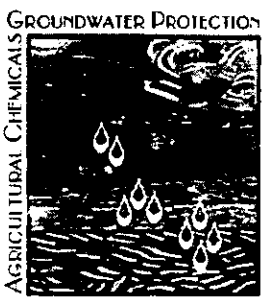
ANNUAL REPORT FOR 2000

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



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

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

Annual Report, Executive Summary For 2000

Status of Implementation of Senate Bill 90-126
The Agricultural Chemicals and Groundwater Protection Act

In the annual report for 1999, several goals for 2000 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 2000/2001 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 2001 for this program are stated on pages five and six.

Colorado Department of Agriculture

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. Pesticide and fertilizer facility inspections continued in 2000.

State Management Plan for Pesticides

EPA is developing a program that would require states to produce management plans for pesticides thought to be significant hazards to groundwater. 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. EPA concurred on Colorado's Generic Pesticide Management Plan (PMP) in March of 2000.

Waste Pesticide Disposal

MSE Environmental Inc., the private contractor is scheduled to conduct another program in April of 2001.

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 2000.

Colorado State University

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.

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.

Best Management Practices

Best Management Practices (BMPs) have been 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 Cooperative Extension Resource Center.

Demonstration Sites and Field Days

Field demonstrations continue to be an integral part of the program to demonstrate BMPs to farmers. In 2000, work focused on a cooperative effort with the Colorado Corn Growers Association to demonstrate BMPs on: crediting nitrogen in irrigation water and manure; nutrient management planning; irrigation scheduling and system adjustments; soil testing laboratory comparisons; use of polyacrylamides; and pest scouting.

Colorado Department of Public Health and Environment

Weld County Long Term Monitoring

In 2000, the program completed the sixth year of a long term monitoring effort initiated in the South Platte alluvial aquifer from Brighton to Greeley. From June through August 2000, 73 wells in the long-term network were sampled. Nitrogen analysis indicated that 79% of the monitoring wells and 69% of the irrigation wells exceeded the nitrate drinking water standard of 10 mg/L. Pesticide data revealed four pesticides, Atrazine, Hexazinone, Metolachlor, and Prometone present in the monitoring well samples. No pesticide was detected at a level exceeding an applicable standard.

San Luis Valley Joint Monitoring Project with the USGS

In 2000, a joint monitoring program with the U S Geological Survey to sample 35 dedicated monitoring wells was completed. The purpose of the sampling project is to acquire a high quality data set to use in an aquifer vulnerability modeling project began this year with the USGS.

North Park, Jackson County, Colorado Regional Monitoring

The 2000 monitoring program included a regional groundwater quality baseline study for North Park, Jackson County, Colorado. No well exceeded the nitrate drinking water standard of 10 mg/L. The 2000 pesticide data revealed no well testing positive for any pesticide.

Aquifer Vulnerability Study Summary

In addition to monitoring groundwater for the presence of agricultural chemicals, the SB 90-126 Program is required to determine the likelihood that an agricultural chemical will enter the groundwater. In the process of writing the generic Pesticide Management Plan (PMP), the staff at CDPHE, CDA, and CSU has studied various types of vulnerability analysis. In 1999, the legislature approved additional funding for a project to develop a method to determine aquifer vulnerability to both pesticides and nitrate statewide. Upon completion of the project, the program will be able to determine groundwater vulnerability to agricultural chemicals statewide.

Revisions to the Chemical Analysis Used on Groundwater Samples

The program has completed an evaluation of the current analysis performed on groundwater samples by the Standards Laboratory at the Colorado Department of Agriculture. We wanted to compare our analyte list to other regional groundwater studies to determine if we were missing key pesticides from the analysis. In addition, we wanted to determine if some current pesticide analysis could be modified or dropped if sufficient proof developed that the analysis was not providing needed data.

State Engineer's Office, Groundwater Management Districts Long Term Monitoring Project

The program provided technical guidance, program planning, and finical assistance to the Office of the State Engineer, Division of Water Resources and the Groundwater Management Districts of Colorado, to begin a long term monitoring project in the High Plains, Ogallala aquifer.

Objectives for 2001 Determined

The following objectives for 2001 have been established:

- Continue production of a report on water quality status in Colorado based on data collected in previous years;
- Continue the 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, pesticide, and water management to farmers;
- Coordinate with other agencies and non-governmental organizations to deal with water quality issues in the South Platte River Basin and throughout the state;
- Continue BMP education work in all vulnerable groundwater areas of Colorado;
- 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;
- Continue developing educational resource materials for groundwater education;
- Finish modification of and 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 performing inspections of facilities requiring compliance with containment regulations;

- Continue to provide information on and enforcement of the containment rules and regulations;

- Continue collection and analysis of groundwater samples for pesticides and nitrates on a regional scale;

- Continue the long term monitoring program in Weld County by collecting and analyzing groundwater samples for pesticides and nitrates;

- Evaluate the sensitivity analysis and vulnerability models developed for Colorado groundwater;

- Design BMP survey for mailing in winter 2001-2002;

- 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

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APPENDIX I

2000 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 three prescribed methods of leak detection must be utilized unless secondary containment is in place) began on September 30, 1997. Regulation of fertilizer secondary containment/storage facilities and mixing and loading pads began on September 30, 1999. Compliance is required by:

- **September 30, 2004** for secondary containment for fertilizer storage tanks with a capacity greater than 100,000 gallons.

During 2000, facilities were visited to provide information and answer specific questions regarding the rules and regulations for bulk storage and mixing/loading facilities. 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.

Pesticide and fertilizer facility inspections continued in 2000. A total of ten pesticide secondary containment structures and 22 mixing/loading pads were inspected. A total of 33 fertilizer secondary containment structures and 33 mixing/loading pads were inspected. In addition, four leak detection inspections were conducted for facilities storing fertilizer in tanks larger than 100,000 gallons. Four Cease and Desist Orders and two Violation Notices were issued during 2000; modifications were needed at some sites. A database of inspection sites continued to be developed in 2000 to track inspections and is near completion. Inspection of pesticide and fertilizer facilities will be ongoing during 2001.

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. The Colorado Department of Agriculture is currently working in conjunction with CSU on developing a set of generic plans for steel containment facilities to compliment the previously mentioned publication which focuses only on concrete. These plans are near completion and should be available for use in 2001.

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

The program continues to review products for registration in Colorado which have groundwater label advisories. As in 1998 and 1999, Balance herbicide was registered for use in Colorado for 2000 after extensive review. A decision regarding re-registration is expected to be made in early 2001.

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. Two subsequent documents were submitted to EPA based on comments received, the last being in January of 2000. EPA concurred on Colorado's Generic Pesticide Management Plan (PMP) in March of 2000.

One of the more significant issues regarding the PMP 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.

In 1999, the SB 90-126 program was given spending authority to begin an aquifer vulnerability project to compliment and improve the existing aquifer sensitivity map. Work on this project was conducted during 2000 and completion will be June 30, 2001. Another related project in conjunction with the United States Geological Survey (USGS) began in the fall of 2000.

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 lbs. 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 $2.65 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 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 lbs. 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 lbs. 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 statewide collection program was conducted in 1999. A total of 19,792 lbs. of pesticides from 47 participants was collected during this program. No collection occurred during 2000, but a program is slated for April 2001 by the private contractor, MSE Environmental Inc.

APPENDIX II

2000 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.

- Cooperated with the Colorado Corn Growers Association to develop and demonstrate BMPs appropriate for corn production for the second year of their EPA 319 program (Appendix IV).

- Collaborated with Colorado School of Mines to develop groundwater vulnerability matrices for assessing pesticide and nitrate contamination potential.

- Developed, published, and distributed a revised Pesticide Recordbook for Private Applicators (Appendix IV).

- 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.

- Collaborated with CDPHE and the US Geological Survey on a joint Groundwater monitoring project in the San Luis Valley.

- Provided 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, working on nutrient management under manured conditions, alternative pesticide management and pest scouting, and using atmometers to schedule irrigations.

