ANNUAL REPORT
FOR 2006

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.colorado.gov/ag/GW

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Executive Summary

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

Contracts with Cooperating Agencies

Contracts as provided in Section 25-8-205.5 (3) (f) and (g) of the Act have been signed for fiscal year 2007 between the Colorado Department of Agriculture and: 1) Colorado State University Cooperative Extension; and 2) the Colorado Department of Public Health and Environment.

Colorado Department of Agriculture (CDA)

Storage Rules

Section 25-8-205.5 (3)(b) of the Agricultural Chemicals and Groundwater Protection Act requires the Commissioner of Agriculture to develop rules where pesticides and fertilizers are stored or handled in quantities that exceed the established thresholds. Pesticide and fertilizer facility inspections continued in 2006.

Pesticide Management Plan (PMP)

In 2006, the EPA determined that they would not publish a final Rule for the PMP. Thus, there is no formal requirement for states with respect to PMPs. However, Colorado will continue to use its version of the PMP developed in 2000 to help guide its groundwater protection efforts.

Federal Regulations for Pesticide Containment

The EPA's final regulations, *Standards for Pesticide Containers and Containment*, were published on August 16, 2006 (Federal Register Vol. 71, Number 158, pp. 47329 – 47437). Colorado has until August

16, 2007 to address the EPA on how it plans to comply with these new regulations. Colorado is currently waiting on guidance from the EPA on how to proceed with its justification for complying with the federal regulations.

Waste Pesticide Disposal

In 2006, Clean Harbors, Inc. took responsibility for this program from MSE. The CDA will work with Clean Harbors to make sure this program continues in an efficient manner.

Pesticide Use Survey

The CDA and CSUCE will be conducting an on-line pesticide use survey for Colorado. Over 900 licensed, commercial pesticide applicators in Colorado's 64 counties will be asked to participate in this voluntary, anonymous survey. After collecting information on types of pesticides applied and use patterns by the commercial applicators, a report will be developed that will present the findings and be made available to interested parties.

Long Term Monitoring Plan

In 2006, Program personnel continued refining a long-term monitoring plan for the Program. This document will be used to drive program monitoring efforts for the next 5-10 years and will also help determine where new well networks should be installed. This plan should be finished in early 2007 to begin aiding the Program's monitoring efforts.

Groundwater Quality Database Project

Program personnel, in conjunction with the Integrated Decision Support Group in the Civil Engineering Department at CSU, are constructing a web-based tool that will interactively query the groundwater quality information associated with the Program. The data will be searchable by an array of parameters, such as water quality constituent, geographic location, and year detected. Public release of this database is expected in the spring of 2007.

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 once during 2006.

Colorado Department of Agriculture Groundwater Monitoring

In 2006, the Program completed the twelve year of a long-term monitoring effort initiated in the South Platte alluvial aquifer from Brighton to Greeley. Nitrogen analysis indicates that 80% of the irrigation wells and 70% of the monitoring wells tested above the nitrate drinking water standard of 10.0 mg L^{-1} (ppm). Pesticide

analysis returned 24 detections spread out in 13 of 17 monitoring wells. The most commonly detected pesticide was deethyl Atrazine (DEA).

The Program initiated a reconnaissance sampling of El Paso County to determine groundwater quality with respect to agricultural chemicals. This low-density sampling project resulted in 49 wells being sampled between September and November, 2006. Of the 49 wells sampled, only one sample had a nitrate concentration above the drinking water standard of 10 ppm. No pesticides were detectable by the CDA laboratory in any well sample.

Colorado State University Cooperative Extension (CSUCE)

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. Colorado State University Cooperative Extension continues 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 groundwater protection is continually being presented to the public through publications, newsletter articles, press releases, and presentations at meetings throughout the state. Presentations on 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 2006, 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.

Finally, CSUCE also partnered with the USDA-Cooperative State Research, Education, and Extension Service (CSREES) Water Quality Program (http://www.usawaterquality.org/) to offer mini-grant opportunities to CE field and campus faculty to encourage educational programs and extend research information on topics related to water quality and water quality.

Ongoing BMP Development and Education

Colorado State University Cooperative Extension has worked with the Colorado Department of Agriculture to develop Best Management Practices (BMPs) 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 Program Advisory Committee has recommended that a significant level of input be received at the local level prior to adoption of recommended BMPs.

Demonstration Sites and Field Days

The Groundwater Program at CSUCE works with crop producers, their advisors, fertilizer dealers, USDA NRCS, commodity groups, and local County Extension faculty, to demonstrate and evaluate new and existing production tools that may improve producer profitability and help protect groundwater. Field demonstration work in 2006 focused on helping growers improve water and nutrient management. One significant project is a limited irrigation trial in Weld County where we demonstrated limited versus full irrigation on grain corn using three different plant populations (~20, 25, and 32 thousand plants per acre).

Colorado Department of Public Health and Environment (CDPHE)

During 2006, the Colorado Department of Public Health and Environment continued to be actively involved with the Agricultural Chemicals and Groundwater Protection Program. The CDPHE continues to review the Program's monitoring data on an annual basis, and provide input on the results. Other activities that the Department has assisted the Program with include work on the Program's Long Term Monitoring Plan and Groundwater Quality Database Project.

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APPENDIX I

2006 Annual Report
Colorado Department of Agriculture

Rules 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 rules where pesticides and fertilizers are stored or handled in quantities that exceed the established thresholds. These rules were adopted in July 1994 and became effective September 30, 1994. The law mandated at least a three year phase-in period for the rules. As a result of comments prior to and at the public hearings, a graduated phase-in schedule was adopted. Regulation of bulk pesticide storage facilities and mixing and loading areas began on September 30, 1997. Regulation of bulk fertilizer storage facilities and mixing and loading areas began on September 30, 1999.

During 2006, facilities were visited to provide information and answer specific questions regarding the rules for bulk storage and mixing/loading facilities. This educational process aids individuals in determining first, whether or not compliance with the rules is required and second, what specifically must be accomplished to meet the requirements.

Pesticide and fertilizer facility inspections continued in 2006. A total of 16 pesticide secondary containment structures and 36 pesticide mixing/loading areas were inspected. A total of 43 fertilizer secondary containment structures and 43 fertilizer mixing/loading areas were also inspected. A total of 36 follow-up inspections were also conducted to ensure that problems noted on previous facility inspections were corrected. In addition, two Violation Notices were issued during 2006. Finally, 34 follow-up inspection orders were issued for problems at facilities that were not serious enough at this time to warrant a Cease and Desist Order or Violation Notice. Inspection of pesticide and fertilizer facilities will be ongoing during 2007.

One requirement of the rules 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, former extension agricultural engineer with Colorado State University Cooperative Extension (CSUCE), 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 CDA or CSUCE free of charge.

Copies of the complete rules and a summary sheet that contains a checklist to allow individuals to determine if the rules apply to their operation are also available from CDA, CSUCE, or via the Internet at *www.ag.state.co.us/CSD/GroundWater/Waterhome.html.*

Finally, the Rules for the storage and mixing/loading of agricultural chemicals were slightly altered in 2006. Since publication in 1994, the Rules have never been formally reviewed. During the eight years since formal facility inspections have begun, some errors and omissions

have been discovered in the Rules. The Groundwater Program's manager and CDA Attorney thoroughly reviewed the Rules and made some minor changes. These changes were approved by the Program's Advisory Committee and the Colorado Agricultural Commission in March of 2006. The latest version of these Rules has been printed for distribution.

Pesticide Registration and Groundwater Protection

The Program continues to review pesticide products for registration in Colorado, which have groundwater label advisories and advise the Department's registration program on the merits of registering these products.

Pesticide Management Plan

In October of 1991, the EPA released their *Pesticides and Groundwater 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 Pesticide Management Plans (PMPs) for pesticides that pose a significant risk to groundwater resources.

The EPA would require a PMP 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 invoked the PMP approach for a pesticide, its legal sale and use would be restricted to states with an EPA-approved PMP.

In 1996, a complete draft of Colorado's generic PMP was finished and provided to EPA for their informal review. A redrafted 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 PMP in March of 2000.

In 2006, the EPA determined that they would not publish a final Rule for the PMP. Thus, there is no formal requirement for states with respect to PMPs. However, Colorado will continue to use its version of the PMP developed in 2000 to help guide its groundwater protection efforts.

Federal Regulations for Pesticide Containment

The EPA proposed standards for pesticide containers and containment in 1994 and has taken public comment three times, in 1994, 1999, and again in 2004. The EPA's final regulations, *Standards for Pesticide Containers and Containment*, were published on August 16, 2006

(Federal Register Vol. 71, Number 158, pp. 47329 – 47437). Colorado has until August 16, 2007 to address the EPA on how it plans to comply with these new regulations. Colorado is currently waiting on guidance from the EPA on how to proceed with its justification for complying with the federal regulations.

Waste Pesticide Disposal

In 1995, CSUCE 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. Approximately 17,000 lbs. of waste pesticides from 67 participants was 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 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. 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. Subsequent programs are as follows:

Year	Pesticides Collected (lbs.)	Number of Participants
1998	0	0
1999	19,792	47
2000	0	0
2001	13,486	34
2002	8,762	33
2003	2,254	7
2004	8,520	10
2005	5,023	11

In 2006, Clean Harbors, Inc. took responsibility for this program from MSE. The CDA will work with Clean Harbors to make sure this program continues in an efficient manner.

Pesticide Use Survey

The CDA and CSUCE will be conducting an on-line pesticide use survey for Colorado. This survey will be for the 2006 growing season and will be conducted in early 2007. The last pesticide use survey was done in 1997 and, after 10 years, updated information is needed. This information is particularly important to help the Department register pesticides for use, especially Section 18 requests, update crop profiles, and provide correct data to keep products registered under the Food Quality Protection Act (FQPA). It also helps provide unbiased, accurate information to identify and address environmental concerns and to focus the Department's water quality monitoring efforts. Updated information is also necessary to better focus the Department's resources on areas that have the greatest potential to impact public health and the environment.

There are over 900 licensed, commercial pesticide applicators in Colorado's 64 counties that will be asked to participate in this voluntary, anonymous survey. After collecting information on types of pesticides applied and use patterns by the commercial applicators, a report will be developed that will present the findings and be made available to interested parties.

Program Comprehensive Publication

In 2006, Program personnel continued working on a comprehensive publication that will provide a history of the work and accomplishments of the Program since 1990. This is an ongoing project that has parts from CDA, CSUCE, and CDPHE. The projected publication date is late 2007.

