# APPALACHIAN RIVERS II CONFERENCE & EXHIBIT

July 28 & 29, 1999

USDOE, Federal Energy Technology Center
Conference Room and Exhibit Center
3610 Collins Ferry Road, Morgantown, WV 26507-0880

JAN WACHTER, Co-Chairman: (Welcome and opening remarks.)

L. ZANE SHUCK, Co-Chairman, and Founder
Hello, and Welcome to Appalachian Rivers II Conference and Exhibit. I would like to tell you a little bit about this conference, and then give you my own perspective on technology and methodology as applied to the study of streams and rivers and their ecosystems. But first, I would like to give special thanks to those who made this conference possible this year. First, to my good friend and co-chairman, Jan Wachter, it has been great working with you on this conference, and thank you very much for your many contributions, and the FETC for hosting the conference here this year. Second, I would like to especially thank Kim Yavorsky, Betty Robey, Lorraine Alvarez, Pam Stanley, Carolyn Moore, Martin Dombrowski, and other staff members who really did a tremendous amount of work to make this conference a success.

ABOUT APPALACHIAN RIVERS II CONFERENCE & EXHIBIT

I would like to take a couple of minutes to tell you what this conference is about. As professionals, we all go off to our own esoteric technical conferences in our fields of specialization and then go to the special break out sessions where we are further specialized and divided from communication with others. This is fine and necessary, however, in the case of streams and rivers, there are so many different federal government and state government agencies, private interest groups, universities, watershed organizations, industries and manufacturers involved in river affairs that communications alone is a serious problem. There are more disciplines involved in stream and river related science and technology than any other system on earth. These are some of the reasons why I place stream ecosystems first, ahead of humans, as the most complicated system on earth from a systems engineering point of view. The combined number of organizations and disciplines gives rise to the largest number of perspectives to be drawn relative to technology and methodology of any other system on earth. Thus, I founded Appalachian Rivers Conference & Exhibit last year to address these issues and the obvious needs, as one of the roles for The WMAC Foundation that I also founded to sponsor such activities. In order to effectively develop appropriate technologies and methodologies, all players need somehow to be at the same table, hearing the same messages, and providing input into the process. This explains why we are all here in the same room hearing all of the same messages and providing input so that all stakeholder representatives can benefit. Such an approach is essential in technology development for such a complex system.

Another issue is that while there are hundreds of conferences dealing with various aspects of streams and rivers, their ecosystems, their regulation and other affairs, and the many associated environmental problems, there are no conferences that focus exclusively upon the **TECHNOLOGY and METHODOLOGY of monitoring, characterizing, and assessing rivers.** There are conferences that pertain to the technology of problem mitigation, such as, AMD, and there are conferences for all aspects of ocean, marine and lakes, but rivers have unique characteristics and need unique technology and methodology. Methodologies are technology driven which further justifies a special technology and methodology conference. So, hopefully, this will explain to you the reasons for the structure of this conference, the program agenda, and why we have these high tech exhibits by the world's leading manufacturers represented here today, and their representatives as part of the program.

A TECHNOLOGY PERSPECTIVE

I would like to now give you my perspective as a biosystem engineer's point of view. During the past three years or so, I have discussed stream and river technology and methodology with the best experts available in most of the relevant disciplines. Considering their ideas along with a couple of my own, I have formulated for you today a unique perspective from a biosystems engineering approach. I have no bias or vested interests, except helping bring the best technology to bear on the world's most complex system to monitor, analyze, characterize, and model. Many people regard humans as the most complex system on earth to monitor, analyze, understand, characterize and model, but in my opinion, the most complex is a stream or river ecosystem.

To put things into perspective, consider how present state of the art technology is developed for humans. State of the art technology for humans allows comprehensive monitoring, characterizing, diagnostics, analysis, understanding and modeling of most all components of the human body, independently, and with dependencies upon other components, and in many ways as subsystems and as a total system. As we think of this in terms of the status of stream and river technology, we can readily visualize the stark contrast between the two technologies measured up against each other, and the shortcomings of stream and river technology. In addition to priority, technology for humans is strongly market driven with huge markets of thousands of products, each with large sales volumes in the millions. Such is not the case for any aspect of stream and river technology. Manufacturers must conduct research and develop technology for large markets. State and federal government agencies are for the most part the only customers for river assessment technology. Most technology available for streams and rivers was developed for oceans, lakes and marine applications under many government programs and represents inappropriate "hand-me-down" tools for streams. To my knowledge, there is no government program specifically for developing **technology** for the monitoring, analysis, characterization, diagnostics, and modeling of streams or rivers. The major private organization that I can think of that considers technology development for streams and rivers is the Canaan Valley Institute. Much of the technology specifically for streams and rivers is developed in universities with very small budgets.

**Appalachian streams & rivers do have unique monitoring, characterization and assessment (MCA) technology requirements.** However, the watershed stewards from 100's of government agencies and divisions are overburdened in labor intensive jobs of dealing with watershed problems of monitoring, mitigation, and administration with little time specifically for MCA technology development. Agencies with watershed related missions & responsibilities have budget pressures that prohibit expenditures for specific MCA technology development projects. Numerous government programs with sizeable budgets do exist for mitigation work and mitigation technology development, but we have failed to develop the technology to first understand the problems and the complex biosystems we are trying to salvage. There is also not much support for fundamental science projects for river ecosystem characterization, because it is viewed more as basic science & research, which is not that popular today. **However, much fundamental science knowledge is missing, and it must be developed simultaneously in an iterative fashion with appropriate technology.**

This begins to create a picture as to why we have such limited technology for assessing streams, even though we have imposed upon ourselves monumental tasks, such as, determining the total maximum daily loads (TMDLS) for over 20,000 streams in the United States. **This predicament with all of the attendant facets is full justification for a special government program for MCA technology development**. We desperately need technology for more efficient and more comprehensive, stream monitoring, diagnostics, modeling and simulation in order to seriously consider ourselves as doing technically competent stream assessment, and I will talk later about a program to address the problem. Some TMDLS may be too severe, while others may be inadequate. The economic and ecosystem-health impacts can both be huge. These are serious national issues.

