ANNUAL REPORT FOR 1998

STATUS OF IMPLEMENTATION OF SENATE BILL 90-126 THE AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION ACT

Colorado Department of Agriculture
Colorado State University Cooperative Extension
Colorado Department of Public Health and Environment

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION

www.ag.state.co.us/DPI/programs/groundwater.html

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In the annual report for 1997, several goals for 1998 were identified by the cooperating agencies. The progress made toward each of the goals is detailed in the following pages.

Memoranda of Understanding

Memoranda of Understanding as provided in Section 25-8-205.5 (3)(f) and (g) of the Act have been signed for fiscal year 1998/99 between the Colorado Department of Agriculture and: 1) Colorado State University Cooperative Extension, and 2) the Colorado Department of Public Health and Environment. The objectives for 1999 for this program are stated on pages 14 and 15.

Education and Communication

Communication is a vital component of the program. Numerous methods are used to provide information to individuals and organizations affected by the program as well as the general public. Fact sheets are prepared to provide information on the program and are being distributed at meetings, conferences, and trade shows. Also, a display board is being utilized at conferences and trade shows to

provide information on the program. Videos entitled Protecting Colorado's Groundwater and Best Management Practices for Colorado Agriculture are available to inform the general public on groundwater quality, agricultural chemicals, and the Act. These videos may be borrowed from the Department of Agriculture or copies may be purchased from the CSU bulletin room. Information on the program is continually being presented to the public through radio shows, mass media, press releases, and presentations at meetings throughout the state.

Development pressures, in once rural outlying areas, have heightened public awareness of the potential for impacts to water quality. The Program has responded to these concerns by offering technical assistance to water conservancy districts, groundwater management districts, and other local entities interested in evaluating water quality in their area. Presentations of how the program works, past and present water quality projects, and plans for future projects with request for local input are made at every opportunity. In 1998, presentations were made at several major meetings and small local groups throughout the state. We consider this type of outreach an important part of the customer service component of the program.

The initiation of the National Certified Crop Advisor program in Colorado has dovetailed into this program to provide a mechanism for training and education regarding the correct use of agricultural chemicals. Over 200 crop consultants and advisors have passed the national and state exam and proven sufficient experience to be certified as crop advisors in Colorado. These individuals and others to be certified in the future are required to obtain continuing education credits to maintain their certification. This affords an ideal opportunity to provide information concerning pesticides and fertilizers and groundwater protection to those making recommendations to farmers.

Best Management Practices

Best Management Practices (BMPs) are being developed at the user level through extensive local input. A general BMP notebook for Colorado Agriculture has been completed and consists of eight subject specific BMP chapters and one booklet providing an overview of the BMP process. The notebook has been provided to producers, pesticide and fertilizer dealers, CSU Cooperative Extension offices, and all

USDA Natural Resources Conservation Service offices. All of the BMP chapters are available through the CSU Bulletin Room.

In 1996, an economic analysis of the BMPs was performed to determine the cost of implementing the BMPs that required purchasing a service or product to adopt the practice. This information has been condensed into two fact sheets that agricultural chemical users can easily utilize. The two fact sheets are titled, Economic Considerations of Nutrient Management BMPs and Economic Considerations of Pest Management BMPs.

The statewide notebook is being utilized to guide local work groups through the BMP development process for regionally specific BMPs. Localized BMP development is continuing in the San Luis Valley, the South Platte River Basin from Denver to the Nebraska state line, and the Uncompahgre Valley of the western slope.

In the San Luis Valley, booklets entitled Best Management Practices for Nutrient and Irrigation Management in the San Luis Valley, Best Management Practices for Potato Pest Management in the San Luis Valley, and Best Management Practices for Small Grain Pest Management in the San Luis Valley have been published to promote BMPs.

On the west slope, a booklet entitled Best Management Practices for the Uncompahgre Valley has been published for practices appropriate to this area.

Localized BMPs for the Front Range/South Platte Basin have also been completed. A document entitled Best Management Practices for Irrigated Agriculture was published from this group's efforts. In addition, a booklet was developed of BMPs specifically for irrigated barley production. This booklet was published and is entitled Barley Management Practices for Colorado: A Guide for Irrigated Production.

To assess program progress, we surveyed approximately 3500 irrigated crop producers state wide in the winter of 1997. We wanted to learn the status of BMP adoption and possible barriers to change. The confidential survey instrument asked producers questions about what specific BMPs and irrigation management and technology they used, and what information sources they utilized for production decisions.

Producers returned more than 1300 surveys for a 40% response. We found that certain BMPs such as soil testing and pest scouting are being used by over two-thirds of Colorado producers. Other BMPs such as record keeping and irrigation water crediting need more emphasis to achieve higher adoption.

In an effort to provide increased access to the BMPs as well as articulate the need for farmers to adopt water quality protection practices, a 20 minute instructional video was produced entitled: "Best Management Practices for Colorado Agriculture". The video shows farmers speaking about why they have adopted practices and the need for continued diligence on their part to protect water quality.

The use of pesticides and commercial fertilizers in urban areas also has the possibility to impact groundwater resources. Five publications describing BMPs for urban pesticide and fertilizer use have been developed and distributed. The five publications are entitled: Homeowner's Guide to Protecting Water Quality and the Environment, Homeowner's Guide to Pesticide Use Around the Home and Garden, Homeowner's Guide Alternative Pest Management for the Lawn and Garden, Homeowner's Guide to Fertilizing your Lawn and Garden, and Pollution Prevention in Colorado Commercial Greenhouses (Appendix I). These publications are available from the CSU Bulletin Room or the Colorado Department of Agriculture.

Demonstration Sites and Field Days

Field demonstrations continue to be an integral part of the program to demonstrate BMPs to farmers. In 1998, work focused on crediting nitrogen in irrigation water and nutrient management planning. Eight demonstration sites were used to show these practices.

One objective of these demonstration trials was to compare crop yields where the fertilizer rate was reduced by accounting for (or crediting) the NO3-N supplied from the irrigation well water. Three different crops were grown at the sites: field-corn for grain and silage and hard red winter wheat. The irrigation nitrogen credits at the sites ranged from 30 to 80 pounds per acre. Irrigation water quantity was measured at each site to determine if the full amount of the credited nitrogen was applied. Atmometers were installed to demonstrate a simple method of keeping track of crop water use (ET) for more efficient irrigation scheduling. A fact sheet has been developed to explain the demonstrated practice,

describe the trial objectives, and provide the results with information on fertilizer cost savings (Appendix I).

A new technology known as in-season nitrate testing was highlighted for demonstration. This tool may help farmers improve nitrogen recommendation accuracy and minimize the use of "insurance" fertilizer. Demonstration plots and field days will be utilized in the South Platte River Basin in 1999. In the future, locations for these plots will be expanded to other regions of the state. (Appendix II).

Groundwater Monitoring

A long-range sampling plan has been developed for the monitoring program. The plan covers three major types of groundwater monitoring. The first type of monitoring is the initial screening surveys to be conducted on all major aquifers subject to contamination from agricultural chemicals. The screening surveys for the South Platte River alluvial aquifer, San Luis Valley unconfined aquifer, Arkansas River alluvial aquifer, the Front Range Urban Corridor, and the High Plains Ogallala Aquifer are complete. The second type of monitoring is a follow-up sampling program to resample, for confirmation, all wells in which any contaminant was detected at a level of concern. Surrounding wells may also be sampled, if available, to determine if the contamination is widespread or only a localized problem. Follow-up sampling is planned in 1999 for the High Plains and West Slope. The third type of monitoring is the specialized sampling needed for evaluation of Best Management Practices or Agricultural Management Areas when established. This long term monitoring, utilizing special wells such as dedicated monitoring wells, was started in 1995 in the Brighton to Greeley reach of the South Platte. In 1998, we continued this long term monitoring project and in 1999 will begin the initial statistical analysis of the data that has been gathered to date.

Before an area is selected for monitoring, CDPHE will contact interested parties to inform them of the sampling program and SB 90-126, and how we envision its implementation. CDPHE will coordinate closely with federal agencies, county extension agents, conservancy districts, and local health officials in the project area.

West Slope of Colorado

The 1998 monitoring program began a regional groundwater quality baseline study for the western slope of Colorado. The West Slope of Colorado includes all of Colorado west of the continental divide. However, this monitoring program excluded the central core of the Rocky Mountains where the land use is predominately National Forest. The majority of the groundwater sampled on the west slope occurs along stream and river valleys in alluvial deposits with some local aquifers on the larger mesas. No single aquifer underlies this area, therefore this survey differs from past work that tended to focus on a single regional aquifer. The agriculture in this region is dominated by ranching with associated hay production. Dry land wheat in Moffat County, corn in the tri river area, dry beans in Montezuma County, and the fruit and vineyards of Mesa County are the exceptions.

Ninety samples have been collected to date with future additions planned. All samples were collected from existing wells that are privately owned and permitted as domestic wells. The samples were analyzed for nitrate and 45 pesticides (Appendix III). Preliminary analysis of the nitrate and pesticide data indicates that groundwater in the majority of the area sampled has not been adversely impacted by current agricultural practice. The major inorganic contaminant of concern in this area is nitrate. Nitrogen analysis indicated that 36% of the wells tested for a level of nitrate-nitrite as nitrogen below the laboratory detection limit of 0.5 mg/L (parts per million). Sixty-three (63 %) percent of the wells tested in the range of 0.5 to 9.9 mg/L, indicating nitrogen present but below the drinking water standard of 10 mg/L. Only one well exceeded the nitrate drinking water standard of 10 mg/L, with a test result of 32.0 mg/L. This well was located in Moffat County, north of Craig. The drinking water standard is used as a benchmark for nitrate levels in all wells regardless of use. Pesticide data revealed one well testing positive for the pesticide Malathion at 0.23 ug/L (part per billion) with a detection limit of 0.1 ug/L. This well was located in Montrose County, west of Montrose.

Well samples were analyzed for basic water quality constituents, nitrate, and selected pesticides. The basic inorganic analysis was performed by the Soils Laboratory at CSU. The Colorado Department of Agriculture, Standards Laboratory performed the laboratory analysis for nitrate as nitrogen and selected pesticides. Temperature, conductivity, and total dissolved solids were measured in the field.

The monitoring program included sample collection, laboratory analysis, and data analysis and storage. Upon completion of the sampling and a full analysis, which should include integration with previous and current studies by other agencies, the resulting sampling program will provide the basis for determining a groundwater quality baseline for this region.

The results from this sampling program have been entered into the CDPHE Groundwater Quality Data System maintained at CDPHE. A detailed report describing the area sampled, the protocol for sampling and analysis, and the results of the analysis will be provided to the Commissioner of Agriculture upon completion of the analysis.

Weld County Long Term Monitoring

Nineteen ninety eight was the fourth year of a long term monitoring effort initiated in the South Platte alluvial aquifer from Brighton to Greeley. The long term monitoring network was established in 1995 and is a combination of three types of wells previously sampled in the area. The long term monitoring network consists of 19 monitoring wells operated by the Central Colorado Water Conservancy District, 60 irrigation wells sampled in 1989, 1990, 1991, 1994, 1995, 1996, and 1997, and 18 domestic wells sampled in 1992 and 1995.

From June through August, 1998, 94 wells in the long term network were sampled. All wells were analyzed for nitrate-nitrite as nitrogen. The 19 monitoring wells and 18 domestic wells were analyzed for 45 pesticides. The pesticide analysis for the irrigation wells was an immuno assay screen for the triazine herbicides.

Nitrogen analysis indicated that 79% of the monitoring wells, 44% of the domestic wells, and 73% of the irrigation wells exceeded the nitrate drinking water standard of 10 mg/L. In the monitoring wells, nitrate levels ranged from a low of 3.0 mg/L nitrate as nitrogen to a high of 88.0 mg/L. The range of values for the eighteen domestic wells was from a low of 1.0 mg/L to a high of 45.0 mg/L. In the irrigation wells, nitrate levels ranged from below our detection level of 0.5 mg/L nitrate as nitrogen to a high of 33.9 mg/L.

Pesticide data revealed four pesticides, Atrazine, Metolachlor, Metalaxyl, and Prometone present in the monitoring well samples. The breakdown products of Atrazine, Deethyl Atrazine and Deisopropyl Atrazine were also detected. Atrazine was present in 37% of the wells, Deethyl Atrazine in 53% of the wells, Metolachlor in 32% and Prometone in 26%. Metalaxyl was detected in two wells (1.1%), and the level of Metalaxyl reached 13.6 ug/L (ppb) in one well. The breakdown product Deisopropyl Atrazine was detected in one well. Detection levels for the other pesticides averaged less than 0.5 ug/L (ppb).

The triazine herbicide screen used on the irrigation wells detects any pesticide in this family, which includes Atrazine, Simazine, Cyanazine, Deethyl Atrazine, and Prometone. The results are calibrated in units of Atrazine equivalent but may be actually composed of one or more of the components. In 1998, triazine herbicides were detected in 91% of the irrigation wells. Levels ranged from 0.05 ug/L to 1.18 ug/L (ppb).

The monitoring wells in Weld County were sampled in cooperation with the Central Colorado Water Conservancy District in June 1998 by Randy Ray of Central and Brad Austin of CDPHE. John Colbert, of CDPHE, sampled the irrigation wells in Weld County in July and August 1998. All West Slope sampling was performed by Brad Austin, July through October, 1998. Field sampling procedures followed the protocol developed by the Groundwater Quality Monitoring Working Group of the Colorado Nonpoint Task Force.