Long Term Monitoring Plan

In 2006, Program personnel continued refining a long-term monitoring plan for the Program. This document will be used to drive program monitoring efforts for the next 5-10 years and will also help determine where new well networks should be installed. This plan should be finished in early 2007 to begin aiding the Program's monitoring efforts.

Cooperative Project with the EPA's Environmental Justice Program

The Program worked with the EPA Environmental Justice Program in 2006 on a community outreach effort for private/household drinking water wells in the San Luis Valley. The EPA Region 8 engaged in a comprehensive initiative to engage the community, instill awareness, and promote a healthy drinking water supply for private/household water well users. The CDA Standards Lab helped with sample analysis for this program. Data provided by the EPA showed few pesticide and nitrate issues and at this time, the Program has no plans to resample any of the tested wells.

Groundwater Quality Database Project

Program personnel, in conjunction with the Integrated Decision Support Group in the Civil Engineering Department at CSU, are constructing a web-based tool that will interactively query the groundwater quality information associated with the Program. Since 1992, over 4,600 samples from approximately 935 wells have been collected throughout Colorado. The website will also contain other water quality parameters collected by the Program including nitrate-nitrogen and inorganic constituents. The data will be searchable by an array of parameters, such as water quality constituent, geographic location, and year detected. An ARC- IMS map will also be available to interactively search the database. Public release of this database is expected in the spring of 2007.

Groundwater Monitoring

Weld County Long-Term Network

History

Analysis of groundwater samples, in 1995, resulted in the discovery of an issue with nitrate contamination of groundwater in the South Platte River alluvial aquifer. The Program became interested in developing a long-term monitoring effort on the Brighton to Greeley stretch of the South Platte River which lies inside the Weld County boundary. The Weld County Long-Term Network is composed of three different well types: a) 20 dedicated monitoring wells permitted by the Central Colorado Water Conservancy District; b) 55 irrigation wells sampled continuously since 1994; and c) Ten domestic wells first sampled back in 1992. Irrigation and monitoring wells are sampled annually, while sampling of the domestic wells only occurs once every three years with 2004 being the most recent sampling. Irrigation, domestic, and monitoring well samples all undergo analysis for nitrate and nitrite. The monitoring well samples are additionally screened for a complete suite of pesticides. Prior to 2005, the irrigation and domestic well samples underwent pesticide analysis for triazine herbicides through use of an immuno-assay test. However, due to the manufacturer's discontinuation of this testing kit, triazine analysis on these wells was not conducted in 2005 or 2006. The Program hopes to either find an adequate replacement method or to analyze these samples for the suite of pesticides the monitoring well samples undergo.

The Program's Weld County Long-Term project has, as of 2005, collected more than 850 groundwater samples with irrigation wells and monitoring wells comprising 68.7% and 23.7% of all samples, respectively. Long-term data shows that about 70% of both the monitoring well and irrigation well samples have nitrate concentrations above the drinking water standard of 10.0 ppm. More recently, 71.7% and 77.8% of the irrigation and monitoring wells sampled in 2005, respectively, have nitrate concentrations above the drinking water standard. Historical pesticide detections show that totals of 485 and 218 pesticides have been detected in irrigation and monitoring well samples, respectively. The irrigation wells sampled in 2005 did not undergo Triazine analysis due to the discontinuation of the testing kit mentioned above, so the most recent count of detected pesticides is not available for these wells. However, the 18 monitoring wells sampled in 2005 underwent the routine analysis for 47 pesticides and returned 20 pesticide detections. The most commonly detected pesticide in the Weld County monitoring wells, historically and most recently in 2005, is deethyl Atrazine, a breakdown product of Atrazine.

2006 Weld County Nitrate Results

There were 43 irrigation wells and 17 monitoring wells sampled in the Weld County Long-Term Network in 2006. Brad Austin of CDA completed sampling of the monitoring well network in May 2006. Rob Wawrzynski (CDA) sampled the irrigation well network between June and August 2006. The re-sampling of monitoring wells 10 and 901 was completed by Rob Wawrzynski, Greg Naugle (CDPHE), and Karl Mauch (CDA) in September 2006.

Nitrogen analysis indicates that 80% of the irrigation wells and 70% of the monitoring wells tested above the nitrate drinking water standard of 10.0 mg L^{-1} (ppm). As seen in Table 1, the mean nitrate concentration is 15.47 and 19.28 ppm for the irrigation wells and monitoring wells, respectively. The area with the highest nitrate concentrations lies between Platteville and LaSalle containing nine wells with nitrate above 20.0 ppm (Figure 1). The highest concentration for any well, 72.7 ppm, is located in this area of Weld County. Another area containing a number of wells with nitrate concentrations above the drinking water standard are a collection of irrigation wells east of HWY 85 between Greeley and Eaton.

Table 1. Descriptive statistics for nitrate found in groundwater samples collected from the Weld County network in 2006. The nitrate detection limit was 0.04 ppm and only one irrigation well sample was below detection limit (BDL).

2006 Weld County Nitrate Results		
	Monitoring Wells	**Irrigation Wells**
Mean	19.28[a]	15.47
Median	15.47	15.28
Standard Deviation	16.57	8.39
Minimum	3.3	BDL
Maximum	72.73	37.77
Sample Count	19	44

a Units for nitrate concentrations are mg L^{-1} or ppm

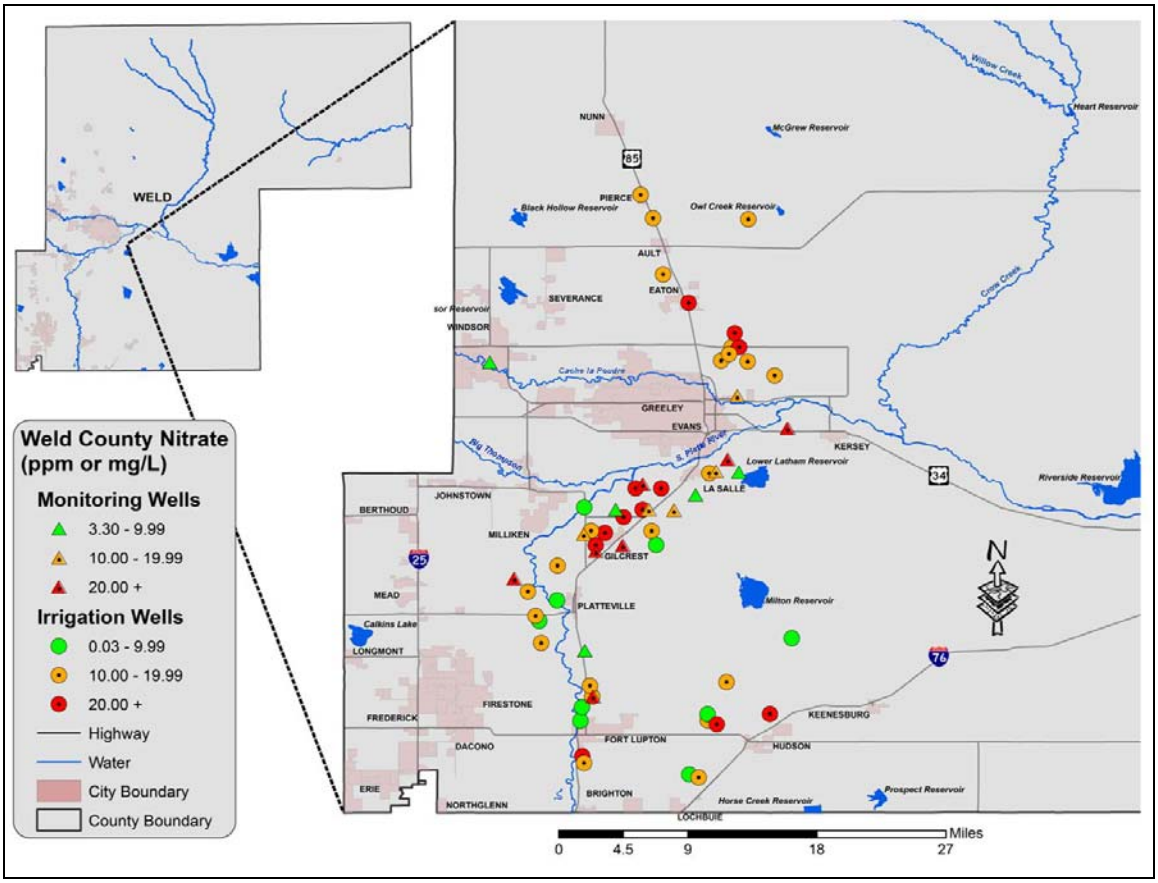

Figure 1 – Map showing the distribution of nitrate concentrations for 43 irrigation wells and 17 monitoring wells sampled from the Weld County Long-Term Network in 2006.

To help visualize how nitrate concentrations for the year 2006 compare to historical concentrations, an 11-year, 95% confidence interval of nitrate concentration was calculated for 42 of the 43 irrigation wells and 17 monitoring wells. Irrigation well ID WL-I-329 was excluded from the comparison because it has tested below the detection limit for nitrate every year since 1996. The 11-year period used for the confidence interval is that from 1996 to 2006. Figure 2 shows that 34 irrigation wells were above the nitrate drinking water standard in 2006. There were 16 of 42 irrigation wells (38%) with nitrate concentrations below the 11-year range while just six wells (14%) tested out above the 11-year range.