During the two days of this conference, you will be hearing the word "model" used many times, and probably in ways that may not be immediately clear as to what is meant. Briefly, I would like to define some basic types of models and clarify what I mean when I use the term model. Some refer to data from any unknown source plotted on a set of axes and with a line drawn through it as a model. This is actually only a "curve fit". It requires absolutely no knowledge of the system, does not tell anything about the system, and really is not a "model". The next highest level is a so-called "black box" model. In this case, some known quantity is input to the black box, and an output is measured. Some correlation curve can be drawn to show the relationship between the input and output for that exact circumstance and set of conditions--which you may or may not know. This type of model also requires absolutely no knowledge about the internal structure or characteristics, and gives very limited information about the system. This is the least desirable type of model, but it may have to be used to gain some insight in the absence of a better type.

In attempting to understand the internal structure, component behavior individually and in combinations, of complex systems, a third type of model is essential. This is what I call an Internal or Intrinsically Based Model and is the type to which I shall refer. This type model is based upon knowledge of the internal components of the system, their individual characteristics, their interrelationships, and their overall behavior as a unit. For a known input, an output can be calculated apriori, and the model can be calibrated by experiment. It can be deterministic or stochastic, and further classified as static, quasi-static, dynamic, transient, etc, based upon its design features and the application system characteristics. **Most importantly, this type model can be used for diagnostics, assessment, mitigation process design, simulation, and intelligent decision making**. This is the type model needed for biosystems and for the modeling of stream and river ecosystems. Ecosystem models most common of this general type are called bioenergetic models. This type model gives direction from which to build the level of basic science knowledge, and the goals and criteria for technology development. The bioenergetic models I have attempted to use are not user friendly, do not ask for the right data, or the right questions, and do not give the needed answers. In general, they were not developed for stream or river diagnostics and assessment, but for lakes or aquaculture. **The basic science knowledge level for streams must be built specifically to meet the lowest level of technology available for each system component monitoring, characterization, and assessment, and they must grow in an iterative fashion toward measured goals.** I do not see this process happening at all, and certainly not in any systematic manner, for streams and rivers. There are several specific and explainable reasons for it not happening, some of which I have already mentioned.

Stream and river ecosystem science is highly multi-disciplinary. Not only are many disciplines involved, but most of the components and sub-component systems are coupled, or interdependent, even more so than in humans. Many approaches being used today are one-dimensional, and single disciplinary, instead of multi-dimensional and multi-disciplinary. Coupling of the component or sub-component systems is seldom included in a quantitative manner in stream characterization, analysis, diagnosis, modeling, overall assessment, and problem mitigation. This is where science and technology must meet and be focused in order to build more comprehensive understanding and assessment capabilities. Different component monitoring and analysis by different state and federal government agencies with different missions and responsibilities greatly complicates and handicaps this science and technology evolution process. Even communications as to what is being done by whom is a problem we have to address.

As a biosystems engineer I find it convenient to classify the major stream components as: water, macro-biota , micro-biota, macro-benthos, micro-benthos, micro-benthic habitat, macro-benthic habitat, macro-biota habitat, micro-biota habitat, and extra-aquatic habitat and influences, with the full realization that, except for extra-aquatic influences, all of these major components and their subsystems are fully interdependent. In this system, there are few truly independent variables, and most any relationship must be described by complex functionals instead of functions.

So what technology is needed? First, consider water quality. Measuring only 7 to 10 variables in a stream or river, as we are now doing throughout the United States, can only tell how bad the quality of the stream is**. It tells very little about the "health" of a stream or river.** Due to budget, manpower, and technology constraints, we may only go out and monitor a stream for a few minutes once a month or less frequently at a specific point in the stream. When interpreting the data, the time of day, previous rainfall history, diurnal variations, total or spectral solar radiation, and numerous other major factors are not considered, because they are generally not available. A point measurement in a stream with several small tributaries, point sources and other major variations along its length can also render interpretation a futile effort. Some variables, such as DO, may vary as much as 60% or more of their value in 24 hours due to normal diurnal processes alone. I have been especially frustrated in attempting to make any sense of historical archived data, or even data that I have been gathering on a stream about every two weeks for a year involving the same variables everyone else is measuring. **One must raise the question of cost/benefit of the methodologies we are using today and the value of the data obtained, versus the cost/benefits of methodologies we could employ, if we modify, apply and develop specific MCA technology for streams and rivers.** Biota and macro-invertebrate sampling is done more like once every one to five years on a given stream because it is so labor intensive and time consuming. Correlation of water quality, biota and benthic macro and micro components of the ecosystems is primitive at best, and seldom attempted because not enough information is available, and the data and responsibilities fall within different state or federal agencies, or divisions. Although some of these represent formidable problems, today's technologies if applied to streams and rivers, can offer huge opportunities for more comprehensive information at greatly reduced cost and manpower requirements, and focus can be on data interpretation and ecosystem understanding.