Aquifer Vulnerability

In addition to monitoring groundwater for the presence of agricultural chemicals, the Agriculture Chemicals and Groundwater Protection Program is required to determine the likelihood that an agricultural chemical will enter the groundwater. This determination is based upon the chemical properties of the chemical in question, the behavior of a particular chemical in the soil types of the region under study, the depth to groundwater, the farming practices in use, and other factors. This type of determination has been described as a vulnerability analysis.

In the process of writing the generic State Management Plan for Pesticides (SMP), the staff at CDPHE, CDA, and CSU has studied various types of vulnerability analysis. The goal has been to satisfy the requirements of the SMP and SB 90-126, while remaining within the

confines of existing staffing, organization, and budget. In early 1996, a project was contracted to conduct a limited test of an aquifer sensitivity method in the northeastern section of the state. The results of this pilot project were evaluated by CDPHE, CDA, CSU, and USEPA and approved for use throughout the state. The Program expanded this effort statewide in 1997 to produce a vulnerability analysis for Colorado. The project was completed in June 1998. This final mapping product will provide a standard method to determine aquifer sensitivity. Upon completion of the next phase, the addition of the vulnerability factors, the program will be able to determine groundwater vulnerability to agricultural chemicals statewide. Results will be evaluated and incorporated into a standard method to delineate those areas of the state where groundwater is vulnerable to contamination from agricultural chemicals. The monitoring program can then target resources to those areas where attention is most needed. This effort will become a key element of the State Management Plan for pesticides implemented under the Federal Insecticide, Fungicide, and Rodenticide Act.

Groundwater Quality Data

In the FY-99 Memorandum of Understanding, the Agricultural Chemicals and Groundwater Protection Program agreed to pursue collecting, evaluating, and entering into a database all existing groundwater quality data available. Groundwater quality data from various regions of the state has been entered as it becomes available. Recently this includes, CDPHE data collected as part of Super Fund preliminary assessment studies by the Haz. Mat. Division, and recently published U. S. Geological Survey data. As the data from these studies is received, it is entered into a database specifically designed for this purpose. In addition, collection and entry of historical data from the U. S. Geological Survey and U. S. EPA is an ongoing process.

The U. S. Geological Survey (USGS) is now wrapping up monitoring in the Upper Colorado Basin area under the National Water Quality Assessment (NAWQA) program. As this data becomes available it will be incorporated into the final analysis for water quality on the west slope. Several water conservancy districts are also actively engaged in collecting groundwater quality data. Unfortunately, this data is not always readily available due to concerns about privacy and future use of the data. The program hopes that as the monitoring effort continues and the agricultural community grows comfortable with our goals and intent, this valuable source of data will become available and enhance our understanding of the overall groundwater quality of the state.

Advisory Committee

The advisory committee continues to be an integral part of the implementation of this program by providing input from the many facets of the agricultural community and the general public that they represent (Appendix V). The committee met two times during 1998. All major program activities are discussed with the committee prior to implementation. The committee has been essential in providing input on program strategy by helping to determine which issues to address first, where geographically to focus efforts, critiquing drafted documents, providing ideas about the most effective means of distributing materials, and giving comments on how the information will be received, in addition to many other items.

Coordination

Coordination with other projects and programs relating to agricultural chemicals and groundwater is an essential part of the implementation of the program. All three agencies work continually to keep abreast of other programs both, governmental and private, so information can be incorporated into the implementation of the Act as well this program's information passed on to other agencies and organizations. Input is sought in all phases of the implementation of this program to avoid duplication of efforts, costs, conflict or duplication of regulation and to insure decisions are made with the most complete knowledge available.

Storage Regulations

Section 25-8-205.5 (3)(b) of the Agricultural Chemicals and Groundwater Protection Act requires the Commissioner of Agriculture to develop regulations where pesticides and fertilizers are stored or handled in quantities that exceed the established thresholds. These regulations were adopted in July 1994 and became effective September 30, 1994. The law mandated at least a three-year phase-in period for the regulations. As a result of comments prior to and at the public hearings, a graduated phase-in schedule was adopted.

Regulation of pesticide secondary containment/storage facilities, mixing and loading pads, and liquid fertilizer tanks greater than 100,000 gallons began on September 30, 1997. For these large liquid fertilizer tanks one of the three prescribed methods of leak detection is required unless secondary containment is in place.

Compliance for liquid and dry bulk fertilizer is required by:

- **September 30, 1999** for liquid fertilizer secondary containment and mixing and loading pads.
- **September 30, 1999** for dry fertilizer storage and mixing and loading pads.
- **September 30, 2004** for secondary containment for fertilizer storage tanks with a capacity greater than 100,000 gallons.

Facility inspections continued in 1998. A total of 35 secondary containment facilities and 29 mixing and loading pads were inspected. All facilities inspected were in general compliance with the regulations. One Cease and Desist Order was issued. Some minor modifications were needed at some sites. A database of inspection sites continues to be developed to track inspections. Inspection of pesticide facilities and fertilizer facilities with storage tanks greater than 100,000 gallons will be ongoing during 1999. In addition, inspection of liquid and dry bulk fertilizer facilities will begin as of September 30, 1999. (Appendix IV)

State Management Plan for Pesticides

EPA is developing a program that would require states to produce management plans for pesticides thought to be a significant groundwater hazard. If a state wants to allow continued use of any of the pesticides identified, it must produce an EPA-approved management plan specific to that pesticide.

In 1996, a complete draft of the generic state management plan was finished and provided to EPA for their informal review. If Colorado can complete and receive concurrence from EPA on a generic plan, it should be much easier for a pesticide specific plan to be approved once the proposed rule is finalized. A redrafted, general state management plan based on EPA's comments on previous versions was submitted in January 1998. Comments on this version were received from EPA in April 1998, and Colorado then submitted a document final in August 1998 for formal review and concurrence. We are currently waiting for EPA's response to the Colorado plan.

As discussed in last year's report, one of the more significant issues involves EPA's demand for a sensitivity analysis/vulnerability assessment map of the state in a Geographic Information System (GIS) format by which to determine where to focus education and monitoring activities. In late 1995, a small EPA grant was obtained to perform a sensitivity analysis pilot project for the northeastern part of the state. This work was completed in 1996 and provided to EPA. EPA reacted favorably to the project and provided funding for a statewide sensitivity analysis, which was completed in 1998. This information has been published in an eight page fact sheet titled Relative Sensitivity of Colorado Groundwater to Pesticide Impact (Appendix I). This publication assesses aquifer sensitivity based on four primary factors: conductivity of exposed aquifers; depth to water table; permeability of materials overlaying aquifers; and availability of recharge for the transport of contaminants. These factors were selected because they incorporate the best data currently available for the entire state and incorporate important aspects of Colorado's unique climate and geology.

Pesticide use data at the county level is another requirement of the SMP. In addition, with the passage of the Food Quality Protection Act by Congress, accurate pesticide use information has become more critical. To try and provide this data, CDA along with CSU Cooperative Extension contracted with the Colorado Agricultural Statistics Service to perform a statewide pesticide use survey. All commercial pesticide applicators were surveyed during the winter of 1997/98. In addition, farmers who responded to a pre-survey that they apply some portion of their own pesticides were surveyed. Data is currently being sorted and transformed into a useable format and will then be analyzed and a report generated.

Major Issues

The SMP is still a major concern. In the comments developed regarding the proposed rule, the program expressed its many concerns. In addition, the Colorado Department of Agriculture worked with the National Association of State Departments of Agriculture and the Association of American Pesticide Control Officials to provide comments and input to EPA on the proposed rule.

There are also concerns with regional concurrence of the plan. A number of meetings were held to work out issues and aid in gaining formal concurrence of Colorado's plan.

Registration of products that pose significant groundwater hazards became an important issue in 1998. If this trend continues in the future, it will take significant program time and resources in determining whether to register a specific product and how it should be done.

Objectives for 1999 Determined

The following objectives for 1999 have been established:

- Produce a report on water quality status in Colorado based on data collected in previous years;
- Use the water quality status report to review program and set priorities for the next 5-10 years;
- Continue the development and implementation of localized BMPs for irrigated crops in the South Platte River Basin;
- Continue demonstration plots in the South Platte River area for displaying improved nitrogen and water management to farmers;
- Coordinate an interagency program to deal with water quality issues in the South Platte River Basin;
- Continue the implementation of localized BMPs in the San Luis Valley and complete development of the localized pesticide use BMPs for the major crops;
- Continue BMP demonstration work in the San Luis Valley;
- Continue the distribution of the BMP video;
- Continue distribution of the fact sheets on the economic considerations of BMP adoption for nutrient and pest management;
- Complete the report summarizing the data on the number of producers who have implemented best management practices and which practices they are adopting;
- Continue developing educational resource materials for groundwater education;
- Continue distribution of urban BMPs to encourage improved agricultural chemical and water management in urban areas;

- Continue to hold in-service training for chemical applicators, agency personnel, etc.;
- Participate in the Certified Crop Advisor program;
- Continue to provide information and training on the containment rules and regulations;
- Continue performing inspections of facilities requiring compliance with the containment regulations;
- Complete collection and analysis of groundwater samples in western Colorado for pesticides and nitrates;
- Continue the long term monitoring program in Weld County by collecting and analyzing groundwater samples for pesticides and nitrates;
- Continue to refine the sensitivity analysis and begin vulnerability determination of groundwater for all of Colorado;
- Complete the pesticide use survey for Colorado;
- Obtain concurrence from EPA on the generic State Management Plan for pesticides;
- Obtain and input results of other groundwater monitoring for agricultural chemicals into the Agricultural Chemicals and Groundwater database;
- Integrate results of other projects to achieve goals in the Act;
- Continue disseminating information on the Act and groundwater protection to special interest groups in Colorado;
- Continue publishing and distributing fact sheets; and
- Continue using the display board to provide information on the program at trade shows and professional meetings.

APPENDICES

TABLE OF CONTENTS

APPENDIX I

Documents Produced and Disseminated for the Agricultural Chemicals and Groundwater Protection Program

Program Information

- ☐ Agricultural Chemicals and Groundwater Protection Program Brochure
- ☐ Annual Report - Status of Implementation of Senate Bill 90-126, The Agricultural Chemicals and Groundwater Protection Act
- ☐ Rules and Regulations Pertaining to Commercial Fertilizers and Pesticides at Storage Facilities and Mixing and Loading Areas and Related Sections of the Colorado Water Quality Control Act - Effective September 30, 1994
- ☐ Summary of Rules and Regulations for Bulk Storage Facilities and Mixing and Loading Areas for Fertilizers and Pesticides - Fact Sheet #8
- ☐ Agricultural Chemical Bulk Storage and Mix/Load Facility Plans for Small to Medium-Sized Facilities
- ☐ Web sites:
  www.ag.state.co.us/DPI/programs/groundwater.html
  www.ColoState.EDU/Depts/SoilCrop/extension/WQ

General Best Management Practices for Agriculture

- ☐ Best Management Practices for Colorado Agriculture: An Overview #XCM-171
- ☐ Best Management Practices for Nitrogen Fertilization #XCM-172
- ☐ Best Management Practices for Irrigation Management #XCM-173
- ☐ Best Management Practices for Manure Utilization #XCM-174
- ☐ Best Management Practices for Phosphorus Fertilization #XCM-175
- ☐ Best Management Practices for Crop Pests #XCM-176
- ☐ Best Management Practices for Agricultural Pesticide Use #XCM-177
- ☐ Best Management Practices for Pesticide and Fertilizer Storage and Handling #XCM-178
- ☐ Best Management Practices for Private Well Protection #XCM-179
- ☐ Best Management Practices for Water Quality - Fact Sheet, January 1993
- ☐ Best Management Practices for Turfgrass Production - Fact Sheet, June 1993
- ☐ Best Management Practices for Agricultural Chemical Handling, Mixing and Storage - Fact Sheet #7, April 1994
- ☐ Soil, Plant, and Water Testing Fact Sheet #11, April 1997
- ☐ Economic Considerations of Nutrient Management BMPs Fact Sheet #13, July 1997
- ☐ Economic Considerations of Pest Management BMPs Fact Sheet #14, July 1997
- ☐ Reducing Fertilizer Costs by Crediting Irrigation Water Nitrogen (Results from 1997 Trials) Fact Sheet #15, April 1998
- ☐ Pesticide Record Book for Private Applicators

Local Best Management Practices

- ☐ Best Management Practices for Nutrient and Irrigation Management in the San Luis Valley - March 1994
- ☐ Best Management Practices for Irrigated Agriculture: A Guide for Colorado Producers - August 1994
- ☐ Best Management Practices for Integrated Pest Management in the San Luis Valley: Small Grains #XCM-195
- ☐ Best Management Practices for Integrated Pest Management in the San Luis Valley: Potato #XCM-196
- ☐ Best Management Practices in the Uncompahgre Valley: Making Vital Decisions
- ☐ Barley Management Practices for Colorado: A Guide for Irrigated Production

Best Management Practices for Industry

- ☐ Pollution Prevention in Colorado Commercial Greenhouses #XCM-206

Homeowner's Guides

- ☐ Homeowner's Guide to Protecting Water Quality and the Environment
- ☐ Homeowner's Guide: Alternative Pest Management for the Lawn and Garden
- ☐ Homeowner's Guide to Fertilizing Your Lawn and Garden
- ☐ Homeowner's Guide to Pesticide Use Around the Home and Garden

Groundwater Monitoring

- ☐ Ground Water Monitoring Activities South Platte River Alluvial Aquifer 1992-1993 Report
- ☐ Ground Water Monitoring Activities San Luis Valley Unconfined Aquifer 1993 Report
- ☐ Ground Water Monitoring Activities Arkansas River Valley Alluvial Aquifer 1994-1995 Report
- ☐ Ground Water Monitoring Activities High Plains Ogallala Aquifer 1997-1998 Report
- ☐ San Luis Valley Fact Sheet #9, February 1995
- ☐ South Platte Valley Fact Sheet #10, March 1995
- ☐ Arkansas Valley Fact Sheet #12, April 1997

Groundwater Vulnerability

- ☐ Relative Sensitivity of Colorado Groundwater to Pesticide Impact Fact Sheet #16, October 1998

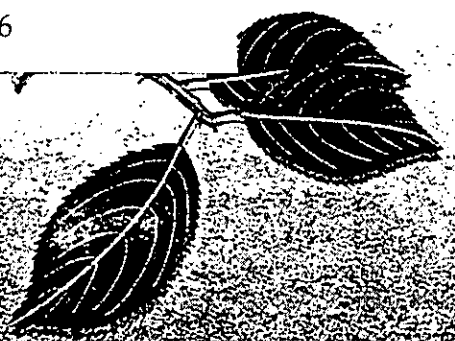
Videos

- ☐ Protecting Colorado's Groundwater
- ☐ Best Management Practices for Colorado's Agriculture

To request any of these educational materials please call the Colorado Department of Agriculture at (303) 239-4180 or the CSU Bulletin Room at (970) 491-6198.