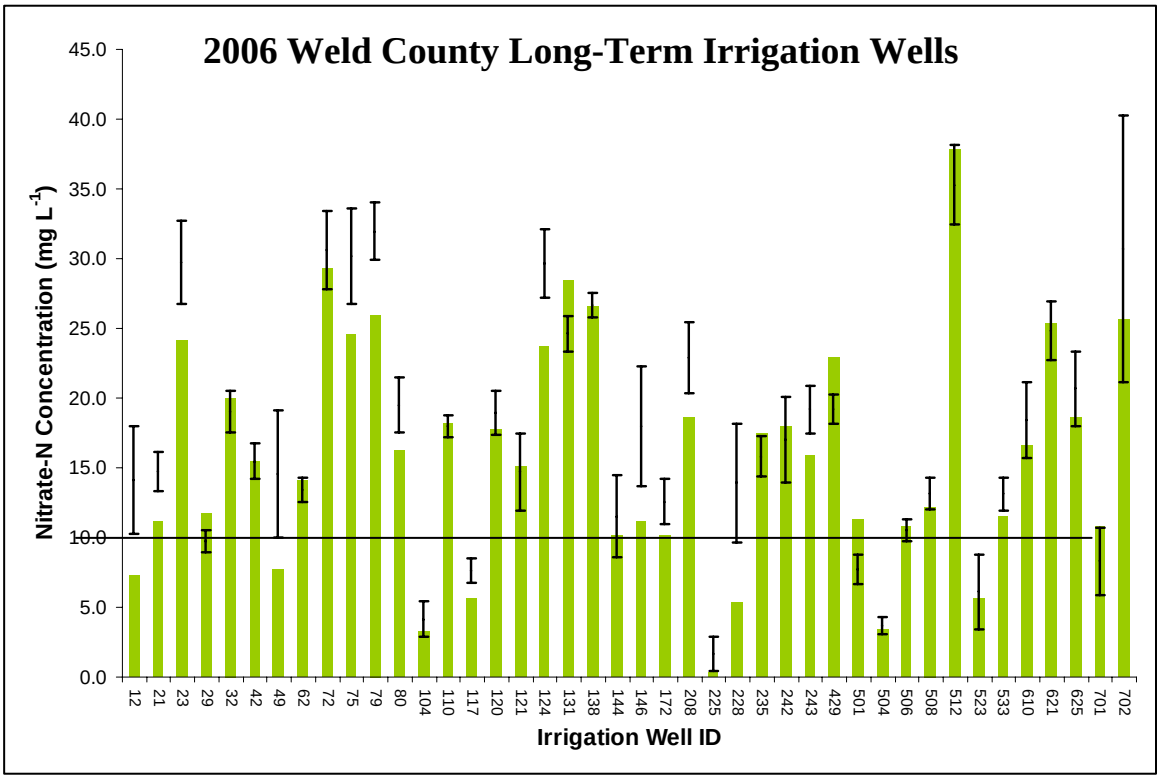

Figure 2 – Nitrate concentrations for 42 irrigation well samples collected in Weld County in 2006 (green bars) compared to individual nitrate concentration ranges from 1996 to 2006 (lines with end caps). The horizontal line is at the drinking water standard of 10.0 ppm.

Of the 17 monitoring wells sampled in 2006, two were sampled twice due to a laboratory accident that resulted in samples needed for pesticide analysis being lost. These two wells, WL-M-010 and WL-M-901, were re-sampled in early September and are distinguished in Figure 3 with a (2) following the well ID.

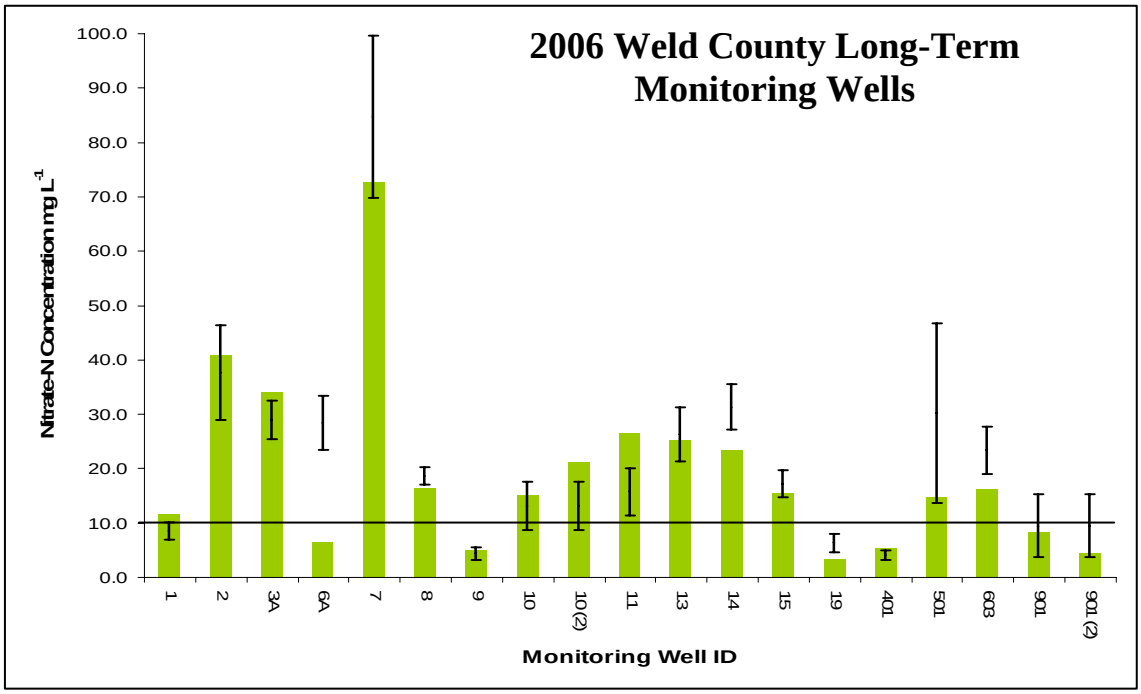

Figure 3 – Nitrate concentrations for 17 monitoring well samples collected in Weld County in 2006 (green bars) compared to individual nitrate concentration ranges from 1996 – 2006 (lines with end caps). The horizontal line is at the drinking water standard of 10.0 ppm.

Twelve monitoring wells tested above the nitrate drinking water standard. Of these, only four wells were above their respective 11-year concentration range, and Well 10 was only above the range in one of the two samples collected[1]. About 71% of the monitoring wells have an 11-year concentration range variation greater than 5.0 mg L^{-1} and two of these wells, Well 501 and Well 7 have large variations of 32.9 and 29.7 ppm, respectively. The interesting point is that the 2006 nitrate concentration values, for both wells, are near the very bottom of their respective range. These two wells are both located within the Platteville to La Salle section of the South Platte. Furthermore, of the 12 wells with high variation in the 11-year nitrate concentration range, seven are located within this area.

2006 Weld County Pesticide Results

Pesticide analysis returned 24 detections spread out in 13 of 17 monitoring wells. Table 2 shows that the most commonly detected pesticide was deethyl Atrazine (DEA). Samples from seven of the 13 monitoring wells with detections (54%) had only one pesticide detected while the remaining samples from six wells[2] yielded a total of 17 pesticide detections. Compared to results from 2005, monitoring well pesticide detections increased in number, however, DEA remained the most commonly found pesticide.

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[1] Well IDs 10 and 901 had two samples collected because of a lab accident. The first sample was collected in May 2006 and the second was in September 2006.

[2] Well 10, sampled twice, had two pesticides detected in the May 2006 sample and only one pesticide detection in the September 2006 sample.

Table 2 – Pesticide analysis results for 17 Weld County Long-term monitoring wells sampled in 2006. The average concentration and maximum concentration are reported. Percent of wells is based on the total sample size of 17 monitoring wells.

2006 Weld County Monitoring Well Pesticide Detections

Pesticide	# Detects	% Wells	Concentration Average	Concentration Maximum
			---------- ppb	----------
Atrazine	3	15.8	0.09	0.17
DEA	7	36.8	0.17	0.64
Bromacil	2	10.5	1.19	1.30
Clopyralid	1	5.3	NA	4.70
Metalaxyl	2	10.5	0.15	0.17
Metolachlor	5	26.3	0.42	0.73
Prometon	4	21.1	0.205	0.33
Total	**24**	**76.5**[a]		

a The total for % Wells represents the 13 wells with detectable pesticides

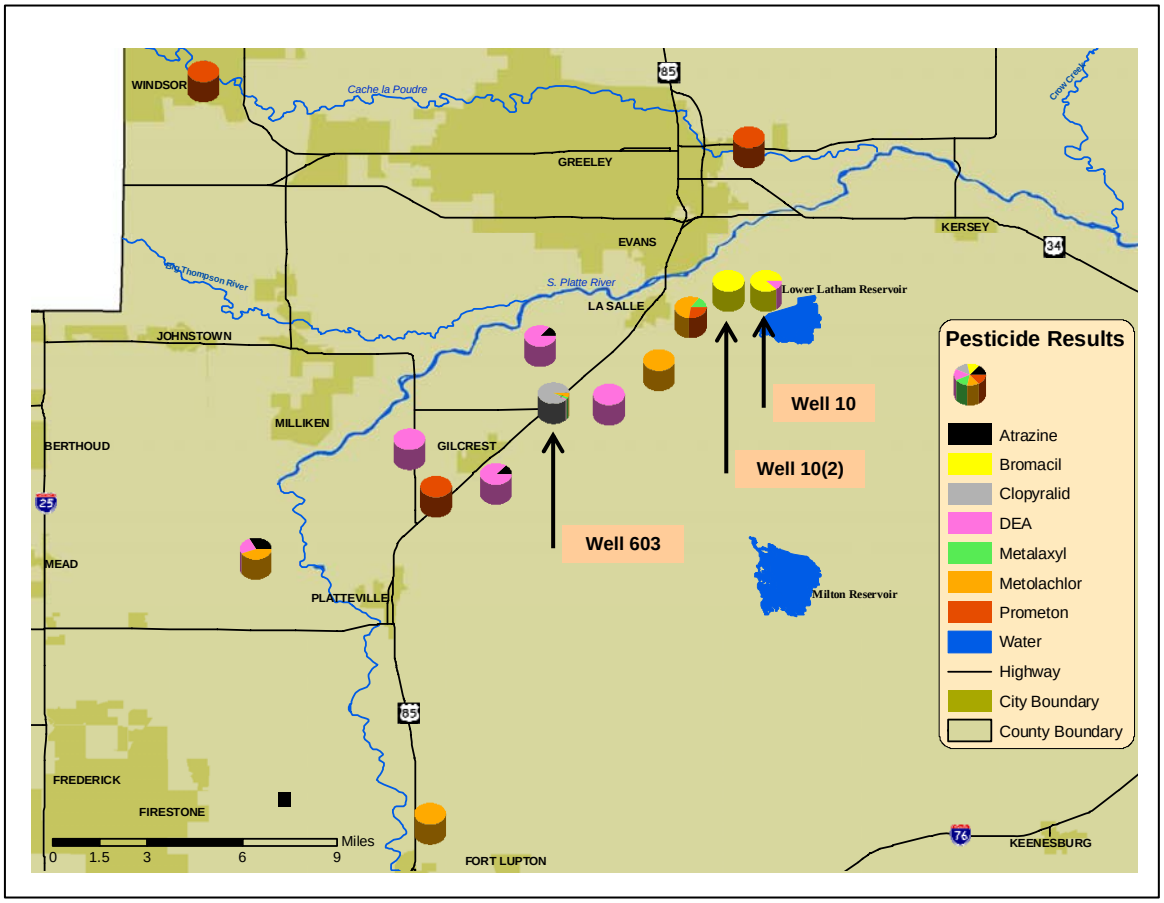


Figure 4 – Shown here are the 13 monitoring wells, of 17 sampled in 2006 from the Weld County Long-Term Network, which have detectable levels of pesticides. Well 10 and Well 10(2) are the same well sampled in May and September, respectively. Well 603 had the most pesticide detections with four.