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

- Cooperated with other CSU faculty and NRCS personnel on a research project to evaluate phosphorus (P) runoff from irrigated fields and used these results to develop a phosphorus risk index to predict potential P losses.

- Cooperated with other CSU faculty on a research project to evaluate nutrient (phosphorus and nitrogen) and fecal bacterial concentrations in runoff from irrigated high elevation mountain hay meadows.

- Cooperated on publishing results from a field project to evaluate ammonia volatilization on fields receiving swine effluent applications.

- 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.

  These were revised and are in the process of being made available via the Internet.

- Distributed a booklet of BMPs specifically for greenhouse growers in Colorado entitled: Pollution Prevention for Colorado Greenhouses

- 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 Pesticide Management Plan. Contracted with a private consultant to prepare a protocol for developing a Colorado groundwater sensitivity map.

Ongoing BMP Development and Education

Colorado State University Cooperative Extension works with the Colorado Department of Agriculture to develop Best Management Practices for Colorado farmers, landowners, and commercial agricultural chemical applicators. Because of the site-specific nature of groundwater protection, the chemical user 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 that 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. Local groups have also developed BMPs for Montrose/Delta area and the lower South Platte Basin. We continue to work with county CSU Extension faculty and NRCS personnel to promote and distribute these localized documents.

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. During 2000 we revised the Homeowner's guides and are in the process of publishing them in the CSU fact sheet series and making them available over the internet.

Demonstration Sites and Field Days

Field demonstrations continue to be an integral part of the program to demonstrate BMPs to farmers. In 2000, work focused on a cooperative effort with the Colorado Corn Growers Association to demonstrate BMPs on crediting nitrogen in irrigation water and manure, nutrient management planning, irrigation scheduling and system adjustments, soil testing laboratory comparison, use of polyacrylamides, and pest scouting. Nine demonstration sites were used to show these practices. The results of these demonstration sites were distributed to the public through the Colorado Corn Newsletter and web site (Appendix IV), at a field day, and numerous oral presentations to farmers and the agricultural industry.

A new technology known as presidedress soil nitrate testing (PSNT) was highlighted for demonstration. This tool may help corn farmers improve nitrogen recommendation accuracy and minimize the use of "insurance" fertilizer. Demonstration plots in the South Platte River Basin in 2000 showed farmers how to use this method to reduce unnecessary nitrogen applications.

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. Other production tools being evaluated and demonstrated to farmers include the portable chlorophyll meter to access N status of growing plants, atmometers (ETgages), PAM (polyacrylamide, an irrigation water treatment for soil erosion prevention), ETgages for simple and effective irrigation scheduling, atrazine alternatives and surge irrigation valves to help decrease irrigation water runoff and leaching.

Education and Communication

Communication is a vital component of the program. Numerous methods are used to provide information to individuals and organizations using agricultural chemicals as well as the general public. We continue to provide written Fact sheets and publications with information on the program and distribute at meetings, conferences, and trade shows. Also, a display board is being utilized at conferences and trade shows to provide information on the program. Information on the groundwater protection is continually being presented to the public through radio shows, mass media, press releases, and presentations at meetings throughout the state. 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 2000, 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.

This past year we worked on improving the quantity and quality of information available over the internet in 2000. Several locations including the CSU Cooperative Extension web site (http://www.ext.colostate.edu), the CSU Cooperative Extension Water Quality web site (http://www.colostate.edu/Depts/SoilCrop/extension/WQ/), and the Agricultural Chemicals and Groundwater Protection Program web site (http://www.ag.state.co.us/dpi/programs/groundwater.html) provide information on BMPs.

APPENDIX III

2000 Annual Report
Colorado Department of Public Health and Environment

Summary of Accomplishments:

- Completed a joint Groundwater monitoring project in the San Luis Valley with the US Geological Survey. Thirty-three dedicated monitoring wells, installed in 1993 by the USGS NAWQA program, were sampled for a broad range of analytes. This data set will be used as the input to a GIS based modeling process to determine the vulnerability of the area to agricultural chemical contamination.

- Completed a regional Groundwater quality assessment of North Park (Jackson County) Colorado. Twenty-one domestic wells were sampled for basic inorganics, nutrients, dissolved metals, and pesticides.

- Continued the long term monitoring project in the South Platte River Basin, a high priority watershed for SB 90-126 efforts. This year the sampling program sampled nineteen (19) monitoring wells and fifty-four (54) irrigation wells.

- Began a regional Groundwater quality assessment of Mesa County, Colorado.

- Cooperated in a joint project with the U. S. Geological Survey, NAWQA program for the High Plains in an assessment of pesticides in the vadose zone overlying the Ogallala Aquifer.

- Responded to citizen's request to sample affected wells in Garfield County.

- Assisted in the planning, design, and funding of a project between CDPHE, the State Engineers Office, and local Groundwater Management Districts to begin a long-term Groundwater quality monitoring project in the High Plains of Colorado.

- Participated and provided contract oversight for the Colorado School of Mines to develop Groundwater vulnerability matrices for assessing the potential for pesticide contamination.

- Initiated a project and provided contract oversight for the U. S. Geological Survey to develop a GIS based statistical approach to Groundwater vulnerability for pesticide contamination.

- Collaborated with Colorado State University researchers on the development of a statewide aquifer sensitivity map and vulnerability model for nitrate.

- Collaborated with the Department of Agriculture Standards Laboratory to revise and refine the laboratory analysis used on all Groundwater samples.

- Assisted the Colorado Department of Agriculture in the development of the generic Pesticide Management Plan and the implementation of the Bulk Storage Regulations.

- Appeared before the Colorado Water Quality Control Commission and the Colorado Groundwater Commission to address Groundwater quality issues.

- Worked on the Certified Crop Advisors Program in Colorado. Served on the Board of Directors. Assisted with certification testing.
- Appointed to the Board of Examiners of water well construction and pump installation contractors.
- Completed the changeover to Access from dBase for all Groundwater data storage and retrieval.
- Addressed groups throughout Colorado on SB 90-126 and issues related to agricultural chemicals and groundwater quality. Groups addressed include chemical dealers, groundwater management districts, crop and livestock producers, and agency personnel.
- Presented results of the High Plains regional survey at the Ogallala Symposium.
- Cooperated with the Colorado Corn Growers Association on their BMP's for corn production project.
- Distributed fact sheets and reports on Colorado groundwater quality to interested parties and fielded questions by phone and e-mail to Colorado citizens.
- Cooperated with county Extension agents on disseminating information about Colorado groundwater quality.
- Worked to coordinate efforts of the Agricultural Chemicals and Groundwater Protection program with other state and federal programs in Colorado.
- Cooperated and provided assistance to the South Platte BMP workgroup.
- Assisted the Water Quality Control Division in reviewing and evaluating suitability of monitoring plans for housed commercial swine feeding operations.
- Evaluated the pesticide survey data to extract information needed to improve laboratory analysis.
- Participated on the Division's agriculture team to ensure program goals are integrated into other agriculturally oriented programs.

Weld County Long Term Monitoring

In 2000, the program completed the sixth 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 1). The long term monitoring network consists of three sets of distinct well types: a) Twenty (20) dedicated monitoring wells operated by the Central Colorado Water Conservancy District have been sampled each year since 1995; b) Sixty (60) irrigation wells that have been sampled in 1989, 1990, 1991, 1994, 1995, 1996, 1997, 1998, 1999, and 2000; c) Eighteen (18) domestic wells sampled in 1992, 1995, and 1998.

