Approved: 3-14-95
Date

MINUTES OF THE SENATE COMMITTEE ON ENERGY & NATURAL RESOURCES.

The meeting was called to order by Chairperson Don Sallee at 8:00 a.m. on March 8, 1995 in Room 254-E- of the Capitol.

All members were present:

Committee staff present: Raney Gilliland, Legislative Research Department
Dennis Hodgins, Legislative Research Department
Mary Ann Torrence, Revisor of Statutes
Mike Corrigan, Revisor of Statutes
Clarene Wilms, Committee Secretary

Conferees appearing before the committee:
Ron Hammerschmidt, Acting Director, Department of Environment
Bill Fuller, Associate Director, Public Affairs Division, Kansas Farm Bureau
Jamie Clover Adams, Director of Legislative and Regulatory Affairs, Kansas Fertilizer and Chemical Association
Written Testimony, E. R. (Dick) Brewster, Amoco Corporation, Oklahoma City, OK

Others attending: See attached list

HB 2120: An Act concerning adoption of rules and regulations; relating to the economic impact statement; requiring an environmental impact statement in certain cases

Ron Hammerschmidt, Acting Director, Department of Environment, appeared in support of **HB-2120** stating the Kansas Department of Health and Environment views the regulation-adoption process as a critical tool for communicating with the public and the regulated community on all new regulatory proposals. (Attachment 1) Concerns were expressed about the very general definition of "environmental rule and regulation". Mr. Hammerschmidt suggested the Committee consider defining more precisely the types of regulations proposed for inclusion in the new process.

Bill Fuller, Associate Director, Public Affairs Division, Kansas Farm Bureau, presented testimony in support of the concepts contained in **HB-2120.** Mr. Fuller stated the Farm Bureau support was based upon adopted policy that recommended regulatory reforms stated on page 2 of Attachment 2. He also told the committee that it was important that costs to individuals, business and agriculture be determined as well as to governmental agencies.

Jamie Clover Adams, Director of Legislative and Regulatory Affairs, Kansas Fertilizer and Chemical Association presented testimony stating her organization's support for **HB-2120** noting objective information on cost, benefits and parties impacted were needed to make reasonable choices. (Attachment 3) Ms. Adams stated the position that limited funds should be used to address real rather than perceived problems. Also included in Attachment 3 was a copy of "Tap Water Blues" which demonstrates a need for objective analysis.

A member questioned page 4 of the bill and the scope of changing every agency's regulations and whether impact on the taxpayers for the functions of state government is really known.

Written testimony was presented to committee members from E.R.(Dick) Brewster, Public and Government Affairs, Amoco Corporation. (Attachment 4) Mr. Brewster stated support for **HB-2120** since Amoco expects their operations to be in full compliance with applicable environmental laws, rules and regulations. Mr. Brewster stated his organization was of the opinion that this bill could help assure that excessive and unneeded costs are not imposed business operations in Kansas.

HCR 5014: A Concurrent Resolution designating certain areas in the Verdigris, Neosho, Fall River and the Big and Little Sandy Creek Valleys as the "Opothle Yahola Historic Trail."

Senator Emert moved to report **HCR 5014** favorable for passage and be placed on the Consent Calendar. Senator Wisdom seconded the motion and the motion carried.

SB 337: An act relating to energy; concerning purchase of energy by municipal energy agencies; relating to financing of energy sales

Discussion opened concerning **SB 337.** Senator Lawrence made a motion to pass **SB-337** as written and without amendments. Senator Hardenburger seconded the motion.

Discussion touched on concern about leaving some segments of business outside the cooperative group who would be working on such bids. The thought was expressed that passing the bill at the present time without further study was premature.

Another member stated the opinion that the new Section 7 would preclude allowing one special entity to be the only one available to be used as a resource. The member stated the premise of the bill appeared to be good.

Senator Lee made a substitute motion to insert the proposed new Section 7 shown in (Attachment 4) of the March 7 minutes and suggested by the Department of Administration. Senator Walker seconded the motion.

Discussion centered around the premise that this bill would give the state flexibility. Another member commented that the amendment would put the situation back into the hands of government at a time when privatizing such business had been suggested. A member commented that without the amendment there was no flexibility and it became a special interest bill.

A further suggestion was made to not name anyone and look to whoever could do the job the best and the cheapest.

The meeting adjourned at 9 a.m.

The next meeting is scheduled for March 9, 1995.

SENATE COMMITTEE ON ENERGY & NATURAL RESOURCES GUEST LIST COMMITTEE

DATE: March 8, 1995

NAME	REPRESENTING
Jamie Clover Adams	KS Fertilizer & Chemical Assn
[illegible]	Hein, Ebert & LeDair
Mike Jensen	Ks Pork Council
JACK RANSON	KANSAS MUNICIPAL ENERGY AGENCY
Gilbert E Hanson, J	KS Municipal Energy Agency
Faith Loretto	Dept. of Administration
Bill Fuller	Kansas Farm Bureau
JANET STUBBS	Ks. Bldg. IND. ASSN.
Marty Vanier	KS Ag Alliance
Jack Glaves	City P-21 & KN
Rich McKee	KS Livestock Assoc.
Ron Hammerschmidt	KDHE
Dale Lambley	KDA
Kenneth M. Wilke	KD Agriculture
Ken Kern	State Conservation Commission
Whitney Damron	Coastal / CIG

State of Kansas

Department of Health and Environment

Testimony presented to

Senate Energy and Natural Resources Committee

by

The Kansas Department of Health and Environment

House Bill 2120

The Kansas Department of Health and Environment (KDHE) is pleased to provide informational testimony on the concepts embodied in House Bill 2120. This bill proposes clarifications to the types of economic impact, environmental benefit, and risk information that should be made available for public discussion during the promulgation of a new substantive environmental protection requirement. KDHE views the regulation-adoption process as a critical tool for communicating with the public and the regulated community on all new regulatory proposals and takes very seriously the responsibility for assuring that comprehensive background information is available for discussion during the regulation-adoption process. The committee may be aware of the Division of Post Audit's ongoing review of the regulation development and adoption process related to the implementation of federal programs. For your convenience I have attached a copy of the study team's scope statement. The committee may wish to see the product of this Post Audit review before taking final action on this bill.

The definition of "environmental rule and regulation" proposed in HB 2120 causes some concern. The proposed definition is very general and does not differentiate between the many types of regulations adopted by KDHE. For example, the agency does adopt federal regulations by reference. These regulations have undergone close scrutiny at the national level. Is it the intent of this legislation to require a total repetition of the process? The department does perform the tasks currently required by statute and Department of Administration directions in adopting these regulations. However, we attempt to avoid unnecessary duplication. Without additional clarification, KDHE reads HB 2120 to require the same adoption process for these types of regulations as those that propose new substantive environmental requirements. For this reason, KDHE recommends that the Committee consider defining more precisely the types of regulations proposed for inclusion in the new process.

Thank you for allowing me to speak today. We are available to work with the committee to address any issues on this bill.

Testimony presented by: Dr. Ronald Hammerschmidt
Acting Director
Division of Environment
Kansas Department of Health and Environment
March 8, 1995

Senate Energy & Nat'l Resc.
March 8, 1995
Attachment 1

SCOPE STATEMENT

Reviewing the Department of Health and Environment's Systems For Assessing the Impact of Rules and Regulations Mandated by the Federal Government

Often, the federal government will impose requirements on the State (or local units of government) as a condition of receiving federal funding. These requirements may also impact private industry and may have a significant economic impact on the State as a whole. One State agency that deals with a large number of federal mandates is the Kansas Department of Health and Environment. The Department administers many State and federal laws and programs concerning the environment and public health. Some of the most significant federal programs cover safe drinking water, solid waste, hazardous waste, and air quality.

When the federal government adopts a substantial change in a federal law or regulation, the Department of Health and Environment has to assess whether that change requires modification of State laws or regulations. If a regulatory change is needed, the Department prepares new or revised regulations, gets comments from interested parties in the public and private sector, and adopts the new regulations. Those changes then go to the Legislature's Joint Committee on Administrative Rules and Regulations for further review and comment.

Legislative concerns have been expressed that State agencies do not always fully explore the ramifications of adopting the changes proposed or mandated by the federal government. More specifically, questions have been raised about whether State agencies consider all the costs imposed on the private and public sectors by the new mandate or change in regulations.

A performance audit of this area would address the following question.

1. **Has the Department of Health and Environment adequately assessed the impact of new federal regulations on State and local government and the private sector before adopting those regulations?** To address concerns about the adequacy of the Department's assessment of the impact of new regulations, we would select several programs that have adopted significant new regulations within the last several years as a requirement for continued federal funding. We would review the reasonableness the process the agency went through to determine the impact of the new regulations. In considering the reasonableness of the process, we would consider whether the Department attempted to assess such things as the cost to State or local governments to implement and enforce the regulations, the cost to private sector business to comply with the regulations, whether the regulations appear to be necessary for the general health and welfare of the citizens of Kansas, and possible adverse consequences to the State's economy. If possible, through surveys or interviews with affected parties, we would attempt to determine whether the regulations' actual impact on the public and private sector has been greater or lesser than the impact estimated by the Department, and whether the Department should have known that at the time it estimated the impact. We also would assess how well the Department communicated its assessment of the impact of new regulations to the Governor and the Legislature. We would contact appropriate federal officials to determine what the ramifications are if a state refuses to adopt or administer new federal mandates associated with the programs selected for this audit. As appropriate, we would contact equivalent agencies in other states to determine whether their states have refused to adopt federal regulations and what their experience has been.

2. **What procedures has the Department established to monitor and measure the impact of new regulations it has adopted?** Through interviews with appropriate agency staff we would determine what procedures have been established to measure the impact of new regulations. For a sample of new regulations, we would review agency reports or other available information to determine whether those procedures have been followed. Finally, we would compare the results of any follow up studies with the original information provided to the Governor and the Legislature to determine how accurate the original information was.

Estimated Completion time: 8-10 weeks (Actual time depends on the number of programs reviewed)

PUBLIC POLICY STATEMENT

SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

RE: H.B. 2120 - Requires certain state agencies to prepare a statement of environmental benefit for proposed new or amended rules and regulations.

March 8 ,1995
Topeka, Kansas

Presented by:
Bill Fuller, Associate Director
Public Affairs Division
Kansas Farm Bureau

Chairman Sallee and members of the Committee:

There is a growing concern that regulatory policy on environmental issues is being established through fear, emotion and politics rather than sound scientific principles. Although many of these regulations individually have laudable goals, there is concern over the cumulative effect of the competitiveness and incentive of individuals, agriculture and business. The avalanche of regulation at all levels of government is resulting in inefficiencies in both the public and private sectors. This burden results in substantial waste of private and taxpayer dollars. The benefits resulting from the activities outlined in H. B. 2120 should result in better priority setting and the focusing of limited resources aimed at risks that are

genuinely significant in their threat to public health and safety and the environment.

My name is Bill Fuller. I am the Associate Director of the Public Affairs Division at Kansas Farm Bureau. We appreciate the opportunity to testify in support of the concepts contained in H.B. 2120.

Farm Bureau support is based upon adopted policy that recommends the following regulatory reforms:

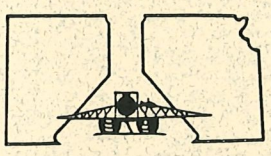
* RISK ASSESSMENT ANALYSIS to determine actual versus perceived risk before regulations are adopted. This assessment should be based upon sound science and be subject to peer review and replication.
* COST AND BENEFITS ESTIMATES associated with public and private sector compliance with regulations should be completed before regulations are promulgated.
* COMPARATIVE RISK ANALYSIS should be required comparing the economic and compliance costs with the health and environmental benefits of the proposed rule.

H.B. 2120 requires the Secretary of Agriculture, the Secretary of Health and Environment and the State Corporation Commission to prepare a statement of the environmental benefit of proposed rules and regulations or amendments. A copy of the environmental benefit statement will be filed with the actual rule and regulation at the

time of filing with the Secretary of State's office. The bill requires a description of the costs of implementation, compliance and enforcement for proposed rules and regulations. It is important that costs to individuals, business and agriculture be determined as well as to governmental agencies.

In closing, we commend those responsible for introduction of H.B 2120 and the strong 120-5 vote in the House. We respectfully encourage approval of H.B. 2120 by this Committee. Thank you!

KANSAS FERTILIZER & CHEMICAL ASSOCIATION



KFCA is committed to professional development and business viability for the plant nutrient and crop protection industry in Kansas.

STATEMENT ON

H.B. 2120

TO THE

SENATE ENERGY & NATURAL RESOURCES

COMMITTEE

SENATOR DON SALLEE, CHAIR

MARCH 8, 1995

Senate Energy + Nat'l Res.
March 8, 1995
Attachment 3

The Kansas Fertilizer and Chemical Association .....

..... a voluntary professional association for those involved in the plant nutrient and crop protection industry. KFCA represents our nearly 500 members interests in legislative matters at all levels of government, as well as providing educational opportunities and business services. The industry is committed to professional development and business viability for the plant nutrient and crop protection retail industry.

816 S.W. Tyler ❑ Topeka, KS 66612 ❑ Telephone: 913-234-0463 ❑ Fax: 913-234-2930

Mr. Chairman and Members of the Committee, I am Jamie Clover Adams, Director of Legislative and Regulatory Affairs for the Kansas Fertilizer and Chemical Association (KFCA). KFCA is the professional trade association of our state's plant nutrient and crop protection industry. Our nearly 500 members are primarily retailers, but also include distribution firms, manufacturer representatives and others who serve the industry. Thank you for this opportunity to comment on H.B. 2120.

The bill has two components. First, it requires more detailed cost analysis in the Economic Impact Statement (EIS). Second, it requires a basic analysis of the benefits and risks of environmental regulation. Governor Graves in his State of the State address talked at length about making hard choices and managing for results. He advocated performance based budgeting to determine whether funds spent on a program were actually accomplishing the stated goals and if not to "turn out the lights." He directed a review of all current rules and regulations with a view toward eliminating those no longer needed and asked his Secretaries to refrain from issuing any rules and regulations in the future until the costs to individuals and businesses could be measured against the benefits to the state. KFCA supports these practical concepts wholeheartedly and believes the changes proposed in H.B. 2120 are necessary to accomplish this task.

We believe all sides would agree that regulation should be implemented in the most cost-effective manner possible. Responsible individuals understand that "slash and burn" will not benefit the citizens of Kansas. However, programs must be cut or trimmed back. Without objective information on the cost, benefits and parties impacted, reasonable choices cannot be made in the effort to solve increasingly complex problems. Hard choices cannot be made without relevant information.

The bill requires an analysis of capital and annual cost, initial and annual cost of implementing and enforcing, an assessment of the paperwork burden and discussion of the data and methodology. These specifics better serve the current analytic requirements of K.S.A. 77-416 to describe other less costly and intrusive methods considered and why they were not chosen. How can these determinations be objectively made without consideration of the facts required by the amendment?

The second portion of the bill requires more detailed analysis of environmental regulations. It requires the agency to spell-out what benefits are gained and what risk is being removed or controlled. Again, information necessary to make an informed decision and address real risk in these times of fiscal restraint.

Some would argue that H.B. 2120 is too costly given the "doing more with less" philosophy advocated by the Graves administration and the citizens of Kansas. KFCA would argue that you don't need an economist to calculate this information, just someone with good analytical and problem solving skills. It is money well spent to insure we make the most informed policy choices and use the limited funds we have to address real rather than perceived problems.

Another argument against cost-effectiveness analysis is dubbed "paralysis by analysis." KFCA would counter that it is better to spend a little longer to get the facts than jump headlong into regulation when we are unsure of the benefits or if a real problem even exists. I have included a copy of a review of the science and methodology used by the Environmental Working Group in Tap Water Blues. This study claimed occurrences of herbicides in drinking water in the Midwest constituted a major public health threat. Further objective review of the data indicates a negligible level of cancer risk and occurrences has been achieved essentially without regulation. The authors of Tap Water Blues recommend a total phase-out of all uses of these herbicides. This juxtaposition clearly illustrates the need for objective analysis before environmental regulations are implemented to insure scarce resources are used to address real problems.

KFCA thanks the Committee for this opportunity to appear in support of H.B. 2120. The bill requires agencies to assess all aspects of a problem in a meaningful way and find the most cost-effective method to solve the problem. It also provides policymakers with the tools necessary to make informed decisions as funds grow tighter and public demands do not lessen. In the closing lines of the State of the State, Governor Graves stated "Programs that are not proving themselves will not be supported; while programs that are critical to our future will find strong and often increasing support." His vision cannot be accomplished without the information H.B. 2120 provides. I would be happy to answer any questions you may have.