Pollution Prevention in Colorado Commercial Greenhouses

XCM-206



Colorado State University® Cooperative Extension

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION

Fact Sheet #16
October 1998

Relative Sensitivity of Colorado Groundwater to Pesticide Impact

Background

The Colorado Department of Agriculture is charged with protecting Colorado groundwater from contamination from pesticides. In order to guide prevention activities, a study was conducted to assess the relative sensitivity of the state's principal groundwater resources to pesticide contamination.

Aquifer Sensitivity is defined as the relative ease with which a pesticide applied on or near a land surface can migrate to the groundwater. Sensitivity is largely a function of the physical characteristics of the overlying area. Sensitivity is not dependent on management practices or pesticide characteristics. Aquifer **"vulnerability"** considers both the sensitivity of the aquifer, as well as the land use, management, and pesticide properties. This analysis of aquifer sensitivity must be used with other supporting information to determine where additional precautions must be taken to protect groundwater from pesticide contamination.

Aquifer Sensitivity Factors

A number of factors have been identified which may affect the susceptibility of groundwater to contamination from pesticides. Of the many possible factors, the following four primary factors were identified as critical in describing the sensitivity of groundwater to pesticide contamination in Colorado:

1) conductivity of exposed aquifers
2) depth to water table
3) permeability of materials overlying aquifers
4) availability of recharge for transport of contaminants

These selected factors incorporate the best data currently available for the entire state and incorporate important aspects of Colorado's unique climate and geology.

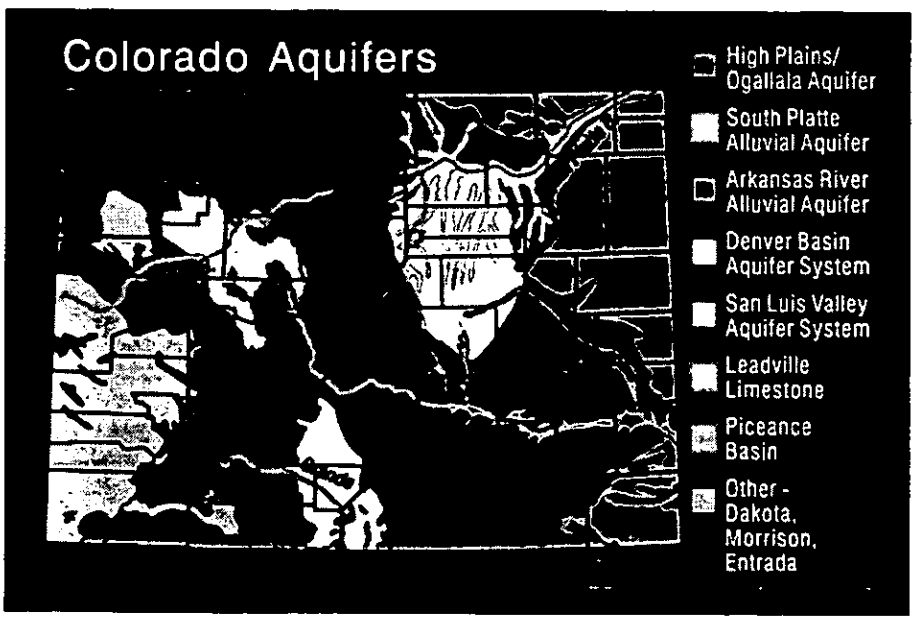


Figure 1. Principal aquifers of Colorado

Table 1. Sensitivity data layers and corresponding factors of consideration.

Data Layer (Index)	Value Range	Factor of Consideration
Location of aquifer (AQU)	0-1	Conductivity of exposed aquifers
Water table depth (WTD)	1-4	Depth to water table
Soil permeability (SOIL)	1-4	Permeability of overlying materials
Available recharge (RCH)	0-1	Availability of recharge for transport

Factor 1) - Extent of Primary Exposed Aquifers

In agricultural regions of Colorado, a number of aquifers supply water for domestic, irrigation, and commercial uses. Between these primary aquifers are regions where groundwater supplies are inconsistent and/or provide low water yields. Conductivity of these priority aquifers is highly variable, but overall is much higher than areas not underlain by one or more of these principal aquifers. Therefore **the presence or absence of one or more of these principal aquifers** was selected as the indicator of high conductivity aquifer areas.

Factor 2) - Depth to Water Table

Depth to the water table affects the length of time required for a pesticide to reach the groundwater. Since reasonably extensive data on depth to water table is available, **depth to water table is incorporated directly** into the sensitivity analysis.

Factor 3) - Permeability of Materials Overlying Aquifers

The permeability of the materials overlying the aquifer affects the time required for water to reach the groundwater, an important consideration when dealing with chemicals such as pesticides that break down over time. Soil characteristics related to permeability include soil texture, particle size distribution, soil structure, and hydrologic group. The hydrologic group designation describes runoff potential of a soil. Soils with high runoff potential will accordingly have low infiltration potential. Because the hydrologic group designation includes consideration of several factors important in controlling the infiltration rate of a soil, it is felt that it carries more information for an analysis at this scale than other single soil parameters. Therefore, the **hydrologic group designation was chosen as the best available representation of the permeability of materials overlying the aquifers**.

Factor 4) - Recharge Availability

The amount of water available for transport of pesticide to the groundwater is an important consideration in Colorado's semi-arid climate. Average annual precipitation in Colorado's agricultural areas ranges from approximately 7 to 17 inches. Low precipitation, coupled with high evapotranspiration rates, leaves little moisture available for infiltration and subsequent aquifer recharge. Estimates of natural recharge rates in agricultural areas of Colorado are around 10 percent of precipitation or approximately 1 inch/year. Estimates of recharge rates from irrigated agriculture range from 5 to 30 inches/year depending on irrigation type, soil properties, and management. Due to the relative abundance of recharge under irrigated agriculture compared with the limited natural recharge supply in Colorado's climate, **the presence or absence of irrigated agriculture was chosen as an indicator of recharge availability**.

Map Description

A geographic information system (GIS) analysis was conducted to incorporate the data layers into a sensitivity map. A GIS is a computer system that allows comparison and analysis of spatial data layers or "digital maps." Each layer and its respective range of values are shown in Table 1 and were used to develop the sensitivity map.

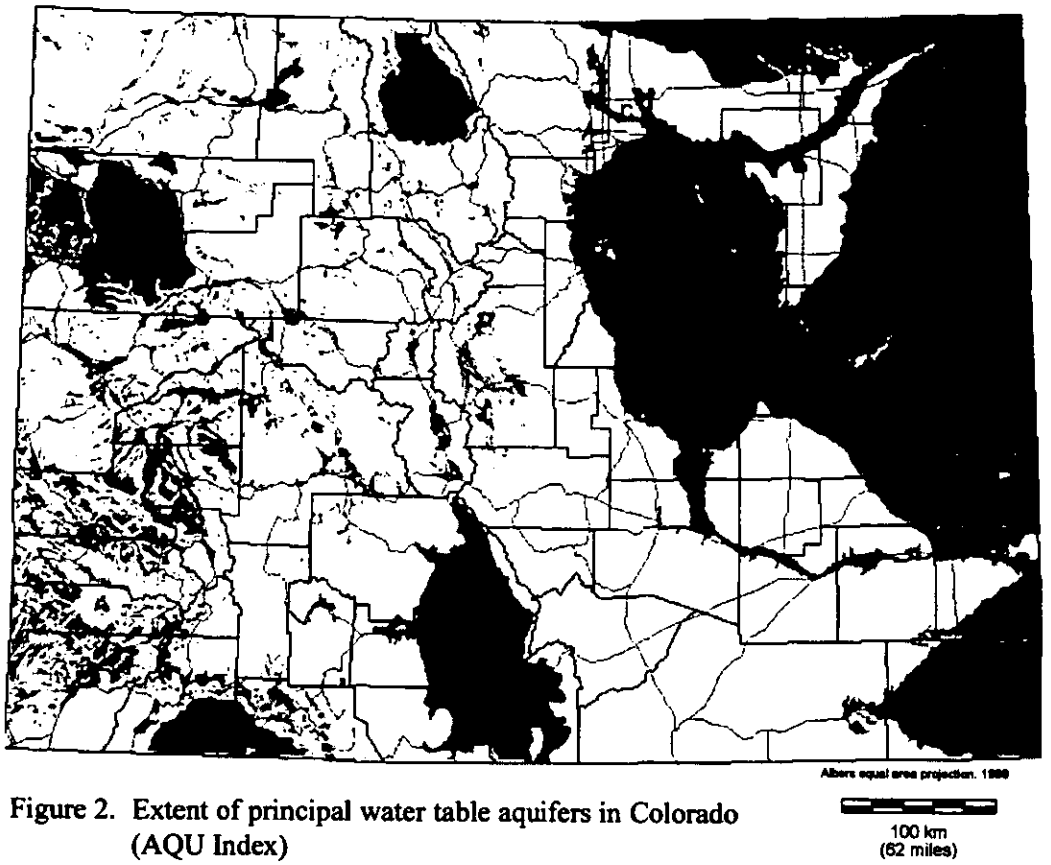


Figure 2. Extent of principal water table aquifers in Colorado (AQU Index)

Aquifer Index

The aquifer map was developed from digitized published reports of aquifer extent or from digitized general geologic maps (figure 2). All areas overlying exposed principal aquifers were assigned a value of 1. Other areas are assigned a value of 0.

Water Table Depth Index

Information on depth to water table was obtained from published reports summarizing water table elevation surveys or from reports of well measurements and well logs. Water table depths were divided into 3 categories for use in sensitivity index calculation (Table 2). The map of the water table depth index is shown in Figure 3.

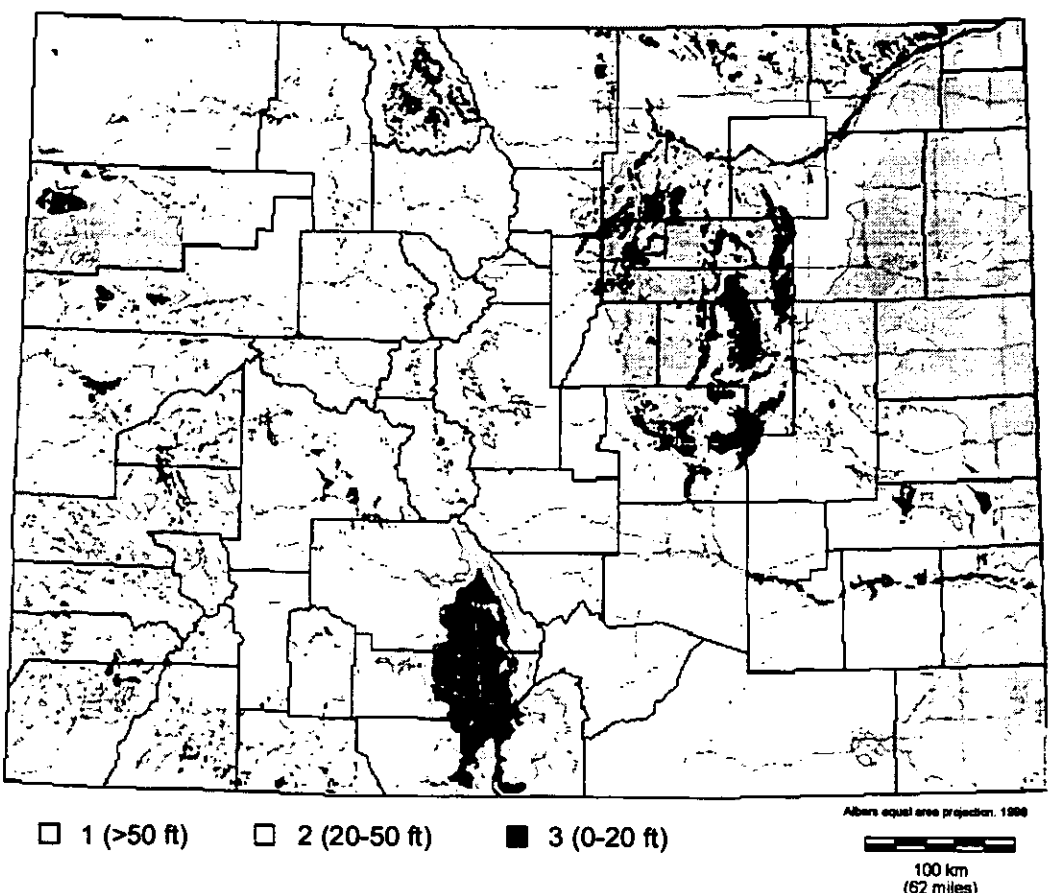


Figure 3. Depth to water table index - (WTD Index)

Table 2. Water table depth index interpretation. (WTD Index)

WTD Index	Depth to Water Table	Interpretation
1	Greater than 50 feet	Low sensitivity
2	20-50 feet	↓
3	0-20 feet	Higher sensitivity

Soil index

Soil map units were reclassified based on their hydrologic group classification. In cases where a single map unit includes soils with different hydrologic group designations, the hydrologic group representative of the majority of land area was selected as most representative of the map unit. The hydrologic groups were assigned numerical indices based on their likelihood to transmit water to underlying groundwater (Table 3). The map of the soil index is shown in figure 4.