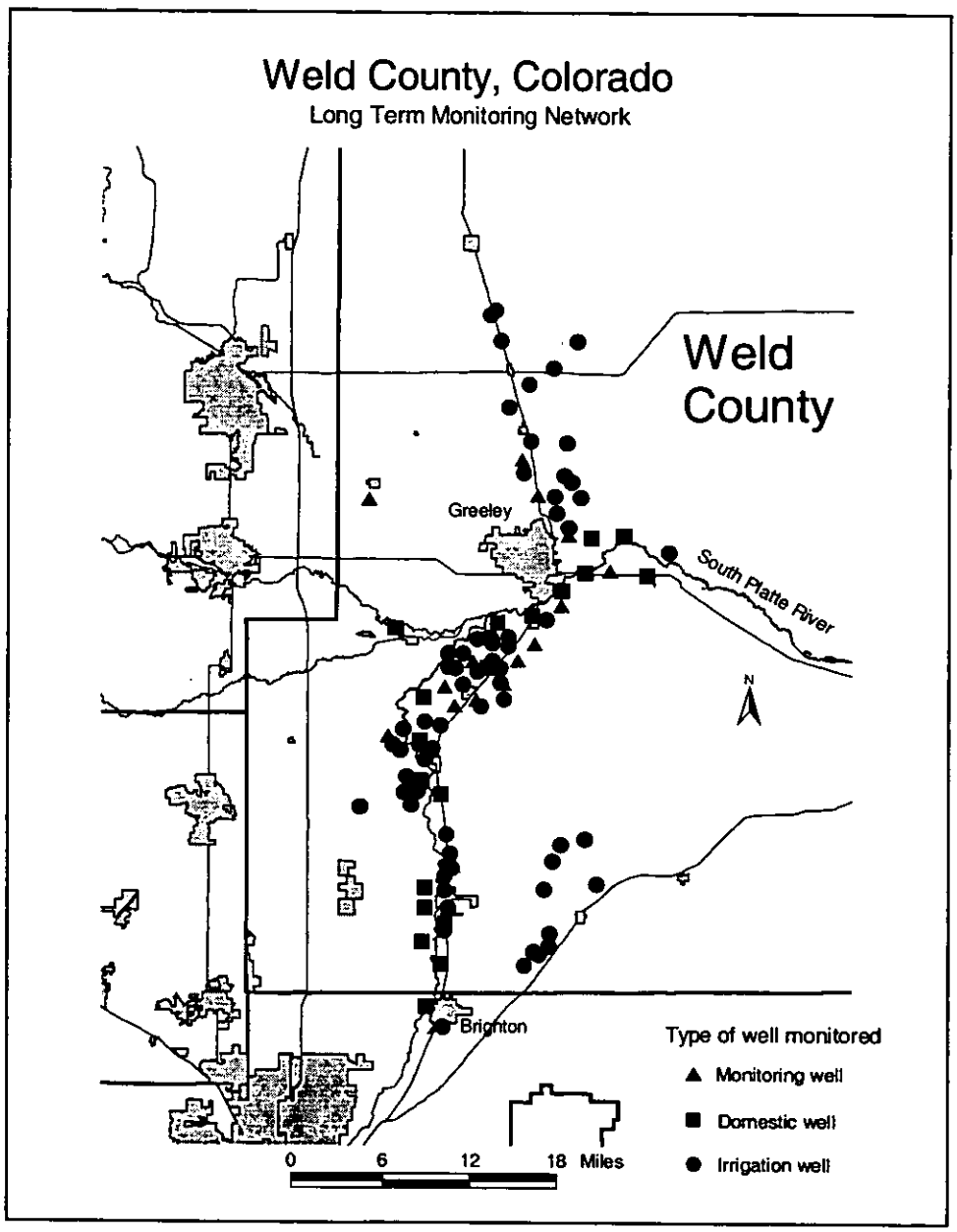


FIGURE 1 - Location and type of wells comprising the Weld County, Colorado long term monitoring network.

From June through August 2000, 73 wells in the long-term network were sampled. All wells were analyzed for nitrate-nitrite as nitrogen. The 19 monitoring wells were analyzed for the complete suite of 45 pesticides listed in Table 2. The pesticide analysis for the 54 irrigation wells was an immuno assay screen for the triazine herbicides.

Nitrogen analysis indicated that 79% of the monitoring wells and 69% 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 4.5 mg/L nitrate as nitrogen to a high of 65.1 mg/L. In the irrigation wells, nitrate levels ranged from below our detection level of 0.1 mg/L nitrate as nitrogen to a high of 35.6 mg/L (Table 1).

Pesticide data revealed four pesticides, Atrazine, Hexazinone, Metolachlor, and Prometone present in the

TABLE 1 - Summary statistics for the Weld County nitrate monitoring results, 1999.

Weld County Long Term Monitoring Network		
	Monitoring wells	Irrigation wells
Mean	26.1	17.0
Median	25.1	16.4
Standard Deviation	16.84	9.66
Minimum	4.5	< 0.1
Maximum	65.1	35.6
# wells sampled	19	54

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

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 47%, and Deisopropyl Atrazine present in 16%. Allowing for multiple products in one well that account for Atrazine of some form present, resulted in 53% of the wells having detections. Metolachlor was detected in 26% of the wells, Prometone in 11% and Hexazinone in 11%. Detection levels for all pesticides averaged less than 1.0 ug/L (ppb). No pesticide was detected at a level exceeding an applicable standard.

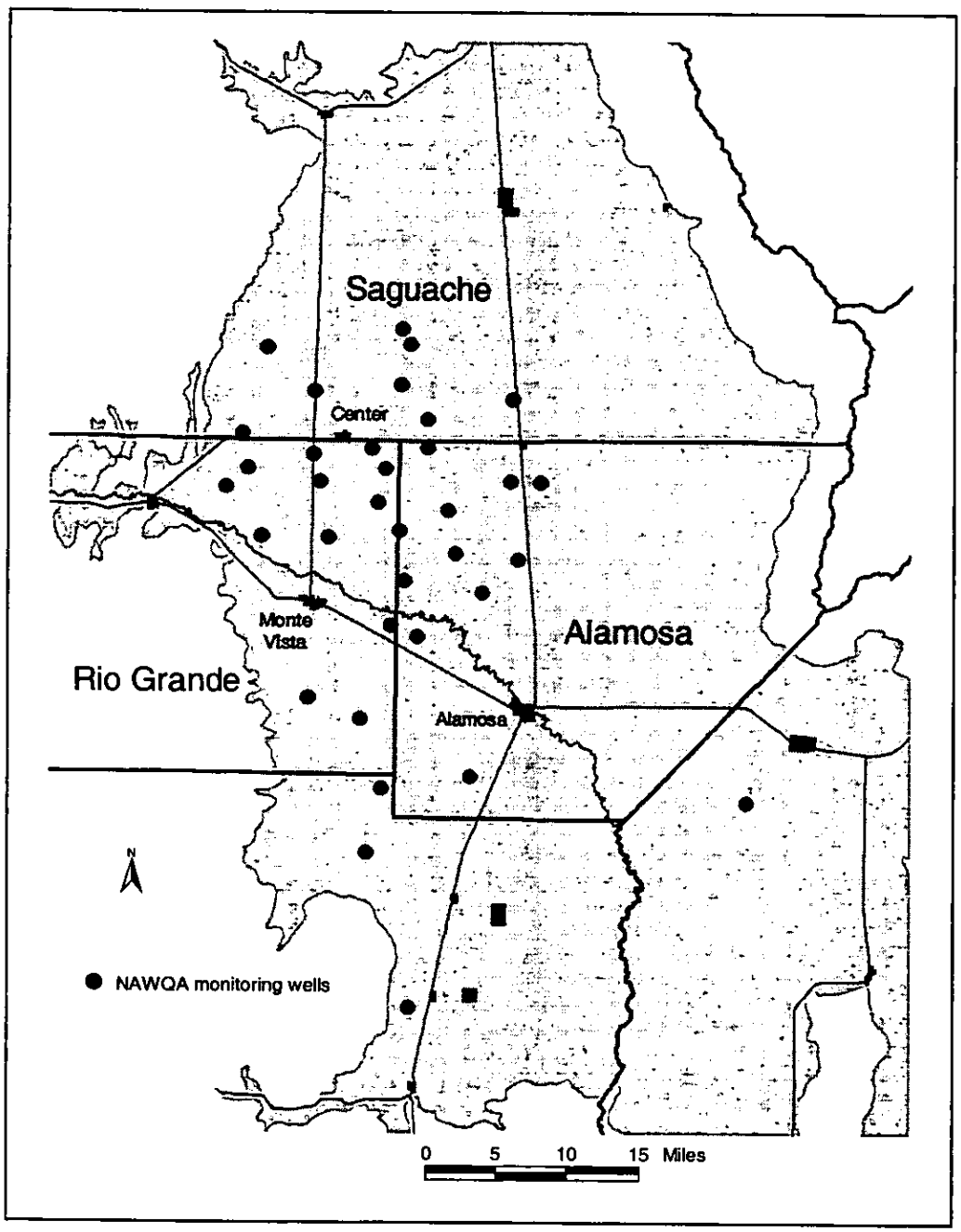
The triazine herbicide screen used on the irrigation wells detects any pesticide in this family, which includes Atrazine, Simazine, Cyanazine, Deethyl Atrazine, Deisopropyl Atrazine, and Prometone. The results are calibrated in units of Atrazine equivalent but may be actually composed of one or more of the components. In 2000, triazine herbicides were detected in 78% of the irrigation wells. Levels ranged from 0.10 ug/L to 0.64 ug/L (ppb).