A Review of the Science, Methods of Risk Communication and Policy Recommendations

in

Tap Water Blues: Herbicides in Drinking Water

by

David B. Baker
Director, Water Quality Laboratory

R. Peter Richards
Water Quality Hydrologist, Water Quality Laboratory

and

Kenneth N. Baker
Associate Professor, Department of Biology

Water Resources Program
Heidelberg College
Tiffin, Ohio 44883

November 14, 1994

The report, *Tap Water Blues: Herbicides in Drinking Water*, was written by Richard Wiles, Brian Cohen, Chris Campbell and Susan Elderkin of the Environmental Working Group and Physicians for Social Responsibility. The report was released on October 18, 1994.

WATER QUALITY LABORATORY

Heidelberg College
310 East Market Street
Tiffin, Ohio 44883-2462

(419) 448-2198 FAX: (419) 448-2124

November 14, 1994

Dear Reader:

As a researcher who has been involved for many years in studies of the impacts of food production on water resources, I was of course interested in examining the report *Tap Water Blues: Herbicides in Drinking Water*. The report, which was prepared by the Environmental Working Group of Washington, D.C., claims that the occurrences of five herbicides in Midwestern tap water constitute the major public health threat posed today by the use of pesticides in our food production systems. In particular, the report indicates that herbicides in drinking water pose unacceptable cancer risks to residents of this region and recommends that three of the herbicides, the triazines, be banned from all uses after September 1996. Our own laboratory was the source of much of the data used to characterize herbicide exposures in the Ohio section of the report.

Upon reading *Tap Water Blues*, we were struck by the contrasts between the way we would assess exposures, estimate cancer risks, communicate those risks to the public, and organize information to support policy development and the way the Environmental Working Group approached these same topics. We are an environmental research and educational organization connected with a midwestern private liberal arts college while the Environmental Working Group is a nonprofit environmental research group based in Washington, D.C. Descriptions/mission statements of both groups are included in the appendix of this review. What we see in *Tap Water Blues* is not an objective analysis of exposure data, calculation of risks, and communication of those risks to the public, but instead erroneous and slanted calculations of exposure, risks communication designed to frighten the public, and policy recommendations not supported by objective interpretation of data.

We have written this review to contrast these two approaches. We offer this review to all concerned with the relationships between food production and water resources. We recognize the limits of our background to address the complex issues ranging from agronomic practices through exposure information to animal toxicology. In a sense, we sit in the middle of these issues. We welcome "reviews" of our review.

Yours for science-informed policy,

David B Baker

David B. Baker
Director

Abstract

Tap Water Blues: Herbicides in Drinking Water was released to the public on October 18, 1994. In preparation for over two years by researchers of the Environmental Working Group, the report's authors set for themselves an ambitious task: determining the aggregate risk of cancer faced by residents of ten Midwestern states due to the presence of five commonly used agricultural herbicides in their drinking water supplies—alachlor, atrazine, metolachlor, cyanazine, and simazine. Focusing on water supplies having the highest concentrations of these herbicides, the authors evaluated over 20,000 samples obtained from various data bases across the Midwest. Combining the data on herbicide concentrations with cancer potency factors for the individual herbicides, they calculated cancer risks for each one. They then summed these estimates to provide estimates of aggregate cancer risks for each of the assessed communities. The authors concluded that the herbicides pose unacceptable cancer risks to residents of the region, and recommend that three of the herbicides, the triazines, be banned from all uses by September 1996. From our perspective of over a decade of research on the occurrence of these compounds in Midwestern drinking water supplies, and the health implications of these occurrences, we felt compelled to prepare this review of *Tap Water Blues*. We are dismayed at the quality of science the authors employed in preparing the report, the conclusions they have drawn based upon their study, and especially the methods with which they have chosen to communicate their findings to the public. It is our belief that it would be a very bad idea to base sweeping changes in the nation's regulatory policies for these herbicides on the research and recommendations laid out in *Tap Water Blues*. The present review details our difficulties with the report. In section II, we have summarized our principle objections to the authors' methods; the following sections elaborate on these objections with re-analyses of the data and a critique of the authors' methods of risk communication. Concerning the quality of science in the report, our primary objections include the authors' failure to use time-weighting of samples within seasons, their failure to use population-weighting in calculating their "statewide" average risks, ambiguity concerning the populations actually represented by these "statewide" averages, their fabrication of a federal standard resulting in inflated perceptions of risk, and the absence of any estimates of cancer occurrences for the affected communities due to the herbicides or any other sources. Concerning the interpretations and conclusions that the authors have made, our objections include their implication of greater significance of the risks than is warranted by their results, and the use of inappropriate comparisons to existing drinking water standards and health advisories. Concerning the authors' methods of communicating their findings, our principle objections include the authors' inclusion of political considerations in reporting state summaries of herbicide use, their decision to release their report through the media (effectively by-passing critical scientific review processes), their highly misleading use of the terms "statewide average risks" (that are not representative of averages, statewide) and "multiple of federal standard" (which implies the existence of a non-existent standard), and their lack of any estimates of actual numbers of cancers that might be expected from the presence of these herbicides in drinking water. For the 52 million residents of the ten Midwestern states forming the focus of this study, we estimate these cancers to number less than 5 per year above the roughly 200,000 that would be attributable to other sources. Finally our review of *Tap Water Blues* has led us to consideration of an important policy issue for legislators and administrators concerned with regulating the use of agricultural chemicals. Since herbicide concentrations are not uniformly distributed throughout a region, some communities may experience relatively higher risks than do others—even if the overall average risks for the entire region are deemed negligible. How policy makers will deal with such inequitable distributions of negligible involuntary risks is becoming a question worthy of direct consideration.

Table of Contents

Tables and Figures

I. Introduction

On October 18, 1994, a report entitled *Tap Water Blues* was released at a series of news conferences. The report states that herbicides in drinking water are the greatest public health threat posed by pesticides today. It presents herbicide-related cancer risks for many individual cities and towns throughout the Midwest. The authors consider the situation so serious that they are calling for a complete phase out of all uses of three triazine herbicides by September, 1996. Understandably, many midwestern residents were alarmed by this message. They sought explanations from agricultural agents and from state and local officials responsible for the safety of drinking water. Often, these agents and officials were totally unaware of the report's existence and lacked the specialized training that might enable them to quickly and effectively analyze and respond to the concerns generated by *Tap Water Blues.*

In the Water Quality Laboratory at Heidelberg College, we have been concerned about the human health implications of herbicides in drinking water since 1983, when we first observed herbicides in northwestern Ohio drinking water supplies. Since that time we have been working with state and federal officials, with pesticide manufacturers, with the farming community, and with environmental groups to evaluate and re-evaluate the health implications of the occurrence of these compounds in drinking water supplies. We have also devoted much effort to communicating risk information to the public.

We now have had an opportunity to review *Tap Water Blues*. While this report represents the most comprehensive study to date of the cancer risks associated with herbicide contamination of midwestern tap water, we conclude that the authors of *Tap Water Blues* have misrepresented the significance of their findings in their press releases to the public through radio, television and newsprint. Furthermore, we see clear indications that the authors deliberately used inappropriate averaging procedures resulting in inflated risk estimates. They fabricated a federal standard against which to compare the risks that they had calculated and presented their results in a way that could easily lead to exaggerated public perceptions of actual cancer risks. They provided virtually no context for the numbers they provide, which are presented so as to generate the greatest public alarm.

How can it be that our interpretation of the data presented in the study differs so drastically from that of the authors of *Tap Water Blues*? Is it a case of scientists disagreeing on the interpretation of data, or does it represent a case of biased methods and faulty science? In an attempt to answer these questions, we have prepared this review of *Tap Water Blues*. We believe that the release of *Tap Water Blues* provides a "window of opportunity" to analyze various uses of water quality data, the communication of risk information to the public, and the organization of information to support policy decisions.

Tap Water Blues was prepared by the Environmental Working Group, a nonprofit research group in Washington, D.C. whose President is Kenneth A. Cook. Mr. Cook wrote the forward to the report. The lead author of the report is Richard Wiles, Director of the Agricultural Pollution Prevention Program of the Environmental Working Group. Other authors include Brian Cohen, Chris Campbell and Susan Elderkin. Dr. David Rall was among the reviewers and endorsed the report's findings at the press briefing accompanying its release. He is the Director of the Science and Health Policy Project, Physicians for Social Responsibility.

In this review, when we use the term "the authors", we will be referring to all of the above individuals, including Mr. Cook and Dr. Rall. Additional background information about these individuals is provided in a Press Advisory that is included in the appendix of this review. We have also included in the Appendix the acknowledgment page from *Tap Water Blues*. It includes a listing of the reviewers of *Tap Water Blues*, the foundations providing support to the Environmental Working Group for the study, and ordering information for the report.

We have three goal in this review and analysis --

1. To evaluate the quality of the science underlying *Tap Water Blues.*

2. To evaluate the risk communication methods of the authors of *Tap Water Blues.*

3. To place the issue of herbicides in drinking water into a context that will support sound policy development.

Because readers of this review may have widely varying backgrounds in the areas of drinking water regulations, pesticide exposure assessment, pesticide toxicity assessment, risk characterization, and risk management, we will provide background on these topics to facilitate understanding our analyses.

II. The Messages of *Tap Water Blues*, and an Overview of our Responses

The initial part of this overview section presents a selection of quotations from *Tap Water Blues* or the Press Advisory that preceded its release that reflect some of the major messages conveyed to the public by the authors. They are shown in bold face type. Our response to each statement immediately follows the quotation and is presented in regular type. In the second part, we use the same approach to comment on the recommendations put forth in *Tap Water Blues*. The final part summarizes our assessment of (1) the quality of the science underlying *Tap Water Blues*, (2) the methods used by the authors to communicate risk, and (3) some policy issues related to herbicide contamination of drinking water.

A. Major Messages from the authors of *Tap Water Blues* and Our Responses

1. "Herbicides in drinking water are the greatest public health threat posed by pesticides today." (p. 61)

If herbicides are the greatest public health threat posed by pesticides today, then any fears the public may have concerning possible pesticide impacts on the safety of our food and water ought to be greatly alleviated. Objective analysis of the data presented in this report (sections III and V, below) indicates that cancer occurrences associated with drinking water contamination by herbicides in the Midwest are essentially negligible. Administrator Carol M. Browner of the U.S. EPA referred to the report, upon its release, as another in a series of "wake-up calls" regarding contamination of drinking water supplies. Upon careful review of *Tap Water Blues*, we view it more as a "wake-up call" regarding the uncritical reliance of policy makers on documents prepared by activist organizations, especially when the public is ill-prepared to evaluate alarmist tactics employed by such groups.

2. "Federal drinking water standards are among the weakest of all national environmental regulations." (p. 2)

With respect to cancer, the current drinking water regulations for herbicides are not as restrictive as the regulations for food for these same compounds. However, the actual cancer risks posed by herbicides in midwestern drinking water under current regulations are no greater than those that would be allowed under existing food regulations, if they were to be applied to water. This negligible risk has been achieved for the most part without any regulation. It is primarily a consequence of the low concentrations of these chemicals in our water supplies.

3. "14.1 million people routinely drink water contaminated with five major agricultural herbicides (atrazine, cyanazine, simazine, alachlor and metolachlor)." (p. 1)

This statement is certainly false. Within the regions where these herbicides are used, <u>far more</u> than 14.1 million people undoubtedly ingest these herbicides in drinking water. Scientists are able to measure these herbicides at very low concentrations, so detections of herbicides are frequent, but most involve concentrations that are inconsequential with respect to human health effects.

The movement of chemicals from land surfaces to surface and ground water is an inevitable consequence of the operation of the hydrological cycle. So long as any herbicides are used in food production, they will move with water. This movement can be reduced, but not prevented. Likewise, water treatment can reduce, but not totally remove, herbicides from drinking water.

Scientific understanding of the occurrence of herbicides in drinking water and in the environment depends on the design and implementation of appropriate monitoring programs, and on the analytical detection limits used in the investigations. Since scientists are able to measure these herbicides at concentrations that are insignificant with respect to human health effects, society must begin to distinguish between technical terms such as detections, trace levels, occurrences; and contaminants, pollutants, and health threats.

4. "More than 3.5 million people in 120 cities and towns face cancer risks more than 10 times the federal cancer risk benchmark, based on average annual exposures to these herbicides." (p. 2)

We have two observations to make regarding the above statement (and its many variants), which is repeated throughout *Tap Water Blues*. First, the risk statements in the text are all expressed relative to a "Federal Standard" which the authors of *Tap Water Blues* invented. No such federal standard exists. The authors have summed the individual risks for all five herbicides and compared the sum with a federal risk allowed for a single herbicide. Thus, they have fabricated a "Federal Standard" five times more restrictive than any existing standard, thereby inflating apparent risks in their messages to the public by a factor of five.

Our second observation relates to an issue that is becoming more and more important in the development of environmental regulations -- that of environmental equity. In our view, the real complaint of the authors of *Tap Water Blues* amounts to the following:

There is an inequitable distribution of negligible, involuntary risks.

Using the approach of the authors of *Tap Water Blues,* coupled with some of our own data, we estimate (sections V and VII, below) that less than five new cancer cases per year would be expected among the entire 52,000,000 residents of 10 midwestern states, due to the occurrence of these five herbicides in midwestern drinking water supplies. However, by describing risks solely as "Multiples of Federal Standard," the authors avoid helping the public understand how small these risks actually are. By EPA definition, less than five cancers per year in this size population represent a negligible or *de minimus* risk for five herbicides. But residents of some cities have a greater chance of being one of the unlucky four than residents of other cities. It is because of such uneven distribution of negligible risks that the authors are calling for a ban of triazine herbicides for the entire region.

We believe that environmental equity becomes an important issue when risks are significant, not when risks are negligible. Of course, we also recognize the necessity of protecting those few communities that are experiencing unsafe levels of contaminants in their water supplies. However, other methods to achieve this goal, besides the imposition of total bans, already exist in the form of compliance attainment programs.

5. **"Across the Corn Belt, we estimate that at least 241,000 individuals are supplied by surface water sources where average annual herbicide levels exceed federal standards." (p. 71)**

The federal standards referred to in this statement are those set under the Safe Drinking Water Act and are applicable to public water supplies. For these 241,000 residents, who make up about 0.5% of the Midwest's total population, current laws mandate that steps be taken to bring the herbicide concentrations into compliance. Compliance can be achieved either through reducing herbicide concentrations in source waters or by initiating herbicide removal at water treatment plants, whichever is deemed most appropriate in local situations.

Because of large safety factors built into the drinking water standards, residents of these cities are unlikely to face any health risks, even though concentrations may exceed the drinking water standards. The health risks for atrazine have recently been described by the EPA as follows:

> Non-cancer effects: EPA has set a Lifetime Health Advisory Level (HAL) for atrazine in drinking water at 3 ppb. EPA believes that water containing atrazine at or below this level is acceptable for drinking every day over the course of one's lifetime, and does not pose health concerns. A Lifetime HAL represents the concentration of a contaminant in water that may be consumed over an average human lifetime without causing adverse health effects. Lifetime HALs are based on health effects that were found in animals given high doses of the pesticides in laboratory studies. This level includes a margin of safety. Consuming atrazine, however, at high levels well above the Lifetime HAL over a long period of time has been shown to result in adverse health effects in animal studies, including tremors, changes in organ weights, and damage to the liver and heart. (EPA 1990)

The same statement is applicable to the other triazine herbicides and metolachlor, which are the herbicides whose standards are based on non-cancer effects. The EPA has also set a Health Advisory Level for a continuous seven year exposure period for atrazine. For seven years, concentrations of 50 ppb would be considered safe for human consumption in drinking water. We know of no public water supplies where that level of contamination has been exceeded or even approached for a seven year period.

Existing drinking water standards for pesticides are intended to be a regulatory "early warning" systems. Indeed, they appear to be functioning in that manner. Under existing regulations, these standards are to be periodically reviewed, and any new and relevant toxicological information is to be considered. If warranted, the drinking water standards may then be changed.

6. **"In the Corn Belt, an estimated 65,000 infants drink these herbicides from birth via infant formula reconstituted with contaminated tap water." (Press Advisory)**

As it stands, the above statement may very well be true, but it is meaningless from a human health standpoint. Human health becomes a valid issue when herbicide concentrations reach levels that are projected to have adverse impacts on infants and children, or adults, for that matter. We know of no credible evidence that such effects occur at herbicide concentrations observed in drinking water, even where they exceed drinking water standards by several fold. If such evidence is brought to the EPA, then it will be evaluated and taken into consideration under review processes

built into federal law and regulations. If the evidence is alarming, the EPA can act immediately to ban the offending substance.