So, what technology do we need developed and what kind of a government program would be needed to address the aforementioned problems? Consider first water quality monitoring. In order to monitor a stream or river to determine its health, as opposed to how bad or whether it can sustain life**, we need to measure at least 40 to 60 variables, which is technically and economically feasible and practical.** These variables need to be monitored in real time 24 hours a day for 11 or 12 months per year. The data should be transmitted hourly, or more frequently as changes in variables occur in real time, to multiple online databases via cellular or satellite systems. River stewards could then spend more time analyzing and interpreting the data than travelling country roads collecting samples and carrying them back to laboratories for analysis. Also, two-way data transmission between stewards in the field with laptop computers and online databases could be very beneficial for interactive analysis of numerous conditions in streams and rivers if appropriate diagnostic software that could use such data were available and installed on the laptops.

It is reasonably feasible today to have <u>online</u> data acquisition, data screening models, data reduction and conversion, data analysis, trend routines, calculated data from routines, diagnostic models, and calculated data from diagnostic models. Such capabilities have numerous other uses beyond assessment, including monitoring for illegal dumping, accidental spills, sabotage, or early warning of hazardous trends such as algal blooms. Watershed organizations also would have access to this technology to the degree they desire, and in many cases they could greatly leverage watershed monitoring.

The level of knowledge of fundamental science aspects of stream ecology needs to be elevated by obtaining data needed for user friendly, diagnostic, and simulation bioenergetic models. This includes data on the seasonal food chain, individual component science, data and models, and relationship data and models among ecosystem components. Methods of micro and macro habitat biometrics and characterizing to levels of abstraction suitable for database and functional representation need to be developed**. Use of various emerging biotechnologies, such as DNA, biometrics, and biosensors to explore the fundamental science aspects of stream ecology could be one excellent approach for Appalachia to enter the biotechnology market for scientific, educational, and research purposes.** As the technologically advanced nations of the world now enter **the biotechnology age,** which will likely change our world, perhaps more than any other single technology including computers, **Appalachia needs to look to this area for opportunities.** Many of the basic resources and pieces of the puzzle are already in place.

Major technology development is needed in the areas of water quality, biota and benthos diagnostic and assessment software, as well as, monitoring systems. This is where application of the above described technology can be instrumental in raising the basic science knowledge level to meet the technology needs and vise versa in an iterative fashion. Only through such an approach, can the roles of all components of stream ecosystems be **accurately understood and assessed**. Only then can we hope to achieve acceptable stream and total ecosystem assessment technology, **and only then will we begin to fully understand what our mitigation and regulatory practices are really accomplishing, and whether for example, our TMDLS are too high, too low, or adequate.** This is my technology perspective.

Now, what type of program structure can most effectively accomplish the above? I think it is very important to bring all of the key players to the table with equal seating at a round table. The general mission of the program would be: a) results-oriented, b) very specific goals & tasks, c) comprehensive data acquisition systems, d) quantitative stream health parameters, e) data required for diagnostic models, f) development of diagnostic models, g) diagnostic models to include bioenergetic ecosystem simulation type, h) 2-way data onsite communications, i) satellite based technology, and j) encourage this program to generate spin-off technology (like space & other programs) for education, environment, energy, and food supply**, and become part of the infrastructure for a biotechnology enhanced economy in Appalachia.**

I would select the team members to be:

a. 6 universities-competitively selected
b. 3 manufacturers-competitively selected
c. 5 federal agencies representatives
d. 12 regional state representatives
e. other univ. + mfg -- unsolicited proposals
f. non-profit manager (such as CVI who could also appropriately involve watershed organizations)

I would start with a budget & term of $20 million/yr for 5 years, with a distribution of:

| | mil $/yr | total/yr |
|---|---|---|
| a. each univ. (6) -------------------- | 1.5 | 9 |
| b. each state rep. (12) --------------- | 0.25 | 3 |
| c. each mfg. (3)----------------------- | 1.0 | 3 |
| d. other univ. & mfgr. proposals--- | 4.0 | 4 |
| e. program manager ----------------- | 1.0 | 1 |
| Total --------- | ---------- | 20 |

Universities & manufacturers would receive annual competitive review for contract renewal and contract awards would also require some cost sharing. Such a high visibility and inclusive program involving the major players in stream and river ecology, environmental affairs, and technology, should have the greatest success and impact.

Now that you have heard my perspective, and I have given you some special concepts to think about during these two days, I am very excited to hear your perspectives and learn about the technologies you have, or are developing. At this time, I would like to introduce to you Tom Keech, who is serving as Session Chairman for our first session today. Tom is an electrical/electronic instrumentation engineer who came from WVU to the U.S. Dept of Energy in 1971. He had a brilliant career here at FETC, serving in many technical and managerial capacities including Deputy Director of the Power Systems Technology Division, and Director of the Fuels Resource Management Division when he retired last year. He is the Founder and President of Process Dynamics (PRODYN), located here in Morgantown.

# APPALACHIAN RIVERS II

# TECHNOLOGY FOR ECOLOGY OF STREAMS & RIVERS

# Thank You

**Jan Wachter**

**Kim Yavorsky**

**Lorraine Alvarez**

**Betty Robey**

**Pam Stanley**

**Carolyn Moore**

**Martin Dombrowski**

# ABOUT APPALACHIAN RIVERS CONFERENCE

**MOST OF YOU WERE PERSONALLY INVITED BECAUSE OF THE ROLE YOU PLAY IN WATERSHED AFFAIRS**

**THIS CONFERENCE IS ABOUT**

**BRINGING TOGETHER PEOPLE OF ALL DISCIPLINES, GOV'T AGENCIES, MANUFACTURERS, UNIVERSITIES, WATERSHEDS, PRIVATE GROUPS, & OTHERS, AS TEAM MEMBERS IN SAME ROOM, AT SAME TIME, TO HEAR SAME MESSAGES, FROM ALL PERSPECTIVES**