Randy Ray of Central and Brad Austin of CDPHE sampled the monitoring wells in Weld County in cooperation with the Central Colorado Water Conservancy District in June 2000. John Colbert, of CDPHE, sampled the irrigation wells in Weld County in July and August 2000. Brad Austin performed all North Park sampling, in August and September 2000. Field sampling procedures followed the protocol developed by the Groundwater Quality Monitoring working group of the Colorado nonpoint task force.

San Luis Valley Joint Monitoring Project with the USGS

The San Luis Valley in south central Colorado has long been of interest to this program. The combination of a large shallow aquifer, overlain by intensive irrigated agriculture, with little or no pesticide impacts, has always posed the question of why this area contrasts with common perceptions on pesticide vulnerability.

In 2000, a joint monitoring program with the U. S. Geological Survey to sample thirty-five (35) dedicated monitoring wells was completed (Figure 2). The wells were originally installed in 1993 by the USGS NAWQA program as part of the Rio Grande Basin regional water quality study. The purpose of the sampling project is to acquire a high quality data set to use in an aquifer vulnerability modeling project began this year with the USGS.



Thirty-three (33) monitoring wells were sampled utilizing the NAWQA program ultra clean sampling technique. The samples will be analyzed for basic ions, nutrients, dissolved metals, and pesticides. The analysis will be performed by the USGS laboratory utilizing detection levels down to 50 parts per trillion.

A GIS based statistical approach will then be used to map the San Luis Valley unconfined aquifer for pesticide vulnerability utilizing the data gathered in 2000.

FIGURE 2 - Location of monitoring wells sampled in the San Luis Valley, Colorado.

process include whether the addition of the pesticide entails adoption of a new analytical method, or simply adding that pesticide to a current method.

The laboratory is also updating and modifying the existing methods used for Carbamate insecticides and Phenoxy Acid herbicides to bring them up to the standards for modern methods. This will make our results more defensible as well as decrease laboratory time in sample preparation.

State Engineer's Office, Groundwater Management Districts Long Term Monitoring Project

The program provided technical guidance, program planning, and finical assistance to the Office of the State Engineer, Division of Water Resources and the Groundwater Management Districts of Colorado, to begin a long term monitoring project in the High Plains, Ogallala aquifer.

In 2000, the local districts planned to collect samples from all 300 wells that were sampled by this program and the districts in 1997. As of this date, 260 wells have been sampled. All samples were run through the basic water quality analysis at CSU (see Table 2). In the future, one half of the wells will be sampled each year on a rotating basis, so as to sample each well once in every two-year period. The samples will be analyzed for nitrate at the CDA standards lab starting in 2001. All well and analysis data from the High Plains sampling program will be shared with this program.

North Park, Jackson County, Colorado Regional Monitoring

The 2000 monitoring program included a regional groundwater quality baseline study for North Park, Jackson County, Colorado (Figure 3). North Park is a distinct drainage basin in the intermontane region of north central Colorado, some 1,200 square miles in area. North Park is in the Atlantic watershed and is drained by the North Platte River and its tributaries, the Illinois, Michigan, and Canadian Rivers. The land use in North Park is predominately cattle ranching with associated hay production. National Forest forms a boundary on the east, south, and west sides of the park.

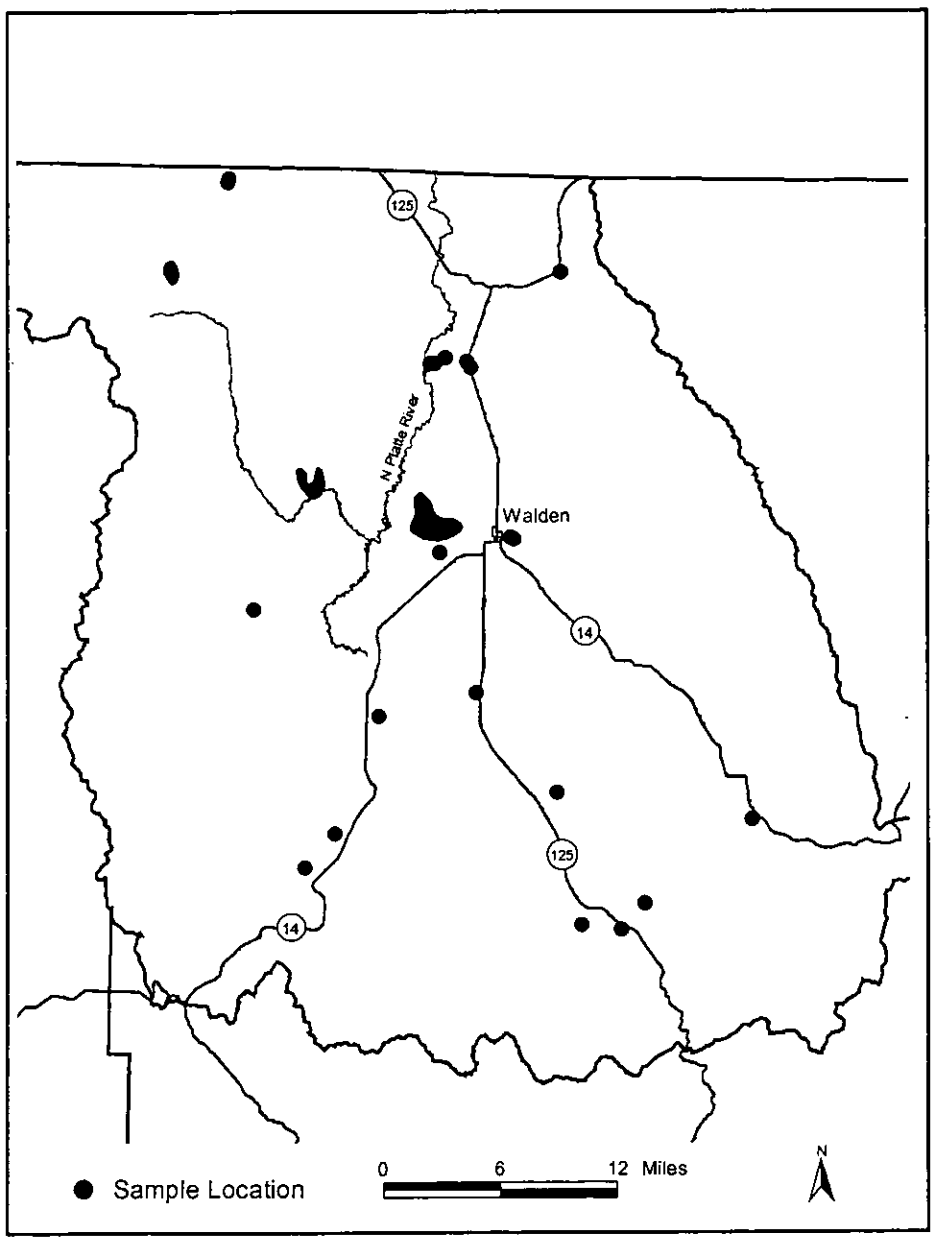


FIGURE 3 - Location of wells sampled in Jackson County, Colorado regional Groundwater quality study.