Of the six wells with multiple pesticide detections, five are located in the Platteville to La Salle section of the Weld County network, including Well 603 (designated in Figure 4) which had detectable levels of DEA, Metalaxyl, Metolachlor, and Clopyralid. There were no pesticides detected at a level exceeding any applicable drinking water standard.

Discussion

Samples taken from monitoring wells and irrigation wells are affected by variations in hydrogeology. First, irrigation wells sample the aquifer at depths deeper than normal monitoring wells. Most of the Program's monitoring wells placed in alluvial aquifers are typically not deeper than 50 ft and have static water levels varying from 34 ft to the just under the surface. This is important to distinguish since the thickness of aquifer material between the surface and the portion of the aquifer being sampled can play a large role in the aquifer's vulnerability to contamination, especially with regards to any lag-time effect in gravitational movement of nitrate. Secondly, most irrigation wells pump from 500 – 2,000 gpm, which can result in an increased turbidity that can influence the chemical and physical properties of the groundwater. Monitoring wells on the other hand are based on passive sampling and if sampled according to protocol, should allow for the collection of an *in situ* water sample without increasing turbidity. With that said, seeing larger variation in monitoring wells compared to irrigation wells is to be expected since contaminants can infiltrate the aquifer zone sampled by monitoring wells more readily and more frequently than the zone sampled by irrigation wells. Another possible reason behind higher variation in the monitoring wells could be a result of the horizontal migration of a nitrate contamination plume which can cause larger fluctuation in concentrations as the plume progresses through the monitoring zone of the aquifer.

Nitrate contamination itself is temporally and spatially variable and at any one time, there could be several contributing factors. Possible factors include, but are not limited to, crop type selection and rotation, number of planted acres, fertilizer application amounts and timing, irrigation amounts and timing, manure usage, just compensation (or lack of) for nitrogen in residue or irrigation water, and private septic systems, or water treatment discharge. To a smaller extent, total annual precipitation and/or large precipitation events, can influence nitrate and pesticide leaching or contamination as well. According to climate data from CoAgmet weather stations in Ault, Lucerne, and Greeley[3] (CoAgmet, 2007), there were only 3.45 in. of total precipitation in 2006 for Weld County. This is significantly lower than the 9.82 in. and 9.65 in. that fell in 2005 and 2004, respectively. Since 2001, agriculture has been plagued by drought which has resulted in less available irrigation water and both a reduction in ditch irrigation (flood or furrow) and an increase in center pivot irrigation. While changes in surface irrigation, total precipitation, and practices on the surface can affect groundwater contaminant concentrations in shallow wells, an aquifer's horizontal variability in hydrologic characteristics such as transmissivity and vadose zone thickness, physical and chemical properties of individual contaminants, and time are important factors to consider when determining why annual concentration differences occur in monitoring and irrigation wells and to what extent.

[3] CoAgmet data for station GLY03, Greeley, CO was incomplete from July 4 – July 26, 2006

Given that monitoring wells sample the uppermost portion of the alluvial aquifer, it makes sense that contaminant detections and concentrations vary from year to year and even within the year as is the case for monitoring well 10 in 2006. In the sample collected for Well 10 in May, Bromacil and DEA were detected at 1.3 and 0.17 ppb, respectively, whereas the sample collected from the same well in September, only resulted in a detection of Bromacil, with a concentration of 1.07 ppb. Figure 4 shows pie charts for the two Well 10 samples side by side but it is important to note that this was done only to show the different results, not to signify that the samples were collected in different locations. Nitrate analysis on the two Well 10 samples shows a 6 ppm increase in nitrate concentration between May and September while analysis on the two Well 901 samples shows nearly a 4 ppm decrease in concentration. The decrease in concentration for both pesticides from May to September in Well 10 and the opposite mixed responses in nitrate results for Well 10 and Well 901, demonstrates the level of variability that can occur within a year and between locations. Due to this and provided all the potential contributing factors mentioned above, a more intensive statistical trend analysis is needed to determine if nitrate or pesticide contamination in the Weld County Long-Term Network is improving or not. The Program hopes to further analyze the abundance of data in 2007, to determine if any trends are apparent. Conducting an isotope study to determine the origin of nitrogen in groundwater samples could also assist us in further determination of how organic and inorganic sources of nitrogen inputs are contributing to nitrate contamination of various wells in Weld County. The Program is hoping initiate a study of this sort in the near future.

El Paso County Reconnaissance Survey

The Program collaborated with Gary Hall, CSU Cooperative Extension, in El Paso County to initiate a reconnaissance sampling of the groundwater quality with respect to agricultural chemicals. Well selection criteria focused on alluvial aquifers, shallow bedrock aquifers of the Denver Basin, agricultural production areas, and the urban-rural transition. This low-density sampling resulted in 49 wells being sampled between September and November, 2006. Distribution of the samples allowed for reasonable coverage of most areas of interest throughout the county. Most samples were collected from wells permitted for domestic use, but an irrigation well, several stock wells, and a few municipal wells were also sampled.

Samples were sent to both, the Soil, Plant and Water Testing Laboratory at Colorado State University for analysis of basic inorganics and dissolved metals, and to the CDA's Standards Laboratory for analysis of nitrate/nitrite and a suite of 47 different pesticides. What follows is an introduction to El Paso County's hydrogeology, general land use, sampling strategy/methods and the results and discussion.

Introduction

The land in El Paso County consists of level to somewhat broken plain in the eastern and southern portions, and of foothills and mountains west of the I-25 corridor and in the northwestern portion of the county near the towns of Palmer Lake and Monument.

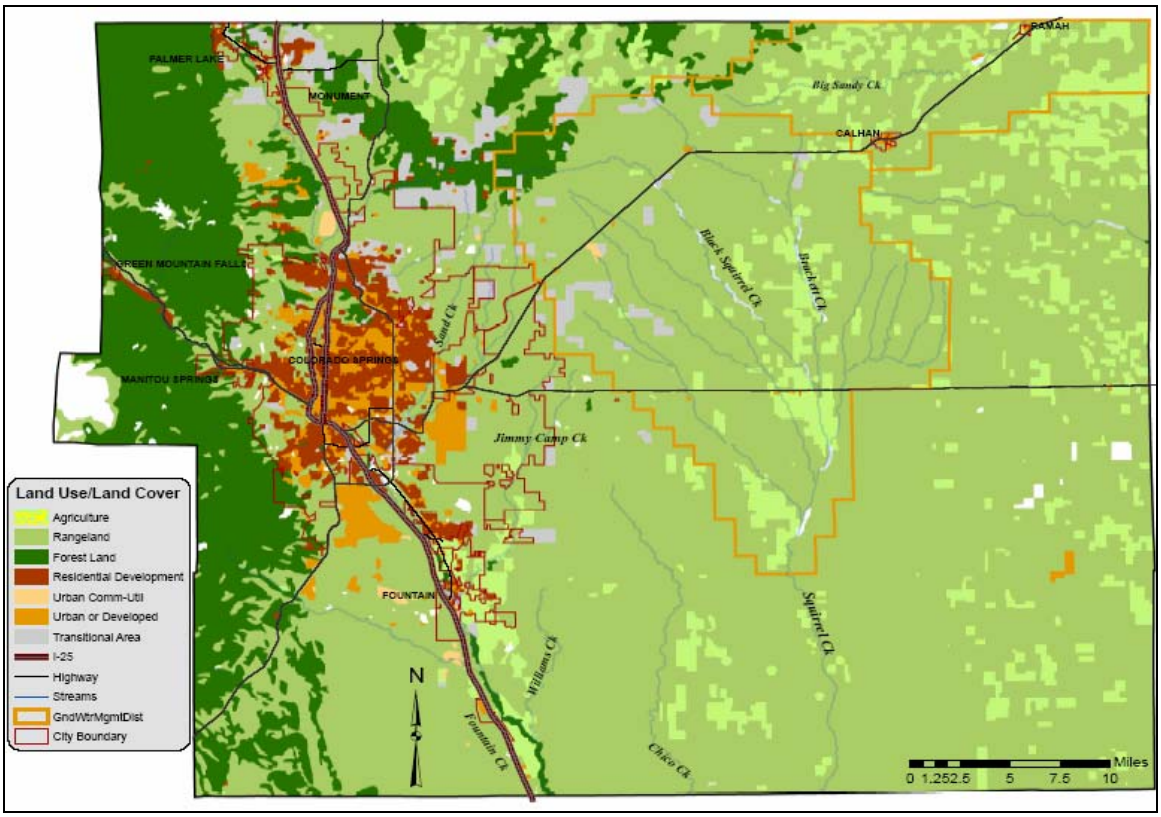


Figure 5 – Land use and land cover for El Paso County. The Program was interested in acquiring well water samples in agricultural production areas and along the urban-rural transition of Colorado Springs.

El Paso County is host to several quaternary alluvium aquifers and the southern terminus of the Denver Basin. In the northern portion of the county, the Palmer Divide creates a unique situation where tributary reaches originate for both the South Platte and the Arkansas rivers. The principal streams in the county are the Monument and Fountain Valley streams which converge south of Colorado Springs, and then join the Arkansas River at Pueblo. Other tributary reaches in the county include the Bracket, Black Squirrel, Squirrel, and the Big Sandy, which actually flows out of the northeast corner of the county before working its way back south to the Arkansas River downstream of John Martin Reservoir. Most wells in the basin tap into these quaternary alluvial aquifers (shown in Figure 6) and have high yields, ranging from about 10 gpm for stock and some domestic wells to more than 1,000 gpm for high-capacity irrigation wells. The alluvial aquifers vary in thickness from 10 to 150 ft. Irrigated land in El Paso County, while not abundant, is efficient at producing mostly alfalfa hay.