Table 3. Relationship of SOIL index to hydrologic groups.

SOIL Index	Hydrologic Group	Infiltration Rates
1	D	Very slow
2	C	Slow
3	B	Moderate
4	A	High

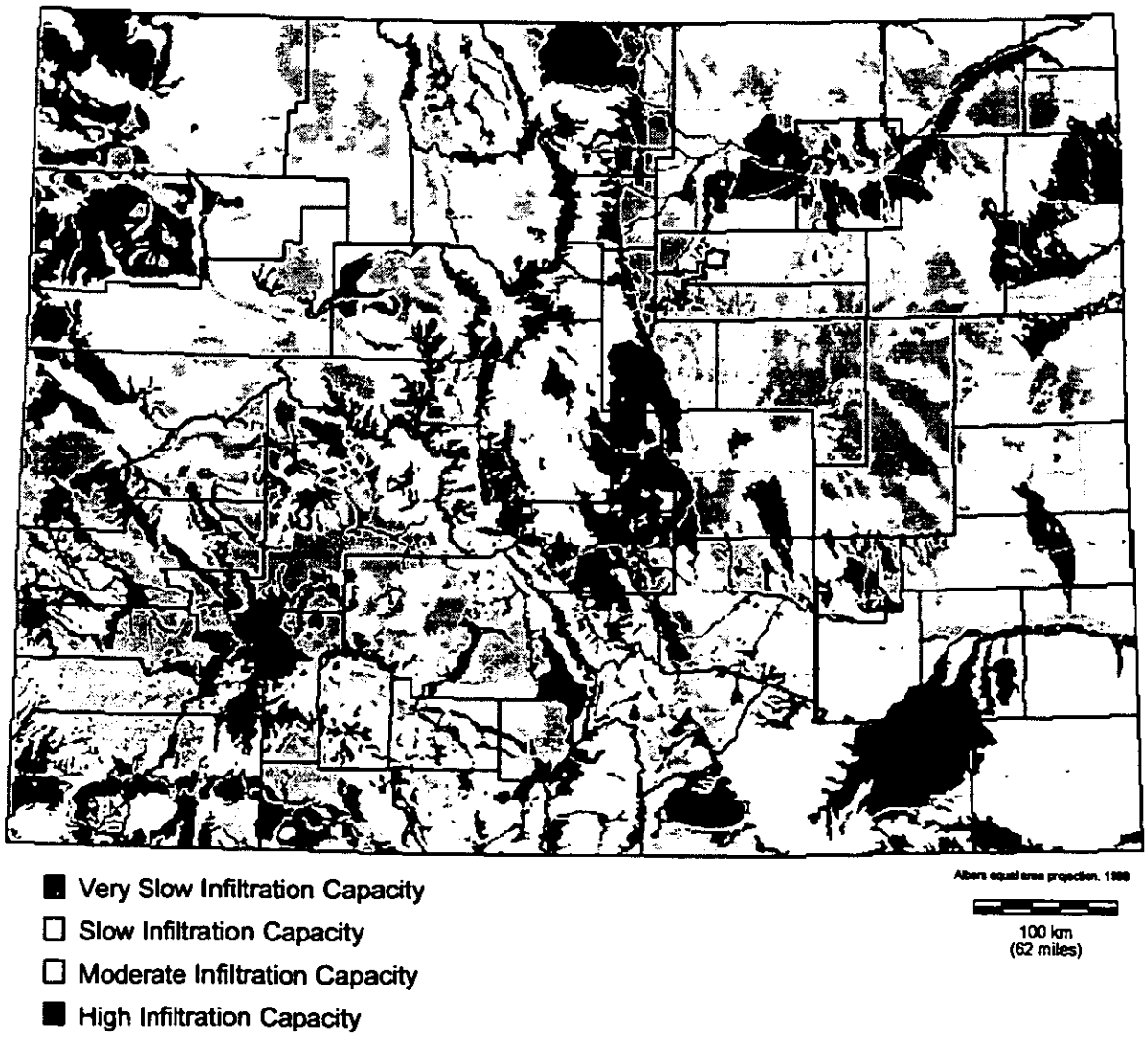


Figure 4. Index of soil infiltration capacity in Colorado - (SOIL Index)

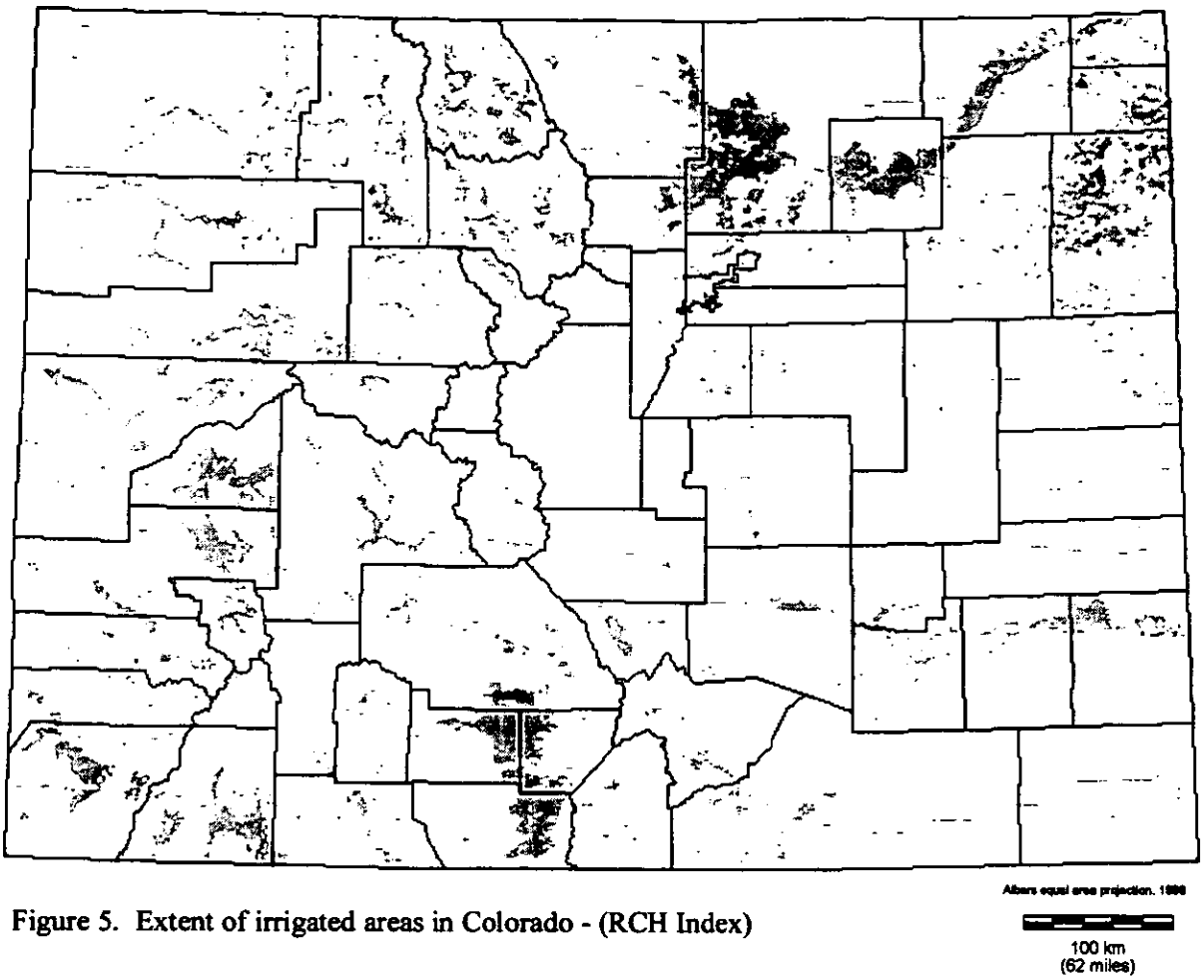


Figure 5. Extent of irrigated areas in Colorado - (RCH Index)

Recharge Index

For the western part of the state within the drainage basin of the Colorado River, location of irrigated lands was obtained from a detailed analysis by the U.S. Bureau of Reclamation. For the remainder of the state, data on location of irrigated lands were obtained from satellite imagery. For calculation of the aquifer sensitivity index, irrigated lands were assigned the value of 1, and non-irrigated lands were assigned to 0. (Figure 5)

Calculation of Aquifer Sensitivity Index (SENSITIVITY)

A sensitivity range was then calculated and scaled to 1 to 4 to obtain the index of SENSITIVITY (Table 4). The map of the SENSITIVITY index is shown in figure 6.

Table 4. Sensitivity index and interpretation.

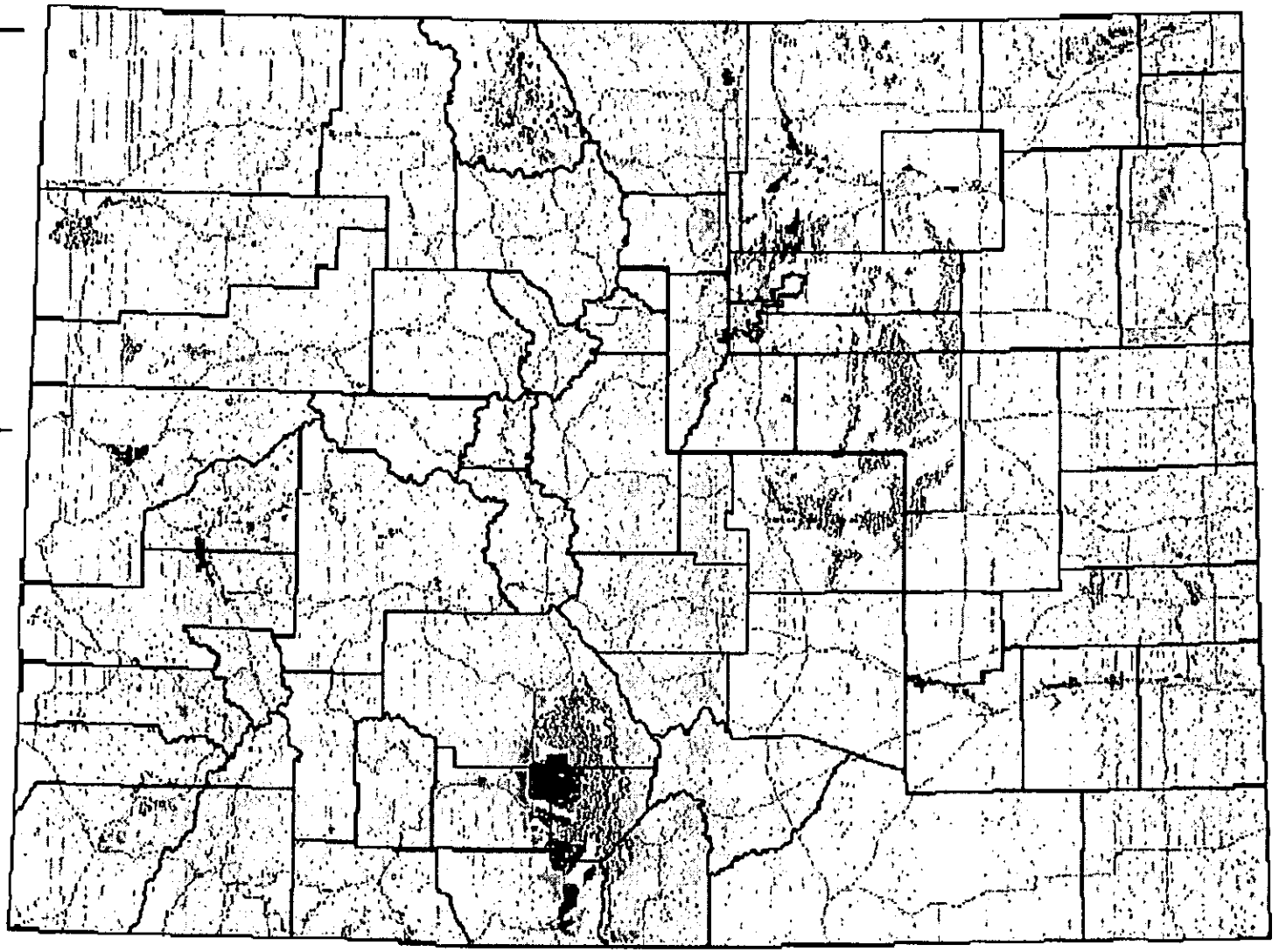
SENSITIVITY Index	Interpretation
1	Area of low recharge and/or aquifer conductivity
2	Low sensitivity
3	Moderate sensitivity
4	High sensitivity

Relative Sensitivity

- Low Sensitivity
- Moderate Sensitivity
- High Sensitivity
- Non-irrigated BUT Shallow Water Table
- Non-irrigated and No Shallow Water Table

IMPORTANT CONSIDERATIONS WHEN USING THIS MAP:

1. Pesticide characteristics are not considered in this analysis.
2. Other areas not identified may also be sensitive to contamination.
3. Map scale precludes use for local planning.
4. Other factors may affect sensitivity and vulnerability of groundwater.



