. The field trip was very Okgr enjoyable and informative. A video of this activity was produced.

Water Resources Center Presents Special Awards to D.C. Students

The D.C. Water Resources Research Center, for the sixth consecutive year, presented Special Awards Certificates and prizes for the best water research projects developed by student participants in the 46th D.C. Science Fair at an Awards Ceremony, March 22, 1992 at the Woodson Senior High School.

The Center was congratulated by the D.C. Public Schools for such consistent work in helping our youth.

TRAINING ACCOMPLISHMENTS

<u>Field of Study</u>	<u>Academic Level</u>			<u>Total</u>
	<u>Undergraduate</u>	<u>Master's Degree</u>	<u>Ph D. Degree</u>	
Chemistry	2			2
<u>Engineering:</u>				
- Agricultural				
- Civil	1	3	1	5
- Environmental	2	2	2	6
- Soils				
- Systems				
- Other *				
Geology				
Hydrology	1			1
Agronomy				
Biology	1			1
Ecology				
Fisheries, Wildlife and Forestry				
Computer Science	1			1
Economics	1			1
Geography				
Law				
Resources Planning	1			1
Other (Business Mgmt)	1	1		2
Total	11	6	3	20

* Less than 5 students in any one field

POSTGRADUATE EMPLOYMENT

Please complete this form by placing an "X" under the applicable columns for positions taken by postgraduate students.

Employer								
Degree Government								
Student	BS	MS	Ph.D.	Federal	State	Local	Private Sector	College Univ.
1	X						X	
2	X	X						X
3		X			X			
4		X						X
5		X			X			

Fiscal Year 1991 Program Report
Grant No. 14-08-0001-G2011

For

The U.S. Department of the Interior
Geological Survey

By

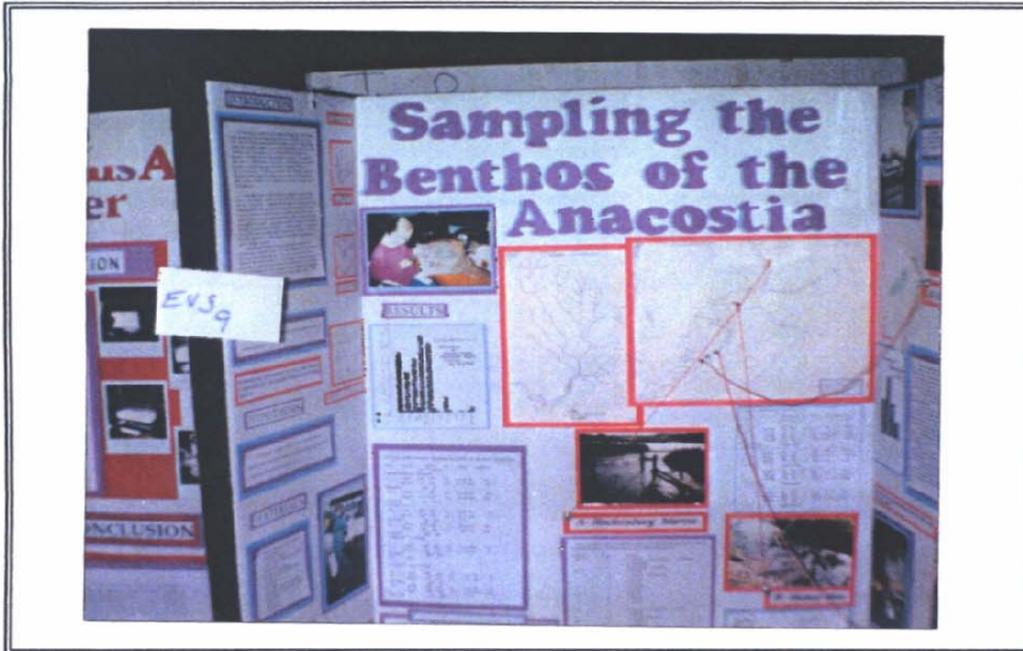
The D.C. Water Resources Research Center
University of the District of Columbia
Washington, D.C. 20008

Dr. H.M. Watt
Director

October 1992

The activities on which this report is based were financed in part by the Department of the Interior, U.S. Geological Survey, through the D.C. Water Resources Research Center.

The contents of this publications do not necessarily reflect the views and policies of the Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement by the United States Government.



Winning Presentation at D.C. Science Fair



The Anacostia River; What can we do to preserve it??



Fankok High School Students Performing Tests on Anacostia River Waters Collected in Field Trip