Historically, most land in El Paso County has been used as rangeland for grazing cattle but current growth of the urban front is resulting in increased development along the northeastern and eastern edges of Colorado Springs (Figure 5). Consisting of four principal bedrock aquifers – Dawson, Denver, Arapahoe, and Laramie-Fox Hills – the Denver Basin underlies a 6,700 mi^2 area extending from the Front Range east to near Limon, and from Greeley south to near Colorado Springs. The deepest aquifer is the Laramie-Fox Hills and ranges in a water-yielding material thickness of zero to 300 ft due to the bowl-shape of the Denver Basin. The Arapahoe, Denver, and Dawson aquifers lie sequentially on top of the Laramie-Fox Hills. The shallowest,

youngest of these (as seen in Figure 6) is the Dawson. Having a physical character of sandstone and conglomerate, with minor amounts of shale, this aquifer generally contains 100-400 ft. of water-yielding material at depths ranging from 200-900 ft. The Dawson receives about 75% of the total recharge of 55 ft^3 s^{-1} supplied to the basin, due to its exposure over a large area at higher elevations where precipitation totals are greater.

The ability of an aquifer to transmit water depends on the permeability and the thickness of the water-bearing material. Transmissivity is a function of this hydraulic conductivity and thickness and can vary from one water-yielding layer to another and from one area of the basin to another. In the Dawson aquifer, transmissivity ranges from 50 to 1200 ft^2 d^{-1} which is one reason it is a principal source of wells yielding as much as 200 gal min^{-1}. Given our interest in monitoring groundwater susceptible to contamination by agricultural chemicals, we were mostly interested in acquiring well samples in the Dawson above all other Denver Basin aquifers. With a high transmissivity and since it receives a majority of the basin's recharge, there is potential for contamination of the aquifer in agricultural production or residential areas. Given the generally confined nature of the other bedrock aquifers in the Denver Basin, the likelihood of contamination due to agricultural chemicals, while possible, is minimal at best and therefore they were not intentionally targeted during well selection. Due to cooperative efforts with Gary Hall, participation from well owners in his network, and in order to cover a large portion of the geographical area of El Paso County with a low density sampling, a handful of wells in bedrock aquifers below the Dawson were selected.

As previously mentioned, most of the irrigated agriculture is alfalfa hay, however, there are some areas of turf production as well. Most of the agricultural production areas are in the alluvial aquifers of Squirrel Creek, Fountain Creek, or just above the Chico Creek alluvial aquifer as seen in Figure 1. The USGS (Brendle, 1997) conducted a study on the nitrate concentrations in the Black Squirrel Creek Basin which includes alluvial aquifers of the Black Squirrel Creek, Bracket Creek, and the northern portion of Squirrel Creek. Their study sampled 36 wells in 1984 and repeated sampling on 28 of those in 1996. What was discovered is that the majority of wells sampled were below the drinking water standard of 10.0 ppm in both years. Only five samples in 1984 and two samples in 1996 had nitrate concentrations above the standard. Turf production farms and residential septic systems were the principle potential non-point sources for nitrate contamination in the study area. Due to this history, it was our prerogative to obtain some well samples in this area.

Selection of wells involved sorting through Gary Hall's database and sieving through the extensive database of permitted wells kept by the Office of the State Engineer (OSE). Desired locations for samples were determined based on OSE wells with available contact information in the area and the selection guidelines mentioned above. Figure 7 shows the final sample locations upon the eventual cooperation of 49 well owners.

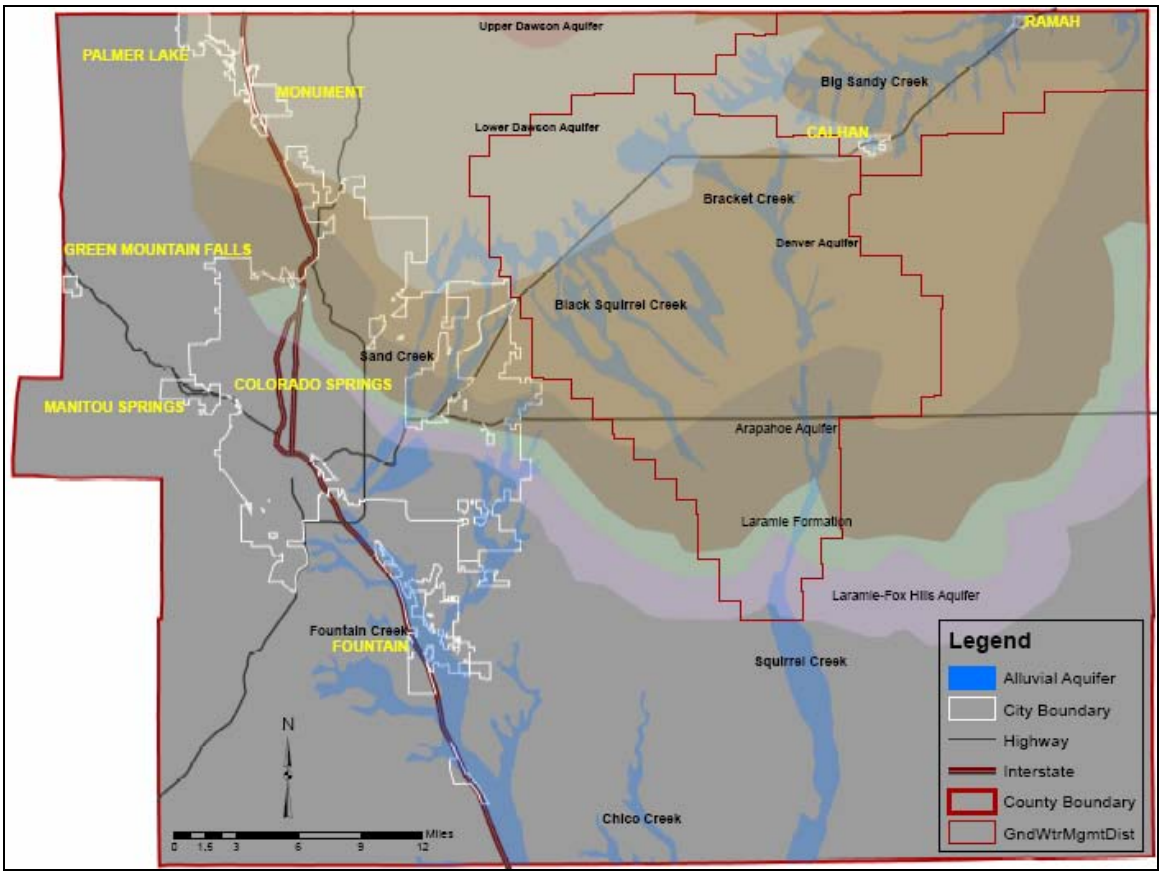


Figure 6 - Map depicting the bedrock aquifers of the Denver Basin and the alluvial aquifers in El Paso County. Selection of wells was partially dependent on the location in an alluvial aquifer or shallow bedrock aquifer such as the Dawson Aquifer. The two delineated groundwater management districts are those of the Upper Black Squirrel and Big Sandy.

Wells were sampled using a protocol for domestic wells aimed at collecting water samples from as close to the well head as possible, and only after adequate purging of any associated plumbing. Temperature and conductivity readings were taken at about two minute intervals and a sustained stabilization of +/- 5% was attained before any collection of a sample took place.

With the exception of a couple of municipal wells, collection of water samples before any filtration or chlorination was successful. Any irrigation, stock, or municipal well not running upon arrival was turned on and run for about 15 minutes before sampling. For domestic wells without a cistern, water was run from the closest source to the well head until the pump initiated. For wells with cisterns, the sample source was run until the plumbing between it and the cistern was adequately purged. Samples were then only collected after the stabilization of temperature and conductivity. Latitude/Longitude coordinates were collected for each well head and the sample source's direction and distance from the well head was also noted. While onsite, determination of major land use in the area around the well was noted. All samples were iced and promptly transported to the CDA and CSU laboratories. All well sampling was conducted by Karl Mauch (CDA).

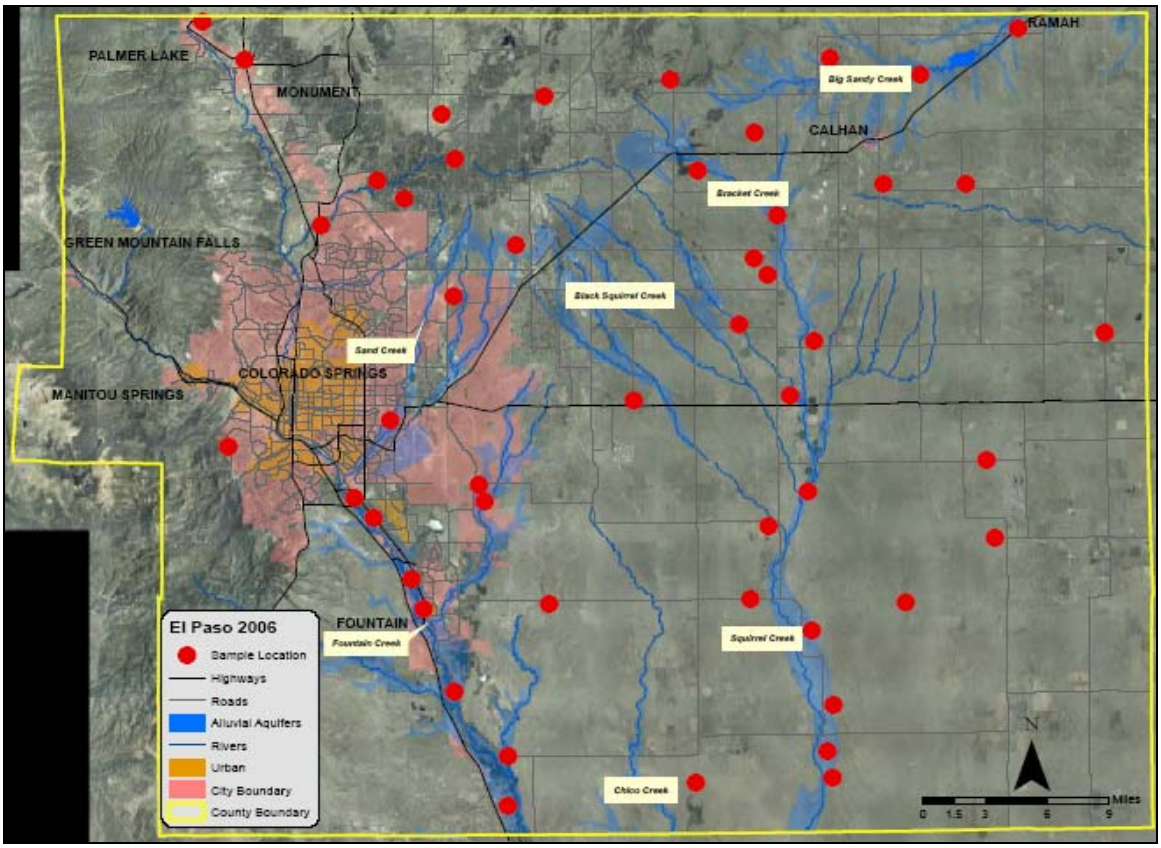


Figure 7 – Forty-nine wells were selected for sampling in the reconnaissance survey of El Paso County in 2006. Most samples were located in alluvial aquifers or in the shallow bedrock aquifers of the Denver Basin in the northern portion of the county.