Note: This map is the result of a general statewide analysis and is intended to indicate regional sensitivity of groundwater to contamination from pesticides based only on the physical setting. Crop types, management variables, and pesticide use were not considered in this analysis. **Use of this map for local decisions is not recommended.**

Figure 6. Relative sensitivity of Colorado groundwater to pesticide contamination

Interpretation of the Sensitivity Map

This map was developed with the objective of a regional-scale assessment of groundwater sensitivity to pesticide contamination. The information presented in the maps should be used to support conclusions concerning areas on a minimum scale of tens of miles. Areas that are denoted on the map as having a low sensitivity may contain individual fields overlying small areas of very sensitive groundwater. Additionally, groundwater delineated as having a low sensitivity may be susceptible to contamination if irrigation or pesticide management practices promote leaching.

Sensitivity index values of 1 (green) represent areas that are not irrigated and/or do not overlie highly conductive aquifers. Conversely, sensitivity index values of 4 (red) represent areas where a very shallow water table in a highly conductive aquifer coincide with at least moderately permeable soils that receive irrigation. Additionally, areas with shallow water tables but which are not currently irrigated are also shown on the final analysis map since these areas might merit particular attention if brought under irrigation in the future.

The map is intended as a general guide in identifying areas of the state in which groundwater, due to its hydrologic and geologic setting, is more or less susceptible to contamination from pesticide use. The analysis considers only the hydrogeologic setting. No consideration of actual pesticide use, crop patterns, management practices, etc. was attempted. Therefore, **this analysis should be combined with knowledge of other factors which might contribute to the overall vulnerability of the groundwater resource in development of protection strategies and management plans.**

This report was prepared by Dr. Maurice Hall, Radford University, in cooperation with the Colorado Department of Public Health and Environment, Colorado State University Cooperative Extension, and the Colorado Department of Agriculture.

For more information or copies of the full report on this sensitivity analysis, contact Reagan Waskom of CSU at 970/491-6103, Brad Austin of the Colorado Department of Public Health and Environment at 303/692-3572, or Rob Wawrzynski of the Colorado Department of Agriculture at 303/239-4151.

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION

Fact Sheet #15
April 1998

Reducing Fertilizer Costs By Crediting Irrigation Water Nitrogen

(Results from 1997 Trials)

More than one hundred years ago prospectors came to Colorado searching for valuable resources underground. While the earth beneath the entire state doesn't yield silver or gold, some areas can provide another resource. This resource is "free fertilizer" in the form of nitrate supplied by irrigation wells pumping groundwater. Groundwater monitoring in irrigated areas along the S. Platte River, the Arkansas River, and the San Luis Valley has revealed several locations where over time enough nitrogen (N) as nitrate has accumulated in the groundwater to benefit crop production. Producers using groundwater to supply a significant portion of a field's water may profit by crediting this N when determining their fertilizer rate.

Soil testing to determine correct fertilizer rates and to ensure top yields is an accepted practice for many producers, but testing irrigation wells as a source of N is less common. However, irrigation water containing nitrate can supply considerable amounts of N because it is applied during the growing season and is immediately available for crop uptake, thus potentially reducing the amount of fertilizer required. Situations where fields are irrigated with more than 50% well water that has nitrate concentrations greater than 10 ppm are most likely to benefit. Ditch water generally does not contribute enough nitrate to warrant crediting.

Crediting the N received in irrigation water is a recommended Best Management Practice (BMP) for N management. Additionally, growers that credit N received through their irrigation water are removing nitrate from the groundwater with the crop and improving water quality while reducing their fertilizer needs.

Trial Descriptions

During the 1997 growing season, CSU Cooperative Extension conducted trials to demonstrate and study irrigation water N crediting. Trials were held in four locations in the alluvial portion of the S. Platte River valley in Weld County. The objective of these trials was to compare crop yields where the fertilizer rate has been reduced by accounting for (or crediting) the nitrate supplied from the irrigation groundwater.

To accurately develop N fertilizer recommendations, all field sites were soil sampled to a depth of two to four feet depending upon the crop and situation prior to the growing season. The soils were analyzed using field kits or by the CSU testing lab. The soil and water test results were used to develop N fertilizer recommendations according to each field's yield goal with and without the irrigation water N credited. The following is a summary of the sites:

Location: Platteville
Cooperator: Wes Moser and Sons
Crop: Grain corn
Irrigation source: 100% groundwater

Location: South Gilcrest
Cooperator: Diamond Hill Ag.
Crop: Winter wheat
Irrigation source: 100% groundwater

Location: North Gilcrest
Cooperator: Glen Fritzler
Crop: Silage corn
Irrigation source: 50% groundwater

Location: LaSalle
Cooperator: Local producer
Crop: Grain corn
Irrigation source: 70% groundwater (assumed)

Site	Fertilizer Applied	Yield/acre
Platteville Corn	0 lb N + Amisorb*	140 bu
	40 lb N-no Amisorb	147 bu
	40 lb N + Amisorb	146 bu
	80 lb N + Amisorb	140 bu
	Turkey Compost (14 Tons/A) + Amisorb	144 bu
Gilcrest Wheat	60 lb N	53 bu
	30 lb N	51 bu
Gilcrest Silage	0 lb N	27 ton
	90 lb N	34 ton
	180 lb N	32 ton
LaSalle Corn	90 lb N	192 bu
	160 lb N	228 bu

*Amisorb is a nutrient uptake enhancement product.

Irrigation water was sampled and analyzed for nitrate throughout the irrigation season at each site. The amount of irrigation water applied was measured using furrow flumes and rain gauges (sprinkler sites) to determine cumulative water and nitrogen additions. The following table is a summary of the N credited and received from the irrigation water.

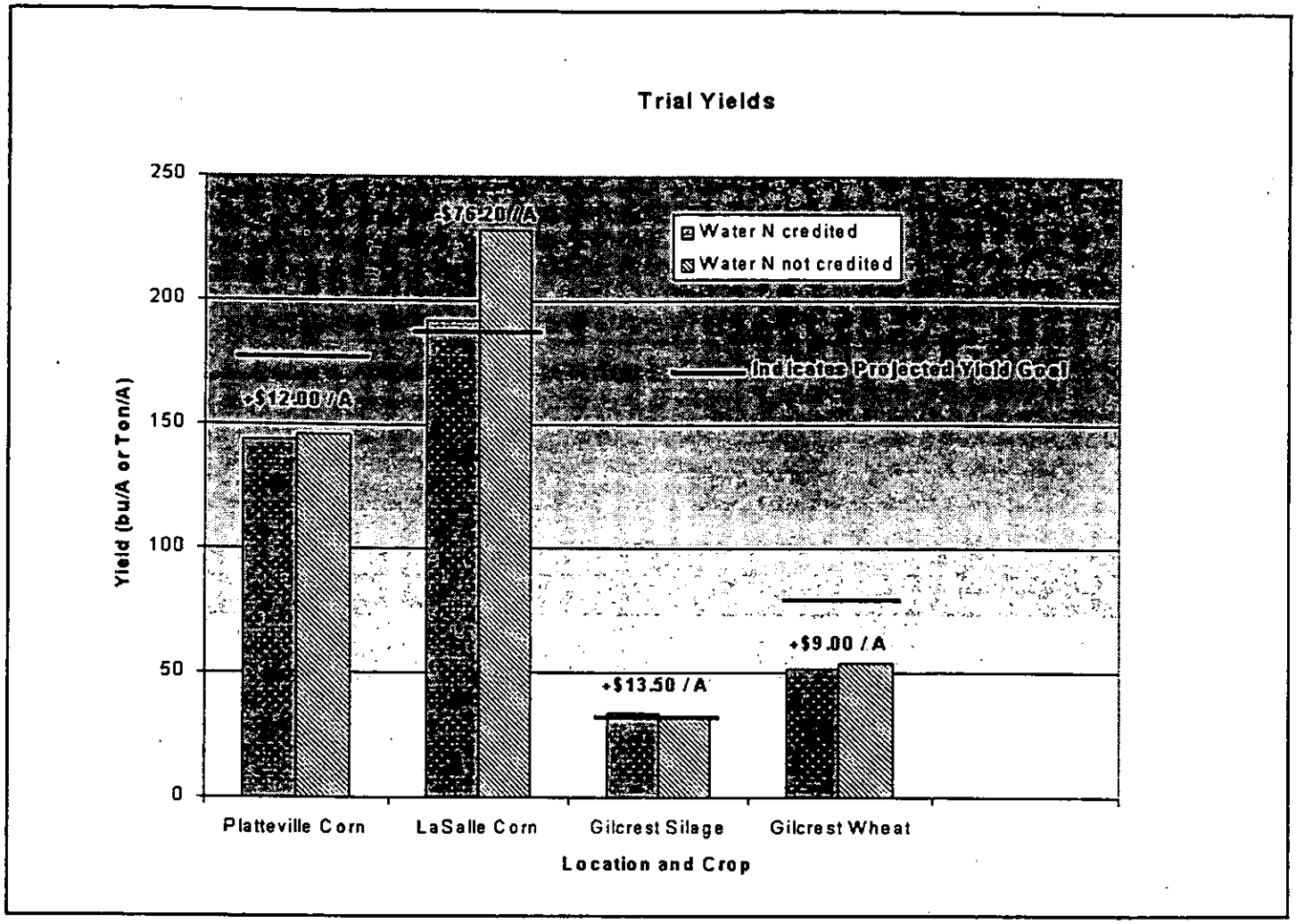
N credited and received from irrigation water

	Site			
	Platteville	Gilcrest Silage	Gilcrest Wheat	LaSalle Corn
	lb N/Acre			
Projected N Credit	40	45	30	50
Actual N Received	120	45	40	18
Made credit?	Yes	Yes	Yes	No

Crop nitrogen sufficiency was monitored throughout the growing season using a Minolta chlorophyll meter. Grain and silage yields were obtained from both hand and mechanical harvesting methods. A weigh wagon and portable load scales were used to weigh grain harvested from trials.

Trial Results

The following figure illustrates that there was no statistically significant yield reduction by cutting-back on the N applied at three of the four sites. At the LaSalle corn site there was a reduction in the yield. The producer thought the field would receive 70% of its water from his well when the fertilizer rate was determined. However, ditch water was abundant during 1997 and the field was only irrigated with ditch water that had nitrate concentrations 75% lower than the well water. Therefore, only 18 of the 50 lb nitrogen per acre credited to the irrigation was applied to the field. The 180-bu projected yield goal was achieved as illustrated by the horizontal lines across the bar graph, but the corn did respond favorably to additional N fertilizer.



At the other three sites where the water credit was met (see above chart), the strips had comparable yields. Additionally, no significant N deficiency was detected with the chlorophyll meter between the strips where the water was and wasn't credited.

The positive or negative dollar figure provided above each set of bars is the per acre return on crediting the N from irrigation water. When the field received the full amount of N from the irrigation water that was estimated before the growing season, there was a net gain of $9.00 to $13.50 per acre in fertilizer savings. Overall, the results from 1997 trials verified that crediting N received in irrigation water during the growing season is a sound economic and agronomic practice. When properly used, growers can maintain yields, reduce fertilizer costs and help clean up groundwater.

However, the trial results also show that growers should be cautions when crediting N from fields with only supplemental water supplied from groundwater. Wells that are only used in dry years should not be counted upon to supply N to a crop.

Because profit margins in irrigated agriculture continue to shrink, growers using groundwater containing nitrate should seriously consider implementing this BMP to improve their bottom line. The next page provides detailed information on how to start using this BMP.

Using Irrigation N Crediting on Your Farm

Implementing this BMP on your farm requires two important pieces of information:

1. *The nitrate-nitrogen content of the irrigation well water (reported as ppm NO_3-N)* :

- Direct analysis of well water by field test kits or laboratories is the only reliable way to accurately determine nitrate content. A nitrate test from a commercial lab generally costs about $10.00 to $20.00.

2. *An estimate of the amount of water to be applied when the crop is taking up the majority of its N:*

- Historical consumptive use, often referred to as evapotranspiration (ET), values can be used to estimate the amount of water that can be credited. However, most of the N required for optimum yields is taken up during the vegetative growth stages of the growing season. Therefore, you cannot credit all of the N in water applied for the whole season. You should only credit about 70% of seasonal ET (about 16 inches) for corn, and only credit water applied before tuberization for potatoes. Local NRCS personnel, water districts, or Cooperative Extension offices can provide local values for crop water use (ET) for your area. With this information, multiply the NO_3-N content of the water by 2.7 (a conversion factor) by the acre feet of water or use the formula below to obtain the amount of N to credit.

In the example below, 36 pounds of N can potentially be subtracted from the recommendation determined by soil testing and yield goal. Remember that reducing a fertilizer rate by crediting the N applied from irrigation water should not be practiced without using soil testing to initially determine a crop's N needs. It also may be wise to test this practice on a few strips or a portion of a field before cutting back N fertilizer applied over a large acreage.

For more information contact Troy Bauder with the CSU Cooperative Extension at (970) 491-4923.

An example situation:

- ✓ Crop: corn
- ✓ Water supply: 60% well (groundwater), 40% ditch
- ✓ Well test results: 18 ppm NO_3-N
- ✓ Seasonal consumptive use for corn in the area is 21 inches of water
- ✓ Inches of water to credit: 21 inches ET x 70% of seasonal (.70) x 60% by well (.60) = 9 inches

Calculation:

$$\text{NO}_3\text{-N in water (ppm)} \times 2.7 \text{ lbs N per acre foot} \times \frac{\text{inches water to credit}}{12 \text{ inches/acre foot water}}$$

$$18 \text{ NO}_3\text{-N (ppm)} \times 2.7 \times \frac{9 \text{ inches water to credit}}{12 \text{ inches/acre foot water}} = 36 \text{ lbs N/A}$$

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APPENDIX II

1998 Annual Report
Colorado State University Cooperative Extension

Summary of Accomplishments:

- Conducted educational programs throughout Colorado on SB 90-126 and issues related to agricultural chemicals and groundwater quality. Groups addressed include commercial applicators, chemical dealers, weed districts, crop consultants, crop and livestock producers, agency personnel, and urban chemical users.