Locally, unconsolidated surface deposits of glacial material, landslide and talus debris, and alluvium overlie a sequence of sedimentary rocks up to 19,000 feet in thickness. These formations are extensively folded and faulted, and the structural complexity of North Park greatly influences the occurrence of Groundwater. The primary aquifers of North Park include Quaternary alluvium, Tertiary sedimentary rocks, older sedimentary formations, and Precambrian crystalline rocks.

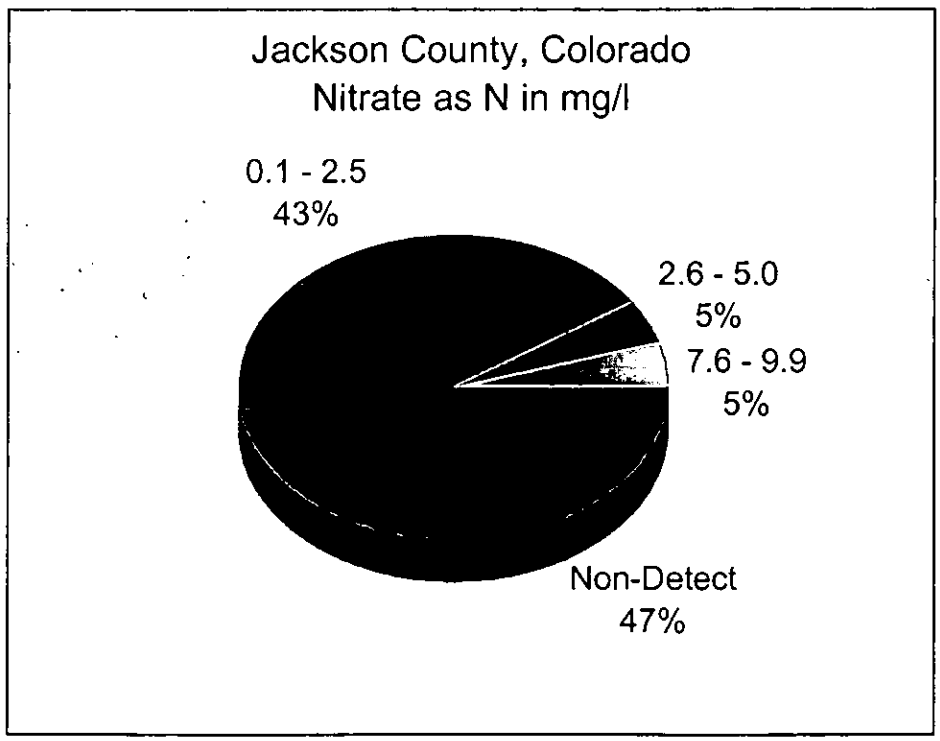
The majority of the Groundwater sampled in Jackson County occurs in the alluvial and terrace deposits along stream and river valleys, with some wells located in the Tertiary Coalmont Formation and Cretaceous Dakota Formation. Granitic materials produced the Groundwater sampled in wells located along the margins of the park. No single aquifer underlies this area; therefore this survey differs from past work that tended to focus on a single regional aquifer.

The annual precipitation on the floor of North Park averages 9 inches, but is much greater in the surrounding mountains. Groundwater within alluvial deposits is typically hydraulically connected to surface water in the adjacent stream and is unconfined. Recharge to the alluvium and other deposits is by infiltration of precipitation, streamflow and other runoff, irrigation ditch seepage and irrigation return flows. The alluvium has an average thickness of less than 25 feet with a depth to Groundwater as little as one foot or at ground level in the marshy areas. Alluvial aquifer well yields range from several gallons per minute to 300 gpm, with domestic wells typically yielding 3 to 15 gpm. Due to the limited saturated thickness and permeability of North Park aquifers, the large capacity wells needed for industrial use or large irrigation projects cannot be supported.

Over 600 well permits are on file for the North Park area, with 67 percent of the existing wells permitted for domestic use, 18 percent for stock, 9 percent for a combination of domestic and stock, and 6 percent falling into municipal, commercial, irrigation, and industrial uses.

Existing water quality in North Park aquifers has been characterized as suitable for domestic and stock use. The poor water quality found in the Coalmont wells is probably attributable to the presence of coal beds if the screened interval of the well intersects them.

In the 2000 survey, no well exceeded the nitrate drinking water standard of 10 mg/L, with test results ranging from below the laboratory detection level of 0.1 mg/l to a high of 9.0 mg/L (Figure 4). The 2000 pesticide data revealed no well testing positive for any pesticide.



Well samples were analyzed for basic water quality at the Colorado State University water testing laboratory. Selected wells were also analyzed for dissolved metals. The Colorado Department of Agriculture, Standards Laboratory performed the laboratory analysis for nitrate, 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.

FIGURE 4 - Breakdown of nitrate levels for 21 wells sampled in Jackson County, Colorado, Colorado Dept Health & Env., 2000.

Aquifer Vulnerability Study Summary

In addition to monitoring Groundwater for the presence of agricultural chemicals, the SB 90-126 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 Pesticide Management Plan (PMP), the staff at CDPHE, CDA, and CSU has studied various types of vulnerability analysis. The goal has been to satisfy the requirements of the PMP 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 an aquifer sensitivity map for Colorado. The project was completed in June 1998. This final map product will provide a standard method to determine aquifer sensitivity to pesticides statewide.

In 1999, the legislature approved additional funding to expand this effort to the next phase, the addition of the vulnerability factors. This project, which will last two years, aims to develop a method to determine aquifer vulnerability to both pesticides and nitrate statewide. A nitrate sensitivity map will be created in a similar fashion to the method developed for pesticides. Those unique factors that influence nitrate movement to Groundwater will be incorporated as new GIS layers for the map. The project will then develop a vulnerability matrix for both pesticides and nitrate. These vulnerability matrices must account for the local factors that influence pesticide and nitrate movement. Irrigation practice, soil properties, pesticide properties, nitrogen leaching chemistry, and pesticide and nitrogen application methods are some but not all of the factors to be investigated.

Upon completion of the project, 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 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 PMP.

Revisions to the Chemical Analysis Used on Groundwater Samples

The program has completed an evaluation of the current analysis performed on Groundwater samples by the Standards Laboratory at the Colorado Department of Agriculture. We wanted to compare our analyte list to other regional Groundwater studies to determine if we were missing key pesticides from the analysis. In addition, we wanted to determine if some current pesticide analysis could be modified or dropped if sufficient proof developed that the analysis was not providing needed data.

The procedure developed was to compare our analysis list to those used by the USGS and EPA. Additional factors included if the pesticide has a Groundwater label advisory, detection rates in other surveys, and most importantly the usage of that pesticide in Colorado. A decision matrix pulled up the top thirty (30) pesticides that fit these criteria. Currently the laboratory is conducting an analysis to determine how many of these thirty we can include in a new analysis. Laboratory factors in the decision

process include whether the addition of the pesticide entails adoption of a new analytical method, or simply adding that pesticide to a current method.

The laboratory is also updating and modifying the existing methods used for Carbamate insecticides and Phenoxy Acid herbicides to bring them up to the standards for modern methods. This will make our results more defensible as well as decrease laboratory time in sample preparation.

State Engineer's Office, Groundwater Management Districts Long Term Monitoring Project

The program provided technical guidance, program planning, and finical assistance to the Office of the State Engineer, Division of Water Resources and the Groundwater Management Districts of Colorado, to begin a long term monitoring project in the High Plains, Ogallala aquifer.

In 2000, the local districts planned to collect samples from all 300 wells that were sampled by this program and the districts in 1997. As of this date, 260 wells have been sampled. All samples were run through the basic water quality analysis at CSU (see Table 2). In the future, one half of the wells will be sampled each year on a rotating basis, so as to sample each well once in every two-year period. The samples will be analyzed for nitrate at the CDA standards lab starting in 2001. All well and analysis data from the High Plains sampling program will be shared with this program.