2006 El Paso County Nitrate and Pesticide Results

Of the 49 wells sampled in El Paso County in 2006, only one sample had a nitrate concentration above the drinking water standard. Table 3 shows the descriptive statistics for the wells sampled. The average concentration was 2.74 ppm and 50% of all samples contained less than 4.1 ppm. As seen in Figure 8, seven wells had nitrate concentrations above 5.0 ppm and four of those were above 7.5 ppm. Six samples were below detection limit and the maximum concentration was 11.5 ppm in the one well exceeding the nitrate standard. No pesticides were detectable by the CDA laboratory in any well sample. Tables 4 and 5 show the detection limits for all analytes tested for in 2006.

Table 3 – Detected nitrate in groundwater samples collected in El Paso County from September to November 2006.

2006 El Paso County Nitrate Results[a]	
Mean	2.74
Median	2.07
Standard Deviation	2.84
Minimum	BDL[b]
Maximum	11.54
25th %	0.23
75th %	4.09
Sample Count	49

a Nitrate results are in ppm
b BDL is Below Detection Limit

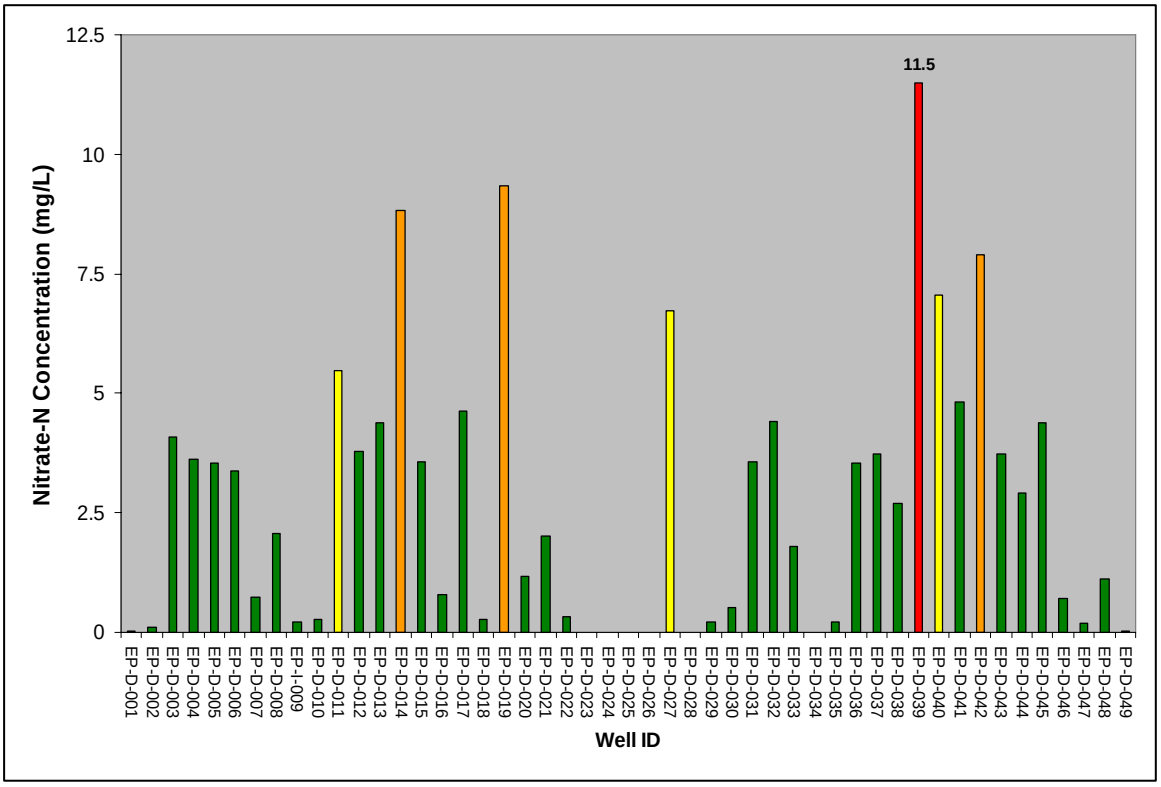


Figure 8 – Nitrate concentrations for 49 wells sampled in El Paso County in 2006. The green, yellow, orange, and red bars are representative of wells with nitrate concentrations less than 5.0 ppm, between 5.0 and 7.5 ppm, between 7.5 and 9.9 ppm, or greater than 10.0 ppm, respectively.

As seen in Figure 9, all wells with nitrate concentrations greater than 5.0 ppm are in alluvial aquifers with the exception of one well on the eastern edge of the county. This well is drilled into the Laramie-Fox Hills aquifer, which due to the bowl-shape of the Denver Basin, has a static water level within 80 ft of the surface at this location. Of the six wells located in alluvial aquifers, with concentrations greater than 5.0 ppm, all of them are located in areas that have numerous potential non-point sources for nitrate contamination including septic leach field

discharge, agricultural runoff and leaching, urban runoff, or water treatment discharge. Any combination of the above sources, have the potential to elevate nitrate concentrations above the widely accepted natural occurrence of 1-3 ppm. This is especially true for groundwater in shallow alluvial aquifers with hydraulic connections to surface water.

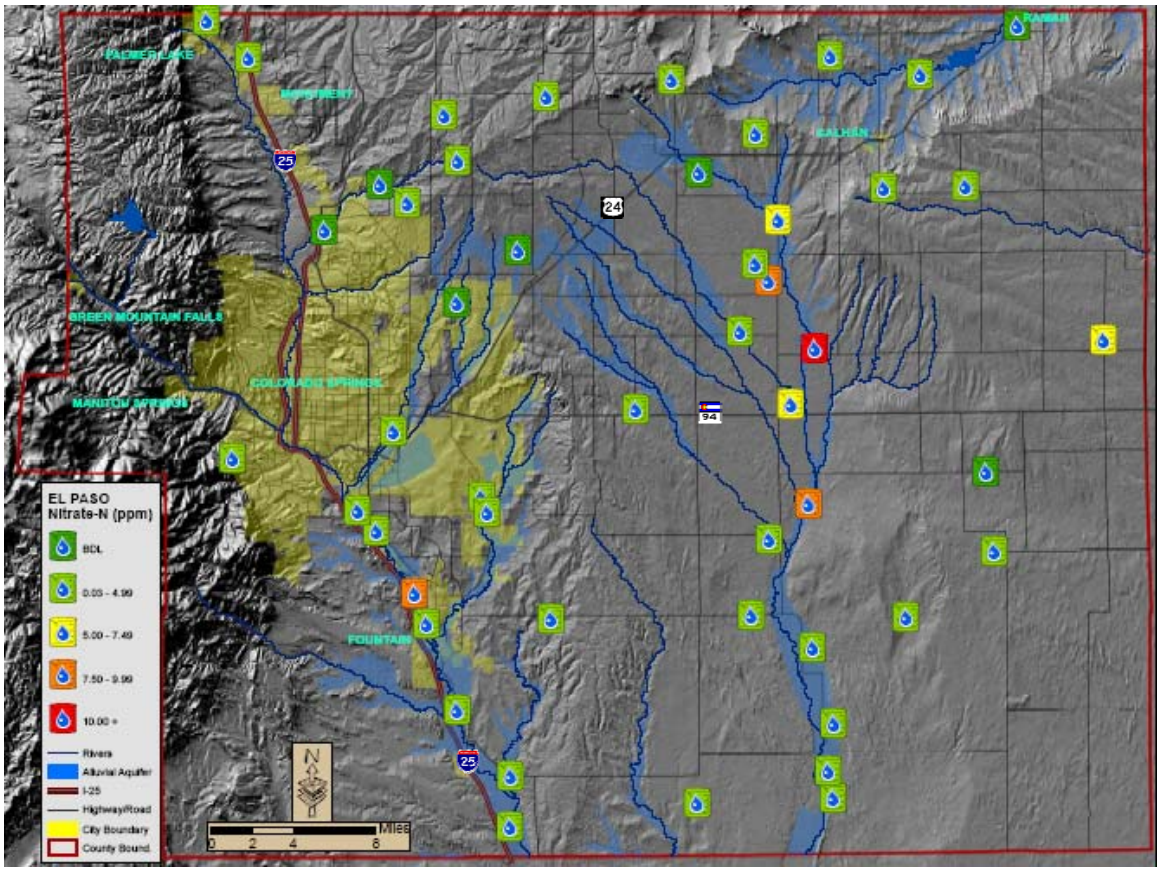


Figure 9 – Distribution of nitrate results for 49 wells sampled in El Paso County in 2006. All wells with concentrations above 7.5 ppm are located in geographical areas under the influence of various potential non-point sources for nitrate contamination.

Discussion

Based on our sample density and due to other wells in the Black Squirrel and Fountain Creek areas with results closer to the natural concentration, it is not likely nitrate contamination is a widespread problem. However, one can not decipher how much variability in nitrate concentration may be occurring in these areas based on these results alone. Further testing in an area of interest with a higher sampling density is suggested for parties interested in this information.

While this low-density, baseline sampling does show that El Paso County groundwater quality is good with respect to agricultural chemicals, it should be stressed that these results are not all inclusive and only coarsely touch the possible variability in alluvial and bedrock aquifers with respect to contamination. The Agricultural Chemicals and Groundwater Protection Program is mainly interested in monitoring groundwater for agricultural chemical impacts such as pesticides

and fertilizer, and does not monitor for bacteriological pathogens nor any volatile organic compounds such as Trichloroethylene (TCE). Lead, chromium, and cadmium are the only toxic heavy metals analyzed for by the Program and this is usually only completed one time – during a reconnaissance, baseline sampling. Given the results of our sampling, the Program has not found anything of concern and thus a resampling of El Paso County is a low priority. That is of course barring any issue that may arise and is related to the Agricultural Chemicals and Groundwater Protection Program's interest or responsibility.

Table 4 – Detection limits for basic inorganics and dissolved metals tested for in El Paso County and Weld County well water samples collected in 2006.