- Conducted training related to the Colorado Best Management Practice Manual. Distributed booklets to Colorado citizens covering nutrient, pesticide, irrigation, manure, and water well management.

- Developed and published a factsheet on N management BMPs entitled (Appendix I):
  Reducing Fertilizer Costs By Crediting Irrigation Water Nitrogen

- Developed and published a factsheet on aquifer sensitivity entitled (Appendix I):
  Relative Sensitivity of Colorado Groundwater to Pesticides

- Conducted a statewide survey of irrigated crop producers to determine status of BMP adoption by farmers. This survey was sent to approximately 3300 producers with irrigated acreage statewide. The information from the 41% of respondents was tabulated and studied to identify progress in the SB 90-126 program and areas needing more effort.

- Worked on the Certified Crop Advisors Program in Colorado; including rewriting the state performance objectives and the state exam and representing Colorado at the National Advisory Board.

- Maintained a CSU Extension Water Quality Website to disseminate BMP information via the internet.

- Developed a focused program to work on education and demonstration projects with farmers in the South Platte River Basin, a high priority watershed for SB 90-126 efforts. This work included farmer demonstrations to show the benefits of crediting N received through irrigation water and working on nutrient management under manured conditions.

- Continued a program to monitor nutrient runoff from high altitude golf courses.

- Cooperated on a field project to evaluate nutrient management on fields receiving swine effluent applications.

- Worked with four local groups in Colorado to develop and disseminate localized BMP guidelines for groundwater protection. The local group in the San Luis Valley published

their findings in two booklets entitled: "Best Management Practices for Potato Pest Management in the San Luis Valley" and "Best Management Practices for Small Grain Pest Management in the San Luis Valley. The local group in the Montrose area headed by the Shavano Soil Conservation District developed and published practices appropriate for the West Slope in a booklet entitled: "Best Management Practices for the Lower Gunnison Basin". A newly established local BMP group in the lower South Platte River Basin began developing practices appropriate for that region.

- Distributed a series of four factsheets to educate Colorado homeowners on BMPs for urban pesticide and fertilizer use. These factsheets are entitled:
  Homeowner's Guide to Protecting Water Quality and the Environment
  Homeowner's Guide to Pesticide Use Around the Home and Garden.
  Homeowner's Guide: Alternative Pest Management for the Lawn and Garden.
  Homeowner's Guide to Fertilizing Your Lawn and Garden.

- Published a booklet of BMPs specifically for greenhouse growers in Colorado entitled:
  Pollution Prevention for Colorado Greenhouses (Appendix I)

- Re-printed and distributed a pocket-sized record keeping book for private pesticide applicators to help them keep track of chemical use and learn about BMPs. (Appendix I)

- Cooperated with county Extension agents on nutrient management demonstrations on farmer fields and conducted manure management field days in eastern Colorado to discuss proper nitrogen, manure, and water management practices.

- Produced newsletter articles, press releases, fact sheets, technical papers, radio and other mass media articles on groundwater protection in Colorado.

- Distributed a 20 minute instructional video entitled "Best Management Practices for Colorado Agriculture".

- Worked to coordinate efforts of the Agricultural Chemicals and Groundwater Protection program with other state and federal programs in Colorado.

- Assisted the Colorado Department of Agriculture in the implementation of the Bulk Storage Regulations and the development of the generic State Management Plan. Contracted with a private consultant to prepare a protocol for developing a Colorado groundwater sensitivity map.

BMP Development

Colorado State University Cooperative Extension is working with the Colorado Department of Agriculture to develop Best Management Practices for Colorado farmers, land owners, and commercial agricultural chemical applicators. The chemical user because of the site-specific nature of groundwater protection must ultimately determine the BMPs adopted for use at the local level. The local perspective is also needed to evaluate the feasibility and economic impact of these practices. The SB 90-126 Advisory Committee has recommended that a significant level of input be received at the local level prior to adoption of recommended BMPs.

Colorado State University Cooperative Extension has compiled a broad set of BMPs encompassing nutrient, pest, and water management which will be used as a template for local committees. These documents were published in a notebook form in 1995 that are updated as needed and expanded to include additional guidelines.

Cooperative Extension has piloted the local BMP development process in the San Luis Valley and in the front range area of the South Platte Basin. The local working committees consist of a small group of producers, consultants, and chemical applicators. The San Luis Valley group has produced a set of BMPs appropriate for their area which are being publicized and will be implemented by cooperating farmers in field scale demonstrations. The South Platte group is working towards consensus in a very complex farming region. Both of these groups have produced BMPs for nutrient and irrigation management - the most serious problem in their respective areas. They are now working on pest and pesticide management BMPs for specific crops. A local BMP group was formed in 1995 in the Montrose/Delta area. The Shavano SCD worked with local Extension agents and producers to develop a set of practices appropriate for the West Slope entitled "Best Management Practices for the Lower Gunnison Basin". During 1996, a fourth local BMP work group was initiated in the lower South Platte Basin. They published their findings in a bulletin entitled "Best Management Practices for the Lower South Platte River Basin."

Field Demonstrations

Colorado State University Cooperative Extension has worked with the USDA Agricultural Research Service and farmers on field research and educational plots to demonstrate improved nitrogen, manure, and irrigation management techniques. New production tools are being evaluated and demonstrated to farmers which may improve producer profitability and help protect groundwater.

Field trials are held on farm fields in Colorado to demonstrate BMPs. Educational field days are held at these sites to acquaint other producers and interested parties with the need for groundwater protection. Farmers are shown BMP's related to nutrient and irrigation management.

A technology known as in-season nitrate testing is demonstrated to farmers on strip trials on their farms. This tool may help farmers improve N recommendation accuracy and minimize the use of "insurance" N fertilizer. By complementing preplant soil testing with in-season testing, it may be

possible to improve N fertilizer requirement prediction accuracy, resulting in reduced leaching of nitrate to groundwater. Quick soil test kits for nitrate have been developed that allow "field testing," thereby alleviating the problem of slow turn-around time in commercial soil testing laboratories. The development of these quick test kits has made the in-season nitrate test a viable soil testing procedure for assessing the N fertility status of crops at any growth stage. It is expected that this will result in the joint use of preplant deep soil nitrate testing and in-season testing which will increase the accuracy of N fertilizer recommendations. The total application of N fertilizer can be decreased without negatively affecting crop yields as farmers adopt this improved technology.

Other production tools being evaluated and demonstrated to farmers include the portable chlorophyll meter to access N status of growing plants and surge irrigation valves to help decrease irrigation water runoff and leaching.

APPENDIX III

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Division
Ag Chemicals Program

Executive Summary

The Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) has responsibility under the Agricultural Chemicals and Ground Water Protection Program (SB 90-126) to conduct monitoring for the presence of commercial fertilizers and pesticides in ground water. This data assists the Commissioner of Agriculture in determining whether agricultural operations are impacting ground water quality.

In 1998, the program began a regional groundwater quality baseline study for the West Slope region of Colorado. The West Slope of Colorado includes all of Colorado west of the continental divide. The majority of the ground water sampled on the west slope occurs along stream and river valleys in alluvial deposits with some local aquifers on the larger mesas. The agriculture in this region is dominated by ranching with associated hay production. Ninety samples have been collected to date with future additions planned. All sample points to date are existing wells that are privately owned and permitted as domestic wells. Nitrate analysis showed only one well exceeded the nitrate drinking water standard of 10 mg/L. Pesticide data revealed one well containing the pesticide Malathion.

In addition to monitoring ground water for the presence of agricultural chemicals, the Ag Chemicals Program is required to determine the likelihood that an agricultural chemical will enter the ground water. This type of determination has been described as a vulnerability analysis. In June 1998, the Program completed a contracted project with Dr. Maurice Hall of Radford University to develop a statewide sensitivity analysis for Colorado. The sensitivity mapping project provides a standard method to determine aquifer sensivity to pesticide contamination statewide. Upon completion of the next phase, the addition of the vulnerability factors, the program will be able to determine groundwater vulnerability to agricultural chemicals statewide. Results will be evaluated and incorporated into a standard method to delineate those areas of the state were ground water is vulnerable to contamination from agricultural chemicals. This effort will become a key element of the State Management Plan for pesticides implemented under the Federal Insecticide, Fungicide, and Rodenticide Act.

Bradford Austin CDPHE

Introduction

The Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) has responsibility under the Agricultural Chemicals and Ground Water Protection Program (SB 90-126) to conduct monitoring for the presence of commercial fertilizers and pesticides in ground water. The Agricultural Chemicals Program has been established to provide current, scientifically valid, ground water quality data to the Commissioner of Agriculture. Prior to passage of SB 90-126, a lack of data had prevented an accurate assessment of impacts to groundwater quality from agricultural operations. This program will assist the Commissioner of Agriculture in determining to what extent agricultural operations are impacting ground water quality. The program also assists the Commissioner in identifying those aquifers that are vulnerable to contamination. The philosophy adopted is to protect ground water and the environment from impairment or degradation due to the improper use of agricultural chemicals, while allowing for their proper and correct use.

This report has been prepared to provide a summary of the work completed in 1998. The monitoring program involves the collection and laboratory analysis of ground water samples. This monitoring program was planned to meet the objectives necessary for a preliminary determination of the existence of agricultural chemicals in the ground water in a safe, cost effective, and timely manner.

The ground water quality sampling program is intended to fulfill the following objectives:

1. Determine if agricultural chemicals are present in the ground water.
2. Provide data to assist the Commissioner of Agriculture in the identification of potential agricultural management areas.

The factors considered in selecting an area for monitoring are:

1. Agricultural chemicals are used in the area.
2. The ground water in the area is shallow in depth or vulnerable.
3. The majority of the agricultural chemical use is on irrigated land.
4. The soil types are conducive to leaching.
5. The alluvial and /or shallow bedrock aquifers are utilized for domestic water supplies.

Before an area is selected for monitoring, CDPHE will contact interested parties to inform them of the sampling program and SB 90-126, and how we envision its implementation. CDPHE will coordinate closely with federal agencies, county extension agents, conservancy districts, and local health officials in the project area.

Ground Water Monitoring Program

West Slope of Colorado

The 1998 monitoring program began a regional groundwater quality baseline study for the western slope of Colorado. The West Slope of Colorado includes all of Colorado west of the continental divide. However, this monitoring program excluded the central core of the Rocky Mountains where the land use is predominately National Forest. The majority of the ground water sampled on the west slope occurs along stream and river valleys in alluvial deposits with some local aquifers on the larger mesas. No single aquifer underlies this area, therefore this survey differs from past work that tended to focus on a single regional aquifer. The agriculture in this region is dominated by ranching with associated hay production. Dry land wheat in Moffat County, corn in the tri river area, dry beans in Montezuma County, and the fruit and vineyards of Mesa County are the exceptions.

Ninety samples have been collected to date with future additions planned (Figure 1). All samples were collected from existing wells that are privately owned and permitted as domestic wells. The samples were analyzed for nitrate and 45 pesticides. Preliminary analysis of the nitrate and pesticide data indicates that ground water in the majority of the area sampled has not been adversely impacted by current agricultural practice. The major inorganic contaminant of concern in this area is nitrate. Nitrogen analysis indicated that 36% of the wells tested for a level of nitrate- nitrite as nitrogen below the laboratory detection limit of 0.5 mg/L (parts per million). Sixty three (63 %) percent of the wells tested in the range of 0.5 to 9.9 mg/L, indicating nitrogen present but below the drinking water standard of 10 mg/L. Only one well exceeded the nitrate drinking water standard of 10 mg/L, with a test result of 32.0 mg/L. This well was located in Moffat County, north of Craig. The drinking water standard is used as a benchmark for nitrate levels in all wells regardless of use. Pesticide data revealed one well testing positive for the pesticide Malathion at 0.23 ug/L (part per billion) with a detection limit of 0.1 ug/L. This well was located in Montrose County, west of Montrose.

Well samples were analyzed for basic water quality constituents, nitrate, and selected pesticides. The basic inorganic analysis was performed by the Soils Laboratory at CSU. The Colorado Department of Agriculture, Standards Laboratory performed the laboratory analysis for nitrate as nitrogen and selected pesticides. The complete analysis performed on all samples, along with laboratory methods and reporting limits for each analyte is presented in Table 2. Temperature, conductivity, and total dissolved solids were measured in the field.

The monitoring program included sample collection, laboratory analysis, and data analysis and storage. Upon completion of the sampling and a full analysis, which should include integration with previous and current studies by other agencies, the resulting sampling program will provide the basis for determining a groundwater quality baseline for this region.