Table 2 - Laboratory 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)
AAtrex	atrazine	Herb	triazine	525.1	0.1
	deethyl atrazine		triazine	525.1	0.2
	deisopropyl atrazine		triazine	525.1	0.2
Agritox	MCPA	Herb	phenoxy acid	515.2	2.0
Balan	benfluralin	Herb	organo fl	525.1	0.2
Banvel	dicamba	Herb	benzoic acid	515.2	0.1
Barrier	dichlobenil	Herb	nitrile	525.1	0.1
Baygon	propoxur	Insect	carbamate	531.1	1.0
Bladex	cyanazine	Herb	triazine	525.1	0.2
Captane	captan	Fungi	carboximide	525.1	1.4
Cygon	dimethoate	Insect	organo ph	525.1	0.5
	p,p-DDT	Insect	organo cl	525.1	0.4
	endrin	Insect	organo cl	525.1	0.3
	heptachlor	Insect	organo cl	525.1	0.6
	heptachlor epoxide	Insect	organo cl	525.1	0.8
Dacthal	DCPA	Herb	phthalic acid	525.1	0.1
Dazzel	diazinon	Insect	organo ph	525.1	0.2
DPX	oxamyl	Insect	carbamate	531.1	2.0
Dual	metolachlor	Herb	acetamide	525.1	0.1
Furadan	carbofuran	Insect	carbamate	531.1	1.5
	3-hydroxycarbofuran		carbamate	531.1	2.0
	methiocarb	Insect	carbamate	531.1	4.0
Gamma-mean	lindane	Insect	organo cl	525.1	0.1
Harness	acetachlor	Herb	acetoalinide	525.1	0.1
Hyvar	bromacil	Herb	uracil	525.1	0.4
Kilprop	MCPP	Herb	phenoxy acid	515.2	2.0
Lannate	methomyl	Insect	carbamate	531.1	1.0
	1-naphthol		carbamate	531.1	1.0
Lasso	alachlor	Herb	organo cl	525.1	0.1
Lorsban	chlorpyrifos	Insect	organo ph	525.1	0.1
Malathion	malathion	Insect	organo ph	525.1	0.1
Marlate	methoxychlor	Insect	organo cl	525.1	0.9
Primatol	prometon	Herb	triazine	525.1	0.1
Princep	simazine	Herb	triazine	525.1	0.2
Prowl	pendimethalin	Herb	dinitroaniline	525.1	1.2
Ridomil	metalaxyl	Fungi	acylalanine	525.1	0.2
Sencor	metribuzin	Herb	triazine	525.1	0.5
Sevin	carbaryl	Insect	carbamate	531.1	2.0
Temik	aldicarb	Insect	carbamate	531.1	1.0
	aldicarb sulfone		carbamate	531.1	2.0

Table 2, continued - Laboratory 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 sulfoxide		carbamate	531.1	2.0
Tordon	picloram	Herb	picolinic acid	515.2	0.35
Treflan	trifluralin	Herb	organo fl	525.1	0.3
Velpar	hexazinone	Herb	triazine	525.1	0.1
Weed B Gone	2,4-D	Herb	phenoxy acid	515.2	0.2

INORGANIC ANALYSIS

	EPA Method	MDL (mg/L)
Nitrate/Nitrite as N	300	0.1

Table 2, continued - Laboratory Methods and Detection Levels

Colorado State University Soils Laboratory

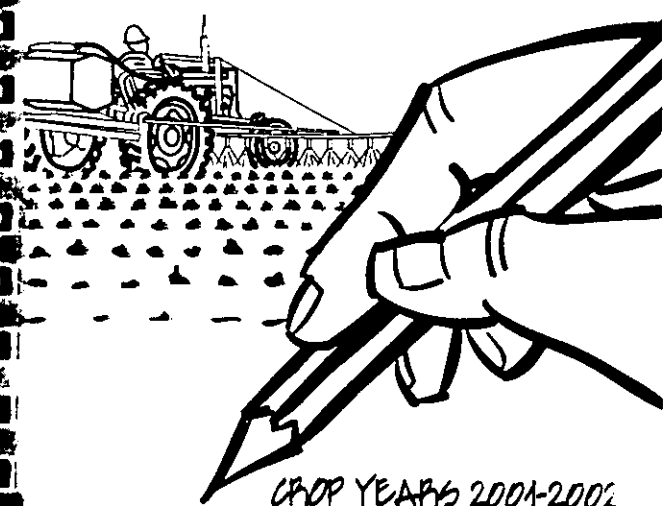
MINERALS AND DISSOLVED METALS ANALYSIS

Basic Water Quality Parameters	Method	Reporting Limit (mg/L)
alkalinity, total	Titration	1.0
bicarbonate	APHA 2320B	0.1
boron	EPA 200.0	0.01
calcium	EPA 200.0	0.1
carbonate	APHA 2320B	0.1
chloride	EPA 300.0	0.1
hardness, total as $CaCO_3$	Calculation	1.0
magnesium	EPA 200.0	0.1
nitrate	EPA 300.0	0.1
pH	EPA 150.1	0.1 pH unit
potassium	EPA 200.0	0.1
sodium	EPA 200.0	0.1
solids, total dissolved	Gravimetric	10.0
specific conductance (TDS)	EPA 120.1	1.0 uS/cm
sulfate	EPA 300.0	0.1
Dissolved Metals		
aluminum	EPA 200.0	0.1
barium	EPA 200.0	0.01
cadmium	EPA 200.0	0.01
chromium	EPA 200.0	0.01
copper	EPA 200.0	0.01
iron	EPA 200.0	0.01
manganese	EPA 200.0	0.01
molybdenum	EPA 200.0	0.01
nickel	EPA 200.0	0.01
phosphorous, total	EPA 200.0	0.1
zinc	EPA 200.0	0.01

APPENDIX IV

Pesticide Record Book

for Private Applicators



CROP YEARS 2001-2002

COLORADO CORN NEWS

Water Quality News

Managing Agricultural Phosphorus to Protect Water Quality By: Reagan Waskom, CSU

Concern about agricultural nutrients and water quality is nothing new in Colorado, but in the past most of our attention was focused mainly on impacts from nitrogen. Phosphorus (P) is now receiving attention nationwide as an important surface water pollutant. Surface water that receives phosphorus due to soil erosion or nutrient runoff from feedlots, fields or lawns suffers from accelerating the process of eutrophication. Eutrophication is the natural aging of lakes or streams brought on by nutrient enrichment. Eutrophication has been identified as the main cause of impaired surface water quality across the country. This decline in water quality restricts use for fishing, recreation, industry, and drinking due to the increased growth of undesirable algae and aquatic weeds and to oxygen shortages caused by their death and decomposition. Recent outbreaks of the dinoflagellate Pfiesteria piscicida in the eastern United States, and Chesapeake Bay tributaries in particular, have dramatically increased public awareness of eutrophication and the need for solutions. In Colorado, reservoirs such as Cherry Creek, Dillon, Chatfield, and Barr are known to be impaired from excess P in inflows.

Agriculture is not the only source of P in the aquatic environment. For example, the USGS estimates that of 40,000 tons of P that enter the S. Platte River Basin each year, almost 1,000 tons annually are from municipal waste discharges directly into the river. Manure and fertilizers applied to cropland and lawns make up the bulk of the P load in most basins and have been identified by the EPA as needing attention.

One of the difficulties in achieving better management of P fertilizer and manure is that small, economically insignificant amounts of P are enough to cause water quality impairment. Lake water concentrations of P above 0.02 ppm generally accelerate eutrophication. These values are an order of magnitude lower than P concentrations in soil solution critical for plant growth (0.2 to 0.3 ppm), emphasizing the disparity between critical lake and soil P concentrations. Continual long-term application of fertilizer or manure at levels exceeding crop needs will increase soil P levels. Most livestock producers apply manures at rates designed to meet crop N requirements but to avoid ground water quality problems created by leaching of excess N. Nitrogen-based management has been advocated by Extension and other crop advisers for many years. The result is a buildup of soil P to excessive levels over time. In many cases we now will need to recommend P based management, significantly increasing the number of acres needed to accommodate all of the manure produced. Livestock and crop producers are going to need help in understanding why they should consider implementing such a radical shift in their nutrient management approach.