# ABOUT APPALACHIAN RIVERS CONFERENCE

## IN ORDER TO:

•BRING YOU STATE OF THE ART TECHNOLOGY

•HELP GET THE TECHNOLOGY YOU NEED DEVELOPED

•DEVELOP A GREATER QUANTIFIABLE UNDERSTANDING
•OF STREAM AND RIVER ECOSYSTEMS

•HELP YOU GET THE DATA YOU NEED TO DO MORE
•COMPREHENSIVE ASSESSMENTS

•INFORM EVERYONE ON ADVANCED MITIGATION METHODS

•OBTAIN INPUT & DISCUSSION FROM EACH OF YOU

# Streams
# Rivers
# Watersheds

# A Technology Perspective

By L. Zane Shuck

## HOW WE DELIVER HEALTH CARE TO HUMANS
## (TECHNOLOGY ISSUES)
# "HUMANS--THE SECOND MOST COMPLICATED SYSTEM ON EARTH"
# (TECHNOLOGY ISSUES)
# A BIOSYSTEM ENGINEER'S PERSPECTIVE

**WE HAVE COMPREHENSIVE DIAGNOSTIC TOOLS FOR EACH COMPONENT**

- **WE KNOW THE RELATIONSHIPS/DEPENDENCIES BETWEEN COMPONENTS**

- **WE CAN MODEL INDIVIDUAL COMPONENTS**
  - **NOT ONLY BLACK BOX, BUT, FROM INTERNAL CONSTRUCTION**

- **WE CAN SIMULATE INDIVIDUAL COMPONENTS**

- **WE CAN MODEL AND SIMULATE THESE COMPONENTS AS SYSTEMS**

- **<u>DEVELOPMENT</u> OF TOOLS AND TECHNOLOGIES IS <u>MARKET DRIVEN</u>**
  **$$ INCENTIVES TO MFGR'S, RESEARCHERS, PROVIDERS, HOSPITALS, DOCTORS ---THE ENTIRE CHAIN**

- **EXTENSIVE GOVERNMENT R & D PROGRAMS FOR MEDICAL <u>TECHNOLOGY DEVELOPMENT</u>**

- **SPACE PROGRAM SPINOFFS - - QUICKLY APPLIED?**

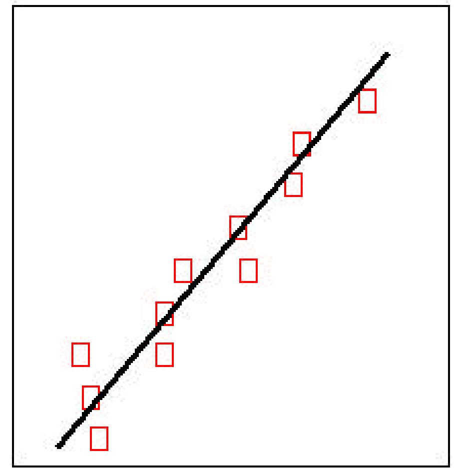
# MODELS

## TYPES

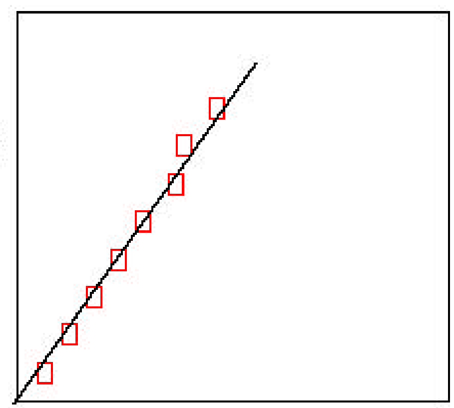
### I. CURVE FIT TO DATA

REQUIRES NO KNOWLEDGE OF SYSTEM

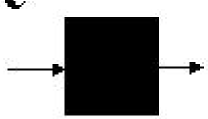
(not really a model)