7. **"Earlier studies have shown that children are particularly susceptible to these chemicals." (Press Advisory)**

This statement is an excellent example of the carefully designed ambiguity used by the authors to frighten the public. Many might infer from the above statement that researchers have shown that alachlor, metolachlor, atrazine, cyanazine, and simazine affect both adults and children and that children are more susceptible to these particular substances. No such studies or research exist.

Instead, it may be stated that children are probably more susceptible to all chemicals than adults are. The best information on this topic probably comes from studies to determine medication levels for infants and children. Not only do infants and children consume different volumes of water relative to their body weight than do adults, but their physiology and biochemistry often are not as effective in clearing the medications from their bodies. But even in children, the dose makes a critical difference. The drinking water concentrations of these herbicides are so low that the combined weight from ingesting all five of them in our most contaminated surface waters would rarely exceed the equivalent weight of one aspirin tablet in a 70 year lifetime, assuming the person consumes two quarts of water a day. This small quantity should be even more reassuring, in view of the relative acute toxicity of aspirin and atrazine. Aspirin is more toxic than atrazine. Even if children are generally more sensitive to chemicals, the herbicide doses they receive in drinking water are so small that they appear not to pose a health threat.

B. Recommendations from Tap Water Blues and our Responses

1. **"A two year phase-out of the triazine herbicides, with total phase-out of all uses of these herbicides to be completed by September 1996." (p. 108)**

While these compounds are currently used in large quantities in corn and soybean production, and they are present in many drinking water supplies at concentrations that can easily be measured, we are unaware of any evidence that these herbicides pose health threats to fetuses, infants, children, or adults, at the concentrations observed in drinking water supplies. If such evidence appears, it should obviously be evaluated.

Furthermore, we are not aware of evidence of significant ecosystem damage from the use of these chemicals. Indeed, earthworms thrive in the no-till systems where these compounds are used to control weeds. These same farming systems reduce cropland erosion and the transport of sediments, phosphorus, and even the herbicides themselves, into our surface waters.

Farmers choose to use these herbicides because they are effective and inexpensive. For economic reasons and probably to a lesser extent in response to pesticide labeling changes and to the growing awareness of farmers that water is also one of their exports, the quantities of these herbicides applied to cropland are decreasing.

New herbicides which are becoming available are used in much smaller quantities -- quantities that are so small that existing analytical capabilities may not be able to

characterize their behavior in the real world. Thus it may be more difficult to monitor and evaluate the health implications of these new compounds.

It should be remembered that current generation herbicides differ greatly from earlier generation pesticides such as DDT. These compounds are much less persistent and have a far lower tendency to bioaccumulate.

In view of the above, we see no compelling reason that use of these compounds should be phased out, as recommended by the authors. Indeed, triazines may be a useful tool in environmentally sound food production for many years into the future. To the extent that agriculture can achieve additional risk reductions associated with the use of herbicides without suffering economic damages, then efforts for risk reduction should certainly proceed. Nevertheless, we should all be aware that minimal, if any, health or ecosystem benefits will appear in connection with these efforts. Instead, we will simply expand margins of safety beyond the current levels.

2. **"Immediate action by EPA to set an enforceable MCL for total chlorinated triazines, including cyanazine and all chlorinated triazine metabolites at levels that present no more than a one-in-a-million cancer risk." (p. 108)**

As noted above, the cancer risks in *Tap Water Blues* have been greatly overstated. In this recommendation, the authors are arbitrarily calling for establishment of a standard that is three fold more stringent than the food standard, under the guise that these compounds have a common mode of action and therefore have additive effects. The authors had already added up the aggregate risk for five herbicides without employing an argument of a common mode of action.

Do the authors really understand the complexity of the standard they are requesting? Do they realize that, since each compound has a different cancer potency, the resulting MCL is a formula with an infinite combination of concentrations that can meet their proposed requirement of a one-in-a-million risk level? It is unclear that they understand this, since they call for an enforceable MCL. The only single number that could insure compliance would be to assume the entire triazine concentration was comprised of the triazine or metabolite with the highest cancer potency.

3. **"Reform of government farm programs to include incentives for farmers to cut back or eliminate use of the most toxic herbicides through greater use of integrated weed management measures based on economic threshold models." (p. 108)**

If what the authors view as enlightened weed control technology results in economic gain for the farmer, as stated in *Tap Water Blues*, why do farmers need incentives to reduce herbicide use? What is the human health or ecosystem benefit that would arise from these incentive payments? In our view, any such incentive payments would buy more improvements in human health and ecosystems if directed elsewhere.

4. **Required weekly monitoring for these herbicides in drinking water during the months of May through September by all public drinking water utilities.**

We agree with the authors that quarterly monitoring for herbicides, as currently required under federal regulations, is inadequate to accurately characterize herbicide concentrations, particularly in rivers. Enough is known about the behavior of these compounds in the environment that monitoring could be tailored to various local situations to improve the efficiency of the monitoring program, as well as its effectiveness in characterizing average concentrations.

C. Additional Overview Comments on *Tap Water Blues*

In the above sections, we have responded to some of the major claims and recommendations of the authors of *Tap Water Blues*. In this section we will highlight some of our additional observations and concerns. These fall into three areas -- quality of their science, quality of their risk communication, and impacts on sound environmental policy.

1. Quality of the Science in Tap Water Blues.

(Note: We consider accurate communication of research to be part of science.)

- The authors use inappropriate averaging procedures in calculating both the concentrations of herbicides for rivers and the calculation of "statewide average" cancer risks. By not time-weighting samples during spring runoff events, they overestimate herbicide concentrations for at least some of the communities they evaluated. By not population-weighting their community cancer risk estimates, they inflate their "statewide average" cancer risks.

- For each state they calculated a statewide average concentration based exclusively on those communities in which they found contamination. Although those communities made only a small proportion of each state's population, these averages were nonetheless referred to as "statewide".

- They provide no context for the data they present. They do not express populations of affected communities as a percentage of state or regional populations. They do not present cancer risks attributable to herbicides as a percent of total cancer risks.

- Rather than convert the relationships between cancer and herbicides into units the public can understand, such as expected cancers per year in their community or state, they confine their presentation to discussing cancer risks expressed in units of "Multiples of Federal Standard" with footnotes defining a federal standard.

- They imply direct relationships between the percent of herbicide detections in water supplies and adverse human health effects for adults and children, ignoring dose-response relationships. While frequently detected, the concentrations of herbicides are, in the vast majority of places and times, at levels which pose no adverse human health risks, according to either the currently applicable federal standards or the more protective standards which the authors are calling for.

- They compare short-term herbicide concentrations with long-term herbicide standards, even though short-term standards are available as part of the EPA's Drinking Water Health Advisory Program. Thus they compare peak herbicide

concentrations during late spring runoff events with a drinking water standard that is intended for comparison with annual average concentrations, rather than comparing them with one-day or 10-day health advisory levels published by the EPA. Because of the transitory effects of runoff from agricultural fields during storms, short-term peak herbicide concentrations in rivers frequently exceed standards that are intended for comparison with long-term average concentrations. Short-term peak herbicide concentrations rarely exceed the EPA's short-term (one day and 10-day) health advisory levels.

- They introduce politics into the report by presenting herbicide applications by congressional district, indicating voting record of incumbents on environmental legislation, and suggesting impacts on cancer risks if certain voting positions prevail.

2. Quality of Risk Communication by the Authors of *Tap Water Blues.*

In our view, the methods of risk communication used by the authors of *Tap Water Blues* are those that have become the "stock-in-trade" of certain environmental activist organizations, whose objectives are more to sway public opinion than to inform it. These methods might be presented as a set of guidelines for a public relations campaign:

- Release study on national TV (Good Morning America) and through a series of news conferences, rather than through the peer-reviewed professional journals that is standard for scientific research.

- Assume role of objective, concerned, research organization serving the public interest and link up with other local and national organizations who assume similar roles.

- Express great concern over the results of their study.

- Emphasize possible links of pollutants to health of infants, children and pregnant women.

- Use the press to carry intended messages to the public through the newsprint, radio and television.

- Count on the necessity of the media to "hook" their audience or readership share through headlines and lead lines.

- Count on weak instantaneous rebuttals from those with opposing views whom the press may contact in their efforts to remain objective.

- Count on the story to have become old news by the time more thorough analysis and review of the study become available.

Using such methods, the authors of *Tap Water Blues* conveyed the results of their study to the public. They apparently succeeded in frightening many people. Our own phone started ringing with calls from concerned people, as did the phones of local health and agricultural officials throughout the Midwest and elsewhere. The calls came not just from mothers of infants and children and pregnant women, but also from the elderly.

It is an understatement to say that the message conveyed to the public by the authors of *Tap Water Blues* is exaggerated. They have effectively broadened the gap between public perceptions of risks associated with herbicide use and scientific perspectives of these same risks. From their perspective, they may consider their communications methods to have been successful. We consider what they have done to be neither risk communication nor risk education. We do not feel the authors of *Tap Water Blues* held themselves to the rigorous ethical standards required of objective scientists in presenting the results of their research.

3. Impacts on Sound Environmental Policy.

Our thoughts on the importance of accurate risk communication and education are reflected in the introduction to a paper that we just published entitled "Herbicides in Ohio's Drinking Water: Risk Analysis, Reduction and Communication" (Baker and Richards 1994) We are repeating those comments below.

> "Wide gaps often exist between *public perceptions* of human health risks associated with particular environmental problems and *scientific perspectives* on the risks posed by these same problems. The magnitudes of these gaps can have serious consequences in that they can undercut the efficiency with which our society addresses environmental problems. In a 1987 report entitled *Unfinished Business: A Comparative Assessment of Environmental Problems*, the U. S. EPA noted that its own resources were not allocated to programs in proportion to the magnitude of environmental risks they posed, as judged by EPA staffers, but rather were allocated more closely in proportion to public perceptions of those risks (EPA, 1987). That report led to the formation of the Relative Risk Reduction Strategies Committee of the EPA's Science Advisory Board (SAB). In 1990, this committee released its report -- *Reducing Risk: Setting Priorities and Strategies for Environmental Protection* (EPA, 1990). The executive summary of their report states:
>
> > There are heavy costs involved if society fails to set environmental priorities based on risk. If finite resources are expended on lower-priority problems at the expense of higher-priority risks, then society will face needlessly high risks. If priorities are based on the greatest opportunities to reduce risk, total risk will be reduced in a more efficient way, lessening threats to both public health and local and global ecosystems."

In *Tap Water Blues*, we see the authors greatly exaggerating the human health risks posed by herbicides. We also see the methods they use to frighten the public and broaden the gap between public perceptions of risk and scientific perspectives of those risks. We believe that the policy recommendations issued by the authors of *Tap Water Blues* regarding safe drinking water regulations, pesticides, and agriculture, are not in the best public interest.

4. An Important Policy Issue.

In reviewing *Tap Water Blues*, an important issue regarding environmental regulations has emerged in our minds. It deals with the target population and degree of society's efforts to protect its citizens from involuntary risks when trade-offs are involved. Simply put, should our negligible risk goal be applied to the midwestern crop production or triazine use area as a whole, to every individual public water supply within the Midwest, or to every individual in the Midwest? In EPA Administrator Browner's response to *Tap Water Blues*, she stated that, "we feel that even one person at risk is too many." To achieve an environment where no one faces even a negligible cancer risk (generally set at $1 \times 10^{-6}/70$ years) due to herbicides in drinking water would require that the average risk for the region as a whole be set at $1 \times 10^{-8}/70$ years. That is, to ascertain that the peak risk for any one individual is not greater than one in a million, we must set the average for the whole region at least 100 fold below that—to account for the non-homogeneous distribution of herbicides in the region's waters. An average risk level of $1 \times 10^{-8}/70$ years among the Midwest's 52 million residents is equivalent to one additional cancer every 135 years in the entire 10 state area. That is asking a lot of our food production systems. In this same area, approximately 200,000 new cancer cases would be expected every year from other other causes.

Within the Midwest as a whole, current herbicide concentrations are at levels which result in an estimated 4 or 5 additional cancers per year. This is essentially a *de minimus* level for the region. Yet because herbicide concentrations are not uniformly distributed, some cities and towns have risk levels from herbicides that are greater than *de minimus*, while other are less. Policy must then address the following question:

> What kind of limits should be set regarding the inequitable distribution of negligible involuntary risks?

In addressing this question, the benefits associated with the use of this herbicides must also be considered. These benefits include not only economic benefits to farmer's, but also environmental benefits associated with the use of these herbicides in conservation farming.

III. Background on Drinking Water Standards and Cancer Risks

A. Standards Set Under the Safe Drinking Water Act

Table 1 is adapted from *Tap Water Blues* and includes the current federal drinking water standards, as set under the Safe Drinking Water Act, and associated cancer risks for the five herbicides in question. In column 3, the current standards are listed for each of the five herbicides. Drinking water standards are the concentrations of chemicals the EPA deems safe for human consumption over a specified period of time. The concentrations are generally reported in units of parts per billion (ppb).

Two types of standards are shown in column 3. Regulatory standards called MCLs (Maximum Contaminant Levels) have been set for atrazine, alachlor and simazine. The second type of standard is a LHA (Lifetime Health Advisory). The EPA's health advisory program was initiated "to provide information and guidance to individuals or agencies concerned with potential risk from drinking water contaminants for which no national regulations currently exist." (EPA, 1989) LHAs are available for all five herbicides. As regulations are established for a particular pesticide, its LHA generally becomes its MCL. With respect health risks, an MCL is interpreted in the same way as a LHA, which was described on page 5 of this review. Both of these standards are designed to protect humans from adverse health effects associated with chronic exposures to these compounds over the lifetime of an individual.

Compliance with MCLs is judged on the basis of annual average concentrations, as calculated by a running average of four quarterly measurements. At least one measurement per quarter (three month interval) is required for vulnerable surface water supplies. However, one measurement per quarter is totally inadequate to accurately characterize pesticide concentrations in river systems draining agricultural watersheds, especially during spring runoff events following pesticide applications. We are in complete agreement with the authors of *Tap Water Blues* in calling for improved monitoring programs for surface water supplies in pesticide use areas.

Table 1. Relationships between cancer potency factors, drinking water standards, and cancer risks.

1	2	3	4	5	6
Herbicide	Cancer Potency Factor	Safe Drinking Water Act		Food Standard Applied to Water	
parameter:	Q*	MCL/LHA ppb	Risk/70 yr x 10^{-6}	MCL ppb	Risk/70 yr x 10^{-6}
Alachlor	0.08	2	4.6	0.44	1.0
Atrazine	0.22	3	19.0	0.16	1.0
Metolachlor	0.01	100	5.7	18.00	1.0
Cyanazine	1.00	1	29.0	0.03	1.0
Simazine	0.12	4	13.0	0.31	1.0

Drinking water standards are based on animal toxicological studies that are required as part of the pesticide registration process. Methods specified by the EPA must be used in these studies. The results of these studies determine whether the drinking water standard for a particular pesticide will be set relative to its cancer causing properties or relative to some other toxicological endpoint, such as developmental or reproductive effects.

Of the five herbicides considered in Tap Water Blues, only alachlor is currently regulated on the basis of its carcinogenic properties. In a cancer classification used by the EPA, alachlor is considered a B_2 carcinogen, which is described as a probable human carcinogen. For the other four herbicides, standards are based on other toxicological endpoints, even though for all of these there is some evidence of carcinogenic activity. However, in the EPA's classification, the cancer evidence places these compounds in a C category and they are considered possible human carcinogens.

The animal toxicological studies for cancer lead to the calculation of cancer potency factors (also called Q* or "Q stars") for each pesticide with carcinogenic activity (Table 1, column 2). The cancer potency factors provide a way to link pesticide concentrations in drinking water with added (above those caused by other agents) lifetime risks of cancer occurrence. Cancer risks, such as those shown in column 4 and 6 of Table 1, are reported in units of excess cancers per million people over their lifetime (70 years). In addition to the potency factor, the volume of water consumed per day and the weight of the individual are also used in the calculation of cancer risks (EPA, 1989). Calculations are normally based on a 70 kg person consuming two liters of water per day.

It should be noted that there is considerable uncertainty in scientific circles over the applicability of current animal testing procedures that lead to the calculation of these cancer potency factors. The testing involves extremely high doses of pesticides and subsequent extrapolation to the low doses humans receive in drinking water. Some researchers believe that at such high doses, cancers arise as a secondary effect from other damage caused by the pesticide, rather than through direct carcinogenic properties of the pesticides. Nevertheless, these cancer potency factors are the basis of current pesticide regulations, and they are, in our view, appropriately taken at face value in the analyses reported in *Tap Water Blues*.