CSU Soil and Plant Testing Laboratory

2006 Detection Limits

Basic Inorganics		Dissolved Metals	
Analyte	**MDL (ppm)**	**Analyte**	**MDL (ppm)**
Boron	0.1	Aluminum	0.01
Bicarbonate	0.1	Barium	0.01
Calcium	0.1	Cadmium	0.005
Carbonate	0.1	Chromium	0.01
Chloride	0.1	Copper	0.01
Magnesium	0.1	Iron	0.01
Nitrate	0.1	Manganese	0.01
Sodium	0.1	Nickel	0.01
Specific Conductance[a]	1.0	Molybdenum	0.01
Sulfate	0.1	Phosphorus	0.01
Potassium	0.1	Zinc	0.01
Alkalinity, total	1.0	Lead	0.005
Total Dissolved Solids	10.0		
Hardness, total	1.0		

a Units of measure for specific conductance are uS cm^{-1}

Table 5 – Detection limits for nitrate and pesticides analyzed for in El Paso County and Weld County well water samples collected in 2006.

CDA Biochemistry Standards Laboratory

2006 Detection Limits

Common Name	Use	MDL (µg L^{-1})	Common Name	Use	MDL (µg L^{-1})
1-Napthol	Breakdown Product	1.0	Dimethoate	Insecticide	0.018
2,4-D	Herbicide	0.084	Endrin	Insecticide	0.16
3-Hydroxycarbofuran	Breakdown Product	1.8	Heptachlor	Insecticide	0.11
Acetachlor	Herbicide	0.056	Heptachlor Epoxide	Breakdown Product	0.086
Alachlor	Herbicide	0.019	Hexazinone	Herbicide	0.027
Aldicarb	Insecticide	1.1	Lindane	Insecticide	0.075
Aldicarb Sulfone	Breakdown Product	0.75	Malathion	Insecticide	0.012
Aldicarb Sulfoxide	Breakdown Product	0.67	MCPA	Herbicide	0.075
Atrazine	Herbicide	0.062	MCPP	Herbicide	0.015
Deethyl Atrazine	Breakdown Product	0.062	Metalaxyl	Fungicide	0.062
Deisopropyl Atrazine	Breakdown Product	0.17	Methiocarb	Insecticide	1.0
Benfluralin	Herbicide	0.042	Methomyl	Insecticide	0.78
Bromacil	Herbicide	0.097	Methoxychlor	Insecticide	0.004
Captan	Fungicide	0.041	Metolachlor	Herbicide	0.007
Carbaryl	Insecticide	0.2	Metribuzin	Herbicide	0.042
Carbofuran	Insecticide	0.26	Oxamyl	Insecticide	1.0
Chlorpyrifos	Insecticide	0.052	Pendimethalin	Herbicide	0.062
Clopyralid	Herbicide	0.28	Picloram	Herbicide	0.32
Cyanazine	Herbicide	0.036	Prometone	Herbicide	0.035
DCPA	Herbicide	0.062	Propoxur	Insecticide	0.81
DDT	Insecticide	0.062	Simazine	Herbicide	0.062
Diazinon	Insecticide	0.017	Triclopyr	Herbicide	0.051
Dicamba	Herbicide	0.19	Trifluralin	Herbicide	0.042
Dichlobenil	Herbicide	0.008	Nitrate[a]		0.04

a Units for nitrate detection limit are ppm

APPENDIX II

2006 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: crop and livestock producers, commercial applicators, chemical dealers, conservation districts, crop consultants, NRCS agency personnel, homeowners, private well owners, real estate professionals, and urban chemical users.

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

- Conducted training related to the Colorado Best Management Practices Manual. Distributed publications to Colorado citizens covering nutrient, pesticide, irrigation, manure, corn, pesticide record keeping, and private water well management.

- Conducted field demonstrations and applied research on limited irrigation under three plant populations for grain corn and cover crops for land that lost irrigation water.

- Conducted irrigation management demonstrations on farmer fields throughout Colorado. Demonstrations included: using ET from atmometers, weather stations data, and WaterMark® soil moistures for improved irrigation scheduling; and the affect of sprinkler nozzle height on corn yield under center pivot irrigation (third year).

- Conducted nitrogen management applied research and demonstrations for the second year using the pre-sidedress soil nitrate test (PSNT) for corn when applied with poultry manure in cooperation with Parker Ag Services Company.

- Continued to cooperate with the Colorado Climate Center to promote and improve the crop water use (ET) reports provided by the Colorado Agricultural Meteorological Network (CoAgMet). See www.CoAgMet.com.

- Served on the Colorado board for the Certified Crop Advisors Program as exam chair responsible for conducting the state exam.

- Maintained a CSU Extension Water Quality Website to disseminate BMP information via the Internet (www.csuwater.info).

- Distributed revised series of four fact sheets on the web to educate Colorado homeowners on BMPs for urban pesticide and fertilizer use.

- Distributed the revised *Pesticide Record books for Private Applicators*.

- Developed Microsoft Excel® and .pdf versions of the *Pesticide Record books for Private Applicators* and made these products available for download at www.csuwater.info.

- Coordinated the incorporation of the Program's groundwater quality data to develop a web-interactive database utilizing the Integrated Decision Support (IDS) Group at CSU.

- Served on the planning committee for the 2006 South Platte Forum. The SP Forum is an interdisciplinary conference that brings together diverse interests in water to communicate and get the latest on water quantity and quality science and policy in the basin.

Ongoing BMP Development and Education

Colorado State University Cooperative Extension (CSUCE) has worked with the Colorado Department of Agriculture (CDA) to develop Best Management Practices (BMPs) 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 has been used as a template for local committees. These documents were published in a notebook form in 1995 that are updated as needed (Private Well Protection was revised in 2005) and expanded to include additional guidelines.

Cooperative Extension 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. Both of these groups have produced BMPs for nutrient and irrigation management - the most serious problem in their respective areas. In 1995, 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." Although most of these work groups have not been active since finishing their local BMP publications, these guides continue to be distributed at the local and state level. Building on these efforts, a crop specific BMP, "Best Management Practices for Colorado Corn" was published in 2003 with support from the Colorado Corn Growers.

Field Demonstration and Research

Field demonstration work in 2006 focused on helping growers improve water and nutrient management. One significant project is a limited irrigation trial in Weld County where we demonstrated limited versus full irrigation on grain corn using three different plant populations (~20, 25, and 32 thousand plants per acre). WaterMark® soil moisture sensors using a Hansen AM400® visual display and logger along with ET from an atmometer were used to schedule irrigations at this site. We also planted four cover crop options (small grains, hairy vetch, forage

millet, and bare fallow) at this site to demonstrate some soil conservation options for farmers losing their irrigation water due to drought or well pumping curtailment. This work is supported by a USDA/NRCS Conservation Innovation Grant (CIG) that provides additional visibility through this partnership. The Central Colorado Water Conservancy District (CCWCD) used this site as a stop on their 2006 water tour and brought approximately 200 people to learn about the work on the site.

CSUCE also continued to loan atmometers (ETgages) to county agents, consultants, and individual farmers in Weld and Phillips Counties in 2006. ETgages are useful for simple and effective irrigation scheduling. A fourth year of a center pivot nozzle height (above and below canopy) replicated demonstration was conducted in Kit Carson County in cooperation with the NE Regional Water Specialist. Nozzle placement can impact water runoff and therefore irrigation uniformity, soil moisture storage, and ultimately yield.

Additionally, we continue to improve the awareness and usability of crop ET information provided by the CoAgMet weather network. Cooperating with field CSUCE faculty and Nolan Doesken in the Colorado Climate Center, we upgraded the usability and output of ET reports from weather stations in the CoAgMet network. Specifically, users now have the ability to choose specific crops, weather stations, and planting dates to customize their reports (see "New ET Reports" link at www.CoAgMet.com). In addition, three more weather stations were added into this network in 2006. These stations are located near Walsh, Stratton, and Sterling.

The second year of a study in cooperation with Parker Ag Services on using the pre-sidedress soil nitrate test (PSNT) for corn in fields amended with poultry manure was conducted in 2006. The PSNT has been used successfully in non-manured fields in Colorado, but has not been extensively tested when manure has been applied and no work has been done on fields receiving poultry manure. The trial results suggested that the original PSNT calibrated value is valid on manured fields and would allow farmers to eliminate a sidedress application with confidence when soil nitrate levels are above the critical level of 15 ppm nitrate-nitrogen.

Education and Communication

Communication to a wide audience 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 booth is being utilized at conferences and trade shows to provide information on the program. Information on groundwater protection is continually being presented to the public through publications, newsletter articles, mass media, press releases, and presentations at meetings throughout the state. Presentations on 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 2006, presentations were made at several major meetings and small local groups throughout the state. Audiences ranged from licensed commercial applicators and Certified Crop Advisors to private well owners and urban homeowners.

Training professionals that advise farmers is critical to making sure growers are provided sound environmentally and agronomically correct advice. A significant collaboration with

USDA/NRCS in 2006 was the second year of an Irrigation Water Management Workshop conducted at CSU research farm (ARDEC) in July. This week-long workshop trained 20 NRCS and CSUCE field staff using a comprehensive curriculum that included topics from soil-plant-water relationships to water quality to irrigation scheduling.

This past year, we continued to provide information over the internet. Several locations including the CSU Cooperative Extension web site (http://www.ext.colostate.edu), and the CSU Cooperative Extension Water Quality web site (http://www.csuwater.info) provide information on BMPs. Soon to be linked to this site is a new information tool that was the result of a major push in 2006 – The Agricultural Chemicals and Groundwater Protection Database Information System (http://ids-nile.engr.colostate.edu/webkit/Groundwater/). This information tool was developed in collaboration with CDA and the Integrated Decision Support Group with the Dept. of Civil Engineering with grant funding from EPA. The information tool provides the general public, researchers, and water policy makers over 15 years of the Program's groundwater monitoring data. This data can be queried in a variety of ways. Outcomes of this project include improved accessibility and knowledge of water quality data; improved use of resources to protect vulnerable groundwater; a GIS tool for directing future groundwater management efforts at multiple scales; and increased stakeholder awareness and involvement regarding any potential or identified groundwater contamination.