### II. BLACK BOX MODEL




measure input



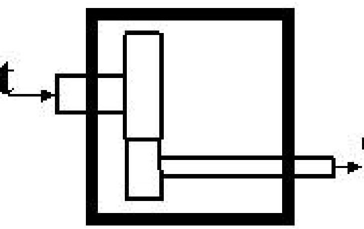
measure output

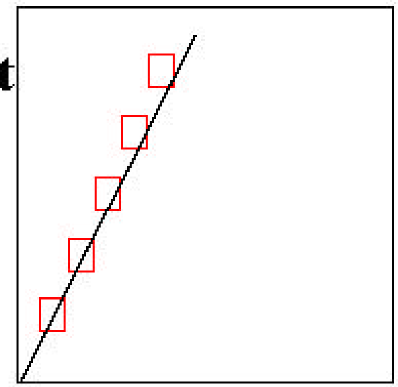
REQUIRES NO KNOWLEDGE OF INTERNAL COMPONENTS - LIMITED USE

# MODELS

## TYPES

### III. INTERNAL - INTRINSIC BASED




**FROM KNOWLEDGE OF INSIDE COMPONENTS , ONE CAN:**

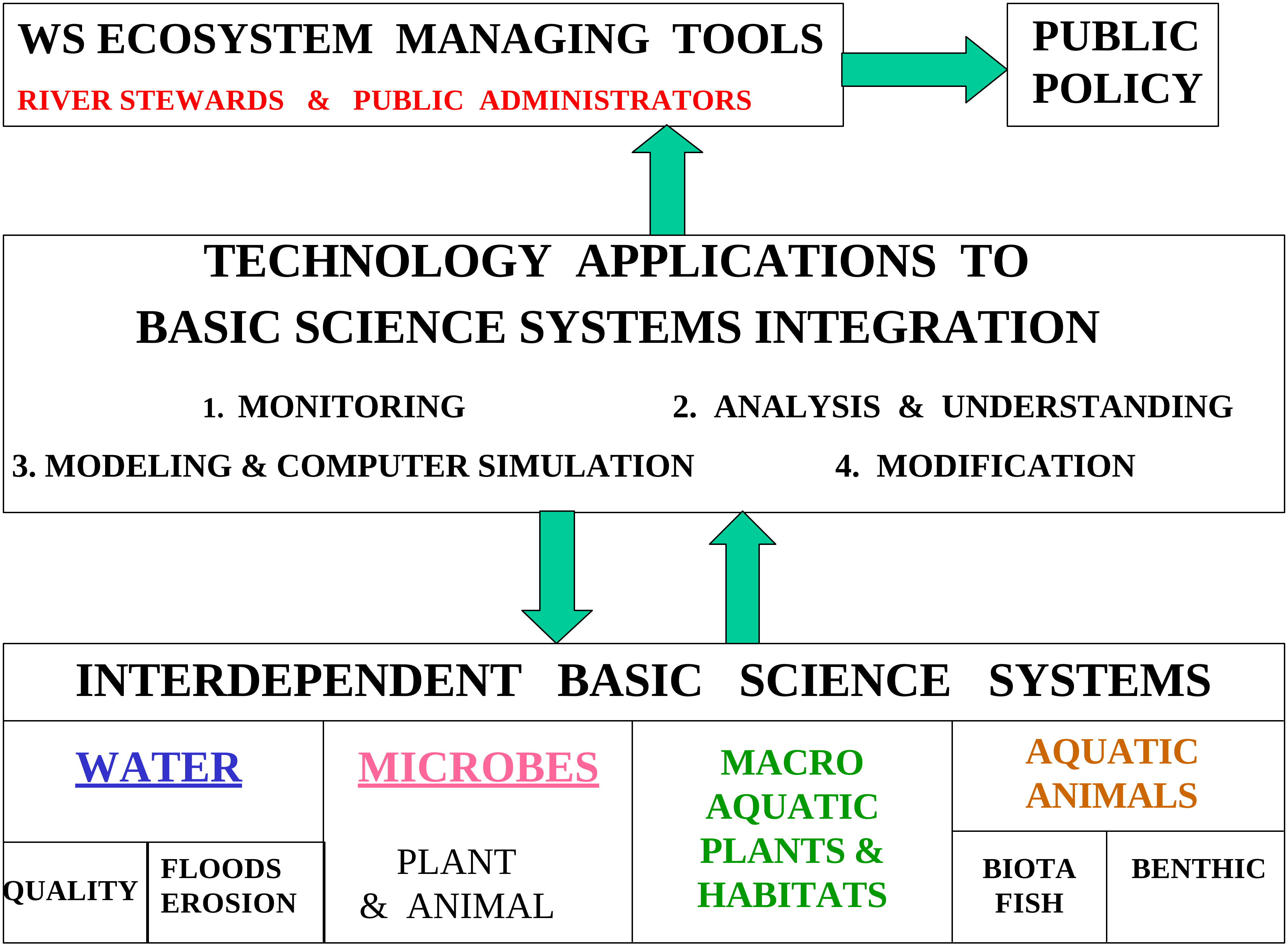
A. CALCULATE APRIORI FOR A GIVEN INPUT
WHAT THE OUTPUT WILL BE

B. CALIBRATE BY EXPERIMENT

C. USE MODEL TO SIMULATE & DESIGN

□ MOST DESIRABLE SCIENTIFIC APPROACH

□ Models can simulate Static, Quasi-static, Dynamic, Steady-state, or Transient time varying systems


WS ECOSYSTEM MANAGING TOOLS
RIVER STEWARDS & PUBLIC ADMINISTRATORS
PUBLIC POLICY
TECHNOLOGY APPLICATIONS TO
BASIC SCIENCE SYSTEMS INTEGRATION
1. MONITORING
2. ANALYSIS & UNDERSTANDING
3. MODELING & COMPUTER SIMULATION
4. MODIFICATION
INTERDEPENDENT BASIC SCIENCE SYSTEMS
WATER
QUALITY
FLOODS EROSION
MICROBES
PLANT & ANIMAL
MACRO AQUATIC PLANTS & HABITATS
AQUATIC ANIMALS
BIOTA FISH
BENTHIC