The MCL for alachlor is 2 ppb, which carries with it an excess lifetime cancer risk of $4.6 \times 10^{-6}/70$ yrs. Under the Safe Drinking Water Act, a range of added cancer risks from 10^{-4} to 10^{-6} per lifetime are considered acceptable. The benefits associated with alachlor's use were considered in the determination of an acceptable risk level. The potency factor was used to calculate the corresponding concentration for the MCL.

Calculation of the MCLs and LHAs for the four other herbicides uses a different approach. Toxicological tests of a variety of types are conducted on multiple species or strains of animals. The test species and strain that is most sensitive to the pesticide, in terms of an adverse health effect, is selected as the basis for setting the human drinking water standard for that pesticide. Two particular pesticide doses are identified from that test —the lowest observable adverse effect level (LOAEL) and the no observable adverse effect level (NOAEL). Somewhere between the LOAEL and the NOAEL is the threshold dose for that species—a concentration above which adverse effects start to appear but below which no effects can be observed.

Drinking water standards are based on the NOAEL dose (EPA, 1989). To account for the uncertainty in extrapolating from animal species to humans, a 10-fold safety factor is introduced. To account for variable sensitivity among individuals and age groups, another

10-fold safety factor is introduced, giving a 100 fold safety factor. Because the triazine herbicides are Class C carcinogens, another 10 fold safety factor is introduced in setting their standards. Finally, a 5-fold factor is introduced to allow part of the estimated safe human dose to enter a person via foods rather than by drinking water. Since residues of these herbicides are rarely detected in foods, this 5-fold factor amounts to an additional safety factor for drinking water. The combined safety factor is then 5000-fold (10x10x10x5). Thus the MCLs and LHA for the triazines shown in column 3 of Table 1 reflect drinking water concentrations that constitute doses to humans 5000 times smaller than the dose which had no observable adverse effect in the most sensitive animal test available for those herbicides. In their discussion (pages 24-25) of the setting of drinking water standards based on NOAELs , the authors of *Tap Water Blues* do not mention the last two safety factors for the triazine herbicides, and refer only to the 100 fold safety factor. These same pages otherwise provide a good overview of the differing ways drinking water standards are set, as well as a comparison with food standards.

Since cancer potency factors are available for all five of the herbicides, cancer risks that accompany consumption of water at the MCL or LHA can be calculated. These risks are shown in column 4 of Table 1.

B. Other "Drinking Water Standards" Presented in *Tap Water Blues*

The authors of *Tap Water Blues* believe that the MCLs and LHAs established under the Safe Drinking Water Act do not provide adequate protection to the public, with respect to cancer risks. They state that food standards for these same five herbicides are based on their carcinogenic activity, and set so that the cancer risk for each herbicide is one in a million (Table 1, column 6). If these same risk levels were applicable to drinking water, the corresponding MCLs can be calculated using the cancer potency factors. These concentrations are shown in Table 1, column 5. The basis for the authors' claim that current federal drinking water standards are among the weakest of all environmental laws is that the cancer risks associated with current Safe Drinking Water Act MCLs and LHAs (Table 1, column 4) are higher than the one in-a-million lifetime risk that would be applied for foods.

Although the food standards are more strict than the water standards, the authors do not believe that even the food standards are adequately protective of human health. They note that these five herbicides may occur simultaneously. They further note that the total risk associated with the five herbicides is likely to be equal to the sum of their individual risks and cite some research to support that position. They believe that the combined risk for the five herbicides should be one-in-a-million for the combination of all five herbicides rather than 5 in a million, as would result from the adding of the individual risks in column 6 of Table 1. They not only believe that this one in a million risk should be the federal standard, but they actually call it a "Federal Standard" and present aggregate risk data for five herbicides as a "Multiple" of this "Federal Standard" throughout the report. Yet, in their recommendations, they back off from this one-in-a-million standard for five herbicides, and suggest one-in-a-million for the sum the three triazines plus their metabolites.

IV. What Is New in *Tap Water Blues?*

The authors of *Tap Water Blues* have made a significant contribution by attempting to answer the question: What is the aggregate cancer risk that may be occurring in the Midwest as a result of the presence of five herbicides in midwestern drinking water supplies? We know of no other study that has set out to address this issue at this scale for five herbicides. The project represents a major effort in data synthesis and interpretation. The concept of the study is sound.

The authors obtained data on pesticide concentrations from large and small data bases throughout regions of heavy herbicide use. They constructed a data set containing herbicide concentration for more than 20,000 samples. From this they characterized the herbicide concentrations for individual cities and towns throughout the study area, focusing on those surface water supplies having the highest concentrations.

Using the cancer potency factors for the individual herbicides and the corresponding concentrations of each herbicide, they calculated the cancer risks associated with each herbicide individually and then summed the risks for the five herbicides to provide an aggregate cancer risk for each community. The resulting aggregate cancer risks were then organized in a wide variety of ways to describe excess cancer risks from herbicides throughout the region.

The authors also conducted an extensive analysis of U.S. Department of Agriculture data to characterize herbicide use in the study area (Chapter 2) and examined alternatives to current weed control practices (Chapter 4). The report includes summaries of pesticide use, herbicide concentrations, and aggregated cancer risks for individual midwestern states.

V. *Tap Water Blues:* Quality of The Science

While the concept of the study is sound, execution of the study is seriously flawed, if it is to be viewed as science. There are several types of flaws in *Tap Water Blues.* The authors used inappropriate averaging techniques, they mislabel their most important product (cumulative risks), they fail to communicate the context of numbers they present, the titles of their tables read more like editorial comments, and they make conclusions that are not only unsupported by their data but are opposite to what the data document.

Several of these flaws can be illustrated using the data in Table 2 which is identical to Table 92 in *Tap Water Blues.*

1. Failure to use time-weighting of samples within seasons.

In Table 2, the seasonally weighted average concentrations for each of the five herbicides are shown for the nine sets of drinking water supplies examined in Ohio. The accuracy of the aggregated risks (column 10) hinges on the accuracy of the concentrations shown in the Table 2. Most herbicide monitoring programs collect many more samples during the immediate post-application period, when pesticide concentrations are high, than during other times of the year when concentrations are low. If annual averages are calculated by summing all of the samples in a year and dividing by the total number of samples, the resulting averages would be biased high because samples were taken much more frequently during a season of the year with high pesticide concentrations. As noted in the footnote to the Table 2, the authors did average each season independently, and then take an average of the seasons to obtain a "true average annual exposure level." However, such seasonal weighting does not adequately address sampling biases in larger data sets such as our own or that of the USGS.

It is common in herbicide monitoring to collect samples more frequently during runoff events when concentrations are high than during low flow periods within a given season. The authors failed to take this into account even though the necessity of time-weighting is noted in papers we have published, some of which they have cited in their bibliography (Baker and Richards, 1991; 1994). The authors obtained some of our early data (1983-1987) through the EPA's STORET data base and used it as a basis for the Maumee River, Sandusky River, Honey Creek, and Cuyahoga River data in Table 2. To illustrate the necessity of time-weighting, we examined the atrazine data from the above data set for Honey Creek during the May 1 - August 31, 1986 period. For the 99 samples we collected during that interval, the simple average used by the authors gives a value of 13.6 ppb while the time-weighted average is 7.0 ppb. Thus during this time interval, the simple average overestimated the time-weighted average by almost a factor of two. We have published time-weighted average concentrations for all five herbicides for the above four rivers for the 1983-1991 time period (Richards and Baker, 1993), but the authors chose not to use those values.

When one of the authors contacted us requesting our data, we offered to help them properly analyze it, but they declined. We have subsequently learned that Minnesota data was misused in a similar fashion. Time-weighting would also have been necessary for some of the U.S. Geological Survey (USGS) data sets, in order to put them into a context useful for toxicological evaluation.

Table 2. The average cancer risk for 15 Ohio cities and towns is 23 times the EPA standard.

Source	Cities Served	Population Served	Combined Average* (ppb)	Atrazine Conc. (ppb)	Alachlor Conc. (ppb)	Cyanazine Conc. (ppb)	Metolachlor Conc. (ppb)	Simazine Conc. (ppb)	Lifetime Risk Multiple of Federal Standard
Scioto River	Columbus, Marion	250,000	2.28	0.67	0.14	0.38	0.82	0.27	16.3
Maumee River	Bowling Green, Defiance, Napoleon, McClure	57,000	5.14	1.97	1.27	0.51	1.28	0.11	30.3
Sandusky River	Tiffin, Bucyrus, Freemont	44,000	5.38	2.84	0.89	0.19	1.37	0.09	25.6
Deer Creek Res.	Alliance	25,000	3.18	2.17	0.10	0.31	0.49	0.11	23.1
Alum Creek Res.	Delaware, Westerville	45,000	2.61	1.93	0.03	0.26	0.31	0.08	19.9
Big Walnut Creek	Columbus	320,000	2.59	1.34	0.10	0.38	0.48	0.29	20.5
Honey Creek	Attica	1,200	9.45	3.81	1.95	0.60	3.00	0.09	45.8
Olentangy River	Delaware	22,000	2.68	1.49	0.29	0.25	0.58	0.07	17.4
Cuyahoga River	Akron	280,000	0.85	0.14	0.02	0.27	0.12	0.30	9.7
Total	15 communities	1,044,200							23.2

* Combine average refers to yearly averages that have been seasonally adjusted to correct for any seasonal sampling biases in the data and provides equal weight to each season. This adjustment produces a true average annual exposure level.

Errors associated with the lack of time-weighting, and even of seasonal-weighting, permeate the text of *Tap Water Blues*. For example, in Table 89 of the Ohio section the authors say that in 50% of the samples collected in Ohio, atrazine is present in excess of the drinking water standard. Our data made up 69% of the total data used by the authors for their Ohio assessment. Our analyses show that for the Maumee and Sandusky rivers and for Honey Creek, atrazine concentrations exceed the drinking water standard of 3 ppb for 12%, 11% and 12% of the time, respectively. In our type of sampling program, it is likely that 50% of the samples are collected during times when atrazine is above the standard. Their statement, while true, totally misrepresents the extent to which atrazine is present at concentrations above its standard. This misrepresentation also applies to the other four herbicides, as well as to similar tables presented for other states.

Because herbicide concentrations have been overestimated, at least for some communities, community-specific risk estimates are also overestimated. We cannot precisely evaluate the overall impact of failure to use time-weighting on the herbicide concentrations presented in *Tap Water Blues,* however the direction of the bias is to overestimate concentrations and associated risks in cases where detailed pesticide monitoring has taken place. Overestimates of community-specific risks create a high bias in statewide average risk estimates.

2. Failure to use population-weighted averages for determining "statewide" average risks.

The method the authors used to determine statewide average risks is described on page 69 -- "In every state ... state-wide average risk and exposure estimates are based on a simple averaging of these community specific risk assessments." The word "simple" suggests that they did not population-weight their averages. Indeed the 23.2 at the bottom of column 10 in Table 2 turns out to be a simple average of the nine values listed above. It means that Attica, with a population of 1,200 and a risk of 45.8 has the same impact on the state average as Akron, with a population of 280,000 and a risk estimate of 9.7. We calculated the population-weighted average applicable to the 1,044,200 residents in the assessed communities of Ohio. The population-weighted average for the above communities is 17.3. This is the value that should be opposite the 1,044,220 residents not the 23.2 simple average used by the authors. But even the 17.3 overestimates risk, because, as noted above, the authors did not use time-weighting in calculating herbicide concentrations in rivers.

The authors were aware that small communities have higher risk factors than large communities, and stated so within their report. In fact they state:

> The smallest systems, those serving less than 3,300 people, account for only 2 percent of the high risk population, but 44 percent of the total number of affected high risk drinking water systems. (Tap Water Blues, p. 74)

Consequently, in using simple averages rather than population-weighted averages, it must assumed they intentionally introduced high biases into the state averages. The following example from *Tap Water Blues* indicates the kind of bias that may occur. The "simple" average risk for 98 communities with a combined population listed as "over 400,000" is 24.9 (our calculation from their Table 24), while the "simple" average risk for 23 larger cites with a population of 3.1 million is 20.0 (our calculation from their Table 23). The "simple" average risk from all 121 large

cities and smaller communities is 24.4. Using population weighting of the simple averages for the two groups gives a weighted average of 20.6.

While the authors do list individual cancer risks for the 23 cities and the 98 smaller communities, they do not list the corresponding populations of the individual cities and communities. Consequently, we cannot evaluate in a more quantitative way, the extent of high bias introduced by the averaging technique that they chose to use.

The two types of errors listed above (lack of time-weighting and lack of population-weighting) compound one-another.

3. Ambiguity about the populations represented by "statewide averages".

Soon after the release of *Tap Water Blues*, confusion arose among state and federal officials regarding statewide average risk factors as reported by the authors. Consider the following:

> On page 69 of the report, the authors state..."In Indiana, statewide (emphasis ours) average life-time cancer risks from these five herbicides in drinking water are 28 times the federal cancer standard. In Ohio, the risks are 23 times the EPA standard."
>
> Table 18 (page 70) of *Tap Water Blues* is entitled "In every affected state in the Mississippi River Basin, cancer risks from herbicide contaminated water exceed federal standards by a factor of 8 or more." The table includes a listing of eight states and their corresponding statewide risks expressed as "Multiple of Federal Standard." The same risk levels of 28 and 23 are listed for Indiana and Ohio, respectively.

It is not surprising that federal and state officials were confused. Some reasonably thought that "statewide averages" applied to an entire state. Initially, we thought so too. But when we examined the methods used to calculate the "statewide averages" for Ohio, we discovered the statistic to be strikingly unrepresentative of the state's waters, overall.

As noted in section 2, above, Ohio's average was a simple average based on drinking water used by 1,044,200 residents. This 9.6% subset of the state's population constitutes a highly nonrandom sample. In fact, it represents a "worst case group" in that these residents derive their drinking water from surface waters in agricultural watersheds. They account for the bulk of total herbicide intake among all of Ohio's residents. The authors intentionally excluded from their dataset the low risk populations deriving drinking water from Lake Erie or the Ohio River. Their choice of the phrase "statewide averages" and their frequent use of the term without clarifying comment, strikes us as exceptionally misleading.

Of course the authors of *Tap Water Blues* know their "statewide averages" do not represent anything like averages statewide, and they cannot be accused of failing to document their methods. But what percentage of the reports' readers or those learning of it through the media would be likely to immediately grasp such distinctions? In our opinion, the authors' use of terms like "statewide averages" and "Multiple of Federal Standard" (see item 4, below) is emblematic of a style of communicating risk to the public that is influenced more by underlying policy objectives than by an honest effort to inform the public debate. Regardless of their personal preferences or political agendas, scientists must hold themselves to high ethical standards in reporting their findings so that there can be no

question of the objectivity of their research or the context within which it should be interpreted.

To help readers understand the authors' calculation of their "statewide average" risks, and to help readers translate those risks into more readily comprehendible terms, we have attempted in Table 3 to combine the statewide average risks as reported in Table 18 of *Tap Water Blues* with the size of the assessed population in each state. This would then allow estimation of the actual numbers of cancer occurrences (not the same thing as cancer deaths) that might be expected per year within each state's assessed population.

But even determination of the assessed populations was not an entirely straightforward matter. Although, for each state, the authors "derived the best estimate of actual drinking water contamination and risk for all the affected communities" (page 69), the text contains no table indicating the size of these affected populations and their associated aggregate risks. However, Table 15 in *Tap Water Blues* does list the size of the exposed population for each of the 14 states and the District of Columbia. That table lists an exposed population of 1,700,000 for Ohio, but the statewide average for Ohio is based on communities with a total population 1,044,200 (see our Table 2, above). No explanation for this discrepancy is provided. Careful reading of the text for each state indicates that for most states the population sizes listed in Table 15 of *Tap Water Blues* does represent the total population of the affected communities, but for several states this is not clear. Thus, in our Table 3, column 4, the percentage affected in each state may actually be lower than listed if the "affected" communities actually have a smaller population than the "exposed" communities.

4. Fabrication of a federal standard resulting in inflated perceptions of risk.

A most serious error in the authors' data presentation is the mislabeling of risk levels throughout the report. The final column of Table 2 should be labeled Aggregate Risk. The numbers in the column are simply the sum of the individually calculated risks for the five herbicides. As such, these are useful in indicating total risk and in simplifying estimation of cancer occurrences in the associated populations.

Instead, the authors label this column "Multiple of Federal Standard." In footnotes throughout the report, this federal standard is said to be a 1×10^{-6} lifetime risk. This labeling implies that there is a "Federal Standard" applicable to the sum of the risks for five herbicides. Furthermore, it is stated that this is an EPA standard. The authors know there in no such standard, and so state in the *Tap Water Blues* --

> And, in concert with the rest of the agency (EPA), the Office of Ground Water and Drinking Water continues to set drinking water standards based on exposure to pollutants in isolation even when most exposures occur simultaneously, ... (*Tap Water Blues,* p. 20)

Furthermore, should there ever be such a standard, it would not necessarily be 1×10^{-6}. In the recommendations section of *Tap Water Blues*, the authors call for a combined risk of 1×10^{-6} for the three triazines plus their metabolites. Are they implying that the risk factors for alachlor and metolachlor (the two non-triazines) either should be -- or already are -- zero?