• The Colorado USDA-NRCS has just adopted a new nutrient management standard that includes an evaluation of P runoff risk on operations that utilize manures or other organic wastes. This risk assessment is designed to identify if there are undue water quality risks from adding P fertilizer or manure to agricultural fields. The P Index ranks fields from "low risk" to "very high risk" and is intended to help producers protect water quality. For more information on the Colorado P Index, contact Reagan Waskom at Colorado State University (970-491-6103).

Use Nitrogen Credits to Reduce Fertilizer Costs

Colorado Corn / CSU Demonstration Site Results - Cooperator: Steve Eckhardt

- Beef feedlot manure supplies approximately 10 lbs. N per acre for each ton applied during the first year following application.
- One inch of irrigation water supplies 0.23 lb. N per acre for each ppm of NO_3-N in the water.
- Many irrigation wells in the S. Platte alluvial aquifer are enriched with NO_3-N.
- Call Troy Bauder (970) 491-4923 with CSU or Ginger Davidson with Colorado Corn (970) 351-8201 for more information.

Background Information

Irrigation water and manure crediting are important best management practices (BMP) for maximum economic yield. Livestock manure is rich in plant available nutrients, especially nitrogen and phosphorus, which should be credited toward the fertilizer requirements of a crop. Irrigation water containing nitrate can also supply considerable amounts of nitrogen because it is applied during the growing season and is immediately available for crop uptake. In most situations, fields applied with manure and irrigated with high nitrate water will not require additional nitrogen fertilizer.

This site demonstrated how adjusting fertilizer rates to account for these nitrogen sources can save input costs while maintaining yields. We applied nitrogen fertilizer at sidedress (30, 105, and 210 lbs. / acre) to six-row strips. These rates approximate fertilizer recommendations with and without manure and water nitrogen credits. We based all rates upon a 200-bu yield goal and pre-plant soil analysis results.

Results: Average* corn grain yield and economic comparisons

Nutrient Management Practice	Fertilizer Nitrogen Rate	Fertilizer Cost	BMP Cost***	Grain Yield	$ Return on Practice**
	-- lb / acre --	-- $ / acre --	-- $ / acre --	-- bu / acre --	-- $ / acre --
Water and manure credit (BMP rate)	30	7.30	5.50	219	40.00
Full water credit only	105	25.40	4.50	217	18.90
No water or manure credit	210	50.80	2.00	218	-45.50
Average				218	

*Results provided are an average of two replications of each treatment.
**Return was computed using a $2.00 / bu corn price and a $0.24 / lb. N cost.
Return on Practice = (yield difference between practice and BMP N rate x $2.00) - N cost difference - BMP cost.
***Cost based upon 40 acre field, includes expenses for labor and laboratory tests, contact authors for further explanation.

What Did We Learn?

Reducing the N fertilizer rate to account for irrigation water and/or manure nitrogen sources did not affect grain yield at this site. Therefore, higher economic return resulted from crediting manure and water N sources. The manure credit and the water credit plus residual soil NO_3-N supplied adequate nitrogen to exceed the 200 bushel yield goal. These results support using all appropriate nitrogen credits for maximum economic yield. Similar results were found at this site in 1999.

Field Background Information:

Soil type:	Julesburg sandy loam
Planting date:	May 1, 2000
Hybrid and population:	NC+3869; 30,000 emerged plants/acre
Manure rate and timing:	Approximately 12 tons applied late Fall 1999, incorporated Spring 2000
Preplant soil NO_3-N:	0 -1'= 7.8 ppm; 0-4' = 5.2 ppm
Presidedress soil NO_3-N:	0 -1' = 19.4 ppm (critical level is 15 ppm)
Irrigation water NO_3-N:	28 to 35 ppm, depending upon well used
Previous crop:	Sugar beets
Starter fertilizer:	None
Sidedress fertilizer:	UAN 32%, applied June 8 (6-leaf growth stage)

COLORADO **CORN NEWS**

1999 Colorado Corn Growers / CSU Cooperative BMP Education Project

Pre-sidedress Nitrate Test (PSNT) Demonstration - Cooperator Ritchie Pyeatt

- The PSNT (pre-sidedress nitrate soil test) is an in-season soil test for corn that has been tested extensively on non-manured fields in Colorado.
- The PSNT may be used on manured fields in Colorado, although the critical level has not been conclusively established.
- The critical level for the PSNT on non-manured corn fields is 13-15 ppm NO3-N in the top 12".
- Call Troy Bauder (970) 491-4923 with CSU or Jerry Alldredge (970) 336-7230 at Weld Co. Coop. Ext. for more information regarding these results.

Background Information

The objective of this demonstration site was to evaluate manure nitrogen crediting and the PSNT (pre-sidedress nitrate soil test) as part of a sound nutrient management program. The PSNT is an in-season soil test for corn that has been tested extensively on non-manured fields in Colorado. This site is one of several trials where the test is being used on manured fields.

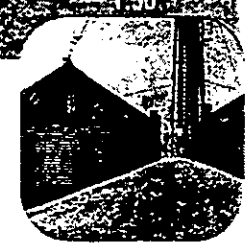
The PSNT was originally developed for the humid Eastern U.S., but has been calibrated for Colorado's soils and climate in recent years. This soil test will allow you to make a confident decision whether to sidedress your corn crop and avoid unnecessary fertilizer costs or yield loss to due insufficient N.

Previous research in northeastern Colorado on nonmanured fields has indicated that if the top foot of soil contains from 13 - 15 ppm NO3-N when the corn is approximately 12 inches tall (6-leaf growth stage) you can expect optimum corn grain yields under typical irrigated Colorado conditions. Lower NO3-N values mean the crop requires additional N for optimal yields. The test will tell you whether or not enough soil N is available, but not how much is needed. Crop producers must assess yield potential as well as soil nitrate levels at the sidedress period to determine actual sidedress N rates.

Results: Average* corn grain yield and economic comparisons

Nutrient Management Practice	Fertilizer Nitrogen Rate	N Cost	BMP Cost	Grain Yield	$ Return on Practice**
	-- lb / acre --	-- $ / acre --	-- $ / acre --	-- bu / acre --	-- $ / acre --
No PSNT (control)	0	0.00	0	169	+10.00
PSNT with Sidedress	50	7.50	1.50	174	1.00
PSNT with Sidedress at 2x rate	100	15.00	1.50	178	1.50
Average				174	

*Results provided are an average of two replications of each treatment.
**Return was computed using a $2.00 / bu corn price and a $0.15 / lb N cost.
Return on Practice = (yield difference between Control and PSNT rate x $2.00) - N cost - Cost to implement BMP
BMP cost is expense of taking PSNT sample = $15.00 analysis + $15.00 labor ? 20 acre field = $1.50 / acre



What Did We Learn?

The pre-sidedress soil NO3-N level of this field (8.0 ppm) was well below the PSNT critical level (13-15 ppm) for non-manured fields at the6-leaf growth stage. We found a small, but not statistically significant, yield increase in the strip plots that received additional fertilizer. This yield increase resulted in a small net return after the cost of additional fertilizer and soil sampling was considered. These results suggest that a PSNT level of 8.0 ppm is below the critical level for manure fields. With additional field trials, we will be able to more accurately pinpoint the critical level for manured fields.

Field Background information:

Planting date:	May 15, 1999
Soil type:	Bresser sandy loam
Hybrid and population:	Pioneer 3730; ~29,000 plants/acre
Manure rate and timing:	20 tons applied Fall 1998
Preplant soil NO3-N:	Unavailable
Pre-sidedress soil NO3-N:	0-1' = 8.0 ppm; 1-2' = 4.5 ppm;
Previous crop:	Dry beans
Sidedress fertilizer:	50 & 100 lbs of Nitrogen applied as anhydrous ammonia, June 14

1999 Colorado Corn Growers/CSU BMP Project

Irrigation Water Nitrate Crediting Demonstration Results
Cooperator: Terry Wiedeman

Quick Facts

- One inch of irrigation water supplies 0.23 lb N per acre for each ppm of NO3-N in the water.
- Many irrigation wells in Weld County are enriched with enough NO3-N to benefit crop production.
- Troy Bauder (970) 491-4923 with CSU or Jerry Alldredge (970) 336-7230 Weld Co. Coop. Ext. for more information regarding these results.