# STREAM ECOSYSTEM

## MAJOR COMPONENTS

WATER

BIOTA MACRO

BIOTA MICROBES

BENTHIC

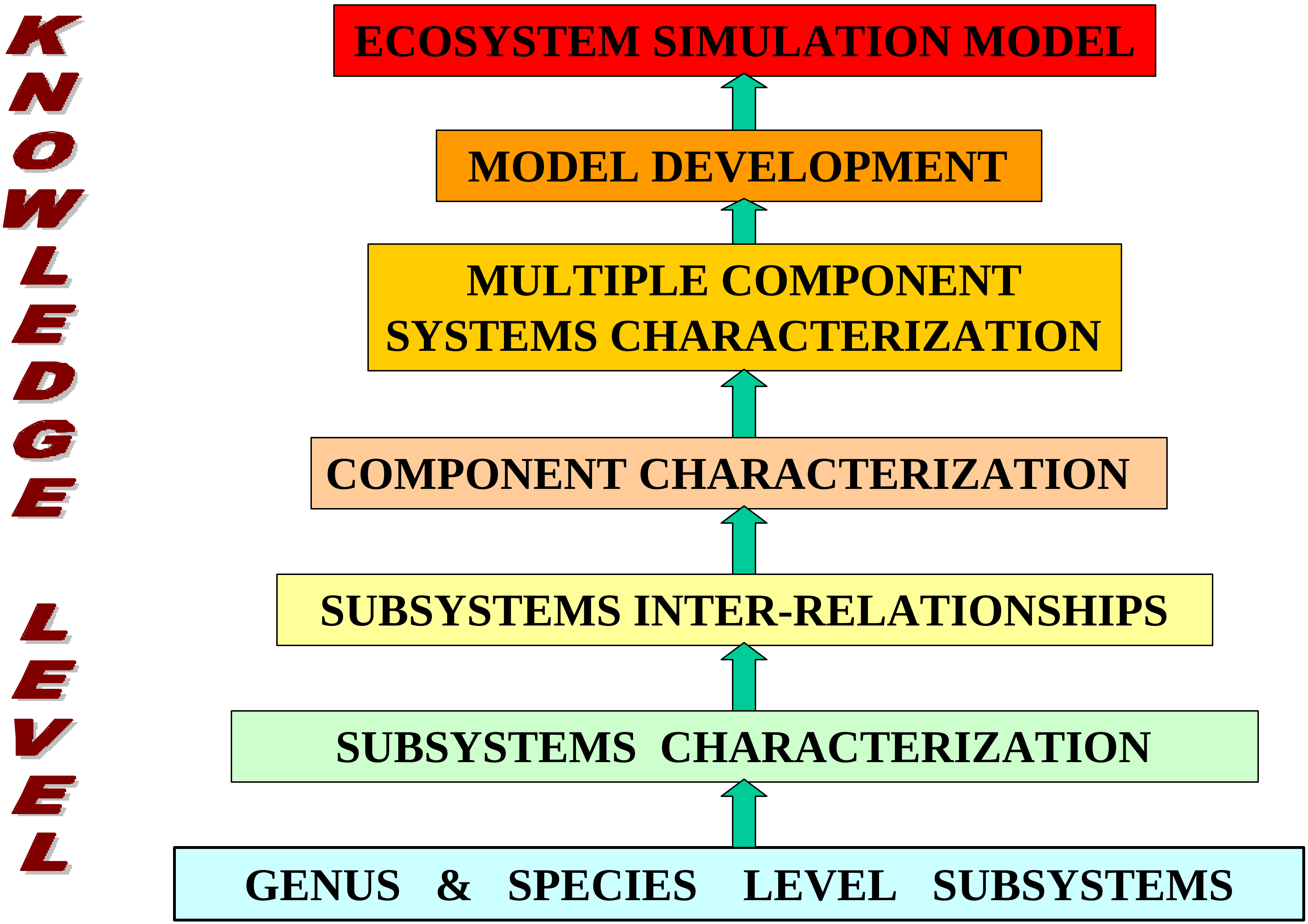
BENTHOS MACRO

BENTHOS MICROBES

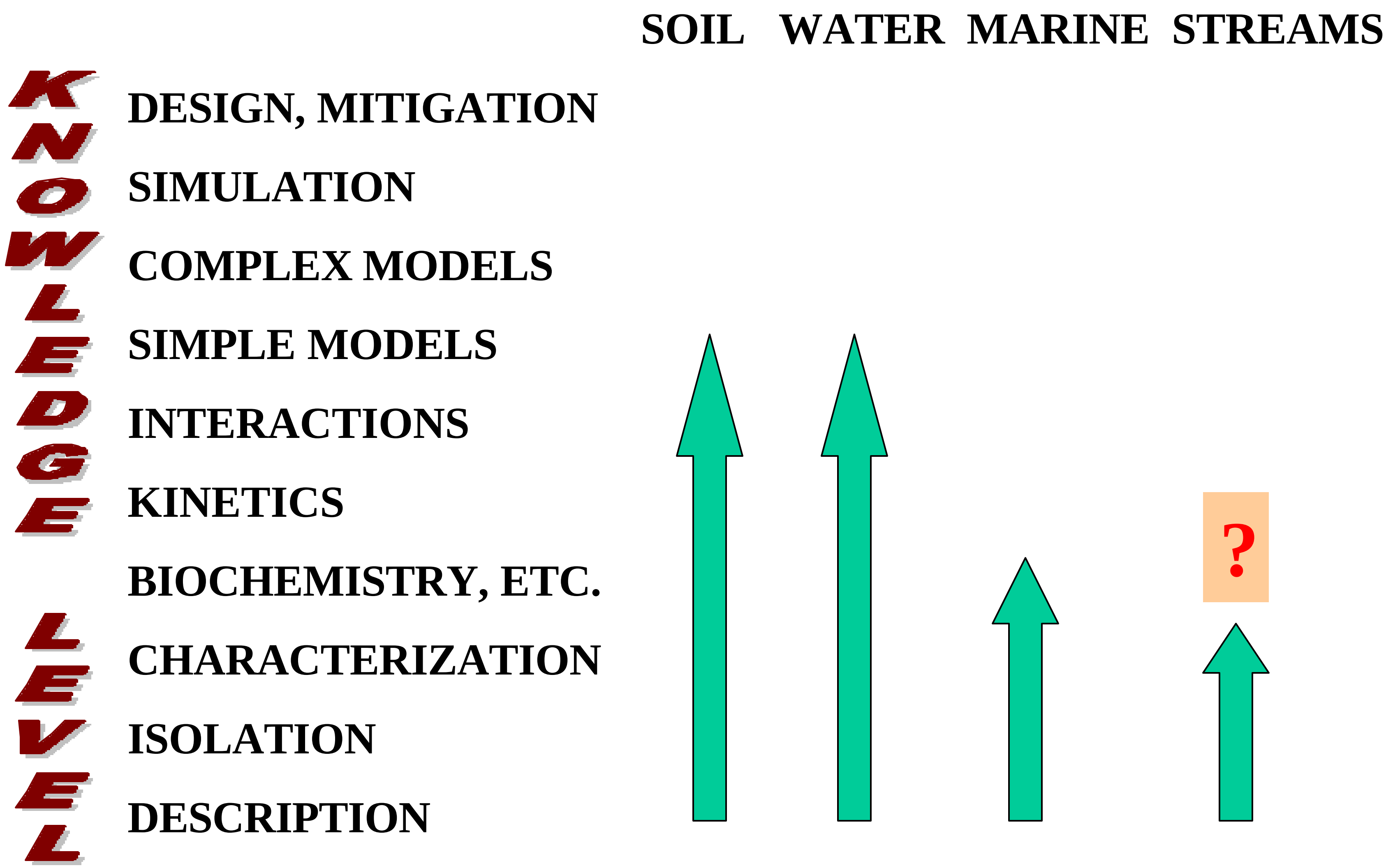
WATER HABITAT

BENTHIC HABITAT

TERRESTRIAL HABIT.