Table 3. Cancer occurrences due to herbicides in worst case Midwestern water supplies.

1 State	2 State Population	3 Population of Affected Communities	4 Percent of State Affected	5 "Statewide Average" Risk	6 Herbicide Cancers per 70 Years	7 Herbicide Cancers per Year	8 Expected New Cancers per Year, All Causes	9 Percent due to Herbicides
Illinois	11,430,602	1,400,000	12%	12.6	17.6	0.25	6258	0.0040%
Indiana	5,544,159	1,300,000	23%	27.9	36.3	0.52	5811	0.0089%
Iowa	2,776,755	760,000	27%	17.4	13.2	0.19	3397	0.0056%
Kansas	2,477,574	830,000	34%	8.1	6.7	0.10	3710	0.0026%
Kentucky	3,685,296	650,000	18%	3.8	2.5	0.04	2906	0.0012%
Louisiana	4,219,973	1,500,000	36%	8.5	12.8	0.18	6705	0.0027%
Minnesota	4,375,099	930,000	21%	30.6	28.5	0.41	4157	0.0098%
Missouri	5,117,073	2,125,000	42%	14.3	30.4	0.43	9499	0.0046%
Nebraska	1,578,385	450,000	29%	9.0	4.1	0.06	2012	0.0029%
Ohio	10,847,115	1,044,200	10%	17.3	18.1	0.26	4668	0.0055%
Total	52,052,031	10,989,200	21%	15.4	170.0	2.43	49,122	0.0049%

If the authors want to reference the aggregate risk to an existing federal standard, the lowest possible standard would be 5×10^{-6}. This would represent the sum of the food standard for five herbicides, with each herbicide having an individual 1×10^{-6} risk level. Consequently, all of the risk levels presented in *Tap Water Blues*, and to the public, would need to be divided by five.

5. Data presentation generally precludes calculations of estimated cancer occurrences for towns, cities, and states.

The important information calculated by the authors is their aggregate risk estimates for individual affected cities and towns. When this number can be coupled with the size of the population, the number of expected excess cancers per year for the affected population can be calculated. For example if a city has an aggregate risk of 20 cancers per million people per lifetime (70 yrs) and a population of 1.4 million, the number of excess cancers per year could conceivably be estimated as follows:

20 cancers/million people/70 yr x 1.4 million people = 28 cancers/70 yr

28 cancers/70 yrs = 0.4 cancers/yr

We have recently learned that the above method of calculating expected cancers actually overestimates the number of cancers that occur, due in part, to the fact that many individuals die from a wide variety of causes before reaching age 70. To more properly estimate the number of cancers to be expected, factorial or actuarial calculations must be performed. Overestimation also occurs because atrazine has only been on the market for 36 years, and the other herbicides for an even shorter time. However, we will continue to use the above method of calculation, because we believe that it is easier for the public, policy makers, and politicians to understand cancer risks when presented as expected additional cancers per year for a community or state, than when presented as multiples of a federal standard. In any case, the numbers of expected cancers per year per state or community that we present actually overestimate the number of cancers that might occur.

Unfortunately, the authors provide only one table in the report in which specific aggregate risks can be associated with specific population sizes. That is for the Ohio data as reported above in our Table 2 (their Table 92). Often, table headings contain the total population for the communities whose individual risks are listed, but the populations of the individual communities are not listed (Tables 23 and 24 of *Tap Water Blues*).

In Table 3, we have used aggregate risk estimates and populations of the affected communities from *Tap Water Blues*, and completed the calculations to reveal what we believe is the significance of the risks they report. In column 2, we list the populations of each of the states in which affected communities were identified. In column 3, the populations of the affected communities are listed, as best as we can discern them from *Tap Water Blues*. We have corrected the Ohio data to the affected population value from Table 2. Column 4 shows the percent of each state's population residing in affected communities. These percentages range from 10% to 42%. Exposures have been assessed for 21% of the population of the entire region. (This is a population weighted average, not a simple average of the percents assessed in individual states.) Column 5 lists the statewide average aggregate risk, as listed either in Table 18 or in the state summaries in *Tap Water Blues*. Once again we have corrected the Ohio risk value by calculating a

population weighted average for the state. Data were unavailable in the report to make similar corrections for other states.

As described above, multiplication of aggregate risks by population size gives cancer occurrences in a lifetime (70 years), and division by 70 gives cancers per year. These two values are listed in columns 6 and 7. In no state does the expected additional cancers amount to even one per year among the affected population. Only 2.4 additional cancers per year among the 11 million residents of the affected communities are expected due to herbicide ingestion through drinking water.

6. Data presentation in forms lacking toxicological context.

Many of the graphs in the report's national summary (Chapter 3) and in the individual state summaries deal with percent detections of individual herbicides or combinations of two, three or four or more herbicides. We present several examples of these graphs from Chapter 3 in Figure 1. Percent detections (i.e., positive samples) are known to be a function of detection limits and timing of sampling. As detection limits drop due to advances in analytical methodology, percent detections increase. The U.S. Geological Survey can now measure atrazine at concentrations equivalent to one five-millionth (1/5,000,000) of the dose that has no observable adverse effect on the most sensitive animal tested and one one-thousandth of the MCL for humans.

Thus, information on percent detections by itself has no quantitative toxicological or human health significance. But the authors of *Tap Water Blues* use the high frequency of detections of individual herbicides and of combinations of herbicides to create the specter of widespread contamination posing significant human health risks. Rather than percent detections, it is time-weighted distribution of concentrations within the detections that has toxicological relevance. When data are displayed in that format, and compared with various water quality standards, conclusions regarding the human health significance of herbicide contamination can be derived. From this toxicological perspective, the detections far more often warrant relief than concern about human health effects. Most of the time, and in the majority of places, herbicides, although frequently detected, are at concentrations far below those thought to be of human health concern.

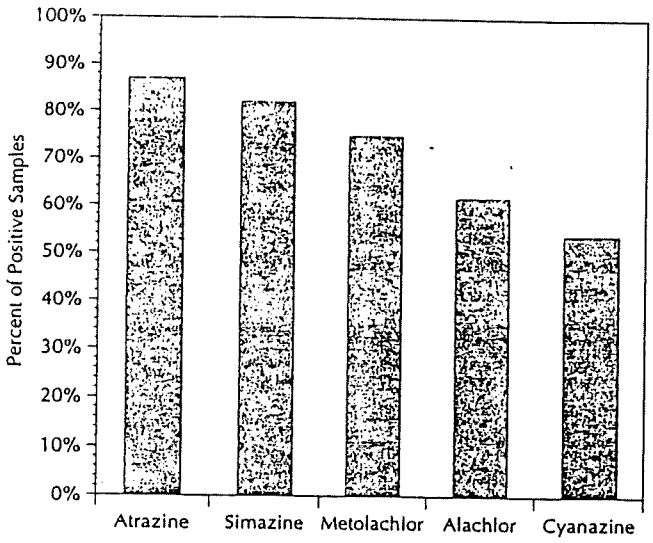
7. General failure to provide context for the data.

- Although *Tap Water Blues* is about cancer, there is not a single place in the entire report where a number of cancer occurrences attributable to herbicides is mentioned. The entire document focuses on risks expressed in terms of a multiple of a fabricated federal standard. We believe presentation of risks as "expected additional cancers per year" in the affected communities is a more understandable context for considering cancer risks.

- Nowhere in the document is the total population of the Corn Belt states mentioned. The percent of the population residing in affected communities is never stated. We obtained state populations from other sources and calculated the percent of each states populations living in affected communities (Table 3).

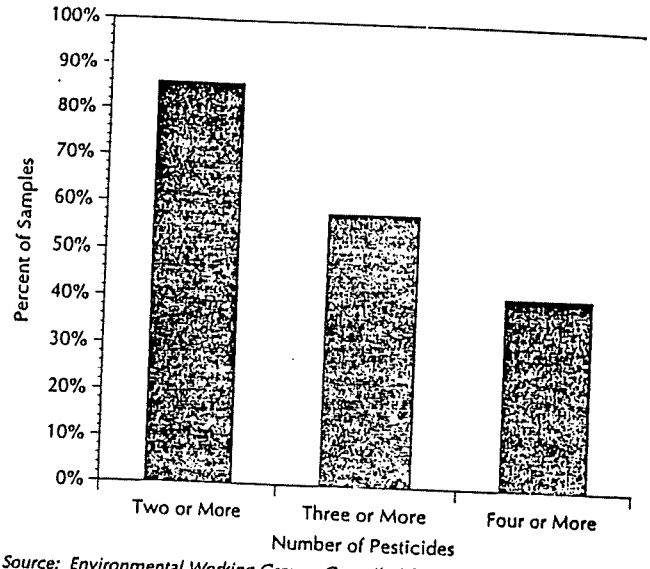
- Background levels of cancer in the region are not mentioned. The authors do not indicate the percentage of the total cancers that may be attributable to herbicides. In Statistical Abstracts, the estimated new cancers of all types during 1990 within a United States population of 253 million is 1,130,000. Assuming this rate is

Figure 2. Eighty-seven percent of all samples collected from rivers in the Mississippi River basin contained atrazine.



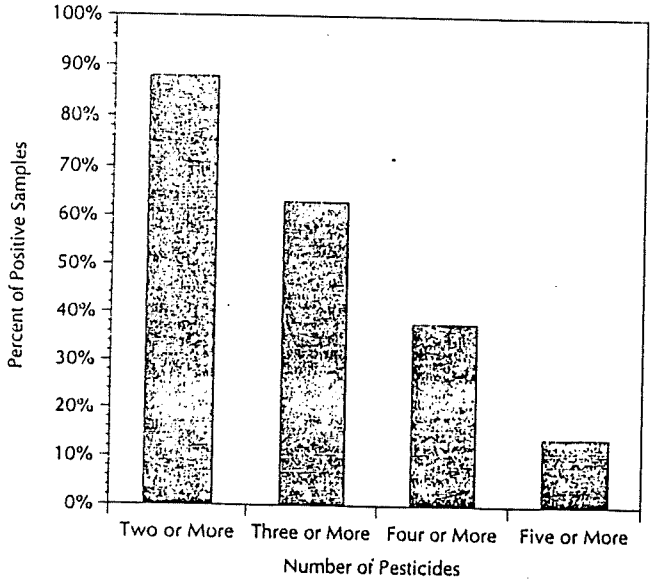
Source: Environmental Working Group. Compiled from USGS River Study 1991-92 (Goolsby 1993).

Figure 3. Eighty-seven percent of all samples collec from rivers in the Mississippi River basin contained two or more pesticides.



Source: Environmental Working Group. Compiled from USGS River Study 1991-92 (Goolsby 1993).

Figure 4. Over 60 percent of samples collected from drinking water reservoirs in the Midwest contained three or more herbicides.



Source: Environmental Working Group. Compiled from USGS River Study 1991-92 (Goolsby 1993).

Figure 1. Representative figures taken from Tap Water Blues.

Table 23. 3.1 million individuals in 23 cities with populations over 25,000 are exposed to cancer risks from herbicide contaminated drinking water that exceed federal cancer standards by a factor or ten or more.

Cities	Lifetime Risk* Multiple of Federal Standard
Springfield, IL	48.5
Mankato, MN	30.4
Bowling Green, OH	30.3
Richmond, IN	29.1
Danville, IL	27.2
Cedar Rapids, IA	26.6
Indianapolis, IN	25.0
Alliance, OH	23.1
Columbus, OH (Hoover Intake)	20.5
Decatur, IL	18.9
Jefferson City, MO	18.5
Delaware, OH	17.4
Marion, OH	16.3
Columbus, OH (Scioto Intake)	16.3
Lawrence, KS (Kansas River Plant)	15.4
Leavenworth, KS	15.2
Kansas City, KS	15.2
Kansas City, MO	15.2
Topeka, KS	13.4
Ottumwa, IA	13.3
Lawrence, KS (Clinton Plant)	12.1
Omaha, NE (Platte Intake)	11.0
Iowa City, IA	10.9
Fort Wayne, IN	10.0

* The federal cancer standard is one additional cancer per million exposed individuals, or 1 X 10^{-6}.

Source: Environmental Working Group. Compiled from state, federal, and drinking water utility data.

uniform across the United States, we have calculated the number of new cancers per year in the affected communities and listed the results in column 8. In column 9, the percent of the new cancers in the affected communities attributable to herbicides is shown.

8. Implication of greater significance of the risks than actually warranted by the results.

The authors describe the results of their findings as follows:

> "Millions Drink Water Contaminated with Toxic Herbicides" (Press Advisory)
>
> "Federal Standards Routinely Exceeded" (Press Advisory)
>
> "Report... demonstrates that many people, especially children, are at great risk of developing long-term health problems ...." (Press Advisory)
>
> "...more than 3.5 million people face cancer risks from herbicides ...more than 10 times the federal cancer standard..." (*Tap Water Blues*, p. 105)
>
> "Unacceptable Cancer Risk" (*Tap Water Blues*, p. 73)
>
> [Authors conclude that their studies warrant] "A two-year phase out of the triazine herbicides, with total phase out ... by September 1994" (*Tap Water Blues*, p. 108)

Are these statements consistent with the expectations of new cancers attributable to the five herbicides that may be drawn from the data? Our review, detailed in the preceding sections, leads us to say no. We agree with the U.S. EPA that the authors have exaggerated the cancer risks associated with herbicides in Midwestern drinking water supplies.

To better inform the public of the results of their studies and place them in context, we believe the authors of *Tap Water Blues* should have issued a statement which would read something like this:

> In examining data on herbicide contamination in surface waters and finished drinking waters in the Midwest, we have found herbicide contamination affecting community water supplies that serve 10.9 million (21%) of the regions 52 million residents. Within these affected communities, the five herbicides used in the largest quantities taken together appear to be responsible for about 2.43 cancers per year. A total of 49,122 new cancers per year would be expected among the regions 10.9 million residents. Herbicides in drinking water appear to account for 0.005% of the new cancers occurring in this region.
>
> (They could then outline what agriculture is doing to reduce risks to human health and to ecosystems that are associated with herbicide use, and identify actions which could be taken to further reduce exposures.)

9. Inappropriate comparisons to existing drinking water standards and health advisories.

Compliance with MCLs and LHAs for herbicides is based upon comparisons with annual average concentrations, not with instantaneous concentrations, seasonal concentrations, highest 12 month concentrations out of 36 months, or highest 28 months (7 years) out of 21 years. Yet, throughout the text, the authors consistently refer to MCLs in the context of these other time intervals. For example, they state:

> We have identified nearly 1.3 million individuals in six states where the four month average exposure for at least one herbicide is above the federal standard. (Tap Water Blues, p. 73)

There is no federal standard for a four month exposure duration. They identified only 240,000 people in the Midwest (0.5%) who consume water in which the annual average herbicide concentration exceeds the applicable federal drinking water standard for at least one pesticide.

The EPA's Health Advisory Program provides guidelines for interpreting the health significance of these shorter term exposure durations. For atrazine safe exposure levels for children for 1 day, 10 day and 7 year periods are 100 ppb, 100 ppb and 50 ppb, respectively. For adults, the 7 year health advisory for atrazine is 200 ppb. Daily and seasonal concentration peaks for atrazine in rivers never approach these values. The authors do not acknowledge the existence of the EPA's health advisory program and insist on comparing short term concentrations with a standard (the MCL) that is intended for comparison with annual average values.

10. Inclusion of politics.

In the sections of the report where state summaries are presented, herbicide use is presented by elected congressman and congressional district rather than by watershed. They also identify those congressmen who have voted for legislation that, in their view, would weaken federal pesticide regulation. The Ohio section concludes with the following statement:

> In spite of the health threat to their constituents, all of these representatives support pesticide industry backed legislation designed to weaken public health standards in federal pesticide law. (Tap Water Blues, p. 249)

It is clear that this nonprofit research organization endeavors to influence policy by influencing voters.

VI. Tap Water Blues: Risk Communication by the Environmental Working Group

The authors of *Tap Water Blues* provide yet another example of how certain environmental organizations use the press to advance their views and their version of "science" while effectively by-passing critical scientific review. It is true that the acknowledgment page (see appendix) indicates that reviewers saw early drafts of the report. (The normal disclaimers are included -- the authors assume full responsibility for any errors and that readers should not imply that the reviewers necessarily endorse the recommendations of the report.) But with no disrespect to the report's reviewers, standard channels for the publication of scientific research entails a much more critical pre-publication review process, with journal editors commonly requesting evaluations from a wide array of experts. The miscalculations and misrepresentation of information that we have pointed out in the previous sections of this report should have been caught by appropriate review.