Background Information:

The objective of this demonstration site was to evaluate irrigation water nitrate crediting as part of a sound nutrient management program. Irrigation water containing nitrate can supply considerable amounts of nitrogen because it is applied during the growing season and is immediately available for crop uptake. In most situations, fields irrigated with nitrate-enriched water will require less nitrogen fertilizer.

Methods:

Three nitrogen fertilizer rates (75, 125, and 175 lbs / acre) were applied to 3-row strips. The highest irrigation water credit applicable to this field was 100 lb /acre. This credit was calculated from the measured NO3-N content of the irrigation water (30 ppm) multiplied by a conversion factor (0.23 lbs /acre inch) times 15 inches of water. Fifteen inches is typical corn water use during the maximum nitrogen uptake period. The 175 lb rate is the recommended rate (based upon soil test results and yield goal) without an irrigation water credit. The 125 lb rate is the recommended nitrogen rate with half water credit, and the 75 lb rate is the recommended nitrogen rate with the full water nitrate credit.

This site also had two varieties, Pioneer 3571 and NC+6589. Both variety and fertilizer treatments were replicated twice.

Terry Wiedeman

What Did We Learn?

Corn variety had a greater impact upon grain yield than did applied N fertilizer rates. Grain yield was not affected by the N fertilizer rates at this site, and therefore the highest economic return resulted from the highest irrigation water credit. The grain yield results from this harvest and a similar trial at this site last season support irrigation water nitrate crediting as a reliable BMP for maximum economic yield. ■

Results: Average* corn grain yield and economic comparisons.

Plot Information			Results			
Water Credit	Fertilizer Nitrogen Rate	Hybrid	Grain Moisture	Test Weight	Grain Yield	$ Return on Practice**
lb/acre			% Water	lbs / bu	lbs / bu	$ / acre
100	75	NC+6589	16.9	55.3	202	+35.75
50	125	NC+6589	16.7	55.5	206	+31.75
None	175	NC+6589	17.3	55.6	195	−35.75
Hybrid Average			16.9	55.4	201	
100	75	P-3571	16.1	55.9	188	+39.75
50	125	P-3571	16.4	55.7	179	−39.75
Hybrid Average			16.2	56.1	183	
Site Average			16.6	55.7	192	

*Results provided are an average of two replications of each treatment.

**Return was computed using a $2.00 / bu corn price and a $0.24 / lb N cost.

Return on Practice = (yield difference between water credit and no water credit x $2.00)- N cost - cost to implement BMP

Field Background Information

Soil type:	Julesburg Sandy Loam
Planting Date:	May16, 1999
Hybrid and population:	NC+6589 and Pioneer 3571 ~33,600 plants/acre
Preplant soil NO_3-N:	0-1'=20.1ppm; 0-3'=10 ppm
Previous crop:	Sugar beets
Starter fertilizer:	None
Sidedress fertilizer:	UAN 32%, applied June 4
Harvest date:	November 8, 1999

WATER QUALITY NEWS

BMP OF THE QUARTER

Colorado Corn Growers/CSU BMP Project Yield Results for the Pre-sidedress Nitrate Test (PSNT)

Demonstration Cooperators: Steve and Judy Kelly

- The PSNT (pre-sidedress nitrate soil test) is an in-season soil test for corn that has been tested extensively on non-manured fields in Colorado.

- The PSNT may be used on manured fields in Colorado, although the critical level has not been conclusively established.

- The PSNT allows producers to have more confidence in their decision to apply additional fertilizer to manured and non-manured corn fields.

- The critical level for the PSNT on non-manured corn fields is 13-15 ppm NO3-N in the top 12".

- Call Troy Bauder with CSU (970) 491-4923 or Jerry Alldredge with Weld Co. Coop. Extension (970) 336-7230.

Background Information The primary objective of the demonstration at this site is to evaluate manure nutrient crediting and the PSNT (pre-sidedress nitrate soil test) as part of a sound nutrient management program. The PSNT is an in-season soil test for corn that has been tested extensively on non-manured fields in Colorado. This site is one of several trials where the test is being used on manured fields.

The PSNT was originally developed for the humid Eastern U.S., but has been calibrated for Colorado's soils and climate in recent years. This soil test will allow you to make a confident, sound decision whether to sidedress your corn crop and avoid unnecessary fertilizer costs or yield loss to due insufficient N.

Previous research in northeastern Colorado on nonmanured fields has indicated that if the top foot of soil contains from 13 - 15 ppm NO3-N when the corn is approximately 12 inches tall (V6 growth stage) you can expect optimum corn grain yields under typical irrigated Colorado conditions. Lower NO3-N values mean the crop requires additional N for optimal yields. The test will tell you whether or not enough soil N is available, but not how much is needed. Crop producers must assess yield potential as well as soil nitrate levels at the sidedress period to determine actual sidedress N rates.

Judy Kelly

Results:

Average* corn silage yield results for PSNT demonstration; harvest date: September 24,1999.

	Field tons/acre	Dry tons/acre	%Dry Matter	Adjusted tons/acre (30% DM)
No Sidedress N	30.8	10.8	34.5	34.9
60 lb Sidedress N	31.5	10.2	33.5	33.9
Average	31.2	10.5	34.0	34.4

*Results provided are an average of three replications of each treatment.

PSNT, continued on page 7

APPENDIX V

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION ACT ADVISORY COMMITTEE

Water Quality Control Commission

Mr. Rob Sakata
P.O. Box 508
Brighton, CO 80601
(303) 659-1559
Original Appointment: 1991

General Public

Mr. John Stout
P.O. Box 11213
Englewood, CO 80151
(303) 708-1841
Original Appointment: 1998

Ms. Barbara Fillmore
18150 North Elbert Road
Elbert, CO 80106
(H) (303) 648-9972
(W) (303) 648-9897
Original Appointment: 1997

Commercial Applicators

Mr. Mark McCuistion
McCuistion Aerial Applicators
P.O. Box 232
Rocky Ford, CO 81039
(719) 254-7999
Original Appointment: 1999

Mr. Steven D. Geist
Swingle Tree Co.
8585 East Warren Avenue
Denver, CO 80231
(303) 306-3144
Original Appointment: 1994

Green Industry

Mr. John Wolff
Grand Lake Golf Course
P.O. Box 590
Grand Lake, CO 80447
(970) 627-3429
Original Appointment: 1998

Mr. Eugene Pielin
GMK Horticulture
2768 Crestview Ct.
Loveland, CO 80538
(970) 663-7333
Original Appointment: 1999

Ag Chemical Suppliers

Mr. Anthony Duran
American Pride Coop
P.O. Box 98
Henderson, CO 80640
(303) 659-3643
Original Appointment: 1998

Mr. Wayne Gustafson
Agland, Inc.
P.O. Box 338
Eaton, CO 80615
(970) 454-3391
Original Appointment: 1991

Producers

Mr. Don Rutledge
10639 County Road 30
Yuma, CO 80759
(970) 848-2549
Original Appointment: 1995

Mr. Max Smith
48940 Road X
Walsh, CO 81090
(719) 324-5743
Original Appointment: 1994

Mr. Lanny Denham
2070 57.25 Road
Olathe, CO 81425
(970) 323-5461
Original Appointment: 1996

Mr. Leon Zimbelman, Jr.
0949 WCR G7
Keenesburg, CO 80643
(303) 732-4662
Original Appointment: 1993

Mr. Steven Eckhardt
21454 WCR 33
La Salle, CO 80645
(970) 284-6495
Original Appointment: 1997

Mr. John Hardwick
24700 County Road 19
Vernon, CO 80755
(970) 332-4211
Original Appointment: 1991

Mr. Dave Latta
706 West Apache Drive
Yuma, CO 80759
(970) 848-2695
Original Appointment: 2001

Mr. Mike Mitchell
1588 E. Rd. 6 N.
Monte Vista, CO 81144
(719) 852-3060
Original Appointment: 1991