KNOWLEDGE LEVEL
ECOSYSTEM SIMULATION MODEL
MODEL DEVELOPMENT
MULTIPLE COMPONENT SYSTEMS CHARACTERIZATION
COMPONENT CHARACTERIZATION
SUBSYSTEMS INTER-RELATIONSHIPS
SUBSYSTEMS CHARACTERIZATION
GENUS & SPECIES LEVEL SUBSYSTEMS

# MICROBIAL COMPONENTS



# MY TECHNOLOGY PERSPECTIVE

**I. DEVELOPMENT OF MONITORING, CHARACTERIZATION, AND ASSESSMENT (MCA) TECHNOLOGY FOR STREAMS & RIVERS**

**APPALACHIAN STREAMS & RIVERS HAVE UNIQUE (MCA) TECHNOLOGY REQUIREMENTS**

**WATERSHED STEWARDS FROM 100'S OF GOVERNMENT AGENCIES & DIVISIONS ARE OVERBURDENED IN LABOR INTENSIVE JOBS OF DEALING WITH WATERSHED PROBLEMS OF MONITORING, MITIGATION, AND ADMINISTRATION WITH LITTLE TIME SPECIFICALLY FOR MCA TECHNOLOGY DEVELOPMENT**

**AGENCIES WITH WATERSHED RELATED MISSIONS & RESPONSIBILITIES HAVE BUDGET PRESSURES THAT PROHIBIT EXPENDITURES FOR SPECIFIC MCA TECHNOLOGY DEVELOPMENT PROJECTS - - - ( BUDGETS DO EXIST FOR MITIGATION TECHNOLOGY DEVELOPMENT)**

# MY TECHNOLOGY PERSPECTIVE

**NO FEDERAL OR STATE PROGRAMS OR BUDGETS EXIST SPECIFICALLY FOR STREAM & RIVER HIGH TECHNOLOGY MCA DEVELOPMENT - - - TMDLS ALONE NEED IT- - -**

**MOST STREAM & RIVER TECHNOLOGY IS "HAND-ME-DOWN" FROM OTHER APPLICATIONS OF OCEAN, MARINE, LAKES, SPACE, AND OTHER ENVIRONMENTAL APPS.**

**CUSTOMERS FOR STREAM & RIVER ONITORING, CHARACTERIZATION, & ASSESSMENT (MCA) TECHNOLOGY ARE STATE & FEDERAL GOVERNMENT AGENCIES**

# MY TECHNOLOGY PERSPECTIVE

**MUCH OF STREAM & RIVER MCA IS CURRENTLY DEVELOPED IN UNIVERSITIES WITH VERY SMALL BUDGETS**

**THE CANAAN VALLEY INSTITUTE IS PERHAPS, THE MAJOR PRIVATE GROUP ACTIVELY PURSUING MCA TECHNOLOGY DEVELOPMENT OTHER THAN MANUFACTURERS**

**NOT MUCH SUPPORT FOR SCIENCE PROJECTS FOR RIVER ECOSYSTEM CHARACTERIZATION, BECAUSE IT IS VIEWED MORE AS BASIC SCIENCE & RESEARCH, WHICH IS NOT THAT POPULAR TODAY**

**SPECIFIC STREAM & RIVER MCA TECHNOLOGY DEVELOPMENT IS NOT MARKET DRIVEN, BECAUSE OF SMALL MARKET.**

# CONCLUSION

THE ABOVE REASONS ARE JUSTIFICATION FOR A SPECIFIC GOVERNMENT (MCA) TECHNOLOGY DEVELOPMENT PROGRAM

**THE PROPOSED GOVERNMENT PROGRAM**
**I. NEEDED TECHNOLOGIES**

**A. <u>WATER QUALITY MONITORING</u>**

- **7 TO 10 VARIABLES CAN TELL HOW BAD, NOT HOW GOOD. MONITOR FOR STREAM HEALTH, NOT JUST STREAM POLLUTION**

- **REAL TIME, 24 HR, 11 TO 12 MONTHS/YR**

- **DATA AUTOMATIC TRANSMIT TO MULTIPLE DATABASES VIA CELLULAR OR SAT. TELE. OR SATELLITE DISH ANTENNA SYSTEMS**

- **REDUCE CARRYING SAMPLES BACK TO LAB**

- **MONITOR 40 TO 60 VARIABLES/PARAMETERS REAL TIME**

**THE PROPOSED GOVERNMENT PROGRAM**
**I. NEEDED TECHNOLOGIES**

**B. DATA TRANSMISSION, STORAGE, DISSEMINATION**

**TWO-WAY DATA TRANSMISSION TO MULTIPLE ON LINE DATABASES ON INTERNET, VIA**

1. **CELLULAR TELEPHONE, OR**
2. **SATELLITE TELEPHONE, OR**
3. **SMALL SATELLITE DISH**

**WITH DAILY OFF-LINE ARCHIVE COPIES**

**LAPTOP COMPUTER & SOFTWARE TO /FROM DATABASES BY STEWARDS IN THE FIELD**

**GOVERNMENT, & WATERSHED ORGANIZATIONS STEWARDS OR PUBLIC MONITOR DATA IN REAL TIME VIA INTERNET FOR ANY ON-LINE STREAM**