On October 18, 1994, after two years of preparation, the authors of Tap Water Blues move it into the public arena, using risk communication techniques aimed at frightening the public and supporting their own policy agenda.

1. The Press Advisory and Press Conferences.

A copy of the press advisory used to announce press conferences for the release of the study is included in the Appendix. It is noteworthy that in the press advisory, cancer is mentioned in only one sentence, where it is given equal weight with birth defects, reproductive disorders, and chronic damage to the liver and heart. The words children or infants occur in three sentences.

In addition to a press conference in Washington, D.C. at the National Press Club, press conferences were to be held simultaneously at 25 cities across the country.

Prior to the press conferences, Richard Wiles appeared with the Administrator Carol Browner of the U. S. EPA on the Good Morning America television show where they discussed the report. Ms. Browner's responses are reflected in the EPA statement which is also included in the Appendix to this report.

Since we did not attend any of the press conferences, we are unable to comment on the way in which the results of the study were presented to the press.

2. The image the authors attempt to project.

The following passage is an imaginary newspaper article on *Tap Water Blues* that might have been written by a reporter who was very favorably impressed by the report and its authors. We contrived this article as an exercise illustrating our understanding of how the authors would like to have their work viewed.

> The report is issued by a nonprofit environmental research organization based in Washington, D.C. Supported by major philanthropic foundations, this group, with great effort, collected extensive data on herbicide concentrations in Midwestern drinking water supplies from multiple sources. They used the most up-to-date EPA cancer potency factors to estimate cancer risks within the affected populations. They then compared these risks with an existing federal standard and, when they did, they found the risks to be very high and unacceptable. This information, they then dutifully communicated to the public. To remedy this situation they call for a two-year phase out of all uses of three triazine herbicides, an immediate tightening of drinking water standards for the triazines and their metabolites, revisions of the safe drinking water act, and major changes in the farm bill which will undergo re-authorization in the upcoming Congress.

In creating and defending this image, the authors give little credence to rebuttals by agricultural groups and industries, governmental agencies at the federal, state, and local level (who trusts government?), the water industry, and "industry-tainted" scientists. Indeed, only they have the courage to speak the truth. In the Ohio section of the report, they state:

> Recent work published collaboratively by researchers at Heidelberg College and Ciba corporation (the manufacturer of atrazine and metolachlor) concluded that the entire population of Ohio, including the population served by Lake Erie and the Ohio River, is exposed to herbicides in drinking water (Richards, et al. 1994). Not surprisingly, the Heidelberg/Ciba analysis then concluded that these pesticides did not pose health risks because they were below EPA standards ... (Tap Water Blues, p. 249).

However, we believe it is the height of cynicism for the authors to accuse others of a lack of objectivity. We had published the results of our Ohio studies three years earlier (Baker and Richards, 1991). Working with Ciba researchers, we extended to Illinois and Iowa the pesticide exposure, risk assessment and risk communication methods our laboratory had developed for Ohio. This work has been published in a proceedings volume (Richards et al, 1994) and more recently has been accepted for publication in *ES&T* (Environmental Science and Technology).

If the authors of *Tap Water Blues*, or indeed any other researchers believe our analyses and interpretations have been biased by a purported "sweetheart" relationship with any of the numerous private and public organizations that have supported our research, they are encouraged to illustrate their accusations with reference to our publications. No more serious assault on a scientist's integrity can be mounted than to impugn his or her impartiality and honesty. To do so without credible evidence amounts to professional slander. We consider our objectivity to be our major asset, for it allows us to work with all parties who seek to bring objective science to bear on environmental issues.

On the other hand, the record is clear in *Tap Water Blues*. The authors' analytical methods, interpretations, and media releases all point to a political agenda that they have attempted to advance through creating public perceptions of health risks far in excess of conclusions warranted by their investigations. We do not make this statement lightly. In fact, the bulk of this rather lengthy critique has consisted of our efforts to document a consistent lack of objectivity running throughout much of *Tap Water Blues*.

3. Press coverage of *Tap Water Blues*.

In the newspaper, radio, and television coverage of *Tap Water Blues*, reporters did attempt to get the other side of the story. Unfortunately, while the authors have been building their case for many months, critics of the report were only afforded an opportunity for hasty reviews and evaluations. But, reporters must meet their deadlines, so the stories were sent off to print, and on to the airwaves, before the "other side" had barely time enough to gather its thoughts. Such is the benefit to an advocacy group of bypassing traditional peer-reviewed avenues of publication in favor of direct marketing through the media.

By the time others have had an opportunity to thoroughly review and evaluate its "science", *Tap Water Blues* is was no longer making headlines. Thus this review, which fairly may be characterized as strongly taking issue with much of the content, methods and conclusions of *Tap Water Blues*, will probably not gain much press. But it is clear that the authors of *Tap Water Blues* intend to use these arguments to advance their policy agenda with the administration, EPA, and Congress. That is why we feel obligated to insert our review into the public record.

4. Effects of the of risk communication methods used by authors.

To the extent that the intent of the authors is to build public sentiment against pesticides, their approach to risk communication is effective. They certainly triggered anxiety among expectant mothers, mothers of infants and children, and the elderly. The telephones of water suppliers, local health departments, agricultural agencies, and other groups began to ring as worried people sought advice in the face of news that their drinking water may be seriously contaminated by "weed killers." One elderly woman called our laboratory concerned that she is being told not to eat the food, not to drink the water and to lock the doors and not go outside. We assured her that she need not fear the tap water, or the food, for which she was grateful.

The charges by the authors and the responses by those charged are probably viewed by the public as "just" arguments between competing groups of scientists over the interpretation of rather straightforward data. Thus the story caption on the front page of the Ohio State University student newspaper (The Lantern, Tuesday, October 25, 1994) read "Experts disagree if Columbus water is cancer causing." While the term "expert" is not synonymous with "scientist", the public may not have made a distinction between the two. Unfortunately, the image of scientists disagreeing on such important issues as the safety of drinking water can undercut the credibility of -- and support for -- the role of science and scientists in addressing critical environmental and health concerns. Effective risk education requires faith among the public in the process underlying risk reduction recommendations.

Perhaps undercutting faith in science is what the authors intend. Whatever the quality of their work in other areas, they have shown little evidence of scientific competency in *Tap Water Blues*. In that the cancer message conveyed to the public by the authors is demonstrably a false message, it effectively widens the gap between public perceptions of risk and scientific assessment of risk. Given the political linkages between public policy and public perceptions, policies regulating herbicide use that were founded on *Tap Water Blues* would not represent scientifically-enlightened government.

On another level, risk communication methods that serve to dissemble rather than inform, and carefully orchestrated public relation programs that target people's fears will prove counter-productive for environmentalists in the long run. At jeopardy is the long-term credibility of all environmental advocacy and research organizations. Eventually, the public comes to discount even well-founded environmental research and justified alarms warning of hazards to human health and natural ecosystems. It is therefore essential that scientific evidence presented on behalf of proposed environmental policies be conducted and presented in a rigorously objective manner.

VII. Policy Issues Related to Herbicides in Midwestern Drinking Water

A. Estimated Herbicide-Related Cancers in the Midwest

In Table 3, we estimated the new cancers per year attributable to herbicides for the 21% of the population of the Midwest drawing upon the most heavily contaminated surface water supplies in each state. How many cancers would be expected in the remaining 79% of the population? While we cannot determine a precise estimate, the risk to the balance of the population appears to be very small.

We have just completed atrazine population exposure assessments for Ohio, Illinois and Iowa (Richards et al, 1994; Richards et al,1995). One of the ways we describe statewide exposures is through ranked population exposure exceedency histograms of the form shown in Figure 2. Population weighting is represented graphically by varying the width of the individual bars on the histogram. The shapes of these ranked histograms are very similar among the three states, with a relatively small proportion of each population exposed to high concentrations and the balance of the population exposed to very low concentrations. We anticipate that for other states within the Midwest, the concentration exceedency histograms will have similar shapes. The lowest concentrations are found in private and public water supplies using ground water. In Ohio, the ranked population exposure curve for alachlor has a similar shape to that of atrazine (Baker and Richards, 1994). The shapes of these ranked exposure histograms appear similar for all herbicide exposures through drinking water that we have observed.

The atrazine concentration histograms relate directly to the distribution of cancer risks from atrazine in each state. The area of the histograms can be viewed as the distribution of cancer risks due to atrazine within each state. The affected communities investigated by the authors of *Tap Water Blues* make up the major portion of the populations with high exposures showing up on the left of the ranked histograms. A very small portion of the populations with high exposure are from badly contaminated private wells and occasional public water supplies using ground water. On each graph, arrows indicate the approximate cutoff for populations reported in Tap water Blues. The areas under the histograms to the left of the arrows reflect the proportion of cancers in each state included in Table 3, while the area under the histograms to the right of the arrows reflect the proportion of cancers in the remainder of each state. The area to the left of the arrows appears to be larger than the areas to the right, indicating that, in these states, more than half of the statewide cancer occurrences are already accounted for in Table 3. We expect similar results in the other states.

One reason for presenting this method of describing exposures, is that it provides us with a mechanism for determining an upper-limit estimate of the number of excess cancers the five herbicides might be expected to cause within the Midwest's entire population of 52,000,000 people. The problem is that the *Tap Water Blues* dataset is based on the most heavily exposed communities within each state. What can we say of the excess cancers due to these herbicides in the remaining communities? If the pattern described above for atrazine holds true for all five herbicides—and we believe this to be probable—less than five excess cancers per year among the Midwest's 52,000,000 residents could be attributed to the combined effects of the herbicides under consideration in *Tap Water Blues.* The affected communities can expect a total of 2.43 excess cancers due to the herbicides (Table 3, column 7), and these communities represent well over half the herbicide-based cancers (Figure 2). All the remaining communities would therefore be expected to see some uncertain amount less than 2.43 excess cancers. Thus, the total number of excess cancers

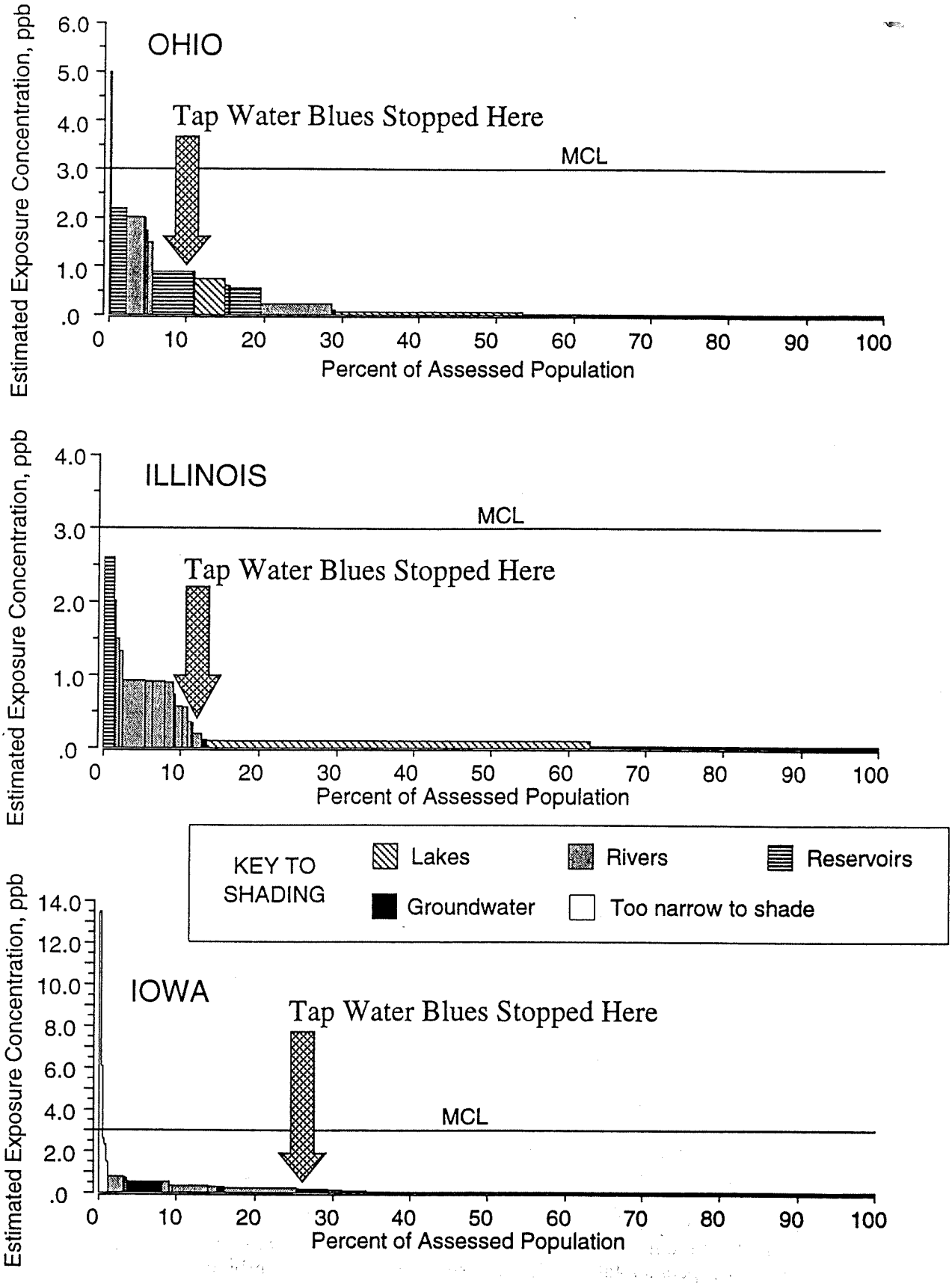


Figure 2. Atrazine exposure exceedency plots for Ohio, Illinois, and Iowa. Each rectangle represents one water source; its width is proportional to the population served by the source and its height is proportional to the estimated exposure concentration for the source.

across the entire Midwest would fall somewhere within the bounds of 2.43 and 4.86/year.

This conclusion is supported by the data in Table 4. In this table, for each of three states, three atrazine concentrations are shown—the (simple) average atrazine concentration in affected communities from *Tap Water Blues*, the population-weighted statewide average atrazine concentrations from Richards et al (1995), and the atrazine concentration associated with a one in a million lifetime cancer risk (our Table 1). The Richards et al average atrazine concentrations are much lower than the average atrazine in the affected communities of *Tap Water Blues*, while they are only somewhat higher than those associated with a one-in-a-million added risk. The authors of *Tap Water Blues* state that atrazine accounts for at least 40% of the total excess cancer burden for the five herbicides. If a five in-a-million risk for the effects of five herbicides were a aggregate acceptable risk level, and atrazine accounted for more than 40% of the total risk, then the atrazine concentrations could be double the values for the one-in-a-million risk shown. The Richards average concentrations in these states are less than double the one-in-a-million concentration.

Table 4. A comparison of atrazine concentrations in *Tap Water Blues* "affected communities" with population-weighted statewide average atrazine concentrations.

State	TWB's Affected Communities Average (ppb)	Population-weighted Statewide Average Concentration* (ppb)	Atrazine Concentration at 10^{-6} Risk (ppb)
Ohio	1.82	0.271	0.157
Illinois	1.09	0.187	0.157
Iowa	0.75	0.177	0.157

*Richards et al., Atrazine Exposures through Drinking Water: Exposure Assessments for Ohio, Illinois, and Iowa. ES&T, in press (January 1995).

Table 5. Maximum estimated cancer cases in the Midwest under various drinking water standards for the five herbicides in relation to estimated background of new cancers per year in this region (200,000/yr in a population of 52,000,000).

Standard	Aggregate Risk	Excess Herbicide Cancers	Combined Herbicide plus Background	Ratio of Combined to Background
units:	10^{-6} per 70 years	cancers/yr	cancers/yr	
Current Safe Drinking Water Standard	71	53	200,053	1.000265
Food Standard or *de minimis* per herbicide	5	3.7	200,003.7	1.0000185
Authors' "federal standard" combined *de minimis*	1	0.74	200,000.74	1.0000037
EPA Goal: no individual risk	approx. 0.01	0.0074	200,000.00074	1.000000037

B. Limits for Midwestern Herbicide-Related Cancer Occurrences under various Drinking Water Standards

In Table 5, the aggregate risks and cancer occurrences in the Midwest that could occur under existing and proposed drinking water standards for the five herbicides are shown. For these risks and numbers of cancers to actually occur, the herbicide concentrations would have to be uniform over the entire region, and at levels equal to their respective standards.