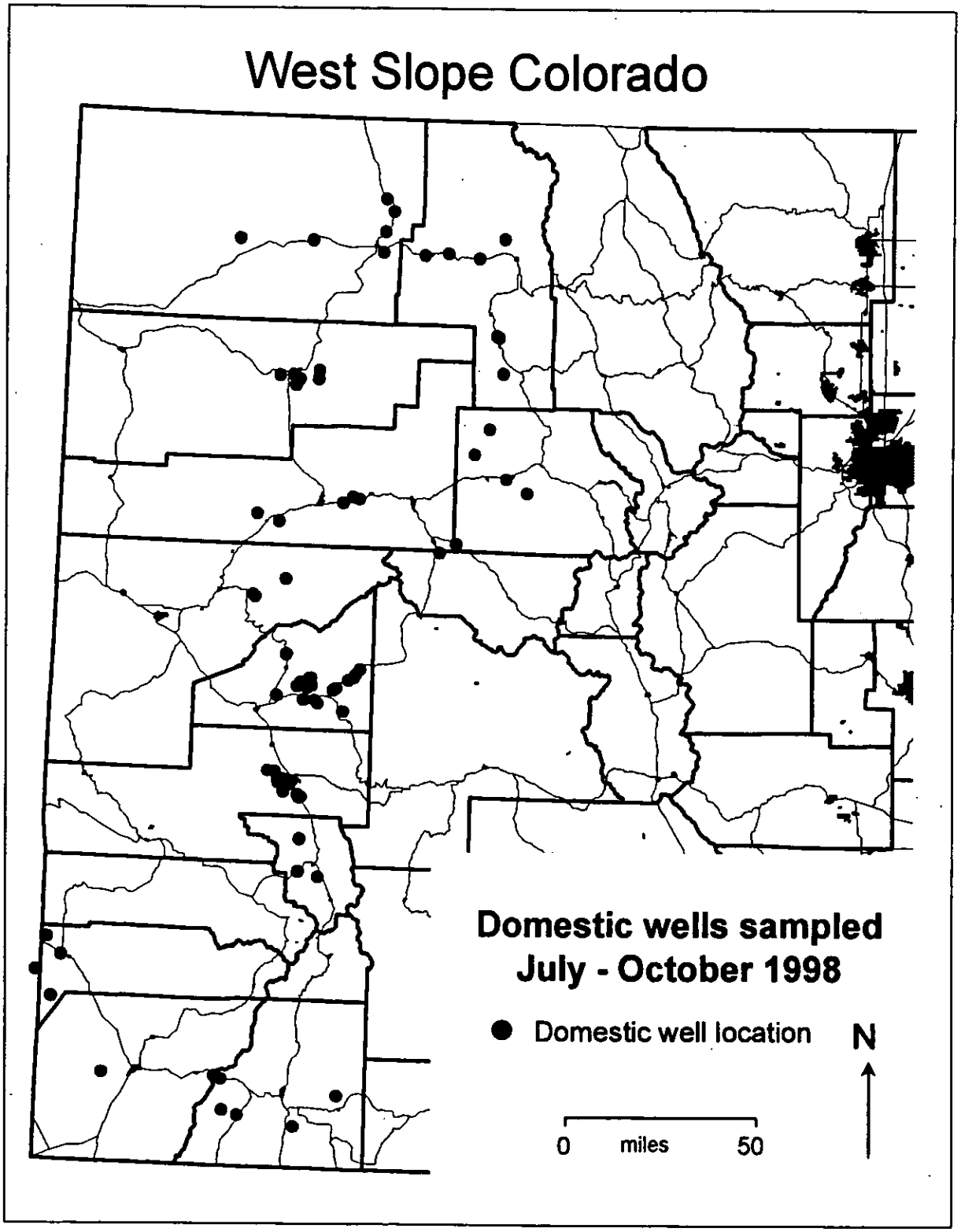

FIGURE 1 - Study area and sampling locations. Map showing the West Slope of Colorado study area and well locations sampled in 1998.

The results from this sampling program have been entered into the CDPHE Groundwater Quality Data System maintained at CDPHE. A detailed report describing the area sampled, the protocol for sampling and analysis, and the results of the analysis will be provided to the Commissioner of Agriculture upon completion of the analysis.

Weld County Long Term Monitoring

Nineteen ninety eight was the fourth year of a long term monitoring effort initiated in the South Platte alluvial aquifer from Brighton to Greeley. The long term monitoring network was established in 1995 and is a combination of three types of wells previously sampled in the area (Figure 2). The long term monitoring network consists of 19 monitoring wells operated by the Central Colorado Water Conservancy District, 60 irrigation wells sampled in 1989, 1990, 1991, 1994, 1995, 1996, and 1997, and 18 domestic wells sampled in 1992 and 1995.

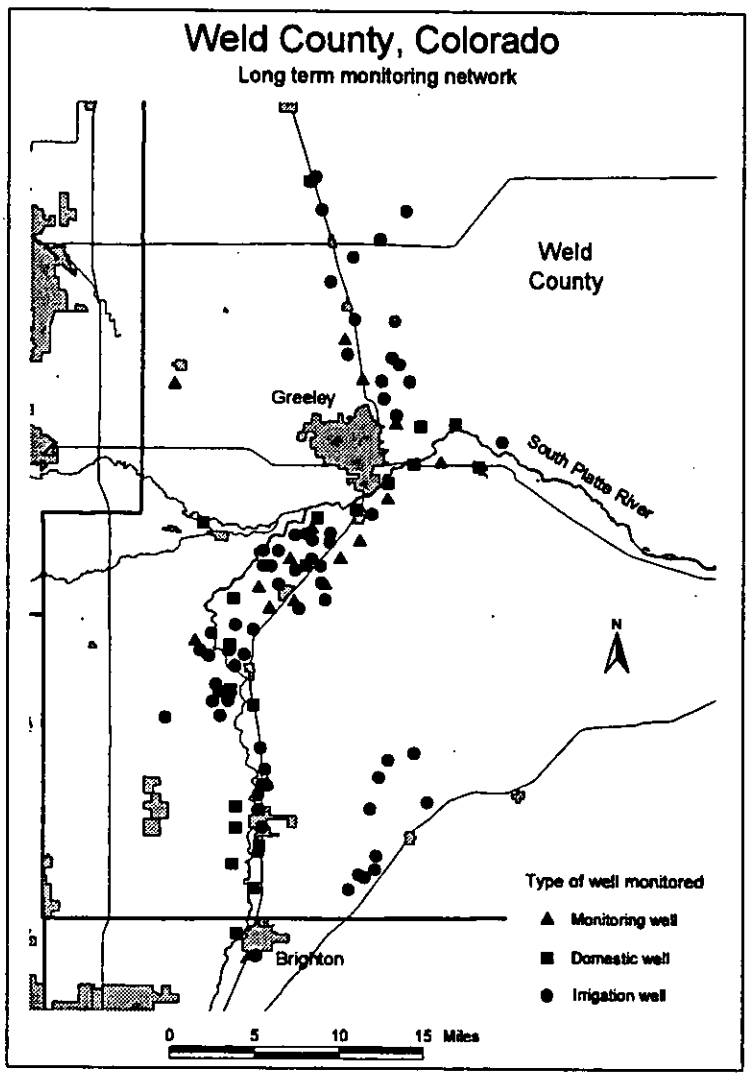

FIGURE 2 - Location and type of wells comprising the Weld County long term monitoring network.

From June through August, 1998, 94 wells in the long term network were sampled. All wells were analyzed for nitrate-nitrite as nitrogen. The 19 monitoring wells and 18 domestic wells were analyzed for the complete suite of 45 pesticides listed in Table 2. The pesticide analysis for the irrigation wells was a immuno assay screen for the triazine herbicides.

Nitrogen analysis indicated that 79% of the monitoring wells, 44% of the domestic, and 73% of the irrigation wells exceeded the nitrate drinking water standard of 10 mg/L. In the monitoring wells, nitrate levels ranged from a low of 3.0 mg/L nitrate as nitrogen to a high of 88.0 mg/L. The range of values for the eighteen domestic wells was from a low of 1.0 mg/L to a high of 45.0 mg/L. In the irrigation wells, nitrate levels ranged from below our detection level of 0.5 mg/L nitrate as nitrogen to a high of 33.9 mg/L (Table 1).

Pesticide data revealed four pesticides, Atrazine, Metolachlor, Metalaxyl, and Prometone present in the monitoring well samples. The breakdown products of Atrazine, Deethyl Atrazine and Deisopropyl Atrazine were also detected. Atrazine was present in 37% of the wells, Deethyl Atrazine in 53% of the wells, Metolachlor in 32% and Prometone in 26%. Metalaxyl was detected in two wells (11%), and the level of Metalaxyl reached 13.6 ug/L (ppb) in one well. There is currently no standard established for Metalaxyl. The breakdown product Deisopropyl Atrazine was detected in one well. Detection levels for the other pesticides averaged less than 0.5 ug/L (ppb).

The triazine herbicide screen used on the irrigation wells detects any pesticide in this family, which includes Atrazine, Simazine, Cyanazine, Deethyl Atrazine, and Prometone. The results are calibrated in units of Atrazine equivalent but may be actually composed of one or more of the components. In 1998, triazine herbicides were detected in 91% of the irrigation wells. Levels ranged from 0.05 ug/L to 1.18 ug/L (ppb).

The monitoring wells in Weld County were sampled in cooperation with the Central Colorado Water Conservancy District in June 1998 by Randy Ray of Central and Brad Austin of CDPHE. John Colbert, of CDPHE, sampled the irrigation wells in Weld County in July and August 1998. All West Slope sampling was performed by Brad Austin, July through October, 1998. Field sampling procedures followed the protocol developed by the ground water Quality Monitoring working group of the Colorado nonpoint task force.

TABLE 1 - Summary statistics for the Weld County nitrate monitoring results, 1998.

	Monitoring wells	Domestic wells	Irrigation wells
Mean	24.5	12.9	15.8
Median	21.6	8.1	15.5
Standard Deviation	19.77	12.69	8.85
Minimum	3	1	< 0.5
Maximum	88	45	33.9
# wells sampled	19	18	56

Note: all values (except # wells) are nitrate-nitrite as nitrogen in mg/L (parts per million).

Table 2 - Laboratories, Methods and Detection Levels

Colorado Department of Agriculture Standards Laboratory

PESTICIDE ANALYSIS

Pesticide Trade Name	Pesticide Common Name	Pesticide Use	Chemical Type	EPA Method	MDL (ug/L)
Harness	Acetachlor	Herb	acetoalinide	525.1	0.1
Lasso	Alachlor	Herb	OrganoCL	525.1	0.1
AAtrex	Atrazine	Herb	Triazine	525.1	0.1
	Deethyl Atrazine		Triazine	525.1	0.2
	Deisopropyl Atrazine		Triazine	525.1	0.2
Balan	Benfluralin	Herb	OrganoFL	525.1	0.2
Hyvar	Bromacil	Herb	uracil	525.1	0.4
Captane	Captan	Fungi	carboximide	525.1	1.4
Lorsban	Chlorpyrifos	Insect	OrganoPH	525.1	0.1
Bladex	Cyanazine	Herb	Triazine	525.1	0.2
Dacthal	DCPA	Herb	phthalic acid	525.1	0.1
Dazzel	Diazinon	Insect	OrganoPH	525.1	0.2
Barrier	Dichlobenil	Herb	nitrile	525.1	0.1
Cygon	Dimethoate	Insect	OrganoPH	525.1	0.5
	p,p-DDT	Insect	OrganoCL	525.1	0.4
	Endrin	Insect	OrganoCL	525.1	0.3
	Heptachlor	Insect	OrganoCL	525.1	0.6
	Heptachlor epoxide	Insect	OrganoCL	525.1	0.8
Velpar	Hexazinone	Herb	Triazine	525.1	0.1
Gamma-mean	Lindane	Insect	OrganoCL	525.1	0.1
Malathion	Malathion	Insect	OrganoPH	525.1	0.1
Ridomil	Metalaxyl	Fungi	acylalanine	525.1	0.2
Marlate	Methoxychlor	Insect	OrganoCL	525.1	0.9
Dual	Metolachlor	Herb	acetamide	525.1	0.1
Sencor	Metribuzin	Herb	Triazine	525.1	0.5
Prowl	Pendimethalin	Herb	dinitroaniline	525.1	1.2
Primatol	Prometon	Herb	triazine	525.1	0.1
Princep	Simazine	Herb	triazine	525.1	0.2
Treflan	Trifluralin	Herb	OrganoFL	525.1	0.3
Weed B Gone	2,4-D	Herb	PhenoxyAcid	515.2	0.2
Banvel	Dicamba	Herb	BenzoicAcid	515.2	0.1
Kilprop	MCPP	Herb	PhenoxyAcid	515.2	2.0
Agritox	MCPA	Herb	PhenoxyAcid	515.2	2.0
Tordon	Picloram	Herb	PicolinicAcid	515.2	0.35

Table 2, continued - Laboratories, Methods and Detection Levels

Colorado Department of Agriculture Standards Laboratory

PESTICIDE ANALYSIS

Pesticide Trade Name	Pesticide Common Name	Pesticide Use	Chemical Type	EPA Method	MDL (ug/L)
Temik	Aldicarb	Insect	Carbamate	531.1	1.0
	Aldicarb sulfone		Carbamate	531.1	2.0
	Aldicarb sulfoxide		Carbamate	531.1	2.0
Sevin	Carbaryl	Insect	Carbamate	531.1	2.0
Furadan	Carbofuran	Insect	Carbamate	531.1	1.5
	3-Hydroxycarbofuran		Carbamate	531.1	2.0
	Methiocarb	Insect	Carbamate	531.1	4.0
Lannate	Methomyl	Insect	Carbamate	531.1	1.0
	1-Naphthol		Carbamate	531.1	1.0
DPX	Oxamyl	Insect	Carbamate	531.1	2.0
Baygon	Propoxur	Insect	Carbamate	531.1	1.0

INORGANIC ANALYSIS

	EPA Method	MDL (mg/L)
Nitrate/Nitrite as N	300	0.5

Colorado State University Soil, Water, and Plant Testing Laboratory

ROUTINE WATER ANALYSIS

Basic Water Quality Parameters (mg/L)	Method	Reporting Limit
Boron	EPA 200.0	0.01
Bicarbonate	APHA 2320B	0.1
Calcium	EPA 200.0	0.1
Carbonate	APHA 2320B	0.1
Chloride	EPA 300.0	0.1
Magnesium	EPA 200.0	0.1
Nitrate	EPA 300.0	0.1
pH	EPA 150.1	0.1 pH unit
Sodium	EPA 200.0	0.1
Specific conductance (TDS)	EPA 120.1	1.0 uS/cm
Sulfate	EPA 300.0	0.1
Potassium	EPA 200.0	0.1
Alkalinity, total	Titration	1.0
Solids, Total Dissolved	Gravimetric	10.0
Hardness, total as $CaCO_3$	Calculation	1.0

Aquifer Vulnerability Study Summary

In addition to monitoring ground water for the presence of agricultural chemicals, the Ag Chemicals Program is required to determine the likelihood that an agricultural chemical will enter the ground water. This determination is based upon the chemical properties of the chemical in question, the behavior of a particular chemical in the soil types of the region under study, the depth to ground water, the farming practices in use, and other factors. This type of determination has been described as a vulnerability analysis.