Finally, we also partnered with the USDA-Cooperative State Research, Education, and Extension Service (CSREES) Water Quality Program (http://www.usawaterquality.org/) to offer mini-grant opportunities to CE field and campus faculty to encourage educational programs and extend research information on topics related to water quality and water quality. Seven programs were successfully accomplished by CSUCE county agents and faculty with the following topics:

- Bacteria and Well Education Program for Gilpin County
- Coal Bed Methane (CBM) Impact Monitoring in Huerfrano County
- High and Dry Demonstration Garden in San Miguel County
- Mesa County Irrigation Audit Program
- No-till Corn Production Using a Kura Clover Living Mulch System
- Private Well and Septic System Educational Programs (five grants funded on this topic utilizing the educational package described below)
- Water Saving Tips for Western Colorado Landscapes DVD

These mini-grants allow us to reach a wider, more diverse audience in areas of the state that we wouldn't be able to contact otherwise and leverage our normal Groundwater Program with CSREES dollars. They also allow us to help seed research and outreach projects that have potential for improving water quality.

In 2006, we also released a *Private Well and Septic System Educational Package.* This multi-media package is intended to help CSUCE agents conduct programming that instructs rural residents on methods to preserve and protect water resources and water quality. It was distributed on the website and a CD, which includes PowerPoint presentations with accompanying overview and learning objectives. These presentations cover: Well Water

Systems; Septic Systems; Water Treatment; Water Quality for Landscape and Crops; Water Use and Conservation; Livestock and Water Quality Protection; and Irrigating Small Acreages. The educational package also has: supporting bulletins and fact sheets; recordkeeping folders/brochures for wells and septic systems; website resources; a DVD from American GW Trust on private wells; a well/septic presentation booth on loan; and groundwater models and curriculum. This package has been extremely well received and was used in over ten workshops in at least six counties. Impact reports from these agents suggest people are using the knowledge to better protect their water source.

APPENDIX III

2006 Annual Report
Colorado Department of Public Health and Environment

The Colorado Department of Public Health and Environment (CDPHE) continues to be actively involved with the Agricultural Chemicals and Groundwater Protection Program. The CDPHE continues to review the Program's monitoring data on an annual basis, and provide input on the results. In 2006, the CDPHE also assisted in the interviewing and selection of the Program's new sampling personnel. Additionally, the CDPHE assisted with the subsequent groundwater-sample collection training during the annual Weld County sampling activities. The CDPHE participated in the Program's annual water tour of the northern High Plains, as well as attended other Program related meetings on an as needed basis.

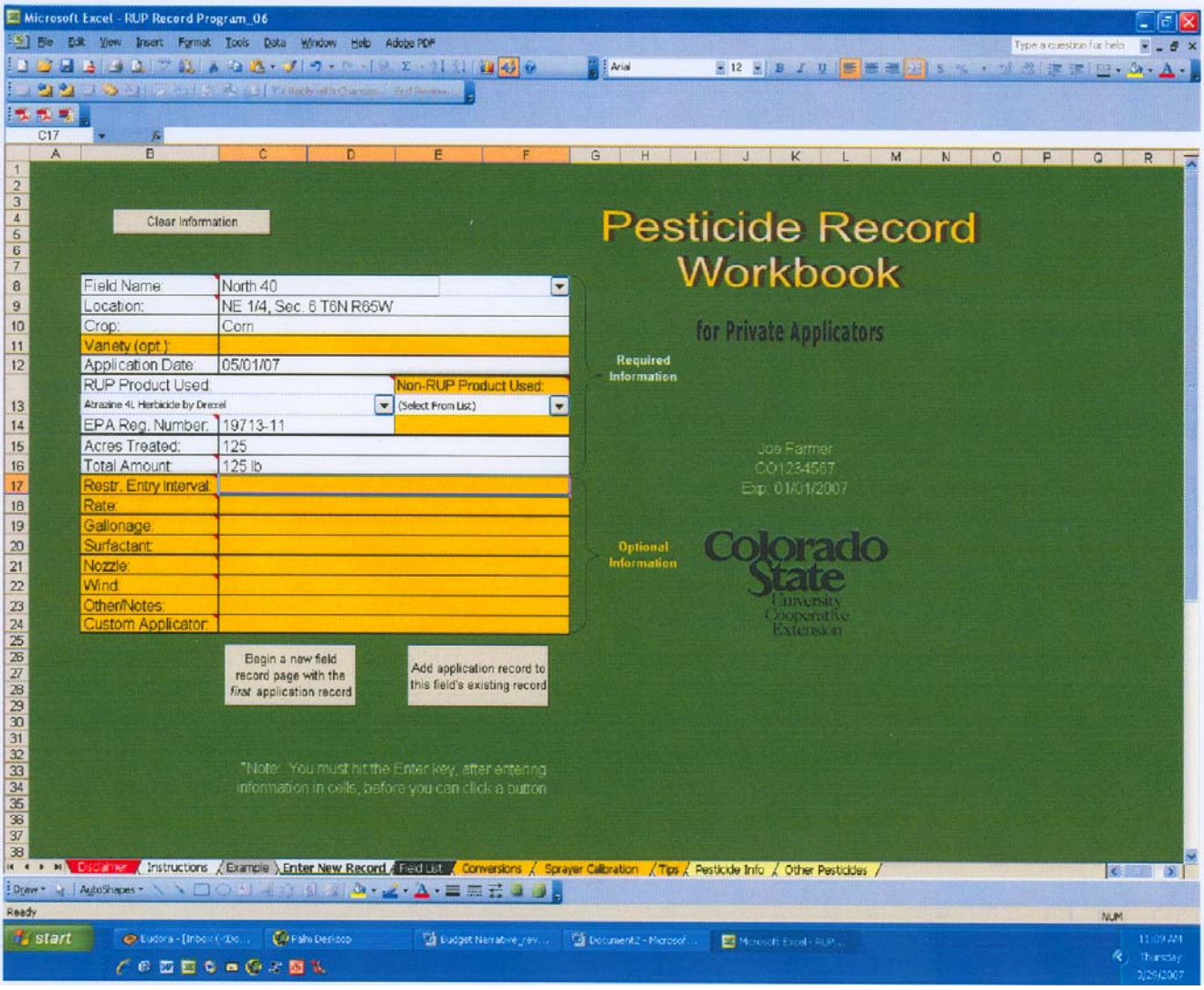
The CDPHE has also been involved in the Program's development of a Web-based pesticide and groundwater information tool. Activities this past year related to this effort included assisting with final quality control and functionality testing. The CDPHE was also involved with scheduling demonstrations of the final product before the Water Quality Control Commission, as well as other State groundwater quality professionals.

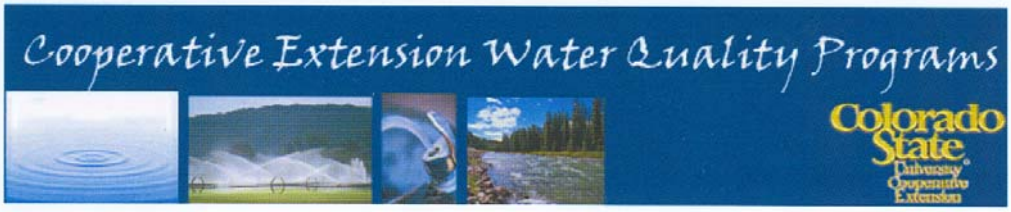
Other activities include finalizing the Program's long-range monitoring plan, which outlines the rationale and proposed schedule for the next ten years of groundwater sampling. Factors that were utilized in developing the long-range plan included historical groundwater sampling data, estimates of pesticide and fertilizer use, and the aquifer sensitivity and vulnerability studies developed by the Program. The long-term monitoring plan also contains allowance to address special sampling situations that may arise through cooperative investigations with other agencies, or due to other special circumstances. Assistance with the short-term monitoring plan has included working with Program staff on locating appropriate monitoring locations, based on local hydrogeologic factors, for the Colorado Springs and Urban Front Range monitoring efforts.

The CDPHE also supports the Program by promoting the Program's activities to outside parties. These activities include communicating the objectives of the Program to other State and Federal agencies, interested parties, and Colorado citizens. Reports, educational materials, and other correspondence have been distributed in an effort to develop an awareness of the importance of the Program to the State's efforts in groundwater protection.

APPENDIX IV

A Microsoft Excel® version of the Pesticide Record Book for Private Applicators was developed and released by CSU Cooperative Extension in 2006.





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Welcome to Cooperative Extension's Water Quality Programs Homepage!

The mission of the Colorado State University Cooperative Extension program is to conduct research and outreach on important issues facing Colorado citizens, and to provide unbiased, research-based information and training to all of Colorado's communities.

The Colorado State Cooperative Extension Water Quality program upholds that mission with a team of state and regional water specialists that work on issues important to Colorado water. These issues include, but are not limited to: salinity, irrigation management, agricultural chemical and pesticide management, non-point source pollution, private well protection, and coal bed methane wastewater management. Training programs and best management practices on these issues are available to all interested persons.

Members of the university Water Quality program also work in conjunction with other university and state agencies including the Colorado Department of Public Health and Environment, Department of Agriculture, and the Colorado Water Resources Research Institute.

What's New- Ground Water Awareness Week

Last Updated: March 8, 2007

APPENDIX V

AGRICULTURAL CHEMICALS AND GROUNDWATER PROTECTION ACT
ADVISORY COMMITTEE
(Revised 2/06)

Water Quality Control Commission

Mr. Robert Sakata
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Brighton, CO 80601
(303) 659-8675
rtsakata@aol.com
Original Appointment: 1991

General Public

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

Mr. John Stout
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(303) 708-1841
johnstout@aol.com
Original Appointment: 1998

Commercial Applicators

Mr. Steven D. Geist
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8585 East Warren Avenue
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Original Appointment: 1994

Mr. Darrel Mertens
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P.O. Box 535
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Original Appointment: 2003

Green Industry

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Original Appointment: 1999

Mr. Mark Krick, CGCS
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Ag Chemical Suppliers

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American Pride Coop
653 Rose Dr.
Brighton, CO 80601
(303) 659-3643
aduran@americanpridecoop.com
Original Appointment: 1998

Mr. Wayne Gustafson
Agland, Inc.
155 Oak Drive
Eaton, CO 80615
(970) 454-4038
Wgustafson@aglandinc.com
Original Appointment: 1991

Producers

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

Mr. Steven Eckhardt
19487 County Rd. 29
Platteville, CO 80651-8710
(970) 539-0443
fsdefi@msn.com
Original Appointment: 1997

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

Mr. Dave Latta
38002 Co. Rd. N
Yuma, CO 80759
Original Appointment: 2001

Mr. Mike Mitchell
1588 E. Rd. 6 N.
Monte Vista, CO 81144
(719) 852-3060
mitch6@amigo.net
Original Appointment: 1991

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

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

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