**INTERNET ON LINE SUMMARY OF APPALACHIAN STREAM RESEARCH, MONITORING, CHARACTERIZATION & MITIGATION PROJECTS**

## THE PROPOSED GOVERNMENT PROGRAM
## I. NEEDED TECHNOLOGIES

## ON LINE

- DATA ACQUISITION, SCREENING MODELS
- DATA REDUCTION/CONVERSION
- DATA ANALYSIS, TREND ROUTINES
- DIAGNOSTIC MODELS (READ ONLY)
- CALCULATED DATA FROM ROUTINES
- CALCULATED DATA FROM DIAG. MODELS
- BIOENERGETIC DIAGNOSTIC MODELS

## THESE CAPABILITIES ALSO HAVE OTHER MERITS

- INDUSTRIAL ACCIDENTS, SPILLS, & DUMPING
- EARLY DETECTION, WARNING & NEIGHBORHOOD
  WATCH (MONITORED BY WATERSHED
  ORGANIZATIONS JUST LIKE AMATURE RADIO)

## THE PROPOSED GOVERNMENT PROGRAM
## I. NEEDED TECHNOLOGIES

### D. STREAM ECOLOGY

- DATA NEEDED FOR BIOENERGETIC MODELS
  - DIAGNOSTIC --USER FRIENDLY
  - SIMULATION & QUERY
- DATA ON SEASONAL FOOD CHAIN
- RELATIONSHIP DATA AMONG ECO COMPONENTS FOR SPECIFIC STUDIES & BIOENERGETIC MODELS
  - WATER
  - BIOTA
  - BENTHOS
  - BIOTA MICROBES
  - BENTHIC MICROBES
  - BENTHIC HABITAT
  - BIOTA HABITAT
  - TERRESTIAL HABITAT
- STREAM LATERAL & TRANSVERSE SECTION DATA
- ON LINE VIDEO DATABASE OF MAJOR SPECIES AND STREAM REPRESENTATIVE REACHES VIDEO

# THE PROPOSED GOVERNMENT PROGRAM
## I. NEEDED TECHNOLOGIES

**E. AUTOMATED SAMPLING, MONITORING & DOCUMENTTION TECHNOLOGY FOR BENTHIC, WATER QUALITY, BIOTA & TERRESTRIAL**

**REMOTE SENSING**
**MICROBES**
**VIDEO USE & VIDEO DATABASE**
**SPECTRA (EMISSION, ABSORPTION, REFLECTION)**
**FLUORESCENCE**
**FIBER OPTIC SPECTROMETER APPLICATONS**
**SPECTROPHOTOMETERS**

**BIOTECHNOLOGY-- WE ARE NOW ENTERING THE BIOTECHNOLOGY AGE. HERE IS AN EARLY OPPORTUNITY FOR APPALACHIA**

**BIOSENSORS**

**THE PROPOSED GOVERNMENT PROGRAM**
**II. MANAGEMENT & ORGANIZATION**

## I. MISSION

A. RESULTS ORIENTED

B. VERY SPECIFIC GOALS & TASKS

C. COMPREHENSIVE DATA AQU. SYS. + DATA

D. QUANTITATIVE HEALTH PARAMETERS

E. DATA REQUIRED FOR DIAGNOSTIC MODELS

F. DEVELOPMENT OF DIAGNOSTIC MODELS

G. DIAGNOSTIC MODELS TO INCLUDE BIOENERGETIC ECOSYSTEM SIMULATION TYPE

H. 2 WAY DATA ON SITE COMMUNICATION

I. SATELLITE BASED TECHNOLOGY

J. LET THIS PROGRAM GENERATE SPINOFF TECHNOLOGY (LIKE SPACE & OTHER PROGRAMS) FOR EDUCATION & ENVIRONMENT

**THE PROPOSED GOVERNMENT PROGRAM**
**II. MANAGEMENT & ORGANIZATION**

## II. TEAM MEMBERS

- **A. 6 UNIVERSITIES-COMPETITIVELY SELECTED**
- **B. 3 MANUFACTURERS-COMPETITIVELY SELECTED**
- **C. 5 FEDERAL AGENCIES REPRESENTATIVES**
- **D. 12 REGIONAL STATE REPRESENTIVES**
- **E. OTHER UNIV. + MFG -- PROPOSAL SUBMISSION**
- **F. NON-PROFIT MANAGER (SUCH AS, CVI )**
  **(INVOLVE WATERSHED ORG. ET.AL.)**

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## III. BUDGET & TERM: $20 MILLION/YR, FOR 5 YEARS

| | MIL $/YR | TOTAL/YR |
|---|---|---|
| A. EACH UNIV (6) -------------------- | 1.5 | 9 |
| B. EACH STATE REP (12) ----------- | 0.25 | 3 |
| C. EACH MFG (3)---------------------- | 1.0 | 3 |
| D. UNIV, MFGRS, PROPOSALS ---- | 4.0 | 4 |
| E. PROGRAM MANAGER ----------- | 1.0 | 1 |
| TOTAL ---------------------- | | 20 |

* UNIVERSITY & MANUFACTURER COMPETITIVE REVIEW EACH YR FOR CONTRACT RENEWAL

* CONTRACT MUST INCLUDE COST SHARING

# SUMMARY

- Need a special government program for MCA development.
- All players need to be at the table.
- We need the MCA advanced technology available to all government, universities, and public in general.
- Here is a plan, free for you to implement.