In the process of writing the generic State Management Plan for Pesticides (SMP), the staff at CDPHE, CDA, and CSU has studied various types of vulnerability analysis. The goal has been to satisfy the requirements of the SMP and SB 90-126, while remaining within the confines of existing staffing, organization and budget. In early 1996, a project was contracted to conduct a limited test of a aquifer sensitivity method in the northeastern section of the state. The results of this pilot project were evaluated by CDPHE, CDA, CSU, and USEPA and approved for use throughout the state. The Program expanded this effort statewide in 1997 to produce a vulnerability analysis for Colorado. The project was completed in June 1998. This final mapping product will provide a standard method to determine aquifer sensitivity. Upon completion of the next phase, the addition of the vulnerability factors, the program will be able to determine groundwater vulnerability to agricultural chemicals statewide. Results will be evaluated and incorporated into a standard method to delineate those areas of the state were ground water is vulnerable to contamination from agricultural chemicals. The monitoring program can then target resources to those areas where attention is most needed. This effort will become a key element of the State Management Plan for pesticides implemented under the Federal Insecticide, Fungicide, and Rodenticide Act

Update on collecting existing Ground Water Quality Data

In the FY-99 Memorandum of Understanding, the Ag Chemicals Program agreed to pursue collecting, evaluating, and entering into a database all existing ground water quality data available. Ground water quality data from various regions of the state has been entered as it becomes available. Recently this includes, CDPHE data collected as part of Super Fund preliminary assessment studies by the Haz. Mat. Division, and recently published U. S. Geological Survey data. As the data from these studies is received, it is entered into a database specifically designed for this purpose. In addition, collection and entry of historical data from the U. S. Geological Survey and U. S. EPA is an ongoing process.

The U. S. Geological Survey (USGS) is now wrapping up monitoring in the Upper Colorado Basin area under the National Water Quality Assessment (NAWQA) program. As this data becomes available it will be incorporated into the final analysis for water quality on the west slope. Several water conservancy districts are also actively engaged in collecting ground water quality data. Unfortunately, this data is not always readily available due to concerns about privacy and future use of the data. The program hopes that as the monitoring effort continues and the agricultural community grows comfortable with our goals and intent, this valuable source of data will become available and enhance our understanding of the overall ground water quality of the state.

Other Activity

A long range sampling plan has been developed for the monitoring program. The plan covers three major types of ground water monitoring. The first type of monitoring is the initial screening surveys to be conducted on all major aquifers subject to contamination from agricultural chemicals. The screening surveys for the South Platte River alluvial aquifer, San Luis Valley unconfined aquifer, Arkansas River alluvial aquifer, the Front Range Urban Corridor, and the High Plains Ogallala Aquifer are complete. The second type of monitoring is a follow-up sampling program to resample, for confirmation, all wells in which any contaminant was detected at a level of concern. Surrounding wells may also be sampled, if available, to determine if the contamination is widespread or only a localized problem. Follow-up sampling is planned in 1999 for the High Plains and West Slope. The third type of monitoring is the specialized sampling needed for evaluation of Best Management Practices or Agricultural Management Areas when established. This long term monitoring, utilizing special wells such as dedicated monitoring wells, was started in 1995 in the Brighton to Greeley reach of the South Platte. In 1998, we continued this long term monitoring project and in 1999 will begin the initial statistical analysis of the data that has been gathered to date.

Recent development pressures, in once rural outlying areas, has heightened public awareness of the potential for impacts to water quality. The Program has responded to these concerns by offering technical assistance to water conservancy districts, ground water management districts, and other local entities interested in evaluating water quality in their area. Presentations of how the program works, past and present water quality projects, and plans for future projects with request for local input are made at every opportunity. In 1998, presentations were made at several major meetings and small local groups throughout the state. We consider this type of outreach an important part of the customer service component of the program.

Before an area is selected for monitoring, CDPHE will contact interested parties to inform them of the sampling program and SB 90-126, and how we envision its implementation. CDPHE will coordinate closely with federal agencies, county extension agents, conservancy districts, and local health officials in the project area.

APPENDIX IV

1998 Annual Report
Colorado Department of Agriculture

Rules and Regulations for Agricultural Chemical Bulk Storage Facilities and Mixing and Loading Areas

Section 25-8-205.5 (3)(b) of the Agricultural Chemicals and Groundwater Protection Act requires the Commissioner of Agriculture to develop regulations where pesticides and fertilizers are stored or handled in quantities that exceed the established thresholds. These regulations were adopted in July 1994 and became effective September 30, 1994. The law mandated at least a three-year phase-in period for the regulations. As a result of comments prior to and at the public hearings, a graduated phase-in schedule was adopted.

Regulation of pesticide secondary containment/storage facilities and mixing and loading pads, and for liquid fertilizer tanks greater than 100,000 gallons (one of the three prescribed methods of leak detection must be utilized unless secondary containment is in place) began on September 30, 1997. Compliance is required by:

- **September 30, 1999** for liquid fertilizer secondary containment and mixing and loading pads.
- **September 30, 1999** for dry fertilizer storage and mixing and loading pads.
- **September 30, 2004** for secondary containment for fertilizer storage tanks with a capacity greater than 100,000 gallons.

During 1998, presentations were made to groups throughout the state on the requirements of the regulations and the time line for compliance. The presentations were given to organizations and associations, which have a substantial number of their members subject to the regulations. In addition, facilities were visited to provide information and answer specific questions. This educational process aids individuals in determining first, whether or not compliance with the regulations is required and second, what specifically must be accomplished to meet the requirements.

Facility inspections continued in 1998. A total of 35 secondary containment facilities and 29 mixing and loading pads were inspected. Facilities inspected were in general compliance with the regulations; one Cease and Desist order was issued. Some minor modifications were needed at some sites. A database of inspection sites continues to be developed to track inspections. Inspection of pesticide facilities and fertilizer facilities with storage tanks greater than 100,000 gallons will be ongoing during 1999. In addition, inspection of liquid and dry bulk fertilizer facilities will begin as of September 30, 1999.

One requirement of the regulations is that the facility design be signed and sealed by an engineer registered in the state of Colorado; or the design be from a source approved by the commissioner and available for public use. The Colorado Department of Agriculture (CDA) in conjunction with Dr. Lloyd Walker, extension agricultural engineer with Colorado State University Cooperative Extension, produced a set of plans that meet the second criteria. The document is entitled, Agricultural Chemical Bulk Storage and Mix/Load Facility Plans for Small to Medium-Sized Facilities. The plans are available from Colorado State University or CDA free of charge.

Copies of the complete regulations and a summary sheet that contains a check list to allow individuals to determine if the regulations apply to their operation are also available from CSU or CDA or via the internet at www.ag.state.co.us/DPI/programs/groundwater.html.

Pesticide Registration and Groundwater Protection

A significant amount of time was spent in 1998 regarding the registration of two corn herbicides (Axiom & Balance) with groundwater impact concerns. Based on scientific review, Axiom was registered for use in late 1998. Data on Balance is still being collected, reviewed and evaluated. A decision regarding registration is expected to be made in early 1999.

State Management Plans for Pesticides

In October of 1991, the EPA released their Pesticides and Ground-Water Strategy. The document describes the policies, management programs, and regulatory approaches that the EPA will use to protect the nation's groundwater resources from risk of contamination by pesticides. It emphasizes prevention over remedial treatment. The centerpiece of the Strategy is the development and implementation of State Management Plans (SMPs) for pesticides that pose a significant risk to groundwater resources.

The EPA will require an SMP for a specific pesticide if: (1) the Agency concludes from the evidence of a chemical's contamination potential that the pesticide "may cause unreasonable adverse effects to human health or the environment in the absence of effective local management measures; and (2) the Agency determines that, although labeling and restricted use classification measures are insufficient to ensure adequate protection of groundwater resources, national cancellation would not be necessary if the State assumes the management of the pesticide in sensitive areas to effectively address the contamination risk. If the EPA invokes the SMP approach for a pesticide, its legal sale and use would be restricted to States with an EPA-approved pesticide SMP.

EPA published the proposed rule for state management plans for pesticides on June 26, 1996. As stated in previous year's reports, comments on the proposed rule were submitted under the signature of the Commissioner of Agriculture, Director of Colorado State University Cooperative Extension and the Executive Director of the Colorado Department of Public Health and the Environment. These comments were printed in the 1996 report. To date, EPA has not published the final rule. It is uncertain when the document will be completed and what will be included based on the comments submitted.

In 1996, a complete draft of the generic state management plan was finished and provided to EPA for their informal review. If Colorado can complete and receive concurrence from EPA on a generic plan, it should be much easier for a pesticide specific plan to be approved once the proposed rule is finalized. A redrafted, general state management plan based on EPA's comments on previous versions was submitted in January 1998. Comments on this version were received from EPA in April 1998, and Colorado then submitted a document final in August 1998 for formal review and concurrence. We are currently waiting for EPA's response to the Colorado plan.

As discussed in last year's report, one of the more significant issues involves EPA's demand for a sensitivity analysis/vulnerability assessment map of the state in a Geographic Information System (GIS) format by which to determine where to focus education and monitoring activities. In late 1995, a small EPA grant was obtained to perform a sensitivity analysis pilot project for the northeastern part of the state. This work was completed in 1996 and provided to EPA. EPA reacted favorably to the project and provided funding for a statewide sensitivity analysis, which was completed in 1998. This information has been published in an 8 page fact sheet titled Relative Sensitivity of Colorado Groundwater to Pesticide Impact. This publication assesses aquifer sensitivity based on 4 primary factors: conductivity of exposed aquifers; depth to water table; permeability of materials overlaying aquifers; and availability of recharge for the transport of contaminants. These factors were selected because they incorporate the best data currently available for the entire state and incorporate important aspects of Colorado's unique climate and geology.

Pesticide use data at the county level is another requirement of the SMP. In addition, with the passage of the Food Quality Protection Act by Congress, accurate pesticide use information has become more critical. To try and provide this data, CDA along with CSU Cooperative Extension contracted with the Colorado Agricultural Statistics Service to perform a statewide pesticide use survey. All commercial pesticide applicators were surveyed during the winter of 1997/98. In addition, farmers who responded to a pre-survey that they apply some portion of their own pesticides were surveyed. Data is currently being sorted and transformed into a useable format and will then be analyzed and a report generated.

Waste Pesticide Disposal

In 1995, CSU Cooperative Extension operated a pilot waste pesticide collection program in Adams, Larimer, Boulder and Weld Counties. The purpose of this type of program is to provide pesticide users an opportunity to dispose of banned, canceled or unwanted pesticides in an economical and environmentally sound manner. Part of the funding for the program was provided by an EPA Nonpoint Source 319 grant. The program was a success. Approximately 17,000 pounds of waste pesticides from 67 participants were collected and safely disposed.

Based on the success of this pilot program, CDA was asked to continue a program that could collect and dispose of waste pesticides in other areas of the state. However, CDA currently has no statutory authority or funding to operate such a program. In light of this, two alternatives were discussed as a way for a waste pesticide collection program to continue. The first was for CDA to seek statutory authority and funding from the Legislature to operate a state-run program. The second was to determine if a private program, operated by a hazardous waste handling company, was possible.

The EPA and the Colorado Department of Public Health and Environment made the possibility of continuing a waste pesticide disposal program significantly easier by the passage of the Universal Waste Rule (UWR) in late 1995. The UWR was developed to encourage disposal of products identified as universal wastes by relaxing the regulations in the Resource Conservation and Recovery Act (RCRA) and therefore making it easier to properly dispose of these products. Waste pesticides were defined in the rule as a universal waste.

CDA spoke to hazardous waste contractors to determine if they would be interested in attempting to collect and dispose of waste pesticides as a private program. One company,

MSE Environmental Inc., stated they would be interested. Discussions were initiated with the company and it appeared it would be possible for MSE to operate a private program at a reasonable cost to the participants. The collection and disposal costs for participants would be between $2.25 and $2.75 a pound.

Based on this information, it was determined that the private program option would be pursued since the possibility of getting legislation passed was slim. Furthermore, the time required for legislation to be passed would considerably delay the operation of a program.

After numerous issues were addressed, MSE targeted two areas of the state to initiate the program, the San Luis Valley and the six counties in northeastern Colorado. Registration for participants was set to begin in early 1997, with a scheduled collection of pesticides set for mid-March 1997. This program was very successful. Over 10,500 pounds of waste pesticides were collected from 33 participants. The cost to participants was $2.65 per pound.

Based on the success of this program, MSE conducted a statewide collection program in November 1997. Over 23,000 pounds of waste pesticides were collected from 75 participants. Again the cost was $2.65 per pound.

There was no pesticide collection in 1998, but a sign-up for a statewide collection program was initiated with an anticipated pick-up of early 1999.

APPENDIX V

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION ACT ADVISORY COMMITTEE 1998

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