Four different standards are shown. The first represents the current standards set under the Safe Drinking Water Act. The combined risk, as calculated from the cancer potency factors and the MCLs or LHAs for the five herbicides, is 71 in a million per 70 years. (The sum of the individual risks in column 4 in Table 1 is 71 x 10^{-6}/70 yr.) This risk gives an estimated 53 cancers per year among the 52,000,000 residents of the Midwest. Approximately 200,000 new cancers per year would be expected in this population. Thus, herbicide-related cancers under the current standards could raise the total number of cancers to 200,053.

The exposure conditions which would lead to the above risk level and number of cancers can be envisioned by considering Figure 2. Imagine that the atrazine concentration histograms filled the entire area under the lines represented by the MCL for each of the three states. Next, imagine that exposure at their MCLs occurred for all five herbicides and in all ten midwestern states. These are the exposure conditions that would result in an expected 53 additional cancers per year in the Midwest. But of course, the actual histograms for atrazine (and also for the other herbicides) fill only a fraction of the area beneath the MCL exposure lines. This mental exercise will hopefully underscore the point that existing concentrations of these herbicides in Midwestern drinking water will result in far less risk of cancer occurrences than would be expected for current standards set under the Safe Drinking Water Act. (Compare our estimated excess cancers of less than five with the 53 excess cancers under the SDWA standard.)

The second standard in Table 5 yields a risk of five in a million over a lifetime. This corresponds to a one in a million risk level for each of the five herbicides and is equivalent to the current food regulations. The expected number of new cancers per year associated with this aggregate risk is 3.7. In the third standard, the aggregate risk is one in a million for five herbicides. This is the "Federal Standard" fabricated by the authors and could result in 0.74 new cancer cases per year among the 52 million residents of the Midwest.

The fourth standard reflects an estimated cancer risk if a goal of "no one at risk" were to be achieved. In this case, we have estimated the average risk level needed to be sure that no single individual has a risk as high as one in a million. An estimated 0.0074 new cancers per year in the Midwest might occur from herbicide concentrations under these conditions.

In the preceding section, we estimated that less than 5 cancers per year may be occurring in the entire Midwest, as a result of herbicide contamination. Comparing this figure with the data in Table 5 indicates that this number is very similar to the 3.7 new cases per year that could occur under the Food Standard. This negligible or *de minimus* level of cancer risk and occurrences has been achieved essentially without regulation. Herbicide concentrations are sufficiently below the existing drinking water standards, that they meet, on average, the cancer risks that would be associated with the more stringent food standard that the authors of *Tap Water Blues* called for.

C. Inequitable Distribution of Negligible Involuntary Risks - A Policy Issue

In the previous section we observe that, on average, Midwestern herbicide concentrations are presently below concentrations associated with cancer risks corresponding to the most stringent existing federal standards (the Food Standards). But "on average" does not mean that all localities use waters containing such low concentrations. Since herbicide concentrations are not uniformly distributed across the Midwest, some communities have higher risks than others, and indeed some have higher risks than the *de minimus* level. This is evident in several of the previously mentioned tables in *Tap Water Blues*, as well as in the ranked exposure histograms shown in Figure 2.

So there is a certain paradox associated with inequitable distributions of negligible risks across a broad geographic region. In Table 5, it is noted that 3.7 additional cancers per year might be expected if herbicide concentrations were uniformly distributed throughout the Midwest and those concentrations were at the food standard. Since herbicide concentrations are not uniformly distributed, a situation could exist where average concentrations were at 50% of the food standard and the expected number of additional cancers would be 1.9 per year. However some communities would have risks above the *de minimus* level, and consequently the herbicides would be subject to regulatory action. Does the fact that some communities have risk levels that are greater than *de minimus* warrant regulatory action against these compounds? The authors of *Tap Water Blues* apparently think so. They are calling for a ban of the triazine herbicides within two years.

What would a triazine ban accomplish in terms of reducing cancers occurrences in the Midwest? From Table 5, it is evident that banning these herbicides would have no appreciable effect on cancer occurrences in the Midwest. The cancer statistics would not change. There are many ways to significantly reduce cancer occurrences in the Midwest and elsewhere. These primarily fall into the category of addressing voluntary risks rather than involuntary risks. Thus, individual choices regarding smoking, diet, sexual activities, drugs and other activities allow individuals to have significant impacts on factors responsible for 80 - 90% of all cancers. Rather than focus on educational programs to achieve cancer reduction through enlightened self-discipline, the authors focus on herbicides which may be responsible for 0.002% of Midwestern cancers.

But what about those few unfortunate communities that are experiencing unusually high cancer risk levels due to herbicides in their drinking water? Is there no middle ground between the polarized responses of ignoring these anomalous "hot spots" as statistically inconsequential at the one extreme and banning the herbicides entirely at the other? Common sense would seem to dictate bringing existing enforcement machinery into play in efforts to bring such local areas into compliance. If existing methods prove to be insufficient, the discussion should then move to how the regulatory mechanisms might be strengthened.

Given the small gains that can be made in cancer reduction through banning triazine herbicides, it is essential to carefully examine the impacts of a triazine ban on midwestern agriculture. While the authors believe that the impacts would be minimal, others believe that such a ban would carry with it substantial costs. Certainly, such disparate claims should be examined. After reviewing *Tap Water Blues*, we are not impressed by the authors' case for imposing draconian restrictions on the use of these herbicides.

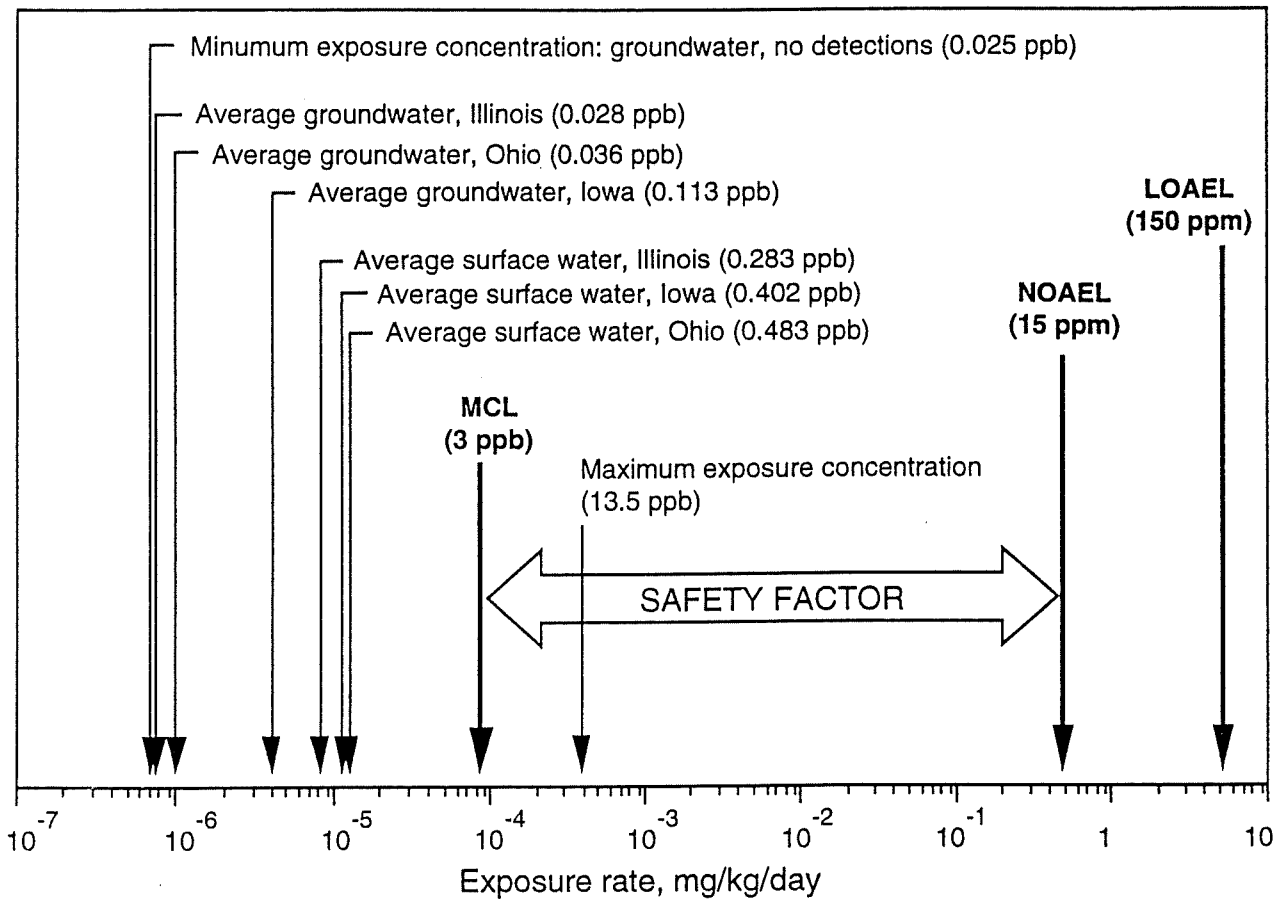


Figure 3. The relationship between average atrazine exposure concentrations in surface and ground water for three states, the MCL, the NOAEL and the LOAEL. Concentrations have been converted to dose rates in milligrams atrazine per kilogram of body weight per day; the corresponding concentrations are listed inthe parentheses with the arrow labels.

D. Non-cancer Health Impacts of Herbicides in Drinking Water

From the above discussions, there is good evidence that the cancer scare raised by the authors of *Tap Water Blues* is nonexistent. Therefore, the question of interest becomes:

> Are current drinking water standards adequately protective of human health with respect to non-cancer effects?

We have previously described the way in which the current drinking water standards have been set for the triazine herbicides and metolachlor. For the triazines the drinking water standards are set such that the MCLs or LHAs result in maximum drinking water doses that are at least 5000 fold lower than the threshold dose for adverse health impacts on the most sensitive animal species. Average herbicide concentrations fall well below the MCLs or LHAs.

To illustrate the safety factors that are present, we use log dose curves of the type shown in Figure 3. We convert the drinking water doses into the same units as used in the animal toxicity studies -- mg herbicide per kilogram body weight per day. This allows us to plot the drinking water doses humans receive on the same scale as the doses which have adverse effects on the most sensitive animal species for which data are available. To cover the range of doses involved, it is necessary to use a log scale that has nine cycles (i.e. the right end of the x-axis is 1,000,000,000 times larger than the right axis.

The threshold for toxicity in the most sensitive animal tested lies somewhere between the NOAEL (no observable adverse effect level) and the LOAEL (lowest observable adverse effect level). The safe drinking water standard (MCL) is set at a dose that is 5,000 fold lower than the NOAEL. The "distance" between the NOAEL and MCL reflects the safety factor incorporated into the standard and is illustrated by the horizontal arrow in the graph. Since the average atrazine doses from surface and ground water are considerably lower than the MCL, the total safety factor is even larger than the safety factor incorporated into the MCL. It should be noted that the position of the threshold for adverse effects on humans is unknown. However the EPA believes that the safety factor incorporated into the MCL provides a margin of safety between the MCL and a human threshold for adverse health effects. Thus even the populations with the highest exposures to atrazine would likely experience no adverse health effects.

In our risk communication efforts, we find it useful to illustrate just how small the herbicide concentrations are in our drinking water supplies. We often find ourselves talking about the high concentrations of herbicides that are present during late spring runoff events. Yet the units of our measurement are parts per billion (ppb), a unit that is difficult to envision. An approach we use is to convert the concentrations in ppb into Lifetime Aspirin Tablet Equivalents (LATEs). In Table 6, we show the total amount of herbicides that an individual would consume during a 70 year lifetime of drinking two liters of water per day for various Ohio communities. The combined concentrations of the five herbicides are taken from Table 92 in *Tap Water Blues* (our Table 2) and are among the highest concentrations observed anywhere in the Midwest.

Only in Attica would the total ingestion of the five herbicides amount to a quantity greater than one aspirin tablet over an entire 70 year lifetime. Along the Maumee River, the amount of herbicide uptake would be equivalent to 0.82 aspirin tablets per lifetime.

Do these quantities of herbicides pose health risks to adults, children or infants? That depends on the toxicity of these compounds. These herbicides are not particularly toxic in relationship to other compounds. In fact, atrazine is less toxic than aspirin (Trotter, et al. 1990; Merck Index 1983). To our knowledge, none of the most powerful drugs in our medicine chests would have any impact on us if given at doses equivalent to those of the herbicides that we receive through drinking water. Based on current assessments of the toxicity of these herbicides, the drinking water standards set up under the Safe Drinking Water Act appear to be adequately protective. Certainly if new information should become available that suggests current concentrations do pose health risks, drinking water standards should be reviewed and updated.

Table 6. Combined quantities of five herbicides ingested in drinking water during a lifetime with concentrations at current levels, expressed in units of Lifetime Aspirin Tablet Equivalents.

Source	Cities Served	Combined Average (ppb)	Lifetime Consumption (LATEs)*
Scioto River	Columbus, Marion	2.28	0.36
Maumee River	Bowling Green, Defiance, Napoleon, McClure	5.14	0.82
Sandusky River	Tiffin, Bucyrus, Fremont	5.38	0.86
Deer Creek Reservoir	Alliance	3.18	0.51
Alum Creek Reservoir	Delaware, Westerville	2.61	0.42
Big Walnut Creek	Columbus	2.59	0.41
Honey Creek	Attica	9.45	1.51
Olentangy River	Delaware	2.68	0.43
Cuyahoga River	Akron	0.85	0.14

*Lifetime Aspirin Tablet Equivalents for 2 liters per day, 365 days per year, 70 years. 1 LATE=370 mg.

E. Additional Considerations for Policy Development

We conclude this discussion of policy issues following from our review of *Tap Water Blues* with three additional observations:

1. Many regulatory programs already in place have resulted in sharp reductions in both farmers' use of these herbicides and their subsequent transport into surface and ground waters. The continuing evolution of Best Management Practices (BMPs) in the use of such compounds is encouraging greater control in their application and shifts by users to a newer generation of weed control chemicals. Both trends lead to continuing decreases in drinking water concentrations of the five herbicides considered in *Tap Water Blues.*

2. Similarly, modern BMP's for the control of sediment and nutrient movement from agricultural fields have the side benefit of further reducing water concentrations of the five herbicides. Conservation tillage practices are proving very effective in

controlling erosion, and the growing popularity of such methods is having the additional value of reducing the runoff of agricultural chemicals into area streams.

3. Improvements in the analytical methods used to monitor the occurrence of agricultural chemicals in natural waters has led to enhanced abilities to single out problem watersheds with unusually high concentrations of contaminants. These areas can subsequently be targeted for special attention, thereby maximizing our ability to direct limited resources towards areas where they can have the greatest effect. Where current enforcement programs prove unable to bring water concentrations into compliance with regulatory standards, such failure will not escape ongoing monitoring, and further corrective actions can be undertaken.

In conclusion, taken together with the detailed analyses we have presented in preceding sections of this review, these three additional considerations lead us to strongly dispute the main recommendations of the authors of *Tap Water Blues*. We do not see signficant health risks associated with present concentrations of the five herbicides they have discussed. We see no merit in either banning the use of these herbicides or accelerating efforts to reduce their use, beyond the regulatory methods that are already in place.

References

Baker, D.B. and R.P. Richards. 1991. Herbicide concentrations in Ohio's drinking water supplies: a quantitative exposure assessment. In: *Proceedings of the Third National Research Conference, Pesticides in the Next Decade: The Challenges Ahead.* Ed. D. Weigmann. pp. 9-30.

Baker, D.B. and R.P. Richards. 1994. Herbicides in Ohio's drinking water: risk analysis, reduction and communication. In: Proceedings of the Fourth National Conference on Pesticides: *New Directions in Pesticide Research, Development, Management and Policy.* Ed. D.L. Weigmann, Virginia Water Resources Center, VPISU, Blacksburg, VA. pp. 200-221.

EPA. 1989. Drinking Water Health Advisory: Pesticides. Lewis Publ., Chelsea, Michigan, 819 pp.

EPA. 1990. National Pesticide Survey: Atrazine. Washington, D.C., U.S. EPA, Office of Water, Office of Pesticides and Toxic Substances.

EPA. 1990. Reducing Risk: Setting Priorities and Strategies for Environmental Protection. Washington, D.C., U.S. EPA, Science Advisory Board. SAB-EC-90-021.

Merck Index, Tenth Edition. 1983. Rahway, NJ, Merck and Co., Inc., 1463 pp.

Richards, R. P. and D.B. Baker. 1993. Pesticide concentration patterns in agricultural drainage networks of the Lake Erie Basin. *Environmental Toxicology and Chemistry*, 12:13-26.

Richards, R.P., D.B. Baker, B.C. Christensen and D.P. Tierney. 1995. Atrazine exposures through drinking water: exposure assessments for Ohio, Illinois, and Iowa. *Environmental Science and Technology*, in press.

Trotter, D.M., A. Baril, M.P. Wong, and R.A. Kent. 1990. Canadian Water Quality Guidelines for Atrazine. Scientific Series No. 168, Inland Waters Directorate, Water Quality Branch, Ottawa, Ontario, 106 pp.

Appendices

- About the Environmental Working Group
- About the Water Quality Lab of Heidelberg College
- Acknowledgment page from *Tap Water Blues*
- Press Advisory announcing the release of *Tap Water Blues*
- Statement of Carol M. Browner, Administrator of U.S. EPA on Pesticides in Drinking Water

ENVIRONMENTAL WORKING GROUP™

About the Environmental Working Group

The Environmental Working Group is a nonprofit environmental policy organization based in Washington, D.C. Established in July, 1993, the Environmental Working Group seeks to improve the environmental performance of the U.S. economy through reform of public policy. Through research, publications and the development of computer databases, Environmental Working Group staff analyze a wide range of environmental issues, including the impacts of agriculture policy on the environment, reform of federal pesticide regulation, and the environmental implications of federal budget and appropriations policy. The Environmental Working Group publishes the only annual review of Environmental Protection Agency programs and performance, the 1993 edition of which, according to *Government Executive* magazine, "may be the most comprehensive audit to date of EPA." Through its Clearinghouse on Environmental Advocacy and Research (CLEAR), the organization provides state and local environmental groups and activists with information on the economic and ecological importance of environmental laws and regulations.

Recent Publications by the Environmental Working Group

Tap Water Blues: Herbicides in Drinking Water — October, 1994.

Looks Like America? Women, Minorities, and USDA's Farmer Committees — September, 1994.

1994 Annual Review of the U.S. Environmental Protection Agency: Program Evaluation, Budget Analysis, and Funding Recommendations — July, 1994.

Sowing Disaster: The Implications of Farm Disaster Programs for Taxpayers and the Environment — July, 1994.

Washed, Peeled — Contaminated: Pesticide Residues in Ready-to-Eat Fruits and Vegetables — May, 1994.

Trading Away U.S. Food Safety (co-authored by Public Citizen) — April, 1994

So Long, CRP — February, 1994.

Stemming the Flow: Agrichemical Dealers and Pollution Prevention–Case Studies from the Great Lakes Basin — August, 1993.

Pesticides in Children's Food — June, 1993.

1993 Annual Review of the U.S. Environmental Protection Agency: Program Evaluation, Budget Analysis, and Funding Recommendations — May, 1993.

Countdown to Compliance: Implementation of the Resource Conservation Requirements of Federal Farm Law — March, 1993.

1718 CONNECTICUT AVENUE, N.W. • SUITE 600 • WASHINGTON, D.C. 20009
TEL (202)667-6982 • FAX (202)232-2592

3-53

ABOUT THE WATER QUALITY LABORATORY

MISSION

The Water Quality Laboratory (WQL) of Heidelberg College is an environmental research, monitoring, and educational organization associated with the science departments of Heidelberg College. Our primary mission is to conduct research and educational programs which will help to minimize adverse impacts of agriculture on the soil, water, and biotic resources of Ohio, the Midwest, and the Lake Erie and Great Lakes ecosystems.

We implement the research aspects of our mission through detailed, long-term studies of the impacts of agricultural land use on regional water quality. This work includes continuing assessments of the concentrations and transport of agricultural chemicals in streams, rivers, and wetlands entering Lake Erie. We also operate large-scale studies of the extent and characteristics of ground water contamination by agrichemicals. We implement the educational aspects of our mission through an active environmental extension program. This involves communication of the results of our own and related environmental research programs to the environmental and agricultural communities, to policy setting bodies, and to the general public. We endeavor to support enlightened management of the state's and nation's soil and water resources through providing accurate assessments and perspectives on issues related to agriculture and the environment. Our educational mission is also expressed through work with undergraduate students in the Water Resources major at Heidelberg College and with graduate and undergraduate students from surrounding institutions.

APPROACH

The approach which we seek to use in implementing our mission is that of **informed, unbiased, cooperative, and active engagement**. We attempt to become informed through our own research and monitoring efforts, and through keeping abreast of similar efforts within the community of governmental, industrial, private sector and academic environmental scientists. We attempt to remain unbiased by examining evidence on all sides of issues. We seek to cooperate with the many organizations and agencies who are concerned with agricultural and environmental issues and are contributing to the resolution of agricultural pollution problems. As full time researchers, our staff members have considerable flexibility in time scheduling. This facilitates our active engagement as participants in local, state, national, and even international deliberations concerning the relationships between food production and environmental quality.

As an independent organization operating within a framework of academic freedom (and attendant responsibility), our staff are able to exercise creativity in designing and establishing effective and efficient approaches to environmental research, monitoring, and educational programs.

SUPPORT

The WQL programs are entirely supported by income from grants and contracts, some of which are for specific research, monitoring, or educational projects and some for general program support. Sources of support include industries, foundations, and local, state, and federal governmental agencies. We often arrange multiple funding sources for our larger projects.

Background on Pesticide Research Work by David Baker, Director, Water Quality Laboratory, Heidelberg College, Tiffin, Ohio

The Water Quality Laboratory, under the direction of Dr. David Baker, has been a leader and innovator in studies of the occurrence of pesticides in surface and ground waters.

1. In 1981, the lab observed high concentrations of multiple herbicides in Lake Erie tributaries during spring runoff events. They were the first group to call attention to the need for detailed storm event sampling in the spring to accurately characterize exposures to current generation pesticides.

2. In 1983, they published a report entitled *Herbicide Contamination in Municipal Water Supplies of Northwestern Ohio.* They documented that most current generation pesticides are not removed by conventional water treatment. These studies were noted in the Congressional Record.

3. In 1984, they initiated studies of current generation herbicides in rainfall. They were the first to call attention to the occurrence of multiple herbicide residues in midwestern rainwater and, in 1987, published the results of their studies in *Nature.* Herbicide monitoring has now been incorporated into the National Atmospheric Deposition Network.

4. At the time of the data call in for the special review of alachlor, the Heidelberg laboratory provided 70% of the data available nationally for the occurrence of alachlor in drinking water .

5. Working with the U.S. EPA research laboratory in Cincinnati, they were involved in studies of treatment alternatives to address seasonal occurrences of pesticides in drinking water. The resulting 1989 publication, "Treatment of Seasonal Pesticides in Surface Waters," appeared in the *J. American Water Works Association* and received a pollution prevention award from the EPA. This work on addressing the problems of the spring flush was published two years before the U.S. Geological Survey's paper on the existence of the spring flush.

6. The Heidelberg laboratory developed the innovative cooperative private well testing program. This program has been sponsored nationally by the American Farm Bureau Federation. More than 45,000 rural private water wells have been tested for nitrates and more than 12,000 wells for atrazine and alachlor, providing one of the best data bases in the country for studying well vulnerability issues. The entire data base has been funded by individuals paying to have their water tested as part of the program.

7. The private well testing program led to the discovery of an alachlor metabolite (alachlor ethane sulfonic acid). Subsequent studies by the USGS indicate that it is the most widely spread agrichemical product in groundwater.

8. Their ongoing studies of pesticide concentrations in Lake Erie tributaries provides the longest term and most detailed data base of its type in the United States. The lab's studies of nutrients and sediments are even more extensive than its pesticide studies. Thus Dr. Baker views pesticides runoff in the context of overall agricultural pollution problems.

9. Dr. Baker is a frequent speaker on agricultural pollution issues at the national, state and local level. He has developed simple and straightforward methods to convey pesticide exposure and risk information.

10. With this background, he is well positioned to review *Tap Water Blues.*

Acknowledgments

We are extraordinarily grateful to Molly Evans for designing and coordinating all production and layout and creating the cover — all on a very tight schedule. A very special thank you goes to Eileen Gannon for her editing skills and her help with desktop publishing as we neared the deadline. Our sincere appreciation goes to Mike Shelhamer for his assistance with tables and figures, to Ken Cook for his editing and insight, and to Elise Caplan, Clark Williams, and Andrew Art for their proofreading and help in bringing this report to completion.

We would also like to thank the following individuals for their review of all or part of early drafts of this project, and their assistance in improving the final version of the report. We have made every effort to respond to their comments and to double-check the data and analyses presented herein. Any errors in this report, however, are the authors', and should in no way reflect on the reviewers listed below. Names and organizations are presented for identification purposes only and are not meant to indicate that the individual or organization has in any way endorsed the recommendations of this report.

Dr. Theodora Colborn, World Wildlife Fund
Dr. Michael DiBartolomeis, President, Toxicology Research International
Don Goolsby, Chief, Midcontinent Herbicide Program, United States Geological Survey
Dr. George Hallberg, University of Iowa Hygienic Laboratory
Dr. Ana M. Soto, Associate Professor, Tufts University School of Medicine
Dr. David Rall, Physicians for Social Responsibility

Tap Water Blues was made possible by grants from The Pew Charitable Trusts, The John D. and Catherine T. MacArthur Foundation, the W. Alton Jones Foundation, the Charles Stewart Mott Foundation, and The Turner Foundation. A computer equipment grant from the Apple Computer Corporation made our analysis possible. The opinions expressed in this report are those of the authors and do not necessarily reflect the views of The Pew Charitable Trusts or other supporters listed above.

Cover photo courtesy of USDA, Soil Conservation Service.

Manufactured in the United States of America. Printed on recycled paper.

Environmental Working Group

The Environmental Working Group is a nonprofit environmental research organization based in Washington, D.C. The Environmental Working Group is a project of the Tides Foundation, a California Public Benefit Corporation based in San Francisco that provides administrative and program support services to nonprofit programs and projects.

Kenneth A. Cook, President

To order copies

Copies of this report may be ordered for $40.00 each (plus 7% sales tax or $2.80 for Washington, D.C. residents) and $3.00 for postage and handling. Payment must accompany all orders. Please make checks payable to:

Environmental Working Group
1718 Connecticut Avenue, N.W. Suite 600
Washington, D.C. 20009
(202) 667-6982
(202) 232-2592 fax

3-56

PRESS ADVISORY

CONTACT: SHARON HISCHMAN
202-547-9009
SUZANNE TURNER
202-745-0707
RICHARD WILES
202-667-6982

MILLIONS DRINK WATER CONTAMINATED WITH TOXIC HERBICIDES

Federal Standards Routinely Exceeded

New Report Documents Severity of the Problem

WHAT: Every spring, farmers across the Corn Belt apply 150 million pounds of five herbicides to their corn and soybean fields. And every spring, rains wash a substantial portion of those chemicals into the drinking water of 11.7 million people in the Midwest and Louisiana. A report to be released Tuesday, October 18th by the Environmental Working Group and Physicians for Social Responsibility demonstrates that many people, especially children, are at great risk of developing long-term health problems from drinking dangerous, yet legal, pesticides in their water.

The report analyzes the water in eight Corn Belt states, Louisiana, Kentucky, and the Chesapeake Bay region. The Corn Belt States – Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, and Ohio – account for the greatest use of and the most serious drinking water contamination from the five herbicides.

WHY: An analysis of more than 20,000 tests for five herbicides in finished tap water and in drinking water sources (rivers and reservoirs) shows that 14.1 million people routinely drink water that is contaminated with pesticides that may cause cancer, birth defects, reproductive disorders, or chronic damage to the liver and heart. In the Corn Belt, an estimated 65,000 infants drink these herbicides from birth via infant formula reconstituted with contaminated tap water. Earlier studies have shown that children are particularly susceptible to these chemicals.

WHEN: 10:00 am, Tuesday, October 18, 1994

WHERE: The National Press Club, Main Lounge

WHO: Kenneth A. Cook, President, Environmental Working Group
Richard Wiles, Director of Agricultural Pollution Prevention, Environmental Working Group, and primary author of the report. Wiles was formerly senior staff officer at the National Academy of Sciences where he directed major studies on pesticides in food and their effects on children, among other issues.
Dr. David Rall, Director of Science and Health Policy Project, Physicians for Social Responsibility. Dr. Rall is founder of the National Toxicology Program and former Director for the National Institutes of Health National Institute for Environmental Health Sciences.

Press conferences will also be held simultaneously in 25 cities across the country. For information about these local press events, call Ed Hopkins at Citizen Action at 202-775-1580.

The Environmental Working Group is a non-profit environmental research organization based in Washington, DC. Physicians for Social Responsibility is a national organization of health professionals and supporters and is a U.S. affiliate of International Physicians for the Prevention of Nuclear War, recipient of the 1985 Nobel Peace Prize. An important focus of its environmental program is the effect of pollution on children's health.

###

United States Environmental Protection Agency

Communications, Education, And Public Affairs (1703)

EPA Environmental News

STATEMENT OF
CAROL M. BROWNER, ADMINISTRATOR
U.S. ENVIRONMENTAL PROTECTION AGENCY
ON PESTICIDES IN DRINKING WATER

October 18, 1994

Most drinking water systems in this country are well regulated and monitored frequently. But this study is another in a series of wake-up calls telling us that we can no longer take for granted that every water system is safe all the time. That is why from day one, drinking water protection has been among the Clinton Administration's top environmental priorities. While our analysis shows fewer people exposed to drinking water with unacceptable levels of these herbicides than the report, we feel that even one person at risk is too many.

The Clinton Administration is dedicated to reducing pesticide use, protecting drinking water and, in general, making up for twelve years of inaction in previous Administrations. Although Congress failed in the last session to pass the Administration's Safe Drinking Water Reform Bill, costing states and municipalities $1.3 billion designated to address drinking water problems, EPA is still taking an array of actions. We are drastically reducing the use of two of the most troubling pesticides, undertaking a review process that could lead to canceled uses altogether of the others, and developing new, long-overdue drinking water standards.

In addition, it is the responsibility of local water systems to let customers know when there is a problem with their water. EPA is aggressively enforcing to assure that water systems comply with their obligations and fully protect the health of the citizens who use their product.

# # #

R-253

Amoco Corporation
4334 N. W. Expressway
Suite 275
Oklahoma City, Oklahoma 73116
405 848-0657
405 848-0693 (FAX)

E. R. (Dick) Brewster
Public & Government Affairs

Representing
The Amoco Companies

February 1, 1995

The Honorable Carl Holmes, Chairman
And Members of the House Committee on
Energy and Natural Resources
Kansas Capitol Building
Topeka, Kansas

Re: **1995 House Bill No. 2120**

Mr. Chairman, Members of the Committee, please accept my regret for being unable to attend your hearing on the above referenced bill in person.

Amoco **supports House Bill No. 2120.** Amoco is the largest producer of natural gas in Kansas, and one of the largest marketers of refined products. Our products can be purchased through 165 branded Amoco locations in Kansas. We operate 1,191 miles of pipeline in Kansas, and produce gas from 1,927 wells. We have 208 employees in the state, and pay $49.3 million in state and local taxes, and collect and remit $16.4 million in motor fuel excise taxes.

And, we plan to expand our operations. Amoco is party to a letter of intent to build a major new natural gas processing plant in Southwest Kansas. Additional expansion in our gas production and pipeline operations will be announced.

Amoco is proud of its record in the area of environmental responsibility. We accept nothing less from our operations than full compliance with applicable environmental laws, rules and regulations. In fact, much of what we do exceeds these requirements.

Changes in existing equipment, installation of new equipment, and changes in procedure to comply with these laws, rules and regulations are not without cost. While we recognize these costs as simply a part of the cost of doing business, there are times when the cost/benefit ratio seems questionable. This bill can help assure that excessive and unneeded costs are not imposed on business operations in Kansas. We laud the Chairman in seeking approval of this legislation.

Kansas has historically provided a good business climate, and we have every reason to believe it will continue to do so. It is important to business planners that it operate in a stable tax and regulatory climate. H. B. No. 2120 will help stabilize that climate in the area of environmental regulation.

Senate Energy & Nat'l Res.
March 8, 1995
Attachment 4

Please do not think Amoco, or the oil and gas industry, desires to be anything less than environmentally responsible in its operations. Our industry in Kansas pays for its own regulation and oversight through its fees and taxes, and we expect to continue to do so. In fact, the industry is proposing to impose yet another fee upon itself to help clean up old oil and gas exploration and development sites which may have been abandoned by operators no longer in business.

As an industry, we will strive to maintain and improve our record of environmental stewardship. Amoco believes this legislation will help us accomplish this goal in a cost effective way.

Again, Mr. Chairman, Members of the Committee, I regret my absence today. We urge approval, of H. B. No. 2120.

I plan to be in Topeka in the coming weeks, and would be happy to discuss this or other proposals impacting our industry with you at your convenience.

Sincerely,